PROCEEDINGS OF THE 49th Annual Conference OF THE WEED SCIENCE SOCIETY OF NIGERIA

THEME:

Challenges of Weed Management in the Face of Growing Food Insecurity in Nigeria

EDITORS:
J. Alhadsan, M. D. Magaji, A. Lado, Y. Garba, D. B. Ishaya,
A. I. Take-tsaba, M. Musa, A. A. Muhammad, S. B. Shamaki, B. S. Haliru

NATIONAL EXECUTIVE COUNCIL

EDITORS

J. Alhassan

M.D. Magaji A.

Lado

Y. Garba

D.B. Ishaya

A.I. Take-tsaba,

M. Musa

A.A. Muhammad

S.B. Shamaki

B.S. Haliru

CITATION

Alhassan J., M. D. Magaji, A. Lado, Y. Garba, D. B. Ishaya, Take-tsaba, M. Musa, Muhammad, A. A., S. B. Shamaki and B. S. Haliru (Eds.). *Challenges of Weed Management in the Face of Growing Food Insecurity in Nigeria*. Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria, held at the Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria, 29th October -1st November, 2023.

ISBN: 978–978–782–923–3.

WSSN UDUS 2023 LOCAL ORGANIZING COMMITTEE

CENTRAL WORKING COMMITTEE

Prof. A. U. Dikko	Chairman
Prof. N. D. Ibrahim	Vice Chairman

PUBLICITY SUB-COMMITTEE

Dr. S. B. Shamaki	Chairman
Dr. A. U. Abdullahi	Member

Prof. M.D. Magaji Member
Prof. U. Aliyu Member
Prof. M. B. Sokoto Member
Prof. A. A. Yakubu Member
Prof. Y. Na ‘Allah Member
Prof. A.S. Muhammad Member
Dr. S. B. Shamaki Member
Dr. A.A. Kamba Member
Dr. L. A. Argungu Member
Mal. H. A. Bagudo Member
Dr. B. S. Haliru Treasurer
Dr.
Prof. J. Alhassan Secretary

FUNDS RAISING COMMITTEE

Dr. L.A. Argungu Chairman
Dr. M. S. M. Jabo Member
Dr. A. N. Abdullahi Member
Dr. Yahaya Garba Member
Dr. B. B. Abubakar Member
Dr. M.Y. Abubakar Member
Lawal Maidoki Member
Bala Ngadda Yakubu Member
Prof. J. Alhassan Treasurer
Mal. I.W. Tambari Secretary

Dr. A. A. Muhammad Member
Dr. A. M. Isa Member
Dr. H. Mu’azu Member
Mal. M. U. Tanimu Member
Dr. M. I. Abubakar Member
Mal. S. A. Lukman Secretary

WELFARE SUB-COMMITTEE

Prof. H. A. Gwandu Chairman
Prof. M. Audu Member
Dr. S. Abdullahi Member
Dr. F.J. Yelwa Member
Mal. F. Umar Member
Mal. Z.Y. Gada Secretary

TECHNICAL, EDITORIAL/PUBLICATIOM SUBCOMMITTEE

Prof. M. Musa Chairman
Dr. A. A. Barau Member
Dr. D. H. Yakubu Member
Dr. G. A. Abubakar Member
Mal. M. Ibrahim Member
Mal. M.R. Sharif Member
Mal. I. Bello Secretary

ACCOMMODATION AND TRANSPORTATION

Prof. A. S. Muhammad Chairman
Dr. Salisu Abdullahi Member
Dr. S. Garba Member
Dr. A. M. Nasir Member
Dr. M. M. Mikailu Member
Dr. N. G. Hayatu Member
Mal. M. S. Bunza Member
Dr. B. B. Abubakar Secretary

Table of Contents

WEED BIOLOGY AND ECOLOGY

PHYTOSOCIOLOGICAL SURVEY AND ALLELOPATHIC EFFECTS OF SOME WEED SPECIES EXTRACTS ON SEED GERMINATION AND SEEDLING GROWTH OF MAIZE (*Zea mays* L.) AND PEPPER (*Capsicum annuum* L.)

B. I. Oluwole[1*], E. Daniya[1], H. Ibrahim[2] and M. T. Salaudeen[1]

[1]Department of Crop Production, Federal University of Technology, Minna, Niger State, Nigeria.
[2]Department of Horticulture, Federal University of Technology, Minna, Niger State, Nigeria
*Corresponding author e-mail: blessingisraeloluwole@gmail.com
Phone: 08161588180; 08121387969

ABSTRACT

Allelopathy is an important agricultural practice that has gained attention in sustainable agriculture management. A weed survey was carried out in irrigation fields of Katcha and Gbako Local Government Areas of Niger State, and a laboratory experiment was conducted in the Department of Crop Production Laboratory, Federal University of Technology, Minna, Nigeria to assess the allelopathic effect of Siam weed (Chromolaena odorata.), Giant thatching grass (Hyparrhenia rufa.), Kodo millet (Paspalum scrobiculatum.), Pigweed (Portulaca oleracea.), Bermuda grass (Cynodon dactylon.) on germination and seedling growth of maize and pepper. The result of the weed survey revealed that twenty-nine weeds were found existing in the fields surveyed and nine were identified as the most dominant and important weed species, namely Cyperus rotundus, Setaria pumila, Digitaria horizontalis, Brachiaria deflexa, Senna obtusifolia, Ageratum conyzoides, Cynodon dactylon, Phyllanthus niruri and Eragrotis sp. Among the weed species, the aqueous extract of Portulaca oleraceae showed more phytotoxic effect which reduced germination percentage in maize by 64 %, plumule length by 83.1% and radicle length by 93.1% respectively, over the control. Similarly, P. oleraceae aqueous extract reduced the same parameters by 100% over the control in pepper. It is clear from this study that aqueous extract of P. oleraceae exerted a stronger inhibitory effect on the germination and seedling growth of maize and pepper than the other weed species, and should be considered important in these crops.

Keywords: Weed extracts, maize, pepper, allelopathy, seedling growth

INTRODUCTION

The plant community of a given area can respond differently to the interactions that exist between climate, soil type and cultural practices, as well as seed bank and animal action, among other factors (Gazola and Schenkel, 2018). Furthermore, weed species which forms part of the plant community can be spread and established once the natural environment is disturbed. For this reason, weed species identification of an area is one necessary aspect required for proper weed control. Weed species infestation differ in various locations as well as same environment. In this regard, the phytosociological indices are important in analyzing the impact, management systems and agricultural practices on the dynamics of growth and occupation of the weed communities (Gazola and Schenkel, 2018).

Phytosociological analysis is the determination of the floristic composition, distribution, structures, functioning and dynamics of the vegetation of an area which forms the plant communities (Gazola and Schenkel, 2018). It is therefore necessary to identify the ecological basis of weed species in an area using the appropriate method (Magalhaes-Guedes *et al.,* 2012). For example, to describe the dynamics of weed species in an agricultural field, the following parameters can be used, weed density, frequency and dominance (Gella *et al*., 2013). The weed species with the highest number of individuals is known as density, while those with larger distribution of species in an area are known as the abundance (Gella *et al*., 2013). The weed species that are able to crowd out the other species due to their growth and rapid accumulation of dry matter are known as dominance (Gella *et al*., 2013).

The interaction between weeds and crops in the field is a complex phenomenon that involves physical problems of competition and allelopathy (Gella *et al*., 2013). Allelopathy is an interference mechanism in which a living or dead plant material releases chemical substances that can inhibit or stimulate associated plant growth (Gella *et al*., 2013). It is claimed that some weed species have allelopathic effects on seed germination and seedling growth of several important crops (Gella *et al.,* 2013). For example, the harmful effects of plants residue in seed germination and plant growth could be attributed to the immobilization of large amounts of nutrients by microorganisms involved in decomposition, by allelochemicals (Gella *et al.,* 2013). However, there is scanty information available on the phytosociological survey of weeds and their allelopathic effect of weed species on germination and growth of widely cultivated important crops such as maize and pepper, in Nigeria.

Maize (*Zea mays* L.) is an annual grassy plant of the grass family belonging to the Poaceae. It is mainly grown particularly in tropical, subtropical and temperate regions of the world for food, feed and source of raw material for the industry (Steward *et al.,* 2018). Globally, the increase in maize production is directly related to the application of technology of cultivation, climate, fertilization and weed management (Barros *et al.,* 2017). However, weeds are undesirable plant found growing among crops. Some weeds in maize crop can produce reproductive organs especially seeds that spread rapidly and compete with it for space, water, light and nutrients (Barros *et al.,* 2017).

Pepper (*Capsicum annuum* L.) belongs to the Solanaceae family. It is an important fruit vegetable in the tropics and the world second most important vegetable after tomatoes (Olaniyi and Ojetayo, 2010). It contributes nutritionally to human diet as a good source of vitamins A, C, E, B1 and B2, potassium, phosphorus and calcium (Grubben *et al*., 2014). Production constraints such as weeds and diseases are major problems attributed for the low yields of pepper in Nigeria (Mohammad and Yahya, 2018). Heavy down pour and high relative humidity favours the rapid and excessive weed growth, which results in high pepper yield losses by 90 % at harvest (Galal *et al*., 2020). These losses are caused, among others by the initial coexistence of pepper with weeds. Immediately after transplanting, the pepper seedlings grow slowly and are very weak competitors for the limiting resources against the weeds. Such weeds if not controlled may outgrow the crop and result in total crop loss (Adigun *et al*., 2018). For these reasons, weed control is recognized as the foremost production-related problem in both conventional and organic pepper crops (Amador-Ramirez *et al*., 2007).

Allelopathy is a process that involves the secondary production of metabolism by plants, microorganisms, viruses or fungi which in turn can influence the growth and development of agricultural and biological systems (Chou*,* 2006). Allelopathic compounds released may regulate plant growth and developmental processes such as photosynthesis, respiration, transpiration, biochemical metabolism, protein and nucleic acid synthesis (Chou, 2006). The action of allelopathic compounds may be stimulatory, neutral, or inhibitory depending on their concentrations and sensitivity of the receiving target plant or plant organ (Rice*,* 2009). Seeds are an important plant organ and most sensitive to allelochemicals for this reason, seed germination is most widely used in bioassay in allelopathic studies (Aliotta *et al.,* 2006). The use of seed germination in bioassays in allelopathy is advantageous because the germination of seeds constitutes a critical step in the propagation and cultivation of most crop species (Ishii-Iwamoto *et al.,* 2006).

The present study was therefore, carried out to investigate the distribution of weed species in some selected irrigated fields in Gbako and Katcha Local Government Areas of Niger State and their allelopathic effects on germination and seedling growth of maize and pepper crops.

MATERIAL AND METHODS

Description of Sampling Area

A total of 14 fields under irrigation in Gbako and Katcha Local Government Areas of Niger State, Nigeria was surveyed between February to March, 2022 dry season. Average field size used was 0.2 ha. Fields for survey were chosen by contacting dry season farmers who were actively involved in maize and pepper production.

Phytosociological Survey

Weed survey data was taken in a “W” pattern as described by Sintayehu (2019) across the maize-based field. A total of 20 quadrat of (0.25m^2) were thrown at equal intervals in each location under study. The average count of the different weed species was recorded after identification of the species and family. The weed species seedlings in each quadrat were clipped and identified based on the use of the Handbook of West African Weeds Akobundu *et al.* (2016).

The relative frequency, relative density and relative abundance of weed species were counted and used to calculate the Importance Value Index (IVI) of a weed species as described below (Lopes *et al.*,2021): IVI= Relative Frequency (RF) + Relative Density (RD) + Relative Dominance (RD)

$$Frequency = \frac{\text{Number of quadrats in which a species was encountered}}{\text{Number of total quadrats}}$$

$$Relative\ frequency = \frac{\text{Species frequency}}{\text{Total frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a species}}{\text{Total area sampled}}$$

$$Relative\ density = \frac{\text{Species density}}{\text{Total species density}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of individuals per species}}{\text{Total number of quadrats where a species was encountered}}$$

$$\text{Relative abundance} = \frac{\text{Number of species abundances}}{\text{Total abundance of all species}} \times 100$$

The IVI is a useful tool for assessing the overall significance of a species because it considers several properties of the species in the vegetation analysis as described by Tauseef *et al.* (2012). In this study, weed species with IVI < 10.0 were considered rare and excluded in the discussion of result.

Laboratory Bioassays

Five weed species namely, Siam weed (*Chromolaena odorata*.), Giant thatching grass (*Hyparrhenia rufa*.), Kodo millet (*Paspalum scrobiculatum*.), Pigweed (*Portulaca oleracea*.), Bermuda grass (*Cynodon dactylon*.) were intentionally collected from the irrigation fields in Gbako and Katcha Local Government Areas of Niger State, Nigeria during the survey between February to March, 2022 dry season.

The extracts of these weed species were obtained in the laboratory. To make the extracts, 50 g of oven dried blended species of each weed species were soaked separately in 1000 ml of distilled water to produce a 5 % w/v solution on a dry weight basis. The solution was stirred for 24 hours at room temperature (25^{0}C) on an orbital shaker at 100 rpm. The extract was then strained through four layers of cheese cloth and then filtered through a Whatman No 1 filter paper. The filtrate (stock) solution was stored in paraffin sealed bottles at 4^{0}C in a refrigerator for 24 hours before it was used.

To conduct the germination and seedling growth of maize and pepper, 10 seeds of maize and 20 seeds of pepper were placed separate in a 9 cm petri dishes lined with a Whatman No. 1 filter paper. Then moistened with 3 ml of the different weed species extracts treatment. Distilled water, served as the control. For each treatment, four replicates were maintained in a Completely Randomized Design (CRD). The petri dishes were placed in a non-illuminated germinator at 25°C. After 7 days and 14 days, respectively, seed germination percentage, and seedling growth in terms of plumule and radicle lengths, and fresh and dry weight, percentage inhibition and stimulation were determined at 7 days for maize and 14 days for pepper, respectively following Javaid *et al.* (2006).

Data Analysis

Phytosociological data for weed species were subjected to important value index analysis as described by Lopes *et al.* (2021). All the data on seed germination and seedling growth of maize and pepper were subjected to analysis of variance (ANOVA). The Least Significant Difference (LSD) was used to separate the treatment means at 5 % level of probability.

RESULTS AND DISCUSSIONS

Phytosociological Study

The weed species composition in the irrigated maize-pepper based field in Katcha and Gbako Local Government Area in 2022 is shown in Table 1. Twenty-nine weed species from 17 different families were identified in the maize/pepper fields. The *Poaceae* family was the most dominant family with 8 weed species, followed by *Euphorbiaceae* and *Rubiaceae* with three species, respectively. This result suggests that the weed species recorded might be specific to the irrigation sites. Our finding is in agreement with Zhiri *et al.* (2022) who reported that weeds and crops are site specific over a wide range of habitat.

In terms of the importance value index, the data recorded revealed that the prevalent weed species associated with maize and pepper were *Cyperus rotundus, Portulaca oleraceae, Digitaria horizontalis, Bracharia deflexa, Senna obtusifolia, Ageratum conyzoides, Cynodon dactylon, Phyllanthus niruri* and *Eragrotis sp.* (Table 1). This shows that these species are adapted to the condition of the irrigated fields, and their ability to interfere with the cultural practices and in reducing the yield of maize and pepper. Our observation is in line with Dada *et al.* (2017) who reported that weed species with high relative importance value can compete for growth resources better than the other weed species with low importance value. In the same vein, this finding suggests the need to control this weed species from their vegetative stage, because of their high density, and rapid ability to absorb and accumulate growth resources like nutrients (Izzet and Yusuf, 2004).

Table 1: The weed species composition and their important value index (IVI) in irrigated Maize-pepper based field in Katcha and Gbako Local Government Area of Niger State in 2022.

Weed species	Family	Relative abundance (%)	Relative frequency (%)	Relative density (%)	Importanc e value index
Ageratum conyzoides L.	Asteraceae	2.3	5.2	8.5	16.0
Brachiaria deflexa (Schumach.) C.E. Hubbard ex Robyns	Poaceae	0.6	11.7	11.9	24.2
Brachiaria lata (*Schumach.*) C.E. Hubbard	Poaceae	1.4	3.7	2.6	7.7
Cleome viscosa L.	Capparidaceae	6.7	0.6	0.3	7.6
Commelina benghalensis L.	Commelinaceae	2.5	0.9	0.3	3.8
Cynodon dactylon (L.) Pers	Poaceae	2.4	4.3	5.9	12.6
Cyperus rotundus L.	Cyperaceae	2.2	9.5	26.9	38.6
Dactyloctenium aegyptium (L.) P. Beauv	Poaceae	7.6	0.3	0.1	8.0
Desmodium scorpiurus (Sw.) Desv	Leguminosae	3.8	0.6	0.2	4.6
Digitaria horizontalis Willd	Poaceae	0.5	12.9	12.1	25.5
Eragrostis tenella Wolf.	Poaceae	6.9	1.5	2.2	10.6
Euphorbia heterophylla L.	Euphorbiaceae	0.9	2.1	0.5	3.5
Euphorbia hirta L.	Euphorbiaceae	1.2	3.1	1.5	5.8
Ipomoea aquatic Forssk,	Convolvulaceae	5.7	0.6	0.3	6.6
Ipomoea triloba L.	Convolvulaceae	7.6	0.3	0.1	8.0
Mimosa pudica L.	Fabaceae	0.7	1.8	0.3	2.9
Mitracarpus villosus (Sw.) Cham. & Schltdl. Ex DC.	Rubiaceae	3.3	1.2	0.7	5.2

Nelsonia canescens (Lam.) Spreng.	Acanthaceae	1.5	3.1	2.0	6.6
Oldenlandia corymbosa L.	Rubiaceae	1.0	2.5	0.8	4.3
Paspalum scrobiculatum L	Poaceae	2.0	2.5	1.6	6.0
Phyllanthus niruri L.	Euphorbiaceae	0.8	6.1	4.1	11.1
Physalis angulate L.	Solanaceae	0.6	3.7	1.2	5.5
Portulaca oleracea L.	Portulacaceae	0.4	16.3	12.8	29.4
Senna obtusifolia (L.) Irwin & Barneby	Fabaceae	16.2	0.6	0.8	17.6
Setaria pumila (Poir.) Roem. & Schult.	Poaceae	7.6	0.3	0.1	8.0
Sida acuta Burm.f.	Malvaceae	3.8	0.3	0.0	4.2
Spermacoce ocymoides auct.non Burm.f.	Rubiaceae	6.8	0.9	0.8	8.5
Spigelia anthelmia L.	Loganiaceae	1.7	0.9	0.2	2.8
Tridax procumbens L.	Asteraceae	1.3	2.5	1.0	4.7

Field Survey: 2022

Laboratory Bioassay

The allelopathic effect of aqueous weed species extract under consideration namely, *Chromolaena odorata, Hyparrhenia rufa, Paspalum scrobiculatum, Cynodon dactylon , Portulaca oleraceae* had a significant effects on all the parameter of the maize seed germination and seedling growth compared to the control (Table 2). Highest germination percentage (83.75 %) was recorded from the control, whole the lowest (30 %) was obtained from *P. oleraceae* extract compared to the other treatments (Table 2). Furthermore, shorter plumules and reduced radicles were observed in the *P. oleraceae* extracts compared to the other aqueous extracts tested (Table 2). In the same disposition, similar minimum plumule dry weights were recorded in the *C. dactylon, P. oleraceae* extracts, respectively (Table 2). In contrast, with the exception of *Hyparrhenia rufa* which produced the maximum radicle dry weight, all the other weed species extracts and the control resulted in similar minimum radicle dry weight (Table 2). In terms of inhibition percentage, all the weed species extracts inhibited the seed germination and seedling growth of maize (Table 2). The highest inhibition of the seed germination and seedling growth of maize was observed with the *P. oleraceae* (-0.64%) followed by *C. dactylon* (-0.46%) aqueous extracts. In general, the aqueous extract of *P. oleraceae* had a strong inhibitory effect on seed germination and seedling growth of maize. This suggests that *P. oleraceae* contain certain strong allelo-chemicals such as fatty and phenolic acids (Wang *et al.,* 2017). These constituents translated into greater inhibition of seed germination, seedling growth as well as lower plumule and radicle dry weight of maize. These results are in agreement with the findings of (Mahfuza *et al.,* 2021) who reported that *P. oleraceae* contains certain allelo-chemicals which can inhibit the germination and seedling growth of several cereal crops. Similar to *P. oleraceae, C. dactylon* had a noticeable inhibitory impact on the inhibition of the germination and seedling growth of maize. These results are corroborated by Sanjeev *et al.* (2019) and Lehoczky *et al.* (2007) who reported that *C. dactylon* had inhibitory effect on germination and seedling growth of some cereal crops namely, rice, wheat, millet and maize.

Table 2: Effect of aqueous extracts of some selected weed species on germination percentage, average plumule length, average radicle length, plumule dry weight, radicle dry weight and percentage inhibition and stimulation of maize.

Treatment	Germination percentage (7 Days)	Average plumule length (cm)	Average radicle length (cm)	Plumule dry weight (g)	Radicle dry weight (g)	Percentage inhibition and stimulation

Chromolaena odorata	61.25b	6.90c	3.85c	0.13c	0.04b	-0.27
Hyperheria ruffa	67.50b	15.20b	12.00b	0.15c	0.53a	-0.19
Paspalum scrobiculatum	63.75b	13.85b	13.73ab	0.22b	0.11b	-0.24
Portulaca oleraceae	30.00d	3.00d	1.03d	0.05d	0.02b	-0.64
Cynodon dactylon	45.00c	5.23c	3.28c	0.07d	0.02b	-0.46
Control (Distilled water)	83.75a	17.78a	15.00a	0.36a	0.19b	-
LSD (0.05)	8.79	1.69	1.90	0.05	0.19	

Means followed by the same letter (s) in a column are not significantly different at 5% level of probability, using the least significant difference.

The aqueous weed species extract under consideration namely, *C. odorata, H. rufa, P. scrobiculatum, C. dactylon , P. oleraceae* had a significant effects on all the parameter of the pepper seed germination and seedling growth compared to the control (Table 3). Highest germination percentage (90.0 %) was recorded from the control, while the lowest (0 %) was obtained from *P. oleraceae* extract compared to the other treatments (Table 3). Furthermore, shorter plumules and reduced radicles were observed in the *P. oleraceae* extracts compared to the other aqueous extracts tested (Table 3). In the same vein, similar minimum plumule dry weight and radicle dry weight was recorded in *P. oleraceae* extract (Table 3). In terms of inhibition percentage, all the weed species extracts inhibited the seed germination and seedling growth of pepper (Table 3). The highest inhibition of the seed germination and seedling growth of pepper was observed with the *P. oleraceae* (-100%) followed by C. *dactylon* (-0.86 %) aqueous extracts.

In general, the aqueous extract of *P. oleraceae* had a strong inhibitory effect on seed germination and seedling growth of pepper. This suggests that *P. oleraceae* contain higher concentration of allelo-chemicals such as fatty and phenolic acids (Wang *et al.*, 2017). These constituents translated into greater inhibition of seed germination, seedling growth as well as lower plumule and radicle dry weight of pepper. These results are in agreement with the findings of Izzet and Yusuf (2004) who noted that *P. oleraceae* contains allelo-chemicals which can influence the physiological processes of germination and seedling growth of several vegetable crops. Similarly*, C. dactylon* had a noticeable inhibitory impact on the germination and seedling growth of pepper. The results of Awal *et al.* (2020) strengthen the findings of our results that germination of okra, radish, water spinach and red amaranth was inhibited by aqueous extracts of *Cyperus rotundus Eleusine indica* and *C. dactylon* due to the presence of allelochemicals in them. Our result also indicate that different weed species have crop-specific inhibition ability against the test crop type.

Table 3: Effect of aqueous extract of some selected weed species on germination percentage, average plumule length, average radicle length, plumule dry weight, radicle dry weight and percentage inhibition and stimulation of pepper

Treatments	Germination percentage (7 Days)	Average plumule length (cm)	Average radicle length (cm)	Plumule dry weight (g)	Radicle dry weight (g)	Percentage inhibition and stimulation
Chromolaena odorata	28.75c	1.63c	1.20b	0.04b	0.01bc	-0.68
Hyperheria ruffa	50.00b	2.43b	1.20b	0.03bc	0.01bc	-0.44
Paspalumscrobiculatum	43.75bc	1.10cd	0.40c	0.05b	0.02b	-0.51
Portulaca oleraceae	0.00d	0.00e	0.00d	0.00c	0.00c	-100
Cynodon dactylon	12.50d	0.58de	0.35cd	0.02bc	0.02b	-0.86
Control (Distilled water)	90.00a	7.15a	1.65a	0.13a	0.03a	-
LSD (0.05)	15.51	0.61	0.39	0.03	0.01	

Means followed by the same letter (s) in a column are not significantly different at 5% level of probability, using the least significant difference.

CONCLUSION

Based on the content of this study, it is concluded that *Portulaca oleraceae* had higher allelopathic impact than the other weed species evaluated and may play some inhibitory role on seed germination and seedling growth of maize (*Zea mays L*) and pepper (*Capsicum annuum L*). A total of twenty-nine weed species were identified in the study area out of which nine were found to be dominant, associated and important in maize-pepper based fields namely, *Cyperus rotundus, Setaria pumila, Digitaria horizontalis, Brachairia deflexa, Senna obtusifolia, Ageratum conyzoides, Cynodon dactylon, Phyllanthus niruri* and *Eragrotis sp*. There is need to assess the allelopathic potential of *Portulaca oleraceae* on different varieties of maize (*Zea mays L*) and pepper (*Capsicum annuum L*) commonly cultivated by farmers in this agroecological zone of Nigeria.

Acknowledgments

We are grateful to the Tertiary Education Trust Fund (TETFund) through the National Research Fund (NRF) (Ref: TETF/ES/DR&D-CE/NRF2020/SETI/26/VOL.1) for providing the grant for the phytosociological survey part of this study. The management of the Federal University of Technology, Minna is appreciated for the enabling environment to undertake the study. We also thank all the farmers that allowed us to collect weeds from their farms.

REFERENCES

Adigun, J. A., Daramola, O. Adeyemi., O. & Olorunmaiye, P. M. (2018). Response of transplanted Chilli pepper (Capsicum frutescens L.) to nitrogen application and weed management in the Nigerian Forest Savanna Transition Zone. *Nigerian Journal of Ecology* 17(2): 1 – 14.

Akobundu, I. O., Ekeleme, F. & Agyakwa, C. W. (2016). Handbook of West Africa Weeds 3rd ed. *International Institute of Tropical Agriculture*. 256 – 260.

Aliotta, G., Cafiero, G. & Martinez – Otero, A. (2006). Weed germination, seedling growth and their lesson for allelopathy in agriculture. Allelopathy: A Physiological Process for Ecological Implications.Springer. *The Netherlands*. 285 – 297.

Amador-Ramírez., M., Mojarro, F. & Velasquez-Valle, R. (2007). Efficacy and economics of weed control for dry chilli pepper. *Crop Protection.* 26:677 – 682.

Awal, M. A., Ahsan, A. K. M. A. & Pramanik, M. H. R. (2020). Effect of aqueous extract of grass weeds on seed germination and seedling growth of vegetable crops. *Asian Journal of Research in Botany*, 4(1):1 – 10.

Barros, I., Pacheco, E. & Carvalho, H. (2017). Integrated energy and economic performance assessments of maize production in semiarid tropics: Comparing Tillage Systems. *Journal of Environmental Accounting and Management*. 5: 211 – 232.

Chou, C. H. (2006). Introduction to allelopathy. *In:* Allelopathy: A Physiological Process with Ecological Implications. M. J. Reigosa, N. Pedrol and L. Gonzalez (eds). Springer, *The Netherlands.* 1 – 9.

Dada, O., Oladiran, M. & Olubode, S. (2017). Influence of weeding regimes on composition and diversity of weed species in upland rice (*Oryza sativa* L.) field. *Nigerian Journal of Ecology.* 16: 62-7462.

Galal, R., Hassanein, A. & Fedlallah, A. (2020). Determination of critical periods of weed competition and weed control influence on yield productivity of sweet pepper (*Capsicum annuum L*.). *Journal of Plant Production*. 11: 127 – 137.

Gazola, A. C. & Schenkel, E. P. (2018). The sedatic activity of Flavinoids from *Passiflora quadrangulanis* is mediated through the GABAergic pathway. *Journal of Biomedical and Pharmacotherapy.* 100: 388 – 393.

Gella, D., Habtamu, A. & Takele, N. (2013). Allelopathic effects of aqueous extracts of major weed species plant part on germination and growth of Wheat*. Journal of Agriculture and Crop Research.* 1(3): 30 – 35.

Grubben, G. K., Wijnand, W. R., Everaarts, A., Fondio, L., Nugteren., J. A. & Corrado, M. (2014). Vegetables to combat the hidden hunger in Africa. *Chronica Horticulture*. 54: 24 – 32.

Ishii-Iwamoto, E. L., Abraham, D., Sert, M. A., Bonato, C. M., Kelmer – Bracht, A. M. & Bracht, A. (2006). Mitochondria as a site of allelochemical action. In: Allelopathy: A Physiological Process with Ecological Implications. Springer. *The Netherlands*. 267 – 284.

Izzet, K. Y. & Yusuf, A, U. (2004). Allelopathic effects of extracts against seed germination of some plants. *Journal of Environmental Biology / Academy of Environmenta Biology*, *India*. 26.

Javaid, A., Tehmina, A. & Rukhsana, B. (2006). Chemical Control of Noxious Weed Parthennium hysterophorus L. *International Journal of Biology and Biotechnology.* 3(2):387 – 390.

Lehoczky, É., Kismanyoky, A. & Németh, T. (2007). Effect of the soil tillage and N-fertilization on the weediness of maize. *Cereal Research Communications*. 35: 725 – 728.

Lopes, C. C., Fontes, C. L. O., Lazzarini, L. E. S., Freitas, F. C. L., Filho, J. H. C. & Sousa, E. R. (2021). Phytosociological survey of weed plants in soybean culture in the Gurgueia valley. Scientia Agraria Parana ensis. https://doi.org/10.18188/sap.v20i1.25964

Magalhães-Guedes, K., Pereira, G. C., Cássia, D. G. & Schwan, R. (2011). Brazilian kefir: Structure, microbial communities and chemical composition. *Brazilian journal of microbiology*. 42:693 – 702.

Mahfuza, B., Abdus-Salam, M. D. & Farhana, Z. (2021). Allelopathic effect of siam weed debris on seed germination and seedling growth of three test crop species. *Acta Scientific Malasysia*, 5 (1): 1 – 4.

Mohammed, T. & Yahya, R. (2018). Performance of Sweet Pepper (*Capsicum annuum* L.) under Five Levels of Nitrogen Fertilizer in Zaria, Kaduna State, Nigeria. *Asian Journal of Advances in Agricultural Research.* 5:
1 – 7.

Olaniyi, J.O. & Ojetayo, A.E. (2010). The effect of organomineral and inorganic fertilizers on the growth, fruit yield and quality of pepper (*Capsicum frutescence*). *Journal of Animal and Plant Sciences, 8*: 1070-1076.

Rice, E. L. 2009. Allelopathy – an update. The Botanical Review 45, 15 – 109.

Sanjeev, K. D., Doo, K., Bishnu, A., Jeong-Ho, K. & Dong-Hyun, S. (2019). Reduced germination and seedling vigor of weeds with root extracts of maize and soybeans, and the mechanism defined as allelopathic. *Journal of Crop Science and Biotechnology*, 22 (1): 6 – 11.

Sintayehu, A. (2019). Weed flora survey in field crops of Northwestern Ethiopia. *Afri*can *Journal of Agric*ultural *Research*. 14:749 – 758.

Steward, P., Dougill, A., Thierfelder, C., Pittelkow, C., Stringer, L., Kudzal., M. & Shackelford, G. (2018). The adaptive capacity of maize-based conservation agriculture systems to climate stress in tropical and subtropical environments: A meta-regression of yields. *Agriculture, Ecosystems and Environment*. 251: 194
– 202.

Tauseef, M., Ihsan, F., Nazir, W. & Farooq. J. (2012). Weed flora and importace value index (IVI) of the weeds in cotton crop fields in the region of Khanewal, *Pakistan. Pakistan Journal of Weed Science Research* 18(3): 319 – 330.

Wang, H., Zhang, L. & Yangyang, W. (2017). Isolating and identifying organic acids from *Portulaca oleracea* and determining their anti-cyanobaterial activity. *Polish Journal of Environmetal Studies.* 26(1):441 – 445.

Zhiri, S.J., Daniya, E. & Kolo, M.G.M. (2022). Upland Rice (*Oryza sativa* L.) Varieties Response to Weed Management Practices and Plant Stand Densities in a Moist Savanna of Nigeria. *Internal Journal of. Plant Production.* 16: 429–44.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EVALUATION OF WEED INCIDENCE AND BIOMASS IN COCOA/COCONUT INTERCROP IN IBADAN, NIGERIA

A.O. Famaye, S.A. Adeosun, K.B. Adejobi, K.O. Ayegboyin and O. Ibe

Cocoa Research Institute of Nigeria (CRIN), P.M.B. 5244, Ibadan, Oyo State, Nigeria E-mail: tunmos2010@yahoo.com

ABSTRACT

A field trial was conducted at Cocoa Research Institute of Nigeria (CRIN), Ibadan between 2019 and 2021 to evaluate the effect of weed incidence and biomass on in cocoa/coconut intercropping system. The experimental design was Randomised Complete Block (RCB) with three replicates. There were four treatments comprising of cocoa sole, cocoa/plantain, cocoa/coconut and cocoa/plantain/coconut. Data were collected on plant height, plant girth and leaf area of cocoa at three months interval after transplanting into the field. Also data on weed incidence was taken 3 months interval using quadrant of 60cm x 60cm. Result in the morphological parameter were subjected to analysis of variance and LSD was used to separate the means that were significant. The weed samples were identified into broad leaves, grasses and sedges. The biomass from each treatment was determined. Result obtained showed cocoa/cocoa/plantain/coconut the least vegetative performance while cocoa/plantain gave the highest and closely followed by cocoa/coconut intercrop. In the case of weed incidence and biomass, the cocoa sole had the highest and the least cocoa/plantain/coconut, followed cocoa/plantain and cocoa/coconut. Cocoa/coconut could be recommended to the farmer as its vegetative performance was significantly higher ($P \leq 0.05$) than cocoa sole (control) and with less weed incidence and biomass than control. Cocoa/plantain/coconut intercropped with the least weed incidence and biomass could not be recommended to farmer because of least performance in vegetative growth. **Keywords**: Cocoa/coconut, weed incidence, biomass

INTRODUCTION

The single species of Theobroma Cacao (L) are cultivated for the international market all over the world (Opeke 1982). In Nigeria, cocoa can be conveniently intercropped with oil palm, kola and citrus. Also, arable crops such as yam, cassava, cocoayam, maize,okra, pepper, cowpea, melon and rice in different combinations can be intercropped with cocoa at early stage of the field establishment (Famaye, 2013). Other tree crops like oil palm have been successfully intercropped with arable crops (Ofoli and Lucad (1988) and Okpala-Jose and Lucas (1989)). Weeds are a limitation to cocoa production in Nigeria especially at early stage of field establishment (Adeyemi et al, 1997). Weed compete for water and nutrients and cause poor growth of the cocoa trees (Opeke 1982). The method of using hoe and cutlass are the traditional method of weed control in Nigeria which is very expensive, labour intensive and time consuming too. Chemical weed control is very expensive and not easily available for most of the peasant cocoa farmers in Nigeria (Famaye, 2013). Intercropping with tree crops have been found to reduce the weed biomass (Famaye and Agboola 2003) and (Famaye et al 2003 and 2011). Coconut is one of the tree crops that can be intercropped with cocoa which was a common practice in South East Asia as reported by Famaye (2013).

The objective of this study therefore is to evaluate the weed incidence and biomass when cocoa is intercropped with coconut in Ibadan South West Nigeria.

MATERIALS AND METHODS

Ten experiment was carried out in Cocoa Research Institute of Nigeria (CRIN) Idi-Ayunre Ibadan (Latitude $7^{0}25'$N and Longitude $3^{0}25'$N) with an altitude of about 122m above sea level in rain forest zone of Nigeria. The cocoa seedlings were raised from CRIN nursery while coconut seedlings were obtained from coconut farmer' nursery. Plantain suckers were obtained from farmers. Land preparation was done after soil selection in March 2019. Tree were cut and debris of trees were removed. The layout and digging of the planting holes were done in May 2019. Treatments considered were cocoa sole, cocoa/plantain, cocoa/coconut and cocoa/plantain/coconut. The experiment was laid out in a randomised complete block design (RCBD) with three replicates. Prior to planting in May soil samples were randomly collected using a soil auger to determine the physical and chemical and chemical properties of the site.

Weeding was carried out eight times during the trial. Quadrant of 30cm x 30cm were raised to take weed samples randomly per treatment before the weeding commenced. Data collected were plant height, stem girth and leaf area of cocoa for growth parameter. The weed species were identified, and the fresh weight was taken. The dry weight was taken after oven drying for 72 hours at a constant temperature of 85^0C. Results obtained were subjected to statistical analysis of Variance (ANOVA) and LSD was used to separate the means that were significant.

RESULTS AND DISCUSSION

The plots were infested with broad leave weeds, grasses and sedges as shown in Table 1. Broadleaf weeds were the major weeds found in the experimental site followed by grasses and the least being sedge. This confirms earlier work that reported broad leaf weed as major weeds found in cocoa farms in Nigeria (Famaye et al 2011). The weed growth in the second year of the trial reduced compared with the weed of the first year. Fig.1 showed the weed biomass from the experimentation. Cocoa/plantain/coconut gave the least weed biomass closely followed by cocoa/plantain and cocoa/coconut. The highest weed biomass was from cocoa sole which was significantly higher ($p \leq 0.05$) than other treatments. This might have been due to exposure to more isolation in the sole plot. The shade occupied by plantain and coconut in cocoa/plantain and cocoa/coconut respectively might have contributed to the reduction in weed biomass as it agrees with earlier work on importance of shade for coffee at early stage of field establishment (Famaye 2002 and 2005). The significant reduction in weed biomass in the two treatments suggest a reduction in labour requirements for weeding on the plots. This agrees with earlier suggestions by Adeyemi (1997) that appropriate intercropping system of good cropping combinations would increase labour efficiency in coffee production.

The plant height, plant girth and leaf area of cocoa are shown in Tables 2, 3 and 4 respectively. Cocoa/plantain and cocoa/coconut were significantly higher ($p \leq 0.05$) in height, girth and leaf area than the cocoa sole and cocoa/plantain/coconut intercropped. Though the result showed that cocoa/plantain/coconut has the least weed biomass but it was not as vigorous as cocoa/plantain and cocoa/coconut intercropped.

The good growth performance in cocoa/plantain and cocoa/coconut than cocoa sole indicated no deleterious effects of intercropping plantain and coconut with cocoa. This agreed with earlier work on beneficial effects of successfully intercropping with cocoa, oil palm, kola and coffee (Ofoli et al., 1988, Okpala-Jose et al, 1989, Famaye 2002, Famaye, 2013, Famaye, 2003). It also confirms the finding of Obatolu et al (1998) on the possibility of intercropping coffee with other crops during early years of field establishment and during rehabilitation of old coffee plots.

Table 1: Common weed species identified at Idi-Ayunre

Weed species	Family	Level of Occurrence	
		2019	2021
Broad leaves			
Tridax procumbens L.	Euphobiaceae	++	++
Euphorbia hirta L.	Euphobiaceae	++	++
Talinum triangulare (Jacq) Willd	Portulacaceae	++	+++
Amaranthus Spinosus L.	Asteraceae	+++	++
Chromoleana Odorata L. R.M. King and Robinson	Compositae	+++	++
Amaranthus Viridis L.	Amaranthaceae	+	+
Ageratum conyzoides L.	Asteraceae	++	++
Euphorbia heterophylla L,	Euphobiaceae	+++	+++
Acanthospermumhispidium D.C.	Acanthaceae	++	+
Boerhaviadiffusa L.	Nyctaginaceae	+	+

Grasses			
Cynodondatylon (L) pers	Poaceae	+	+
Panicum maximum Jacq	Poaceae	+	+
Sedges			
Cyperus haspan Linn	Cyperaceae	+	+
Cyperus rotundus L.	Cyperaceae	+	+
MaricusalternifoliusVahl	Cyperaceae	+	+
Cyperus esculentus L.	Cyperaceae	+	+

+++ High infestation (60-90% occurrence); ++ Moderate infestation (40-59% occurrence); + Low infestation (1-39% occurrence)

Table 2: Effects of cocoa/coconut intercrop on plant girth of cocoa

Treatments	3	6	9	12	15	18	21	24
CocoaSole	0.83	0.88	1.57	1.78	1.8	1.93	1.28	2.04
C/P	0.68	0.74	1.78	1.87	1.91	2	2.24	2.4
C/C	0.64	0.68	1.56	1.73	1.78	1.9	2.01	2.02
C/C/P	0.6	0.63	1.37	1.49	1.51	1.84	1.89	1.93
Mean	0.69	0.73	1.57	1.72	1.75	1.92	1.86	2.10
LSD (P<0.05)	0.16	0.17	0.27	0.26	0.27	0.11	0.65	0.33

Months After Transplanting

Table 3: Effects of cocoa/coconut intercrop on plant Height of cocoa in Ibadan

	Months After Transplanting							
Treatments	3	6	9	12	15	18	21	24
Cocoa Sole	49.26	49.74	56.6	78.41	82.5	85.47	90.68	100.91
C/P	38.53	39.68	57.07	86.25	88.46	93.02	99.81	112.89
C/C	35.56	38.83	45.91	80.91	84	90.91	93.64	103.93
C/C/P	34.25	35.14	40.23	72.3	80.13	84.12	87.57	90.48
Mean	39.4	40.8475	49.9525	79.4675	83.7725	88.38	92.925	102.052
LSD (P≤0.05)	10.84	9.94	13.17	9.21	5.58	6.78	8.30	14.70

Table 4: Effect of cocoa/coconut intercrop on leaf area of cocoa in Ibadan

Treatments	3	6	9	12	15	18	21	24
Cocoa Sole	146.1	179.62	206.87	268.73	275.4	284.32	301.8	323.3
C/P	138.91	155.29	224.68	284.38	292.12	298.24	320.23	345.41
C/C	123.42	131.07	215.24	253.24	274.86	285.16	298.93	320.8
C/C/P	120.52	125.35	201.52	243.35	257.9	280.53	290.36	301.73
Mean	132.24	147.83	212.08	262.43	275.07	287.06	302.83	322.81
LSD (P<0.05)	19.52	39.54	16.11	28.61	22.23	12.28	20.01	28.45

Months after transplanting

Note: C/P = Cocoa/Plantain, C/C = Cocoa/Coconut, C/C/P = Cocoa/Coconut/Plantain

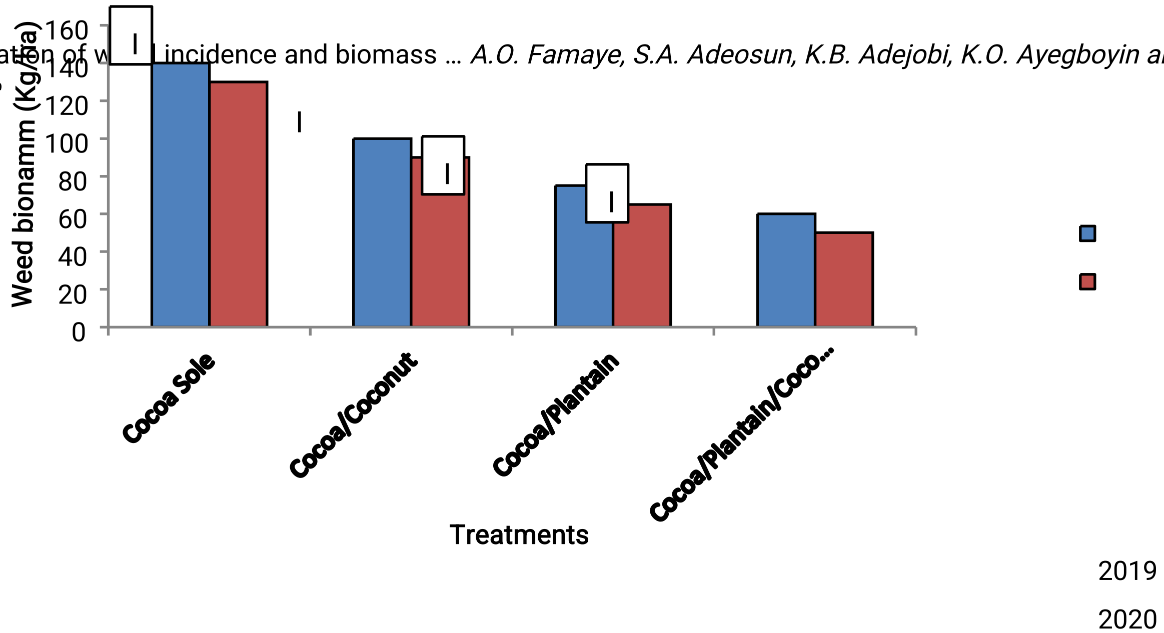


Figure 1: Effects of intercropping on weed biomass of cocoa in Ibadan

CONCLUSION

Conclusively, cocoa/plantain/coconut intercropped with the least weed biomass which the cocoa seedlings were not as vigorous morphologically as those of cocoa/plantain and cocoa/coconut could not be claimed as the best intercrops in this trial. Therefore, cocoa/coconut intercrops which are of good plant growth with lower weed incidence and biomass could be recommended to cocoa farmers in Nigeria instead of sole planting.

Acknowledgement

The Executive Director (CRIN) Dr. P.O. Adebola is acknowledged for permission to publish the paper.

REFERENCES

Adeyemi, A.A. (1997). Farming syatem in coffee. In Proceedings of Coffee Production Technology Transfer Workshop at ABU College of Agriculture ,Kabba, Kogi State 155N111B-633X. pp39-46.

Famaye A.O. (2002). Efefcts of shade regimes on growth of coffee species in Nigeria. Mppre Journal of Agricultural Research pp 184-194.

Famaye, A.O., Adeyemi , E.A. and Olaiya, A.O. (2003). Spacing trials in cocoa/kola/citrus intercrop. In Proceeding of 14th International Cocoa Research Conference Accra Ghana pp. 501-504.

Famaye A.O. and Agboola A.A. (2003). Evaluation of weed biomass in coffee canophera intercrops with maize, cassava and plantain. Nigeria Journal of Weed Science Vol. 16 pp 9-14.

Famaye A.O. (2005). Evaluation of nutrient uptake in coffee intercropped with maize, cassava and plantain in Nigeria. Nigerian Journal os applied sciences Vol. 23, pp 1-5.

Famaye A.O., Iremiren G.O., Olubamiwa O., Aigbekaen A.E. and Fademi O.A. (2011). Intercropping cocoa with rice and plantain influencing cocoa morphological parameters and weed biomass. Journal of

Agricultural Science and Technology B1 746-750 ISSN 1939-1250.

Famaye A.O. (2013). Handbook on cocoa production pp 47

Ofoli M.C. and Lucas E.O. (1988). The performance of oil palm (Elis guinensis Jacq) and some food crops under intercrops system and effects on the soil under factors cassava based cropping system research II. Contributions from the Second Annual Meeting of the Collaborative Group in cassava based cropping Syatem Research, IITA, Ibadan, November 7-10, 1988.

Okpala-Jose A. and Lucas E.O. (1989). Performance of live mulch/maize/cassava/oil palm intercropping system I- assessment of the biological yields of the oil palm yield of food crops and economic returns, paper presented at the International Conference on oil palm and products, Benin City, Nigeria, Nov, 21-15, 1989.

Okpeke L.K. (1982). Tropical Tree Crops pp. 71-81

Obatolu C.R., F.A. Okelala, Adeyemi A.A., Oduwole A..Omolaja S.S., Famaye A.O. and Ojelade K.T.M. (1989). Coffee production Manual, A publication of the Cocoa Research Institute of Nigeria 29 pp.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

ALLELOPATHIC EFFECT OF NEEM (*Azadirachta indica* L.) LEAF EXTRACT ON THE GROWTH OF SOME WEEDS

S. Abdullahi[1], J. Alhassan[2], I. Nuradeen[1] and A. I. Lawal[1]*

[1]Department of Forestry and Environment, Usmanu Danfodiyo University Sokoto, Nigeria
[2]Department of Crop Science, Usmanu Danfodiyo University Sokoto, Nigeria
Corresponding author: auwalibrahimlawal7@gmail.com/ 08063280771

ABSTRACT

Experiment was conducted at the Screenhouse of the Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto to determine the effect of Neem (Azadirachta indica L.) leaf extract on the growth of some weeds. The experiment was a pot experiment with soil from natural environment of weed. Neem leaf extract (0.0, 10.0, 20.0, and 30.0% extract) solution was applied two weeks after germination as post-emergence treatment. Each treatment was repeated ten (10) times in a Completely Randomized Design (CRD). Data were taken on weed dry matter and weed control efficiency fortnightly (at 4th week, 6th week & 8th weeks) after the treatment application. The result revealed that, the growth of weed species was reduced significantly with 45.2% control efficiency. The inhibitory effect was increased as the extract concentration increased. It was concluded that, Neem leaf extract had an influence on the growth performance of some weeds with 45.2% control efficiency.

Keywords: Allelopathy, Neem Leaf extract, Weed growth, Seedling growth, Inhibition.

INTRODUCTION

Any direct or indirect and harmful or beneficial effect by one plant (including micro-organisms) on another through production of chemical compounds that escape into the environment is called allelopathy (Rice, 1984). Allelopathy term was coined by (Molisch 1937), which generally refers to the detrimental effect of one plant species on seed germination, growth and reproduction of another plant species. Allelopathy is an important factor in determining vegetation pattern, species diversity and vegetation dynamics. Allelopathic strategies aim at reducing environmental pollution and maintaining ecological balance especially soil fauna and flora through reduced use of chemical herbicides or substituting them with natural products (plant and microbial products). In agricultural practice, allelopathy is exploited for weed control (Kohli *et al.*, 1998). The chemicals with allelopathic activity are present in many plants and in many organs, including leaves, flowers, fruits and buds (Ashrafi *et al*, 2007, May & Ash, 1990; Inderjit, 1996).

Azadirachta indica, is an evergreen tree native to Southeast Asia. It is belonging to the family Meliaceae. It is a valuable multipurpose tree with religious, medical and social uses, since last 4000 years. It is widely used in toothpastes, soaps and lotion today, as well as being a biological insecticide. Many chemicals such as nimbin, nimbidin, nimbidol, gedunin, sodium nimbinate, quceretin (anti-protozoal), salannin (repellent), and azadirachtin (repellent, anti-feedant, antihormonal) present in the neem trees (Sankaram, 1987).

Weed, general term for any plants growing where it is not wanted. Ever since humans first attempted the cultivation of plants, they have had to fight the invasion by weeds into areas chosen for crops. Weed interfere with a variety of human activities, and many methods have been developed to suppress or eliminate them. These methods vary with the nature of weed itself, the means at hand for disposal, and the relation of the method to the environment.

Weeds absorb required nutrients for the growth of vegetables, flowers or any other plant. Weeds are unwanted plants, non-useful persistent effectively competing with the beneficial and desirable plants for space, nutrients, sunlight and water. Some plant species produce allelochemicals that could suppress the growth and germination of other seedlings and weeds growing near. Weed can significantly reduce yield quality of seedlings. In general weeds are genetically wild traits which take and receive more amount of all these resources and inputs compared to the seedling and leaving very small amount. Reduction in crop yield due to weed was reported to be as high as 24% compared to the diseases and pest with 16.4% and 11.2%, respectively. Crops compete for one or more growth factors such as water, nutrient and light unless protected (Zzet *et al.,* 2004). Organic chemicals can have suppressed weed growth and increased crop growth, they hardened the soil, decrease soil fertility, polluted the air and post significant health risks to human and the environment. Allelopathy is an important factor in determining vegetation pattern, species diversity and vegetation dynamic. Neem tree species produce allelochemicals that could suppress the growth and germination of some weed, Allelopathy strategies aim at reducing environmental pollution and maintaining ecological balance especially soil fauna and flora through reduced use of chemicals herbicides or substituting them with natural products (plants and microbial products).

To ensure sustainable management there is desire to reduce herbicide use and human invasion into the ecosystem unless monitoring of weeds populations indicates intervention is necessary to determine the allelopathic effect of NLE on the growth of weeds.

Therefore, this study was aimed to evaluate the effect of Neem leaf extract (NLE) on the growth of some
weeds in an attempt to develop environmentally sound plant protection needed for crop growth.

MATERIALS AND METHODS

The experiment was carried out at the Faculty of Agriculture Usmanu Danfodiyo University, Sokoto, which lies on a latitude of $13^{0}\,8'3''$ N and longitude $5^{0}12'53''$ E Sokoto State. Leaves of neem tree were collected at Faculty of Agriculture shelterbelt Usmanu Danfodiyo University, Sokoto. The leaves were washed using ordinary water and air dried under normal room temperature for one week. The dried leaves were grinded and made into powder using electric grinder. The study consisted of four treatments and ten replicates having different level of aqueous extract. Aqueous extract was prepared with distilled water and shaken. To make sufficient extract, 100g, 200g, and 300g of neem leaf powder was added to 10litter of distilled water representing 10.0, 20.0, and 30.0% extract, respectively. For control treatment (0 percent extract) same amount of water without leaf powder was used. All mixture (powder and water) was shaken thoroughly (Miah *et al.,* 2010). This experiment was conducted using polythene bags filled 4.5kg of soil from natural environment of weed infestation. Length and diameter of the polythene bags used was 25.5cm and 16.5cm respectively. NLE solution was applied two weeks after germination as post-emergence treatment. Each treatment contained 10liter of the solution and each replicate from every treatment was supplied with 1liter of the concentration at every application. Irrigation with the extract was done twice in a week at two days interval of normal water irrigation for the period of three weeks. Data on identified weed species per pot, weed count per pot, weed density, weed frequency, weed dry matter and weed control efficiency were collected.

$$\text{Weed density} = \frac{(\text{Total number of individuals of species in all pot } 1)}{(\text{Total number of pot studied}) \times (\text{area of pot})}$$

$$\text{Weed frequency} = \frac{\text{Number of pot which species occured}}{\text{Total number of pot occured}} X\ 100$$

Weed dry matter; the weed samples collected from each pot were oven dried at 70°C to a constant weight
and weighed to obtain the weed dry matter.

$$\text{Weed control efficiency} = \frac{DMC - DMT}{DMC} X\ 100$$

Where DMC is weed dry matter in control treatment and DMT is weed dry matter in treatment pot. The experiment was laid in a Completely Randomized Design (CRD) with four treatments replicated ten times each. The data collected was analyze using Descriptive statistics.

RESULTS AND DISCUSSION

Weed Species Identified and Count

Figure 1 below shows data on the weed species identified and their count. Six (6) species of weeds were identified before the treatment application. The result showed that *Brachypodium sylvaticum* had the highest count
(90), followed by *Commelina benghalensis* and *Medicago sativa* (60), *Amaranthus spinosus* (50), *Tribulus terrestris* (40) and *Urtica dioca* with the least (30). This indicated that *Brachypodiunm* species had the highest abundance in the study area and *Urtica dioca* had the least.

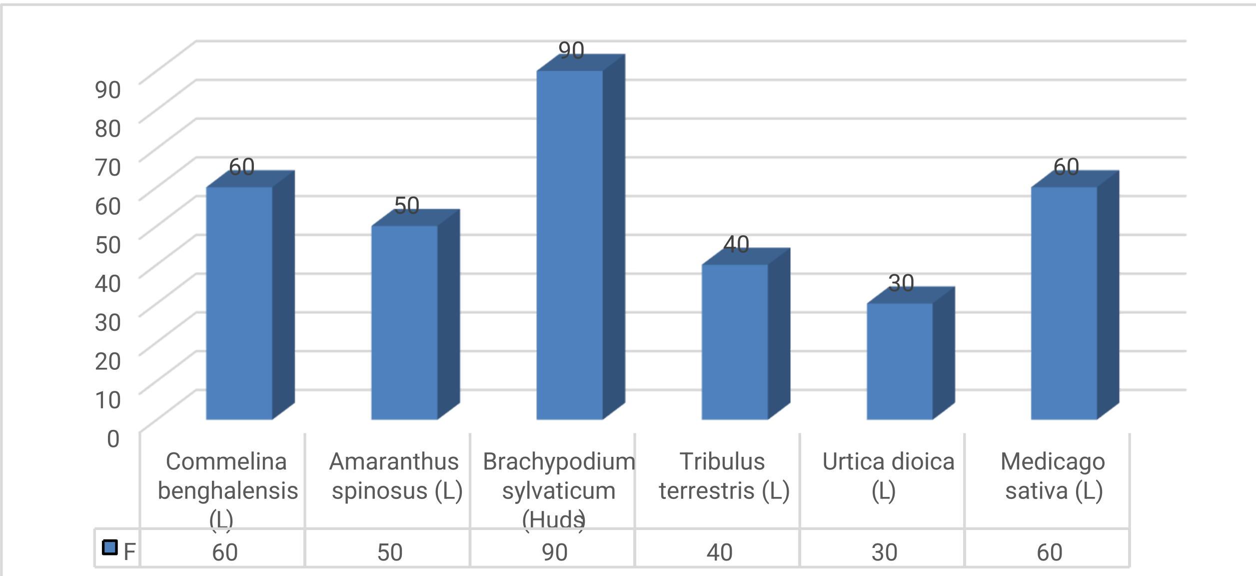


Fig 1: Weed Species and their count before treatment application.

Determination of Tolerance, Resistance and Susceptibility of weed as affected by NLE treatment

Figure 2 below showed the comparative distribution of weed density as affected by the treatments after application of extract.

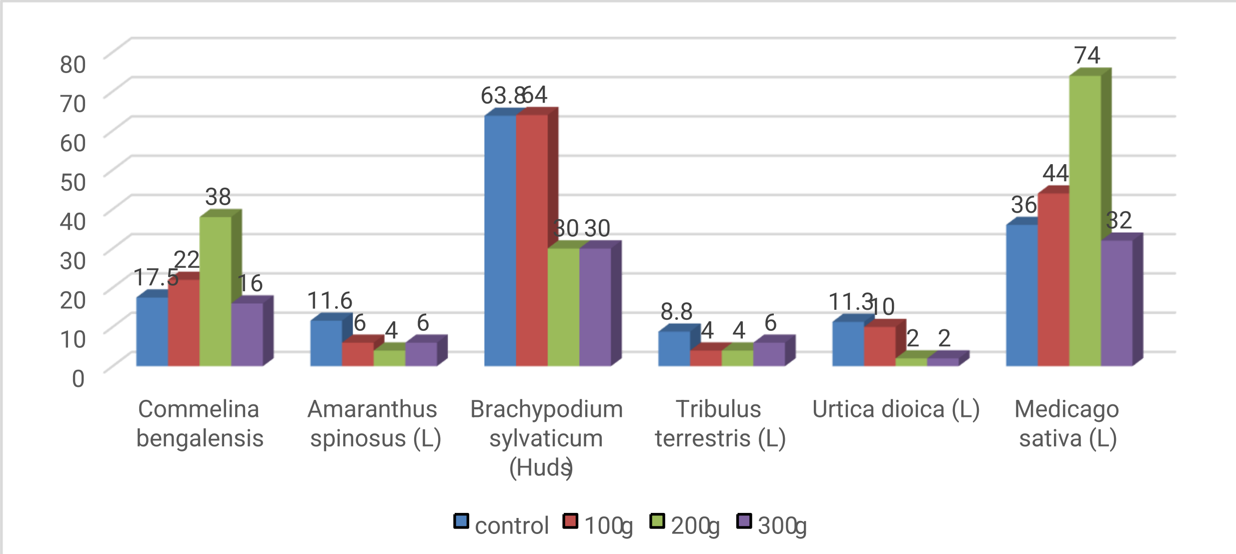


Fig 2: Effect of the treatment (NLE) on the growth of some weed species

The figure shows low growth of *Urtica dioca* in 10%, 2% and 2% treatment, this shows that it is susceptible to NLE and may be as a result of allelo chemicals available in the neem which inhibit growth of plant (Sangether *et al.*, 2015). Increase in extract concentration had highest effect decrease of the studied parameter of weed growth (count) which agreed with the research of Morteze *et al.,* (2013) and Safari *et al.,* (2010). Similar trend was also found in Amaranthus and *Tribulus.* The result in figure 2 also showed increased in control with, 100g of *Brachypodiunm,* this shows that constant application of the NLE in higher concentration will suppress *Brachypodium* and *Medicago*. Inhibitory effect was increased as the extract concentration was increased. Therefore, this study showed that higher concentration of NLE could affect the growth and germination of weed.

Weed Dry Matter Determination

Table 1 indicated that the control treatment had the highest weed dry matter values, then 100g treatment followed by 200g treatment and finally 300g treatment in that order.

Table 1: Weed Dry Matter

Treatments	Weed dry matter (g)
Control 0g	81.90g
100g	56.79g
200g	37.55g
300g	30.00g

Weed dry weight was remarkably influenced by leaf extract concentration. Distinctly higher weed biomass (81.90g) was recorded in control treatment. However, weed biomass drastically decreased when *Neem* leaf extract was applied along with irrigation water even at minimum concentration. *Neem* leaves release Nimbolide and Nimbic acid compound (Hisashi and Abdus salam), which may inhibit the growth of weed. Khan *et al. (2005)* reported that leaf aqueous extract of Neem tree has inhibitory effect on germination percentage, seedling length and biomass yield. He also suggested that Neem tree can be exploited as bioherbicides for sustainable weed management.

Weed Control Efficiency

Table 2 shows the control efficiency at 8 weeks. From table 2, 300g treatment with 45.27% had the highest weed control efficiency followed by 200g treatment with 36.05% and then 100g treatment with 12.56%.

Table 2: Weed Control Efficiency

Treatments	Weed control efficiency (%)
100g Extract	12.56%
200g Extract	36.05%
300g Extract	45.27%

The weed control efficiency obtained from the three (3) treatments with respect to the study indicated the higher the quantity of the extract the higher the efficiency. This might also be due to the allelochemicals presence in *Neem* leaf extract Narwal *et al.* (1997). Therefore, allelopathy could play an important role in weed management in organic agriculture which could be one of the most important aspects of organic farming.

CONCLUSION

From the result of this study, Neem leaf extract had Influence on the growth performance of some weeds. The highest control efficiency values among all the treatments were obtained from 300g with 45.27%, which had the lowest dry matter and weed count. The use of this plant extract as herbicides to control the weeds will bring a great success in this area. Moreover, the positive allelopathic effect should also be investigated to exploit it in crop production.

REFFERENCES

Ahmed, R., A.T Hoque, and M.K Hossain (2008) Allelopathic effects of leaf litters of Neem tree on some forest and agricultural crops. *Journal of Forestry Research*, Volume (19)19-24

Asif, T., M.K Jabbar, A. Kahliq, A. Matloob, R.N Abbas, Bahadur.S., S.K Verma, S.K Prasad, A.J Madane, S.P Maurya, (2015) Eco-friendly weed management for sustainable crop production-A review. *Journal Crop and Weed*. 2015; 11(1):181-189.

Bhadoria. P.B.S. (2011) Allelopathy: a natural way towards weed management. *Amer. J. Exp. Agric*. 2011; 1:7-20.

Chandra S., P. Chatterjee, P. Dey and S.Bhattacharya (2012) Allelopathic effect of Ashwagandha against the germination and radicle growth of Cicer arietinum and *Triticum aestivum*. *Pharmacognosy Research* 4 (3): 166.

Chon, S.U., Y.M. Kim and J.C. Lee, (2003). Herbicidal Bioherbicide effect of Raphanus sativus L. in cotton potential and quantification of causative field of Çukurova Region in Turkey, Turkish VI.

Duke S.O and J.Lydon (1987) Herbicides from natural compounds. *Weed Technology* 1 (2): 122–128.

Dzyubenko, N.N. and N.I. Petrenko, (1971) On and Bioherbicicidal Effect of the Parts of Plant Biochemical Interaction of Cultivated Plants and Residues on the Growth of Both Weeds and Corn, Weeds. In: *Phyysiological- Biocemical Basis of Plant VII*. Turkish Phytopathology Congr., 26-29

Hedge R.S. and D.A. Miller, (1990). Allelopathy and seedling. *Fisiologia Vegetal Cali.*, pp: 67.

Horsley S.B (1977) Allelopathic interference among plants. II. *Physiological modes of action*. p. 93–136.

Kadioglu, I., Y. Yanar, and U. Asav. (2005). Allelopathic effects of weed leachates against seed germination of some plants. *Journal of Environmental Biology* 26:169-173.

Kadioglu, I., Y. Yanar, and U. Asav. (2005). Allelopathic effects of weed leachates against seed germination of some plants. *Journal of Environmental Biology* 26:169-173.

Khaliq, A., A. Matloob, Z.A. Cheema, and M. Farooq. (2011). Allelopathic activity of sole and mix incorporation of crop residues against rice and its associated grassy weed-jungle rice (Echinochloa colona [L.] Link). *Chilean Journal of Agricultural*

Khanh, T.D., M.I. Chung, T.D. Xuan, and S. Twata. (2005). The exploitation of crop allelopathy in sustainable agricultural production. *Journal of Agronomy and Crop Science* 191:172-184. Li, Z., Q. Wang, X. Ruan, C.

Pan, and D. Jiang. 2010. Phenolics and plant allelopathy. Molecules 15:8933-8952.

Kohli R.K. (1998) Allelopathic interactions in forestry systems. Environmental Forest Science. 1998;

54:269-283.

M.M Javaid (2012) Allelopathic Effects of aqueous and organic fractions of euphorbia dracunculoides lam. on germination and seedling growth of chickpea and wheat. *Chilean Journal of Agricultural Research* 72(4).

Morteza.S., A.Davari, F.Tarnian, M.Shahreki and E.Shahreki (2013) Allelopathic Effects of Neem tree on Seed Germination and Initial Growth of four range species. *Annals of Biological Research,* 2013, 4 (1):152-159 Mushtaq W. and M.B. Siddiqui (2018) Allelopathy in Solanaceae plants. *Journal of Plant Protection Research*. Vol. 58, No. 1: 1–7.

Narwal, S.S., (1994) Allelopathy in Crop Production, *Food Chem.*, 31: 744-748.

NMA (2009). Sokoto weather. Weather record Book of Sultan Abubakar international Airport, Sokoto State, Nigeria.Pp1-2.

Pacanoski Z, V.Velkosa , S.Tyr and T.Veres (2014) Allelopathic potential of Jimsonweed on the early growth of maize(Zea mays L.) and sunflower (Helianthus annuus L.). *Journal of Central European Agriculture* 15 (3): 198–208.

Qasem, J.R. (1995). Allelopathic effect of some arable land weeds on wheat (Triticum durum L.): A survey. *Dirasat* 22:81-97. (In Arabic with English summary)

Qasem, J.R., and C.L. Foy. (2001). Weed allelopathy, its ecological impacts and future prospects. *Journal of Crop Production* 4:43-119.

Rice, E.L., (1984. Allelopathy, 2nd Edn. Academic effect of the subterranea organs of johnsongrass press, New York, pp: 1-67. (Sorghum halepense) on the growth of maize

Sangeetha.C and Baskar.P (2015) Allelopathy in weed management: A critical review. *African Journal of Agricultural Research.* Vol.10(9) 1004-1015

Seema.D., S.Kumar, R.k Singh and S.J Ram (2017) Allelopathy for sustainable weed management. *Journal of Pharmacognosy and Phytochemistry* 2017; SP1: 832-837.

Singh, H.P., D.R. Batish, and R.K. Kohli. (2003). Allelopathic interactions and allelochemicals: new possibilities for sustainable weed management. *Critical Review in Plant Sciences* 22:239-311.

Wasihun.R. (2018) Allelopathic potential of Neem on germination and early seedling growth performance of agricultural crops. *International Journal of Agriculture Innovations and Research* Volume (6) 2319-1473.

Zzet.K and Y.Yanar (2004) Allelopathic Effects of Plant Extracts Against Seed Germination of Some Weeds. *Asian J. Plant Sci.*, 3 (4): 472-475.

EFFECT OF SEEDBED, COVER CROPS AND DENSITIES ON WEED POPULATION AND WEED FREQUENCY IN YAM/ MAIZE/CASSAVA INTERCROP AT ISHIAGU-EBONYI

E.C. Umeokechukwu[1], C.F.E. Davids[2] and P.S.O. Okoli[3]

[1]Federal College of Agriculture Ebonyi State
[2]Crop Science and Biotechnology, Imo State University
[3]Chukwuemeka Odumegwu Ojukwu, University
eumeokechukwu@gmail.com

ABSTRACT

This field experiment was carried out at the Teaching and Research Farm of the Federal College of Agriculture Ishiagu- Ebonyi State during the 2014 and 2015 planting seasons to evaluate the effect of seedbed practices, cover crops and density on weed population and weed frequency in a yam /maize/ cassava intercrop. Ishiagu is located in the southern part of Ebonyi State and lies on Latitude 5^0 57^1N and Longitude 7^0 34^1E with a mean annual rainfall of 1350mm with average humidity of 88% and a mean annual temperature of 29^0C and with a gentle slope topography. It was a split –split plot experiment laid out in a randomized complete block design (RCBD) with three replicates. Seedbed as the main plot was made up of ridge and flat. The cover crop, the sub plot treatment and was made up of three cover crops, 'egusi' melon, sweet potato and pumpkin. The sub-sub plot was the density which was made up of the control (0), 10,000, 20,000, and 30,000 stands/ hectare of the cover crops. Data were collected on weeds population and weeds relative frequency. The weed population was not affected by the seedbed practice and cover crops but was significantly affected by the cover crop density, as it reduced the weeds. Comphera celosiioides maintained the highest weed frequency in both seasons.

Keywords: Seedbed, Cover crop, Density, Intercrop, weed frequency.

INTRODUCTION

Weeds are naturally occurring plants that are injuries to crops in agricultural systems. Weeds harbor insects and disease organisms, serve as alternate host to pests, compete with crops for nutrient, moisture, light and space. Weed reduces crop yield and quality by competing with the crops (Akobundu, 1987). Weeds can cause about 80% crop production loss if not controlled (Yaseen *et al*, 2015). Inappropriate seedbed practices may reduce crop growth and yield. Whereas selection of an appropriate seedbed practice for crop production is very important for optimum growth and yield. A good soil management protects the soil from water and wind erosion, provides a good weed free seedbed for planting, breaks hardpans that may limit root development and allows maintenance and even an increase in organic matter distribution (Wright *et al*, 2008) Conventional seedbed has been found to adversely affect soil structure and cause excessive breakdown of aggregates, leading to soil erosion in high rainfall areas. In addition to the recent increase in fuel prices, seedbed preparation now accounts for more than 25% of agricultural production cost (Reddy, 2012). Such concern has necessitated interest in finding systems that minimizes negative impact of conventional seedbed to the environment while maintaining sustainable crop production. Intercropping has potential as a means of weed control process because it offers the possibility of a mixture of crop capturing a greater share of available resources than in sole cropping (Altieri and Liebman, 1986). Studies have shown that prostrate crops like 'egusi' melon suppressed weeds and reduce early weeding in maize (Akobundu, 1993), cucumber intercropped with okra reduced weed infestation and pumpkin intercropped with maize reduced weed growth in the plots. Intercropping these smothers like 'egusi' melon and groundnut and cowpea with tuber crops and cereals have become a common practice in tropical agriculture (Wahua, 1985). In the tropics, land tenure system and climatic conditions pose a great constrains to farmers. The land is either owned by community or leased from owner for farming activities. Farmers therefore are confronted with intensification of land use with reduced fallow period because of increasing population and to maximize the acquired/ hired land (Reddy, 2012). Reduced fallow period increases weed spread. Tropical farmers carry out weeding manually by hoeing and slashing. Manual hoe weeding is the most commonly employed method of weed control by the farmers. Frequent hoe weeding disturbs soil surfaces, stimulates weed germination and encourages weed persistence in many ways (Akobundu, 1987). Effective weeding using hired or family labor during peak periods of farm operation in certain areas of the country is not feasible. This is because labor is scarce and is being demanded by other economic sectors, thereby making wage payment to be very high (Akobundu, 1987).

Intercropping was adopted by tropical farmers as a measure of risk management against crop failure. The elimination of one hand weeding by the introduction of a smother crop like *Citrullus vulgaris* in an intercrop of Cassava/Maize/Melon has been reported by Akobundu (1993). Intercropping suppresses weeds better than sole cropping and thus provides opportunity to utilize crops as tools for weed management (Rao, 1976). However, different cover crops are used indiscriminately in intercrops without proper references to proper crop associations by the resource poor farmers. This experiment was conducted to evaluate the effect of using different seedbed practices and cover crops at varying densities to control weeds in the field of yam/cassava/maize intercrop.

MATERALS AND METHODS

The experiments were carried out at the Teaching and Research Farm of the Federal college of Agriculture Ishiagu Ebonyi state, during the 2014 and 2015 cropping seasons. The soil of the study area is Ultsoil, the vegetation is typical of the derived savannah. The area has a tropical wet and dry climate with mean annual temperature of 29^0C and 1350mm (Nwite *et al*, 2008). Rainfall starts appreciably in April and ends in November. The land was under fallow after five years of farming with arable crops. The land was cleared by slashing manually, ploughed, harrowed and ridged as treatment A_1, while treatment A_2 was cleared by slashing manually, ploughed and harrowed (flat).

Treatments and Experimental Design

The experiment was a split –split plot, laid out in a randomized complete block design which was replicated three times. The seedbed was the main plot treatment, which was made up of ridge and flat. The cover crop was the sub plot treatment which was made up of 'egusi' melon, sweet potato and pumpkin. The sub-sub plot treatment was the cover crop density which had four levels, control (0), 10,000, 20,000 and 30,000 stands /hectare of the cover crops. The main plot size was 25m x 13m (325m^2) the sub plot size was 25m x 3m (75m^2) while the sub-sub plot was 5m x3m (15m^2) with one meter (1m) in between plots and blocks.

Planting

Yam: Setts of *Dioscorea rotundata* cultivar 'agboghohu' of about 100g were planted. The yam setts were planted on the crest of the ridges and on the flats at 25cm from the beginning of the ridges/flats and at a distance of 1m x 1m, 1m within rows and 1m between rows at the rate of 10,000 stands/ ha.

Cassava: *Manihot esculantus*, variety TMS 0581 stem cuttings were planted on the mid ridges/flats, 30cm from the beginning of the ridge/flat and at distance of 1m x 1m by the right side of yam stands at the rate 10,000 stands /ha.

Maize: The maize *Zea mays*, variety 'Oba super 2' seeds were planted, at the foot of the ridges / flats, 30cm from the beginning of the ridge/flat and opposite the cassava stands, 1m within rows and 1m between rows. Three seeds were planted per hole and thinned to one stand at 2WAP to give population of 10,000 stands / ha.

Cover Crops

Melon: *Citrullus vulgaris* 'egusi' melon seeds were planted four per hole at a depth of 2.5- 4cm on the mid ridges/flats same side with maize and on holes at a distance of 1m x 1m and thinned at two weeks after planting (2 WAP) to appropriate population rates, as control (0), 15, 30, and 45 stands per sub -sub plot.

Sweet potato: *Ipomoea batatas*, white variety, ex-Igbariam cuttings sourced from National Roots Crops Research Institute Umudike were planted on the mid-ridges and flats. Vine cuttings of 25cm long were planted at angle of 45^0 on the same side with maize opposite the cassava. The four vine cuttings were planted per hole and thinned to appropriate population at 2WAP. The planting population included, control (0), 10,000, 20,000 and 30,000 stands /ha.

Pumpkin: *Cucurbita moschata.* This was planted on the mid ridges and flats on the same side with the maize, 1m x1m ($1m^2$) at a population of 0, 10,000, 20,000 and 30,000 stands /ha. Four seeds were planted per hole and thinned to appropriate density after two weeks.

Cultural Practices

i. **Yam staking**. Yam vines were trained and staked using sticks as they sprout.
ii. **Weeding**. Weeding was carried out on all the plots at two weeks after planting and the control plots were weeded again at 5wks and 9wks after planting.
iii. **Fertilizer application**. A blanket application of NPK (15:15:15) was carried out to ensure an even fertilizer application at the rate of 200kg/ha (Enwezor et al, 1989)

Data Collection

Weed Population: The population of weeds per treatment was assessed with the use of quadrat according to the procedure of Lado *et al* (2010). A 30 cm x 30cm ($900cm^2$) quadrat was used to assess the population of the weeds. Using the quadrat three random throws were taken within the plots. The weeds that fell within the quadrat were counted, identified to species level, recorded and average taken. Weed identification and naming were achieved using flora (Johnson.1997; Akobundu and Agyakwa.1998, Balogun, 2007). This was repeated at 4WAP, 8WAP and 12WAP. These were subjected to statistical analysis (ANOVA) using GenStat® version 3.0 (2003) software package, significant means were separated using FLSD at 5% probability level as described by (Wahua, 2010). Interaction effects were reported only when significant.

Weed Relative frequency: The ecological analysis of the weed flora was carried out to determine the relative frequency of the weed species, according to Wirjahaja and Pancho (1975) and Barbour *et al* (1999) using the equation:

$$\text{Relative frequency} = \frac{\text{frequency of one weed species}}{\text{Total frequency of all weed species}} \times 100$$

Three random quadrat throws were taken on the plots and the number of weeds species occurring within the quadrat were counted, identified and used for the calculation.

RESULTS AND DISCUSSION

Weed Population

Weed population was not affected by the seedbed type in both years. This did not agree with Yaseen *et al* (2015) who found that deep tillage practice-controlled weeds in field of tomatoes 60 days after sowing. The cover crop species had no effect on the weed population in 2014 but in 2015. Sweet potato controlled the weed incidence more than other cover crops. Sarkar (1992) suggested that an increase in sweet potato population density increases the numbers of vines per unit area leading to reduced weeds number. Cover crop density decreased the weeds population in both years. The 30,000 stands of cover crop density reduced the weed population similar to that of control which had few weeds.

This report agrees with Holt (1995) that said the manipulation of crop row spacing may reduce light interception by weeds leading to lesser weed incidence. Interaction effects were not significant except for cover crop species and cover crop density in 2015 in which the sweet potato reduced the weed population more than other cover crops.

Table 1: Effect of seedbed, cover crop species and density on weed population (900cm^2) in 2014

		Density/ha					Cover crop mean
		No cover crop	10, 000	20, 000	30, 000	Mean	
Seedbed	Cover crop						
Flat	Egusi melon	5.0	13.0	13.0	8.0	10.0	
	Pumpkin	5.0	11.0	11.0	8.0	9.0	
	Swt potato	5.0	13.0	10.0	8.0	9.0	
	Means	5.0	12.0	11.0	8.0	9.0	
Ridge	Egusi melon	5.0	15.0	10.0	9.0	10.0	10.0
	Pumpkin	5.0	13.0	10.0	9.0	9.0	9.0
	Swt potato	4.0	14.0	11.0	8.0	9.0	9.0
	Means	5.0	14.0	10.0	9.0	9.0	
	Cover crop density means	5.0	13.0	11.0	9.0	9.0	

LSD 0.05 for 2 seedbed means =NS; LSD 0.05 for 2 a means at the same or different b =NS; LSD 0.05 for 2 cover crop means=NS LSD 0.05 for 2 a means at the same or different c =NS; LSD 0.05 for 2 density means=1.5; LSD 0.05 for 2 b means at the same or different c =NS; LSD 0.05 for 2 seedbed means at the same or different levels of cover crop or densities=NS; NS= Not significant. a =Seedbed, b = Cover crop species, c = (Cover crop) density

Table 2: Effects of seedbed, cover crop and density on weed population (900cm^2) in 2015

Seedbed	Cover crop	Density (population/ha)					Cover crop means
		No cover crop	10, 000	20, 000	30, 000	Mean	
Flat	Egusi melon	4.0	15.0	13.0	10.0	11.0	
	Pumpkin	5.0	16.0	13.0	10.0	11.0	
	Swt potato	6.0	14.0	9.0	6.0	9.0	
	Means	5.0	15.0	12.0	9.0	10.0	
Ridge	Egusi melon	5.0	17.0	14.0	11.0	12.0	12.0
	Pumpkin	4.0	14.0	12.0	11.0	12.0	11.0
	Swt potato	3.0	10.0	9.0	6.0	7.0	8.0
	Means	4.0	14.0	12.0	9.0	10.0	
	Cover crop density means	5.0	15.0	12.0	9.0	10.0	

LSD 0.05 for 2 seedbed means= NS; LSD 0.05 for 2 a means at the same or different b =NS; LSD0 0.05 for 2 cover crop means =3.3 LSD 0.05 for 2 a means at the same or different c =NS; LSD 0.05 for 2 density means=1.57; LSD 0.05 for 2 b means at the same or different c = 3.8; LSD 0.05 for 2 seedbed means at the same or different levels of cover crop or densities=NS; NS= Not significant. a =Seedbed, b = Cover crop species, c = (Cover crop) density

Weed Frequency

Relative frequency of the weeds indicated that there were twelve weeds identified at the field during the 2014 planting season while in 2015 thirteen plants were observed. *Gomphera celosiodes* had the highest relative frequency of 24.1%. This was followed by *Eleusine indica* with the relative frequency of 22.2% in 2014.

Table 3: Effect of seedbed on weed species relative frequency (%) at 4WAP, 8WAP and 12WAP in 2014

Weeds species	4WKS		8WKS		12WKS		Means
	Flat	Ridge	Flat	Ridge	Flat	Ridge	

Comphera celosiioides	33.3	27.8	19.9	16.6	25.0	22.2	24.1
Setaria longiseta	2.7	5.6	5.5	8.3	8.3	8.3	6.5
Paspalum scrobiculatum	5.5	5.6	5.5	5.5	8.3	8.3	6.5
Lantana camara	5.5	5.5	8.4	8.3	8.3	8.3	7.4
Eleusine indica	27.7	25.0	27.7	22.2	16.6	13.8	22.2
Ageratum conyzoides	5.5	5.6	8.3	5.5	5.5	8.3	6.5
Mimosa pudica	5.5	5.6	5.5	5.5	5.5	8.3	6.1
Axonopus compressus	2.7	2.7	5.5	5.5	5.5	5.5	4.6
Tridax procumbence	2.8	5.6	2.7	5.5	2.7	2.7	3.7
Chromolena odoratum	2.7	5.6	2.7	5.5	2.7	5.5	4.1
Cyperus haspan	2.8	2.7	2.7	5.5	5.5	2.7	3.7
Calopogonium mucunoides	2.8	2.7	5.5	5.5	5.5	5.5	4.6
Total	100	100	100	100	100	100	100

Table 4: Effect of seedbed on weed species relative frequency (%) at 4wks, 8wks and 12 WAP in 2015

Weed species	4WKS		8WKS		12WKS		Mean
	Flat	Ridge	Flat	Ridge	Flat	Ridge	
Gomphrena celosioides	11.1	16.6	13.8	11.1	11.1	13.8	12.9
Setaria longiseta	5.5	11.1	5.3	8.3	8.3	8.3	7.8
Paspalum scrobiculatum	5.5	11.1	8.3	8.3	5.3	8.3	7.8
Lantana camara	8.3	5.5	11.1	8.3	8.3	8.3	8.3
Eleusine indica	25.0	13.8	16.6	13.8	11.1	11.1	15.2
Ageratum conizoides	8.3	5.5	5.5	5.5	11.1	8.3	7.4
Mimosa pudica	5.5	5.5	5.5	5.5	5.5	8.3	6.0
Axonopus compressus	8.3	5.5	5.5	8.3	5.5	5.5	6.4
Tridax procumbence	5.5	5.5	5.5	8.3	2.7	-	5.5
Chromolena odoratum	8.3	5.5	8.3	8.3	8.3	8.3	9.4
Cyperus haspan	2.7	5.5	5.5	5.5	8.3	8.3	6.0
Calopogonium mucunoides	2.7	5.5	5.5	5.5	8.3	8.3	6.0
Imperata cylindrical	2.7	2.7	2.7	2.7	5.5	5.5	3.6
Total	100	100	100	100	100	100	100

The 2015 planting season had a decreased weed relative frequency. *Gomphera celosiodes* had a relative frequency of 12.9%, while *Eleusine indica* had weed relative frequency of 15.2%. These two weed species maintained a high relative frequency more than other weeds for both years, indicating species specificity in association with the intercrop. This agreed with Gupta (2007) that certain weeds are hosts specific in their association. The only new weed in 2015 was *Imperata cylidrica.* Broad leaf weeds dominated at all times.

CONCLUSION

The two seedbed practices did not reduce weeds in the cropping system. Therefore, any of the seedbed practice could be adopted for the cropping system. The cover crop species: Sweet potato controlled the weed incidence more than other cover crops. As suggested by Sarkar (1992) that an increase in sweet potato population density increases the numbers of vines per unit area leading to reduced weeds number. Cover crop density decreased the weeds population in both years. The 30,000 stands of cover crop density reduced the weed population.

REFERENCES

Akobundu, 1. 0 (1987) *Weed Science in the Tropics Principle and Practices*, John Wiley and sons Chichester, UK 522p

Akobundu, 1. 0 (1993) Integrated weed management in non-legume cover crops to reduce soil degradation, *IITA Research* No 6:11-16

Akobundu, I. O and Agyakwa, C. W (1998) *A Handbook of West Africa Weeds,* International Institute of

Tropical Agriculture, Ibadan.564 p

Altieri, M. A. and Liebman, M (1986) Insect, Weed and Plants disease management in multiple cropping system .in Francis, CA (eds) *Multiple Cropping System.* Macmillan `Publishing Company New York: 383p

Balogun, O. H (2007) Some common weeds and forage of West Africa. *Weeds and Forage Crops.* God's Glory Publications, P.O. Box 21057. Ibadan - Nigeria 54p

Barbour, M.G, Burk, J. J. Pitts, W.D Gillian F.S, and Schwart .M,W (1999) *Terrestrial Plant Ecology* 3rd Edition, Benjamin Cummings.

Enwezor, W.O.E, Udo, J and Ajotade, K. A (1989) *Fertilizer Procurement and Distribution, Fertilizer use and Management Practice for Crops in Nigeria*. Savenda Publishers, Nsukka, Nigeria p25-28.

GenStat® Version 3.0 (2003) Statistical Software Package

Gupta, O. P (2007) *Fundamentals of Weed Science*, Agrobios (India), agrobio@sify.com

Holt, J. S (1995) Plant response to light: A potential tools for weed management. *Weed Sci. 43*:474-482

Johnson, D. E (1997) *Weeds of Rice in West Africa*, ADRAO / WARDA, Cote d'Ivoire, 312p

Lado, A., Karaye, A.K., Alhassan, J. and Yakubu A,I. (2010) Influence of Nutrient Sources and Weeding Regimes on Weed Growth and Bulb Yield of Irrigated Onion. *Nigerian Journal of Weed Science. 23*:59-72

Nwite, J.C, Igwe, C.I and Wakasuki, T, (2008) *Evaluation of Savannah Rice*. Management System in an inland valley in Southeastern Nigerian soil chemical properties and rice yield paddy water environ 6:299-307

Roa, A.N and Shetty, S.V.R (1976). Some biological aspects of intercropping system on crop weed balance. *India Journal of Weed Science 8*: 32-43.

Reddy, S. R (2012) *Principles of Crop Production*. Kalyani Publishers, New Delhi 110002. 790p

Sarkar, K.A. (1992) Effects of plant density on yield of sweet potato. *Thai Journal of Agricultural Science.* agris.fao.org visited 26/6/2018

Wahua T. A. T (1985) Effects of melon (*Colocynthis vulgaris)* population density on intercropped maize and melon Exp. *Agric Journal 21*: 281-289

Wahua, T.A.T (2010) *Applied Statistics for Scientific Studies*. Transparent Earth Nigeria ltd, Port-Harcourt.

Wirjahdja, S. O and Pancho, J.V (1975). Weed survey sampling method and vegetation analysis. *Biotrep Tech. Bull 4*:20.

Yaseen. T, Ullah. W, Ahmad. M, Ali. K, Naveedullah, Abdullah and Amin. M (2015) .Effect of seedbed and weed control methods on weed density and tomato (*Lycopersicum esculentum*) productivity. *Pakistan Journal of Weed Science 21(2)*:153-161.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

FLORISTIC SURVEY AND ETHNOBOTANY OF AQUATIC MACROPHYTES OF GURARA DAM, KADUNA STATE

R.Y. Ogunshakin[1,2], F.O. Takim[2], Y.A. Birnin-Yauri[1], O.I. Enodiana[1] and G.A. Adukwu[1]

[1]Aquatic vegetation Programme, National Institute for Freshwater fisheries Research, New Bussa, Niger State.
[2]Department of Agronomy, Faculty of Agriculture, University of Ilorin
Email: ***rantiogunshakin@yahoo.com***

ABSTRACT

The aim of this study focused on identifying the aquatic macrophytes, their coverage and their ethnobotanical value through local people's information in Gurara Dam within Kachia Local Government Area in the (Guinea Savanna Forest) region of Kaduna State. The study was conducted in the year 2022 and constitutes the first description and ecological observations concerning plant communities in the Dam. To control aquatic weed effectively there is need to know the coverage of aquatic plant species and its ethnobotanical value by local communities and this can help keep wild plants population under check through control by utilization. The designated area of all sampling stations in the reservoir was inventoried and the biological forms and spatial distributions of the aquatic macrophytes were noted. Six sampling stations were sampled in the Dam along the shoreline and the open water, with the aid of line transects. Eighteen sampling plots were established at 500M intervals. A 30M x 30M sampling plot was established for each station which extended from the open water to the shoreline. Across each sampling plot, a perpendicular line transect was laid. Plants species within each transect were identified to species level. Ethnobotanical information was documented through semi-structured questionnaire interview with local informants by applying Participatory Rural Appraisal (PRA) field technique and showing the plants in question (Martin 1995). Thirty persons were interviewed which includes about 60% fisher folk, 35% farmers/herdsmen and 5% herbalists of which 80% were males and 20% weres female by gender category. For estimation of plant species cover, the Braun-Blanquet scale of abundance rating was employed. The results of the floristic survey showed that all the aquatic macrophyte in Gurara Dam were herbaceous and mostly angiosperms. A total of 20 plant species belonging to 9 families were recorded. About 93% of these plants were restricted to the Dam while 98% were emergent species, 78% of the species occurred both on the shoreline and islands of the reservoir, 1% were also found to be submerged. Some species has high coverage in all the stations; these include Poligonum lanimerum, Cyperus difformis, Cyperus rototundas, Mariscus longibracteatus, Cyperus iria, Kellinga squamulata. Ludwingia erecta, Mariscus longibracteatus., Cyperus iria., Kellinga s., while Cerophyllum dermerssum and Ipeoma spp, had the lowest coverage. Information on utilization is valuable and first of its kind and may prove profitable to the common man. A total of 17 plants belonging to 9 families were reported to be used in the treatment of different ailments and also as food for human and animals. Members of the family Cyperaceae (47.4%) had the highest number of species used in traditional healing followed by family Poaceae

(24.5%). The plant part most frequently used were the leaves (98%) followed by stem (92%). The study revealed that 80% of the plants used for treating ailments were sourced from the wild, while 20% were cultivated. Most of the traditional healers obtained their extracts by boiling the medicinal plants and administered them orally. Some medically important plants that drastically reduced in abundance over time were also identified.

Keywords: Aquatic macrophytes, Floristic survey, Ethnobotany, Control by utilization

INTRODUCTION

Macrophytic vegetation plays a crucial role in maintaining and functioning of lake and river ecosystems. Macrophytes provide food for invertebrates and wildlife, protect small fish and create spawning habitats, act as refuges for zooplankton, and oxygenate water, many of the plant species also play important role in meeting day to day needs of the rural people (Madsen, 2004). Macrophytes also play an important role in nutrient transport to and from sediments. They can be found throughout the littoral zone. Plants are important to the overall ecology of a water body, the proliferation of some species can be unhealthy; of particular concern are the exotic or non-native plants which can frequently crowd out native aquatic plants (Madsen, 2004). They can become nuisances primarily because there are no natural controls to their growth. A lack of predators or pathogenic organisms allows exotics to out-compete native species for growing space, light, and nutrients. Shoreline and bottom disturbance can affect native plant communities, making it easier for exotic species to become established (Madsen, 2004). Excess nutrients from runoff and other sources can also lead to overgrowth of both native and exotic species (Madsen, 2004). Aquatic plants are referred to as "weeds" when they are a non-native species, or a native species growing in such abundance that the use and enjoyment of water bodies is impaired. Understanding the dynamics of aquatic plant populations in a given water body has become increasingly important due to the introduction and spread of numerous non-native species. These plants are generally introduced from other parts of the world, some for seemingly beneficial or horticultural uses; however, the majority has escaped cultivation and now causes widespread problems (Madsen, 2004).

Non-native plants affect aesthetics, drainage, fishing, water quality, fish and wildlife habitat, flood control, human and animal health, hydropower generation, irrigation, navigation, recreation, and ultimately land values (Pimentel *et al*., 2000; Rockwell, 2003). The direct economic impacts, such as those listed above, are easy to quantify; however, there are other impacts of aquatic plants that are much more difficult to ascertain. These impacts include the intrinsic benefits of aquatic habitats and the ecosystem services these habitats provide (Charles and Dukes, 2007). Ecosystem services provide an important portion of the total contribution to human health and welfare on this planet (Costanza *et al*., 1997).Globally, it is estimated that marine systems provide $21 trillion in ecosystem services, followed by freshwater habitats at $4.9 trillion (Costanza *et al*., 1997).These estimates highlight the importance of conserving aquatic habitats and the services they provide to human welfare (Costanza *et al*.,1997).By any measure, the cost of invasion is significant, and the investment in management and research has not kept pace in order to minimize the costs associated with invasions (Sytsma, 2008). Improved understanding of aquatic plants and the role they play in lake and river ecosystem is essential to the proper management of freshwater bodies. The present objective of this study focused on identifying the aquatic macrophytes, the extent of coverage of aquatic macrophytes and the ethnobotanical ultilization through local people's information on the macrophytes found in Gurara reservoir within Kachia Local Government Area in the (Guinea Savanna Forest) region of Kaduna State and constitutes the first descriptions and ecological observations concerning plant communities in the reservoir. To be able to control aquatic weed effectively there is need to also know the relationship among various aquatic plants species and its ethnobotanical utilization by local communities.

MATERIALS AND METHODS

The present study was undertaken in Gurara Dam, Kachia Local Government Area, Kaduna State, Nigeria. The entire areas of each of the collecting stations (reservoir) were inventoried and the biological forms (Esteves, 1998) and spatial distributions of the aquatic macrophytes were noted. Six (6) designated sampling stations were sampled in the Dam along the shoreline and the open water, with the aid of line transects,18 sampling point were then established at 1km intervals, A 30m x 30m sampling plot, which was established at each location, extend from the open water to the shoreline, across each sampling plot, a perpendicular line transect was laid. Plants species within each transect were identified to species level according to Hutchinson and Dalziel (1957-1972) and the one we were not able to identify were pressed and labeled in the field and subsequently identified by consulting the specialized literature, including Obot and Ayeni (1987), Akobundu and Agyakwa (1998), Cook (1996), Scremin.-Dias *et al*. (1999), and Pott and Pott (2000). Ethnobotanical information was documented through semi-structured questionnaire interview with local informants, thereby applying Participatory Rural Appraisal (PRA) field technique and showing the plants in question (Martin 1995). The key informants were accompanied in boats and in fields. For ethnobotanical queries, about 20 persons were subjected to enquiry, which includes about 60% fisher folk, 35% farmers/herdsmen and rest 5% herbalists of which 80% are male and 20% female by gender category. For estimation of plant species cover, the Braun-Blanquet scale of abundance rating was employed. The scale is as indicated below (Causto, 1988).

Table 1: Braun-Blanquet cover scale

Rating	Description
–	Absent or not Present
+	Sparsely or very sparsely present cover very small
1	Plentiful but of small cover value
2	Very numerous or cover, 5-25%
3	Any number of individuals,25-50%
4	Any number of individuals,50-75%
5	Cover greater than 75%

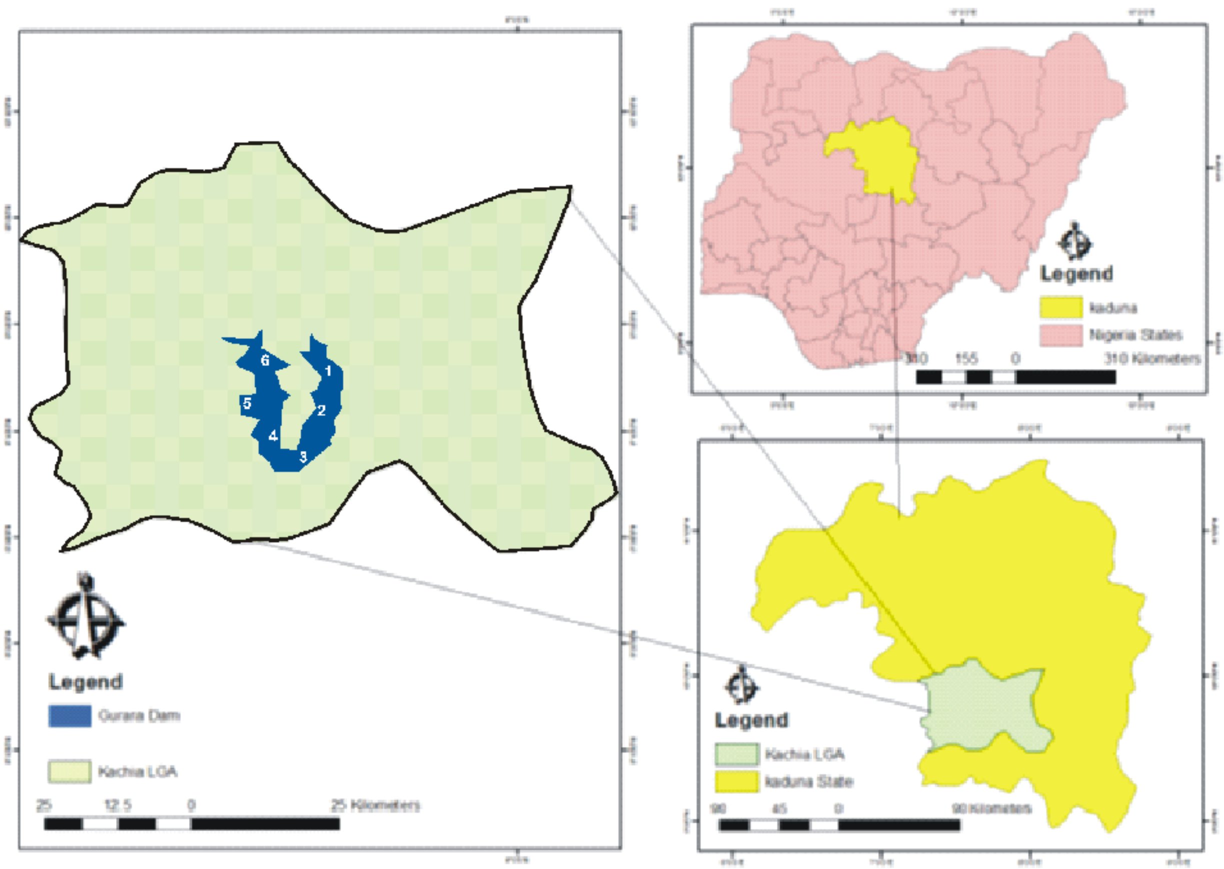


Figure 1: The Administrative Map of Kaduna State showing Kachia Local Government Area where the study area
was located.
Source: Modified from Kaduna State Administrative Map by Enodiana O.I

RESULTS AND DISCUSSION

A total of 19 plant species belonging to 9 families were recorded as shown in Table 2. The results of the floristic survey showed that all the aquatic macrophyte in Gurara Dam were herbaceous and mostly angiosperms. Table 2 shows the plant species composition and distribution. About 93% of these plants were restricted to the reservoir 98% were emergent species 78% of the species occurred both on the shoreline and islands of the reservoir 1% were also found to be submerged. The data for the cover estimate is presented in Table 3. Some species had high coverage in all the sites, these include *Poligonum lanimerum, Cyperus difformis, Cyperus rototundas, Mariscus longibracteatus, Cyperus iria, Kellinga squamulata., Ludwingia erecta*. Table 3 showed *Mariscus longibracteatus. Cyperus iria, and Kellinga s.*, had the highest coverage while *Cerophyllum dermerssum* and *Ipeoma spp,* had the lowest coverage. Other species were intermediate in their coverage estimate. The data indicate that there was a large variation in the composition and distribution of macrophytes in the reservoir. Some of the recorded floristic species are widely distributed in the tropics and temperate zone and therefore well known in botanical literatures, these include, *Polygonum lanigrum*, *Polygonum salicifolium*, *Cyperus sp*, *Ludwingia erecta*, and *Mariscus longibracteatus.* Most of these plants acquired global distribution with the help of man and animal who have acted as agent of dispersal for centuries, either intentionally or inadvertently. Efforts made on the ethnobotany of Gurara Dam have a detailed account of this interesting group of plants. In the present attempt thorough investigation undertaken and information collected from the locals, living adjacent to the lake shores and people dealing with the lake products. This information on ultilization is valuable and first of its kind and may prove profitable to the common man as shown in Table 4*.* A large proportion of the recorded plant species are emergent form Table 2, these are mostly confined to the shoreline of the reservoir, the emergent macrophytes perform several functions, they help in consolidating the bank of the river thus preventing erosion, they also serve as forage for grazers and are also harvested dried for fodder in Gurara dam as shown in Figure 2. Some of these macrophytes also serve as detritus. (Ita, 1993), noted that detritus serves as a source of food for benthos, zooplankton and also add nutrients to the pond giving rise to the production of more food for fishes. Although aquatic plants have some positive impacts on the fishes in the reservoir, the high infestation and existence of some invasive types could be regarded as nuisance. Excessive growth of some aquatic species, such as *Cyperus* and *Polygonum* species was above in all sites sampled. It is well known that in waterbodies where the growth of aquatic macrophyte are excessive, large amount of soluble nutrient are absorbed, thereby reducing the production of planktons and other organisms on which the fishes feed (Pokomy *et al.*,1990).

Table 2: Taxonomic list, distribution and occurrence of aquatic macrophytes at sampling stations in Gurara Dam

Species	Family	Biological Form	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
			Site A B C	Site A B C	Site A B C	Site A B C	Site A B C	Site A B C
Polygonum lanigerum	Polygonaceae	Emergent	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Polygonum salicifolium	Polygonaceae	Emergent	- - +	- - +	+ - +	- - +	- - +	+ - +
Cyperus difformis	Cyperaceae	Emergent	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Cyperus iria	Cyperaceae	Emergent	- + +	- - +	+ + +	- + +	- - +	+ + +
Cyperus rotundus	Cyperaceae	Emergent	- + +	+ + +	+ + +	- + +	+ + +	- - +
Kellinga squamulata	Cyperaceae	Emergent	- + +	- + -	+ + +	- + +	- + -	+ + +
Mariscus longibracteatus	Cyperaceae	Emergent	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Cyperus iria	Cyperaceae	Emergent	- + +	- + -	+ + +	- + +	- + -	+ + +
Echinochloa stagnina	Poaceae(Graminae)	Emergent	- - -	- - +	- + +	- - -	- - +	- + +

Echinochloa obtusiflora	Poaceae(Graminae)	Emergent	- - -	- - +	- + -	- - +	- - +	- + -
Mimosa pigra	Fabaceae	Emergent	+ - +	+ + +	+ + +	+ - +	- - +	- - +
Ludwingia erecta	Onagraceae	Emergent	+ - +	- - +	+ + +	+ - +	- - +	- - +
Ludwingia hyssopifolia	Onagraceae	Emergent	- - -	- - +	- + -	- - +	- - +	- + -
Neptunia oeracea	Fabaceae	Emergent	+ + +	- _+ +	+ + +	+ + +	- - +	- - +
Alternanthera sessillis	Amaranthaceae	Emergent	+ - -	- + -	+ + -	+ - -	- + -	+ + -
Eclipta alba	Asteraceae	Emergent	+ - +	- - +	+ + +	+ - +	- - +	- - +
Panicum laxum	Poaceae(Graminae)	Emergent	- - -	- - +	- - -	- - -	- - +	- - -
Heliotropium indicum		Emergent	+ - +	+ + +	+ + +	+ - +	+ + +	+ + +
Ipeoma spp	Convolvulaceae	Emergent	- - -	- - +	+ - -	- - -	- - +	+ - -
Ceratophyllum dermersum	Ceratophy llaceae	Submerged	- + -	- - +	- - -	- - -	- - -	- - -

Table 3: Cover estimates of macrophytic vegetation in Gurara Dam Using Braun-Blanquet cover scale

Scientific Name	Cover estimate site					
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Polygonum lanigerum	4	4	4	4	4	3
Polygonum salicifolium	2	1	+	_	_	2
Cyperus difformis	4	4	4	_	+	3
Cyperus iria	3	2	3	+	2	2
Cyperus rotundus	+	+	+	3	_	1
Kellinga squamulata	2	2	_	1	1	_
Mariscus longibracteatus	5	5	5	2	1	3
Mimosa pigra	+	+	-	+	2	+
Echinochloa stagnina	_	_	+	+	+	_
Echinochloa obtusiflora	_	_	+	_	_	+
Ludwingia erecta	+	_	2	+	1	3
Ludwingia hyssopifolia	_	+	1	2	_	+
Neptunia oeracea	+	+	1	_	+	_
Alternanthera sessillis	+	_	_	+	1	1
Eclipta alba	1	_	1	+	_	+
Panicum laxum	_	_	+	_	_	+
Heliotropium indicum	+	+	+	+	+	+
Ipeoma spp	_	_	_	+	_	_

Ceratophyllum dermersum	+	_	_	-	_	_

Table 4: Checklist of the utility value of common macrophytes in Gurara Dam.

Species	Family	Plant parts Used	Ethnobotanical uses
Polygonum lanigerum	Polygonaceae	Leaves and stem	Part of concoction for the treatment of small pox and Gastric complaints
Cyperus difformis	Cyperaceae	Leaves and stem	It is used as a livestock feed, In diarrhea.
Cyperus iria	Cyperaceae	Leaves and stem	It is used as a livestock feed, Aromatic, as a medicine
Cyperus rotundus	Cyperaceae	Leaves and stem	It is used as a livestock feed, In scorpion sting, febrile & dyspeptic
Kellinga squamulata	Cyperaceae	Leaves and stem	Used as a livestock feed, Roots, rhizome used as poultice on sores, in diarrhea.
Mariscus longibracteatus	Cyperaceae	Leaves, stem and inflorescence	It is used as a livestock feed
Echinochloa stagnina	Poaceae(Graminae)	Leaves	It is used as a livestock feed
Echinochloa obtusiflora	Poaceae(Graminae)	Leaves	It is used as a livestock feed
Mimosa pigra	Fabaceae	Stem	The stem is used for fence,and fishing traps construction
Ludwingia erecta	Onagraceae	Leaves	It is used as soup ingredient
Neptunia oeracea	Fabaceae	Leaves	Part of concoction for the treatment of yellow fever
Alternanthera sessillis	Amaranthaceae	Leaves	Soap
Eclipta alba	Asteraceae	Leaves and Buds	Antidote to snake bite and asthma
Panicum laxum	Poaceae(Graminae)	Leaves	It is used as a livestock feed
Heliotropium indicum		Whole plant	Used on skin disease
Ipeoma spp	Convolvulaceae	Leaves	Part of concoction for washing new born babies
Ceratophyllum dermersum	Ceratophy llaceae	Whole plant	Laxative & Plants are cooling antipyretic, useful in biliousness and ulcers.

CONCLUSION

This study indicated the presence of aquatic macrophytes in Gurara dam and the rate at which aquatic plant may also colonize other waterbodies in Nigeria, It has been often argued that it would be better to find a use for weeds than to lavish expenditure on their eradication. Ethno-botanical studies on aquatic flora have been rarely conducted in this area. It is imagined that such type of studies should further be conducted in the future in study area. This emphasizes on two pronged strategy of control through utilization of aquatic vegetation resource applying sustainable harvesting tips, combining conservation of ecologically important species as well utilization of economically important species including less known species and integrated management of the lake habitat comprising the watershed from an ecosystem approach. This will promote lake-based ecotourism potential, maintenance of aquatic biodiversity and upgrading community development through income generation from otherwise weedy problematic weeds. It is therefore essential that further studies on the ecology of floristic vegetation and soil/sediment analysis so as to properly understand the ecology and to monitor and manage the influx of invasive plants in the reservoir, most especially *Polygonum species* and other aquatic plants that can bore heavy financial loses, hence the need to stem the tide of aquatic weed infestation in the Dam.

REFERENCES

Akobundu I.O.and Agyakwa C. W, 1998. *A Handbook of African Weeds*. 2nd Ed International Institute of Tropical Agriculture. INTEC Press Ibadan, Nigeria .

Costanza R, R d'Arge, R de Groote, S Farber, M Grasso, B Hannon, K Limburg, S Naeem, R.V O'Neill, J Paruelo,
R.G Raskin, P Sutton, and M van den Belt. 1997. Th evalue of the world's ecosystem services and natural capital. *Nature*. 387:253-260.

Cook, C. D. K. 1996. *Aquatic and Wetland Plants of India*. Oxford University Press, New York.

Esteves, F. A. 1998. Fundamentos de limnologia. Interciência/ Finep, Rio de Janeiro.

Hutchinson, J. and Dalziel, J. M. 1954-1972. *Flora of West Tropical Africa*, 2nd Ed. (Revised by R.W.J. Keay & F.M Hepper) Crown Agent, London

Martin. G.J. 1995. *Ethnobotany.* Chapman & Hall, London. pp. 168.

Madsen J.D. 2004. Invasive Aquatic Plants: A threat to Mississippi water resources, In: 2004 *Proceedings, Mississippi Water Resources Conference*. pp 122-134.

Obot E.A. and Ayeni J.S.O. 1987. The biology of Burugu (*Echinochloa stagnina* Beauv.) in Lake Kainji: a case study. In: Olatunde AA and Ayeni JSO (eds) *Proceedings of the annual conference and general meeting of the Ecological Society of Nigeria, National Institute for Freshwater Fisheries Research, New Bussa* 17- 20 June 1987.

Pimentel D, L Lack, R Zuniga and D Morrison. 2000. Environmental and economic costs of nonindigenous species
in the United States. *BioScience* 50:53-65.

Pott, V. J. and Pott, A. 2000. Plantas aquáticas do Pantanal. Embrapa, Brasília. Rockwell WH. 2003. Summary of a
survey of the literature on the economic impact of aquatic weeds. *Report to the Aquatic Ecosystem Restoration Foundation.* http://www.aquatics.org/pubs/economic_impact.pdf. 18 p.

Scremin-Dias E., Pott, V. J., Hora, R. G. and Souza, P. R. 1999. Nosjardins submersos da Bodoquena: guia para identifi cacao de plantas aquáticas de Bonito e região. Editora Universidade Federal do Mato Grosso do Sul,
Campo Grande. Sytsma MD. 2008. Introduction: workshop on submersed aquatic plant research priorities. *J. Aquat. Plant Manage*. 46:1-7.

Smith, 2004. Introduction and summary in: "Control of Africa's floating water weeds. In: Valley and Smith, (2004) the aquatic and marsh plant communities of the reservoir site Pp67-68.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

A REVIEW ON THE ROLE OF ALLELOPATHY OF NEEM (*Azadirachta indica* L.) ON THE GERMINATION OF PLANT SEEDS

Y.B. Kajidu[1], S. Bukar[2], M. Gana[1] and S. D. Joshua[1]

[1] Department of Crop Production, University of Maiduguri
[2]Department of Agronomy and soil science, Borno State University, Maiduguri
Corresponding email: kajidu@unimaid.edu.ng

ABSTRACT

Allelopathy refers to direct or indirect depriving effects of one plant on another through release of substances into the environment. Allelochemicals have the potential to be used as bioherbicide, this may help in weed control through the inhibition of weed seed germination and seedling growth. Neem (Azadirachta indica. A. Juss) belongs to the family Meliaceae. Neem plant possess allelopathic activities due to presence of various allelopathic compounds these include Flavonoid, Nimbolide–B, Nimbic acid-B, Saponins, Alkaloids, Tannins, Azadirachtin, Mibolides, Gedunin, Salanin, Valassin and Terpinoids. Neem leaf extracts were treated with different plant species. These allelochemicals inhibited plant seed germination and seedling growth when treated with higher (50%- 100% or 0.3 g/mL) concentration but lower concentration of the Neem leaf extracts showed slight or no inhibition of seed germination and seedling growth. Thus, this review shows that Neem allelochemicals possess the potentiality as an inhibitory substance (bioherbicide) against weed seeds.

INTRODUCTION

The term allelopathy is from the Greek-derived allele (meaning “compounds”) and pathy (meaning “mutual harm” or “suffering”) and was first used in 1937 by Austrian scientist Hans Molisch in the book Der Einfluss einer Pflanze auf die andere - Allelopathie (The Effect of Plants on Each Other) (Willis and Rick 2007). Different authors have defined allelopathy as to; the direct or indirect effect of plants upon nearby plants or their associated microorganisms by the production of allelochemicals that obstruct with the growth of the plant (IAS, 2018); Allelopathy refers to direct or indirect depriving effects of one plant on another through release of substances into the environment (Patterson, 1983). The concept of allelopathy can be employed in the organic management of weeds and reduce our heavy reliance on synthetic herbicides. Although practices, such as intercropping, crop rotation, cover crops and mulching have been used conventionally for various benefits, integration of allelopathic crops would enhance its weed suppression benefit, implementation of allelopathic plant extracts in combination with reduced doses of herbicides could be an alternative strategy for a sustainable weed management program (Khamare *et al.*, 2022).

Allelopathy in Agriculture

Allelopathy has several applications in agriculture as outlined by Priyanki and Jamni (2021); Allelopathy can be useful in weed management where Allelochemicals have the potential to be used as bioherbicide, this may help in weed control through the inhibition of weed seed germination and seedling growth. Allelopathy can useful in crop nutrition; Allelochemicals play an important role in plant nutrition. These allelochemicals released into the root-zones, produced by plant, algae, bacteria and fungi, regulate dissolution, transport, release and chelation of mineral nutrients. Allelopathy can help to improve Nitrogen use efficiency (NUE) (Priyanki and Jamni 2021). Allelopathy is useful in insect pest management as extensive use of synthetic insecticides usually have a negative effect on the environment, human and animal health, and most critically, develops resistance against insects. Scientists are therefore turning towards the discovery and use of natural insect suppressants. Many allelopathic plants have been identified by researchers which include, *Leucaena leucocephala* allelopathic on wheat and many seedlings, *Eucalyptus* is allelopathic on many food crops (Ferguson *et al*., 2016), Sunflower *Helianthus annus* is allelopathic on hairy Crabgrass, Sida and *Amaranthus*, Crabgrass (*Digitaria sanguinalis*) is allelopathic on Wheat, Maize Soybean. Sorghum *Sorghum bicolor*, Rice *Oryza sativa* and Neem *Azadirachta indica* are allelopathic on many weed seeds. However, only a few phenolic compounds have been reported as allelopathic compounds of these plants (Xuan *et al.,* 2004; Rajashekhara *et al.,* 2007).

Allelopathy also aids in plant disease control such as soil borne pathogens, nematodes which causes substantial losses to crop production as it disturbs the crop stand and lowers the quality of production, Priyanki and Jamni (2021). Allelochemical also act as growth regulator in modern agriculture, as allelopathy are well associated with production of phytohormones which their presences as growth regulators is very significant. Allelochemicals plays a major role in abiotic stress management, regulate temperature fluctuations, change in rainfall, increase incidence of drought, and floods may pose threats to crop production and food security in the future Priyanki and Jamni (2021). Khamare *et al*., (2022) outlined some possible applications of allelopathy in agriculture which includes crop rotation, cover cropping, mulching, allelopathic activity of water extract and allelochemicals as natural herbicides.

Neem as an Allelopathic plant

As referenced by Hoda *et al*., Neem (*Azadirachta indica*. A. Juss) belongs to the family Meliaceae. It is an evergreen tree native to Indo-Pakistan subcontinent, Indian subcontinent and Southeast Asia. The species has long history as a traditional ingredient for household remedies. Oil extracts from the seeds have been used for soaps and cosmetics, and twigs of the plants has been used as tooth-brushes. Farmers also used traditionally various parts of the plants to control insect pests in stored crops and for livestock diseases Hisashi *et al*., 2014. (Cheneya and Knudson, 1988). Mehall and Callaway (1991); Indrajit (1996) and Ashrafi *et al*. (2007) stated that the allelopathic substance are found in shoots fruits and seeds of many plants. Therefore, Neem plant possess allelopathic activities due to presence of various allelopathic compounds (Jagtap *et al*., 2016). Azadirachtin, an allelochemical from Neem plant. These compounds are released into the environment through living and functional manner which can be through volatalization, root exudation, photodecomposition and biodecomposition either positively or negatively (Gross and Parthier, 1994; Seligler, 1996; Ferguson *et al*., 2016). It was also reported that litter and extracts of Neem plants have significant inhibitory or allelopathic activity (Rickli *et al*., 2011; Sindhu *et al.,* 2005). It is thus suggested that *Azadirachta indica* contains strong allelochemicals that may effectively control weeds through aqueous extracts and residues as well as weed inhibiting agents (Ashrafi *et al*., 2008). Abd El- Hamid *et al*., (2017) also reported allelopathic interactions of Neem plant include both stimulatory and inhibitory effects on *Zea mays* plant the results of their study revealed that stimulatory and inhibitory effect of Neem aqueous leaf extract may be due to the presence of bioactive secondary compounds (allelochemicals). However, Neem leaf extract at low concentrations stimulated germination and increased plant height of *Senna sophera* (Ogunyemi and Odewole 2011). Bashir *et al*., (2021) also reported that Neem seed cake has no allelophathic effect on bean, soya bean, groundnut, sesame, and bambara groundnut crops. With the modern biotechnological tools and enhanced isolation methods, more allelochemicals will be studied and be famous so as it is used for weed management. Currently, it is difficult to replace use of herbicides entirely, but an integrated weed management approach may lead to success. These allelochemicals or the byproducts of allelopathic species can be incorporated with other weed management practices to get better weed control, limit chemical use for weed control, decrease costs of production, and avoid any weed resistance (Khamare *et al*., 2022). Poisonous compounds are universal in many plant species and such allelopathic activity of Neem cannot be distinguished from that of other plant species only by the phenolic compounds. Therefore, there may be another allelopathic substances in Neem. Allelopathic substances have potential as bioherbicides (Gross, and Paritheir 1994; Putnam, 1988). Natural compounds are considered to be more eco-friendly than most synthetic herbicides (Duke *et al.,* 2000; Macías *et al.,* 2007). Neem is considered a promising source of herbicides with no or significantly low toxicity to mammals.

Effects of Neem (*Azadirachta indica*) Allelopathy on the germination of plant seeds

Studies were made by different authors on the allelopathic effect of *Azadirachta indica* on the germination, radicle and plumule emergence as affected various concentrations of Neem leaf extracts shows significant reduction in the germination percentage, radicle and plumule emergence of the test plants.

Some Neem allelochemicals

Table 1 presents some allelopathic chemicals found in Neem in different concentration according to different authors. Allelochemicals such as penolic acids and flavonoids have shown to have a significant percentage concentration 318 mg/gm and 269mg/gm respectively Abd El- Hamid *et al.*, (2017). Others are Nimbolide–B, Nimbic acid-B, Saponins, Alkaloids, Tannins, Azadirachtin, Mibolides, Gedunin, Salanin, Valassin and Terpinoids which all have inhibitory effects on seed germination (Table 1).

Table 1: Neem allelochemicals

Allelochemical	Concentration	References
Nimbolide B (1) µM	0.1–3.0	Hisashi *et* al., (2014)
Nimbic acid B (2). µM	0.3–1.0	
Total phenolic acids (mg/gm Gallic acid)	318±0.67	Abd El- Hamid *et al.*, (2017)
Total flavonoids (mg/gm rutin)	269.3±0.708	
Total Saponins (gm %)	2.07±0.167	
Total Alkaloids (gm %)	1.77±0.13	
Total Tannins (gm %)	1.77±0.06	
Azadirachtin		Farooq *et al.*, (2011)
Tannins, Terpinoids, Phenols and Steroids		Shruthi *et al.*, (2014)
Azadirachtin, Nimbidin, Mibolides, Gedunin, Salanin, Nimbin, Valassin		(Sharma *et al.*, 2011)

Response of *Vigna radiata* (L.) seeds treated with different concentrations of aqueous *Azadirachta indica* A. Juss. leaf extract.

Germination percentage, vigour index, tolerance index, phytotoxicity, fresh, dry weight, plumule and radicle length of V. *radiata* (L.) seedlings treated with different concentrations of aqueous *Azadirachta indica* A. Juss. leaf extract are presented on Table 2, germination percentage, vigour index and tolerance index were significantly higher at 5% Neem leaf extract concentration, the least were recorded at the highest 20% concentration, the phyto-toxicity percentage were significantly higher due to inhibition as a result of the Neem leaf extract. Fresh weight, radicle and plumule length of *Vigna radiata* were also affected by the allelochemicals present in the extract exhibiting lower weight and height as compared to the control (Table 2).

Table 2: Response of *Vigna radiata* (L.) seeds treated with different concentrations of aqueous *Azadirachta indica* A. Juss. leaf extract.

Parameters	Different concentration of extract (%)				
	Control	5.0	10.0	15.0	20.0
Germination %	94.59±0.305^{b}	98.100 ± 0.109^{a}	86.63 ± 0.328^{c}	77.27 ± 0.608^{d}	62.156 ± 0.569^{e}
Vigour index	2000.24±40.45^{b}	2493.21± 111.05^{a}	1263.69± 125.31^{c}	797.55± 11.53^{d}	410.31± 11.83^{e}
Tolerance index	100.00 ± 0.00^{b}	117.50± 2.50^{a}	94.26 ± 3.18^{c}	62.78± 5.24^{d}	54.82 ± 2.32^{e}
Phytotoxicity %	0.00 ± 0.00^{d}	40.73± 15.78^{e}	32.93± 15.39^{c}	38.77± 3.60^{b}	57.35± 7.66^{a}
Fresh weight(g/plant)	0.266±0.021^{b}	0.333±0.017^{a}	0.216±0.012^{c}	0.1567±0.003^{d}	0.126±0.003^{e}

Dry weight(g/plant)	0.051 ± 0.001^{e}	0.072 ± 0.001^{d}	0.081 ± 0.002^{c}	0.104 ± 0.010^{b}	0.114 ± 0.01^{a}
Plumule (cm)	15.87 ± 0.33^{b}	18.12 ± 0.63^{a}	10.84 ± 0.32^{c}	7.46 ± 0.00^{d}	4.33 ± 0.60^{e}
Radicle (cm)	5.23 ± 0.22^{b}	7.29 ± 0.51^{a}	3.58 ± 0.97^{c}	3.19 ± 0.14^{d}	2.26 ± 0.50^{e}

Source: Shruthi *et al.*, (2014)
Mean ± SE followed by the same superscript on the same row are not statistically significant between the Concentration, when subjected to SPSS Package ver.14.0 according to Tukeyís mean range test at 5% level significance.

Germination percentage of receptor Cowpea varieties to varying percentage of Neem leaf extract

Response of cowpea varieties to germination as affected by varying concentration of Neem leaf extract is presented on Table 3, all the cowpea varieties were significantly affected by having lower germination count as a result of phyto-toxicity exhibited by the Neem allelochemical at higher extract concentration of 50%. However, Yaro da kokari variety has shown a level of tolerance when treated with up to 30% of the concentration (Table 3).

Effects of aqueous methanol extract of Neem leaves on the germination percentage of test plant species

Effects of aqueous methanol extract of Neem leaves on the germination percentage of test plant species shows that with increase in the concentration (0.3 g/mL) seed germination of the test plant was significantly reduced as compared to the control which had the highest rate of germination and treating the test seeds with the less Neem leaf extract concentration (0.001g/mL) except for cress, wild buckwheat, sand fescue and barn yard grass (Table 4).

Table 3: Germination percentage of receptor Cowpea varieties to varying percentage of Neem leaf extract

Treatments (Neem leaf extract)	Cowpea varieties				
	Dan'ila	Yaro da kokari	Kanannado	Aloka	Dan-eka
Control	70.0bc	83.3a	98.3a	98.3a	100.0a
10%	90.0a	85.0a	83.3ab	97.7a	96.7a
20%	83.3ab	85.0a	70.0bc	97.7a	98.3a
30%	75.0abc	88.3a	73.3bc	91.7a	56.7b
40%	75.0abc	31.7b	25.0d	90.0ab	21.7c
50%	65.0c	5.0c	56.7c	83.3b	1.7d

Values in the columns followed by same letter(s) are not significantly different P=0.05 according to (DMRT). Source (Lawan, *et al.*, 2011)

Table 4: Effects of aqueous methanol extract of Neem leaves on the germination percentage of test plant species

Concentration (g/mL)	Cress	Lettuce	Alfalfa	Wild buckwheat	Sand fescue	Timothy	Barnyard grass	*Echinochloa colona*
Control (0)	100.00a	100.00a	100.00a	96.67a	70.00a	76.67a	100.00a	66.67a
0.001	93.33b	100.00a	100.00a	90.00b	40.00b	73.33a	93.33bc	63.33ab
0.003	93.33b	93.33b	93.33b	83.33c	23.33c	73.33a	96.67ab	63.33ab
0.01	60.00c	66.67c	90.00b	66.67d	10.00d	60.00b	90.00c	60.00b
0.03	3.33d	0.00d	70.00c	56.67e	0.00e	33.33c	73.33d	46.67c
0.1	0.00d	0.00d	43.33d	53.33e	0.00e	16.67d	50.0e	36.67d

0.3	0.00d	0.00d	23.33e	6.67f	0.00e	10.00e	20.00f	6.67e

Mean with same letters in a column are not significantly different P=0.05
Source (Abdus Salam and Hisashi, 2010)

Allelopathic effect of aqueous Neem (*Azadirachta indica* A. Juss.) leaf extract on seed germination in some crop plants

Allelopathic effects of aqueous Neem (*Azadirachta indica* A. Juss.) leaf extract on seed germination in some crop plants shows that germination percentage was significantly inhibited as a result of the leaf extract at 100% concentration however treating the seeds with lower Neem leaf concentration of 10% showed significantly slight inhibition except for *Vigna unguiculata* that recorded lower germination count (66%) (Table 5).

Table 5: Percentage Germination of Seeds Percent Germination of Seeds

Seed name's	Control	10%	25%	50%	75%	100%
Vigna mungo	100	90	86	90	76	63
Vigna aconitifolia	100	90	96	100	73	66
Vigna unguiculata	96	66	40	100	63	50
Cicer arietinum	93	73	56	60	46	40

Source Jagtap *et al*., (2016)

CONCLUSION

The findings of this review shows that Neem allelochemicals inhibited plant seed germination and seedling growth when treated with higher (50% - 100% or 0.3 g/mL) concentration but lower concentration of the Neem leaf extracts showed slight or no inhibition of seed germination and seedling growth. Thus, this review shows that Neem allelochemicals possess the potentiality as an inhibitory substance (bioherbicide) against weed seeds as an alternative to the proliferation of adulterated herbicides.

REFERENCES

Abd El–Hamid H. A., Lamis M. N., Ibrahim M., Ammar Y. and Mohamed A. H. (2017). Allelopathic Effect of Neem (*Azadirachta indica* A. Juss) Aqueous leaf extract on The Germination and Growth of Some selected Crops and Weeds. *Biolife*. 5(4), pp 428-436.

Abdus Salam and Hisashi K. (2010). Evaluation of Allelopathic Potential of Neem (*Azadirachta indica*. A. Juss) against Seed Germination and Seedling Growth of Different Test Plant Species. *International Journal of Sustainable Agriculture* 2 (2): 20-25

Ashrafi Z. Y., Mashhadi H. R. and Sadeghi S. (2007). Allelopathic effects of Barley (*Hordeum Vulgare*) on germination and growth of wild variety (*Hordeum spontaneum*). *Pakistan Journal of Weed Science Research*. 13(1-2): 99-112.

Ashrafi Z. Y., Rahnavard A., Sadeghi S., Alizade H. M. and Mashhadi H. R. (2008). Study of the Allelopathic Potential of Extracts of *Azadirachta indica* (Neem) *Online Journal of Biological Sciences* 8 (3): 57-61, 2008 ISSN 1608-4217 © Science Publications

Bashir K. A., Yusuf U., and Musa D. D. (2021). The Allelopathic Efficacy of Neem Seed Cake on the Germination and Growth Vigour of Some Leguminous and Oil Seeds. *Int J Agriculture Technology*. 1(1): 1-6

Cheneya W. R. and Knudson O. M. (1988). Germination of *Azadirachta indica* seeds enhanced by endocarp removal. *International Tree Crops J*., 7: 143-146

Duke S. O., Dayan F. E., Romagni J. G. and Rimando A. M. (2000). Natural products as sources of herbicide, current status and future trends. *Weed. Res*., 40, 99–111. 15.

Farooq M., Jabran K., Cheema Z., Wahid A. and Siddique K. (2011). The role of allelopathy in agricultural pest management. *Pest Management Science*. 67. 493-506. 10.1002/ps.2091

Ferguson J. F., Bala R., and Carlene C. (2016). A Chase Allelopathy: How Plants Suppress Other Plants. This document is HS944, one of a series of the Horticultural Sciences Department, UF/IFAS

Extension. Original publication date July. Revised March 2013. Reviewed August 2016. Visit the EDIS website at http://edis.ifas.ufl.edu.

Gross D. and Paritheir B. (1994). Novel natural substances acting in plant growth regulation. *J. Plant. Grow. Regul* 13, 93–114.

Hisashi Kato-Noguchi , Md Abdus Salam, Osamu O. and Kiyotake S. (2014). Nimbolide B and Nimbic Acid B, Phytotoxic Substances in Neem Leaves with Allelopathic Activity *Molecules* 19, 6929-6940; doi:10.3390/molecules19066929 ISSN 1420-3049 www.mdpi.com/journal/molecules I. A. S. (2018). International Allelopathy Society http://allelopathy-society.osupytheas.fr/about/ Inderjit I. (1996). Plant phenolics in allelopathy. Botanical Review. 62:186-202.

Jagtap M. B., Tayade S. K. and Athawale N. K. (2016). Allelopathic effects of aqueous Neem (*Azadirachta indica* A. Juss.) leaf extract on seed germination in some crop plants IJSR - *International Journal of Scientific Research* Volume: 5:2 425-426. ISSN No 2277 – 8179

Khamare Y, Chen J and Marble S. C. (2022). Allelopathy and its application as a weed management tool: A review. Front. Plant Sci. 13:1034649. doi: 10.3389/fpls.2022.1034649

Lawan S. A., Suleiman M. and Yahaya S. U. (2011). Inhibition of Germination and Growth Behavior of some Cowpea
Varieties using Neem (*Azadiracta indica*) Leaf Water Extracts *Bayero Journal of Pure and Applied Sciences*, 4(2): 169 – 172

Macías F.A., Molinillo J. M. G., Varela R. M. and Galindo J. G. G. (2007). Allelopathy—a natural alternative for weed control. *Pest. Manag. Sci.*, 63, 327–348.

Mahall B. E. and Callaway R. M. (1991). Root communication among desert shrubs. Proceedings of the National Academy of Science of the United State of America. 88: 874-876.

Ogunyemi, S. and Odewole A. F. (2011). Effect of Neem (*Azadirachta indica* A. Juss) on Seed Germination of *Senna sophera* L. Roxb and *Crotalaria ochroleuca* G. Don. *The African Journal of Plant Science and Biotechnology*, 5(1), 63-65

Patterson D. T. (1983). Research on exotic weeds. In: Wilson CL, Graham CL (eds.) Exotic plant pests and North American agriculture. Academic Press, New York, pp.522

Priyanki B. and Jimni P. (2021). Allelopathy in Agriculture. *Science for Agriculture and Allied Sector* a monthly enewsletter Volume 3 – Issue 3 Online ISSN: 2582-368X Article Id: AL202141

Putnam A. R. (1988). Allelochemicals from plants as herbicides. *Weed Technol.*, 2, 510–518.

Rajashekhara R. B. K., Shivananda T. N., Joshi S. and Siddaramappa R. (2007). Effects of allelochemicals from selected carbon sources under flooded soil conditions on histological abnormalities induced in rice (*Oryza sativa* L.) roots. *Allelopathy Journal.*, 20, 347–354.

Rickli H. C., Fortes A. M. T., Da-Silva P. S. S., Pilatti D. M. and Hutt D. R. (2011). Allelopathic effect of aqueous extract of *Azadirachta indica* A. Juss. On Lettuce, Soybeans, Maize, Beans and *Bidens pilosa*. Semina. *Ciencias. Agrarias*. 32, 473–484.

Seligler D. S. (1996). Chemistry and mechanism of allelopathic interactions. *Agronomy Journal*, 88: 876-885.

Sharma P., Tomar L., Bachwani M., and Bansal V. (2011). Review on Neem (*Azadirechta indica*): Thousand Problem One Solution, *Int. Res. J. of Pharmacy.* 2(12), 97-102

Shruthi H. R., Hemanth N., Kumar K. and Shobha J. (2014). Allelopathic Potentialities of (*Azadirachta indica* A. Juss). Aqueous leaf Extract on Early Seed Growth and Biochemical Parameters of *Vigna radiata* (L.) Wilczek *International Journal of Latest Research in Science and Technology* ISSN (Online):2278-5299 3:3 109-115. https://www.mnkpublication.com/journal/ijlrst/index.php ISSN: 2278-5299 109

Sindhu, A., Kumar, S., Sindhu, G., Ali, H. and Abdulla, M. K. (2005). Effect of Neem (*Azadirachta indica* A. Juss) leachates on germination and seedling growth of weeds. *Allelopathy Journal.* 16, 329–334

Willis, and Rick J. (2007). *The History of Allelopathy*. Springer. p. 3. ISBN 978-1-4020-4092-4. Retrieved 2009-0812.

Xuan, T. D., Tsuzuki, E., Hiroyuki, T., Mitsuhiro, M., Khanh, T. D. and Chung, I. M. (2004). Evaluation on phytotoxicity of Neem (*Azadirachta indica* A. Juss) to crops and weeds. *Crop. Prot.* 2004, 23, 335–345

WEED MANAGEMENT IN FIELD CROPS

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EFFECT OF ORGANIC NITROGEN RATE AND WEED MANAGEMENT METHODS ON SWEET SORGHUM (*Sorghum Bicolor (*L*) Moench)* IN THE NIGERIA SAVANNA

I.A. Adebisi[1], J.A.Y. Shabayan[2] and U.L. Muhammad[2]

[1]Department of Agronomy Ahmadu Bello University Zaria, Kaduna State Nigeria
[2]Department of Agronomy, Federal University of Kashere, Gombe State Nigeria
(Correspondent author, Email: *ademola2adebisi @yahoo.co.uk)* 08037701575

ABSTRACT

A field trial was conducted during the wet season of 2020 at Samaru in the northern guinea savannah to study the effect of organic nitrogen, weed control methods and plant density on sweet sorghum (Sorghum bicolor (L) Moench) in the Nigeria savanna. Treatments were four levels of poultry manure (0, 50, 100 and 150 kg N h^{-1}) sourced poultry manure at (0, 3, 6, and 9 tons h^{-1}), three weed control methods (S- Metolachlor + atrazine at 2.5 kg a.i/ha applied as pre-emergency, hoe weeding at 4, 8 and 12WAS, and weedy check), three plant densities 2, 3 and 4 plants/stand). The experiment was laid out in a split plot design with factorial combinations of organic nitrogen and weed control methods assigned to main plots, while plant density was assigned to sub-plot. Results showed that application of 100 kg Nh^{-1} improved the growth and yield of sweet sorghum. Application of S- Metolachlor + atrazine at 2.5 kg a.i/ha gave better weed control comparable to conventional hoe weeding treatment. The 3 plants/stand recorded higher growrh and yield characters than other plant densities evaluated. Based on this findings, it could be concluded that application of 100 kg organic nitrogen sourced from poultry manure applied at 150 N kg/ha and pre- emergency application of S- Metolachlor + atrazine at 2.5 kg a.i/ha, and stand density of 3 plants/stand were optimum for sweet sorghum production in the Sudan savannah agronomical zone of Nigeria.

Keywords: Weed control, organic nitrogen, plant density, Rate, Growth

INTRODUCTION

Sweet sorghum (*Sorghum bicolor* (L) Moench) is a sub- species of saccaharatum a tropical perennial plant that belong to the same species of as grain sorghum. It is a member of genus in the grass family *Poaceae*. It is similar to grain sorghum in all standards but contain high sugar (40-50%) rich stalk (Dogget, 1988). The crop originated from East Africa, where its production now extends to other region of the world, (Cark *et al*., 1980). Low temperature as low as 18^0C can influence formation of tillers of sweet sorghum, this makes the crop to be perennial (Duncan *et al* 1984). Shahib *et al*., 1997), reported that most varieties of sweet sorghum develop re-growth or ratoons after stalk harvest there by enabling multiple harvest per growing season.

The name sweet sorghum is used to identify varieties of *sorghum bicolor* that are sweet and juicy, (Anikwe *et al* 2000). Sweet sorghum required medium to heavy soil, having good drainage for better yield quality of grains, green cane yield or fodder. Soils that contain high salts, alkaline or having high calcium should not be selected for sweet sorghum production. Sandy loam and slit soils that contains adequate organic matter and annual rainfall of 6001000mm is required for it growth and soil ph. range of 5 .5-7.0. Good growth, sweet sorghum requires a lot of sunshine and warmth. Ideal temperature is between 21-27^0C. (Ferrais, 1986). It has potential to be a good substitute for ethanol production. Sweet sorghum ranked 5th behind other cereal crop like rice, maize, wheat, maize and barley (Popescu,*et al*; 2014). Therefore, it is particularly suitable as a feedstock for a variety of bioprocesses, largely because of its high yields of both lignocellulosic biomass and fermentable saccharides (Murdy *et al; 1994*). It is less economically important for refined sugar production than sugar beet and sugarcane, but can produce more raw fermentable sugar under marginal conditions than those crops. Whole sorghum stalk, and its bagasse, has been subjected to studies of a wide array of pretreatment, enzymatic hydrolysis, and fermentation processes (Popescu,*et al*; 2014). Potential fermentation products of sweet sorghum are wide ranging; those demonstrated, by (Dogget *et al*; 1980) include ethanol, acetone, butanol, various lipids, lactic acid, hydrogen, and methane. In addition to cellulose for paper production, waxes, proteins, and allelopathic compounds, such as sorgoleone are also important product of sweet sorghum (Dogget et al; 1980). In Africa, stems of sweet sorghum are chewed like sugar cane and the seed extract are used for traditional medicine for the treatment of hepatitis, and decoctions of twigs with lemon to treat jaundice, leaves and the panicles of sweet sorghum are used with other herbal mixture against pneumonia (Rajvanshi and Nimabkar,2001). The crop has long root that help to extract left over nutrients from the previous crop planted on the field most especially nitrogen-fixing preceding rotation (Reddy *et al.*, 2005). The production of biofuel from sweet sorghum in Nigeria has not being well developed like the Western world. The construction of the ethanol plant refineries that will be using sweet sorghum as raw material has commenced in many state of the country, when complete it will help to generate not less than 406,000 jobs to solve the unemployment problem of Nigeria (Udeme, 2012). Fiber from the crop is a good source of pulp for paper are quality that encourage farmers to cultivate sweet sorghum in large quantity as grain sorghum.

MATERIALS AND METHODS

Field experiment was conducted during the wet season of 2020 at the research farms of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Samaru ($11^0$11'N; $7^0$38'E, and 686m above the sea level) in the Northern Guinea savannah of Nigeria. The treatments consist of four levels of organic nitrogen using poultry manure as source (0kg N ha-1, 50kg N ha^{-1}, 100kg N ha^{-1} an d 150kg N ha^{-1}) that is equivalent to (0, 3, 6, and 9 tons/ha) respectively, three weed control treatments: (using S-Metolachlor + atrazine at 2.5 kg a.i/ha applied as pre emergence, hoe weeding at 4WAS and 8WAS and weedy check) as well as three planting density of (106000, 160000 and 213000 plants/ha). The experiment was laid out in a split – plot arrangement with poultry manure rate and weed control treatments assigned to the main plot, while plant density assigned to the sub-plot. Each plot size was 3.0 X 5m (15.0m^2) consisting of 4 rows of 0.75m apart and 5m in length, while the net plot size was 1.5m X 5m (7.5m^2) with alleyway of 0.75 m between plots and 1.5 m between replicates. The land was cleared harrowed twice and ridged at 0.75m apart before the experimental plots were laid out as per the treatment. Seeds of sweet sorghum cultivar for the experiments was obtained from a sorghum breeder in the Department of Plant Science of Institute for Agricultural Research (IAR), Zaria. Five (5) seeds per stand were sown and later thinned to 2, 3 and 4 plants per stand according to treatments at a spacing of 75cm x 25cm inter and intra rows respectively. Seeds were treated with Apron star to control any incidence of pest and disease such as stem borer. cypermethrin at 0.75kg a.i/ha was sprayed, using a knapsack sprayer to control insects. S- Metolachlor + atrazine at 2.5 kg a.i/ha was applied as per emergency, using CP3 knapsack sprayer fitted with a green deflector polyjet nozzle and set at a pressure of 2.1kg-m ^{2} to give a spray volume of about 250L/ha. Spraying was done in the morning when the weather was calm to avoid drift. Poultry manure was weighed and applied as per the treatments a day before sowing by band placement on the ridges by drilling. Harvesting was done manually when the seed is in the soft dough stage. Stalk was cut as close as possible to the ground by help of cutlass. Grain was harvested by cutting the panicle just near the top node. Panicle was sun dried, threshed and winnowed in the air to remove chaff and obtain clean grain. The following weed, growth and yield parameters were collected: weed cover score, weed dry weight, plant height, and shoot dry weight. While yield parameters are: 1000- grains weight, brix yield, number of grains per panicle and grains yield per hectare. Weed covers score was visually assessed at 8 and 12 WAS using a scale of 0 to 10, where scale 0 represent no weed cover and scale 10 represent complete weed cover. Weed dry weight was obtained by taking weed samples at random from 1m^2 quadrat in each plot at 4 and 8 WAS. Weed samples were cleaned free of soil and oven dried at 70^0C to a constant weight, and the dry weight was recorded. Plant height (cm) was measured from the ground to the top of fully opened leaves of at 4, 8 WAS, from five randomly tagged plants using a graduated meter rule and mean recorded. Shoot dry weight per plant was determined by sampling five plants per plot at 4, 8 WAS, plants were cut from base cleaned and oven dried at 70^0C to constant weight. Means of the weight was determined and recorded. A randomly selected 1000 dried grains were counted and recorded. Harvested panicles from each net plot were threshed, winnowed and weighed; grains were weighed and expressed in kilogram per hectare by extrapolation. The amount of sugar that is contained in the extracted juice of sweet sorghum stalk was determined using a refractor meter which was taken to the laboratory where the polarity of the sugar was determined using Polari meter and expressed in percentage. General linear model procedure (GLM) of the statistical analysis system (SAS) package was used for statistical analysis of all the data collected and differences between the treatment means was compared using Duncan Multiple Range test as described by Duncan (1984).

RESULTS AND DISCUSSION

Effect of organic nitrogen rate, weed management methods and plant density on sweet sorghum shows Table 1. Effect of different levels of organic nitrogen on weed cover was only significant at 12WAS. 150 kg N recorded highest weed cover score while lowest weed cover score recorded are from plots treated with 0 kg N/ha, which was statically similar to what was obtained from 50 kg N/ha of organic Nitrogen (Table 1). Similarly, plots treated with 150 kg N/ha of organic nitrogen and the weedy check recorded highest weed dry weight. While least weed dry weight was obtained from 100 kg N/ha of organic nitrogen and hoe weeded control plots. This was statically similar to what was obtained at 100 kg N/ha and S- Metolachlor + atrazine at 2.5 kg a.i/ha (Table 1). Four (4) plants per stand gave the lowest weed cover score and weed dry weight.

Effect of organic nitrogen on plant height was not significant, except at 8WAS in which 150 kg N/ha gave highest plant height, while lowest plant height was recorded with 0 kg N/ha. Similar trend was observed with dry shoot matter. There was no significant difference on the effect of plant density on plant height and shoot dry matter throughout the sampling period (Table 2). Effect of organic nitrogen on 1000 grains weight (g), brix yield (%) and number of grains per panicle was not significant throughout the trial (Table 3). However, the level of organic nitrogen application was significant on the yield per hectare as the highest yield was recorded from plots that received 150 kg N/ha of organic nitrogen (Table 3). Higher yield recorded can be attributed to the favorable weather conditions recorded in the year, efficient water use ability of the crop and better agronomic practices as well as adequate nitrogen availability which helped the crop to maximize growth thus, enhanced better production of grains and stalk yield. This result is in line with findings of Jibril (2017), who reported that the growth and the yield of sweet sorghum are boosted when there are fewer competitions for growth resources during critical stage of development.

CONCLUSION

This study revealed that application of 150 kg N/ha of organic nitrogen improved the growth and yield of sweet sorghum when planted at plant density of 4 plants per stand resulted to 177,778 plants/ha. The use of S- Metolachlor + atrazine at 2.5 kg a.i/ha gave a remarkable season long weed control which was comparable with the conventional hoe weeding.

Based on the findings from this research work, it could be recommended that organic nitrogen soured from poultry manure applied at 150 kg N/ha and the use of prim extra gold herbicide applied at 2.0kg a.i/ha with the plants density of 4 plants per stand resulted to 177,778 plants /ha could be used in production of sweet sorghum in the Sudan savannah agronomical zone of Nigeria.

Table 1: Effect of organic nitrogen, plant density and weed management on weed cover score and weed dry weight in sweet sorghum during the wet season of 2020 at Samaru

Treatments	Weed cover score			Weed dry weight		
	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Nitrogen (kg/ha) (N)						
0	4.29	3.85	5.44a	131.96c	187.06c	208.11b
50	4.48	3.67	4.89ab	206.04ab	235.65b	280.64a
100	4.59	4.19	5.59a	173.25bc	258.73b	282.25a
150	4.11	3.96	4.48b	235.21a	316.98a	309.43a
SE+	0.380	0.260	0.260	15.450	12.020	11.770
Plant density/stand (D) 2	3.83b	3.00b	4.53b	176.08b	239.20	270.19
3	4.28ab	3.42b	4.61b	151.92b	241.54	265.66
4	5.00a	5.33a	6.17a	231.85a	268.08	274.46
SE+	0.330	0.230	0.230	13.380	10.410	10.190
Weed control (W) S-metolachlor + atrazine at 2.5 kg a.i/ha	4.39	3.61b	4.83b	194.99	260.72a	262.14
Hoe weeding	4.39	4.14a	5.14ab	179.83	235.82b	268.23
Weedy check	4.33	4.00a	5.33a	185.02	252.28ab	279.95
SE+	0.180	0.130	0.150	9.940	7.970	7.630
Interactions						
N X W	NS	NS	NS	NS	NS	NS

N X D	NS	NS	NS	NS	NS	NS
W X D	NS	NS	NS	NS	NS	NS
N X W X D	NS	NS	NS	NS	NS	NS

Weed cover score based on 1 – 9 scale where 1 is no weeds and 9 for complete weed cover. Means followed by the same letter(s) in the same column within the same treatment group are statistically similar at 5% level of probability using DMRT,S-metolachlor (290g/l) + atrazine (370g/l) sourced from Primextra Gold 660 SCWAS = Weeks after sowing NS = Not significant at 5% level of level of probability,

Table 2: Effect of organic nitrogen, plant density and weed management on plant height and shoot dry weight in sweet sorghum during the wet season of 2020 at Samaru

Treatments	Plant height			shoot dry weight		
	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Nitrogen (kg/ha) (N)						
0	32.04	69.37b	110.70b	0.94b	4.00b	5.76b
50	34.19	121.00a	151.19a	1.74a	3.99b	5.11b
100	33.33	128.56a	143.63a	1.54a	5.46a	6.95a
150	33.44	129.04a	153.29a	1.69a	4.53b	6.66a
SE+	1.82	6.95	4.48	0.150	0.280	0.270
Plant density/stand (D) 2	32.75	120.56a	148.61a	1.41	4.78	6.45
3	34.39	114.72ab	140.75ab	1.51	4.43	6.13
4	32.61	100.69b	129.75b	1.51	4.27	5.78
SE+	1.581	6.020	3.851	0.130	0.240	0.230
Weed control (W) S-metolachlor + atrazine at 2.5 kg a.i/ha	32.75	108.08	139.19	1.38	4.39	6.24
Hoe weeding	33.44	116.36	140.42	1.49	4.63	6.07
Weedy check	33.56	111.53	139.50	1.55	4.46	6.05
SE+	0.78	4.70	3.66	0.09	0.13	0.21
Interactions						
N X W	*	NS	NS	NS	NS	NS
N X D	NS	NS	NS	NS	NS	NS
W X D	NS	NS	NS	NS	*	NS
N X W X D	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in the same column within the same treatment group are statistically similar at 5% level of probability using DMRT, S-metolachlor (290g/l) + atrazine (370g/l) sourced from Primextra Gold 660 SCWAS = Weeks after sowing NS = Not significant at 5% level of level of probability, * = significant at 5% level of probability.

Table 3: Effect of organic nitrogen, plant density and weed management on stand count and crop vigour score in sweet sorghum during the wet season of 2020 at Samaru

Treatments	Crop vigour scores			Stand count		
	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Nitrogen (kg/ha) (N)						
0	4.78	4.04b	3.70b	43.33c	32.96d	23.15
50	5.67	4.56ab	4.59a	45.11bc	47.78c	46.44
100	5.22	4.59ab	4.29ab	50.44b	61.33b	55.88
150	5.19	5.22a	4.89a	61.56a	72.00a	66.78
SE+	0.300	0.290	0.230	1.830	0.780	1.305
Plant density/stand (D) 2	5.19	4.97a	4.56a	52.06	53.78	52.92
3	5.22	5.22a	4.86a	49.47	53.33	51.4

4	5.22	3.61b	3.69b	48.81	53.44	51.13
SE+	0.26	0.26	0.20	1.590	0.680	1.135
Weed control (W) S-metolachlor + atrazine at 2.5 kg a.i/ha	5.31	4.81	4.47	47.42b	48.72c	48.07
Hoe weeding	4.92	4.42	4.36	48.92b	54.11b	51.52
Weedy check	5.42	4.58	4.28	54.00a	57.72a	55.86
SE+	0.210	0.150	0.130	1.43	0.59	1.010
Interactions						
N X W	NS	NS	NS	NS	NS	NS
N X D	NS	NS	NS	NS	NS	NS
W X D	NS	NS	NS	NS	NS	NS
N X W X D	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) in the same column within the same treatment group are statistically similar at 5% level of probability using DMRT,S-metolachlor (290g/l) + atrazine (370g/l) sourced from Primextra Gold 660 SCWAS = Weeks after sowing NS = Not significant at 5% level of level of probability,

Table 4: Effect of organic nitrogen, plant density and weed management on 1000 grains weight, brix yield and grains yield (kg/ha) in sweet sorghum during the wet season of 2020 at Samaru

Treatments	1000 grains weight	Grain yield (kg/ha)
Nitrogen (kg/ha) (N)		
0	39.40b	748.30
50	42.78a	714.48
100	43.67a	706.11
150	43.85a	762.65
SE+	0.74	67.99
Plant density/stand (D) 2	42.11ab	648.54b
3	41.50b	828.39a
4	43.89a	721.72ab
SE+	0.76	48.08
Weed control (W) S-metolachlor + atrazine at 2.5 kg a.i/ha	47.22a	677.48b
Hoe weeding	45.22b	936.46a
Weedy check	35.06c	584.72b
SE+	0.64	58.88
Interactions		
N X W	NS	NS
N X D	NS	NS
W X D	NS	NS
N X W X D	NS	NS

Means followed by the same letter(s) in the same column within the same treatment group are statistically similar at 5% level of probability using DMRT,S-metolachlor (290g/l) + atrazine (370g/l) sourced from Primextra Gold 660 SCWAS = Weeks after sowing NS = Not significant at 5% level of level of probability,

REFERENCES

Anikwe, L.S., Atthor F.M. Sakav, T. (2000) Effect of different planting pattern, weed control and manure rates on growth, yields and yield components of Maize. *Indian Agronomy journal.*42:265-268.

Clark,J.W., F.R.Miller and R.Creeiman.1980. Utilization of sorghum biomass for energy. Sorghum Newsletter.23:4445

Dogget , H. 1988. *Sorghum.* 1st Edition Longman, Green and co. Ltd London

Duncan, R.R.,A.J Bocholt and F.R., Miller. (1984). Descriptive Comparism of Senescent and Non-senescent sorghum genotypes. *Agronomy Journal 73:849-853.*

Ferraris, R. and D.A.,Charles-Edward (1986). A comparative analysis of the growth of sweet sorghum and forage sorghum crops. II Accumulation of soluble Nitrogen and Carbohydrates. *Journal of Australian institutes of Agricultural Science vol:45:156-164*

Jibril, H.J (2017). Influence of weed control treatments and plant density on the growth and yield of sweet sorghum *(sorghum bicolor (L) Moench* Sub species *saccharatum* varieties in the Sudan savannah. Unpublished thesis submitted to the Department of Agronomy Faculty of Agriculture Ahmadu Bello University Zaria, Nigeria..

Popescu. A; and Condei R. (2014) some consideration on the prospects of sorghum crop scientific paoer series Management Economic Engineering in Agriculture and Rural Development Vol.14.(3). Present situation. Forest Kyoto. 70: 69-76 CCAB Abstracts production at Soba Research Station, Sudan, Annual Report Quality, 28(2): 623-632.

Rajvanshi,A.K. and N., Nimbkar (2001). Sweet sorghum R&D at the Nimbkar Online:http://www.icrisat.org/media/2004/media13.htm.

Reddy, B.V.S, Ramesh S, Sanjana-Reddy, P., Ramaiah B., Saliath, P.M. And Rajashekark. (2005). Sweet sorghum – A potential alternative raw material for bio-ethanol and bio-energy. *International Sorghum and Millets Newsletter* 46:79-28

Shahib, S.D; H.k. Singh and C.B. Signh. (1997). Effect of plant population and nitrogen on biomass and juice yield of sweet sorghum (Srghum *bioclor(L). Indian Journal of Agricultural Science104(3):*Pp46

Udeme, C.O. (2012) http://www.the bioenergy site.com/news/270/Nigeria-global-recoginition-for-ethanol-project

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

INFLUENCE OF SOME SELECTED POST EMERGENCE HERBICIDES ON DRY MATTER CONTENT OF RICE (*Oryza sativa.*) VARIETIES AND ASSOCIATED WEEDS

M.U. Tanimu[1], J. Alhassan[2], A.I. Yakubu[2] T.S. Bubuche[1], O.E. Fadeiye[3] and R.O. Tiamiyu[2]

[1]Department of Crop Science, Faculty of Agriculture, Kebbi State University of Science and Technology, Aliero, Kebbi State Nigeria

[2]Department of Crop Science, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria

[3]National Cereals Research Institute, Birnin Kebbi Station, Kebbi State, Nigeria

Correspondence e-mail *musaumar99@yahoo.com*

ABSTRACT

The trial was conducted in the screen house of Teaching and Research Farm of Kebbi State University of Science and Technology Aliero located at Jega to evaluate three selected post emergence herbicides for weed control on rice (Oryza sativa L.) in Sudan Savanna zone of Nigeria. Treatments consisted of two rice varieties (Faro 44 and Faro 52), three herbicides namely BRACER (Bispyribag sodium, 100g a.i./l), BRACERPLUS (Bispyribag sodium, 40g a.i./l) and cyhalofop 120g a.i./l) and NOMINEEGOLD (Bispyribag sodium,100g a.i./l). Each of the herbicides were applied at three levels; BRACER 250ml(25g a.i./l), 275ml(27.5g a.i./l) and 300ml (30g a.i./l), BRACERPLUS 129ml(20.64g a.i/l.),142ml(22.72 g a.i./l) and 155ml(24.8 g a.i./l) NOMINEEGOLD 200ml(20.0 g a.i./l), 300ml(30 g a.i./l) and 400ml(40 g a.i./l); with hand weeding at 4 and 8WAS and weedy check imposed as control. The treatments were laid out in a completely randomised design with three replications. Ten kilogram (10kg) of the soil was measured and filled into each of the sixty -six (7-Litre) plastic pots that were placed equidistant to one another in the screen house. Thirteen (13) weed species were identified in the weed flora, The results obtained showed that D. horizontalis, A. sessilis, H. granularis V. leptoclada and L. hyssipifolia followed each other in their densities (D). D. horizontalis is the most frequent of all the weeds, its followed by A. sessilis,, H. granularis, V. leptoclada and C. leptostachya in that order. Application of Nomineegold at 0.3 l ha^{-1} produced higher plant establishment count, while at 0.4 l ha^{-1}, portrayed the highest weed control efficiency (WCE) of 87.96% and weed dry matter of 11.75g among the chemical weed control treatments, while Bracer plus applied at 0.142 l ha^{-1} produced the highest crop dry matter or straw yield of 34.83g.Faro 52 produced higher weed control efficiency than Faro 44.

Keywords: Crop dry Matter, Postemergence Herbicides, Screen House, Treatment, Weed dry matter

INTRODUCTION

Rice (*Oryza sativa*L.) is an annual grass that belongs to the family Poaceae and genus *Oryza*. It is regarded as the first cultivated crop of Asia (Anon. 2009a). The centre of origin of rice is believed to be south-east Asia (*Oryza sativa)* and Africa *(O. glaberrima*). Some of the important rice producing countries are China, Burma, India Indonesia Japan United States of America, Spain, Italy and Brazil, before it was spread to Africa (Desrosiev, 1999). Although the original parental species of rice are native to South-East Asia and certain parts of Africa, centuries of trade and exportation have made it a common place in many cultures world – wide (IRRI, 2008). Rice is grown in more than 100 countries of varying climatic conditions and is particularly productive in tropical region with abundant moisture (Oko *et al.,* 2012). Rice is a staple for more than 60 % of the worlds' seven billion people and more than 90% of this rice is consumed in Asia {Mohanty, 2013; Chauhan *et al.*(2014)}. During the year 2017 nearly 482 million metric tonnes of paddy were produced worldwide (Anon., 2018a). Although rice protein ranks high in nutritional quality among cereals, protein content is modest. The minerals, vitamins and other constituents of rice except carbohydrate are reduced by milling (Anon. 2012). In Nigeria, rice is important for several reasons including being a major contributor to internal and sub-regional trade (Oko *et al*., 2012). Two types of rice have been mainly cultivated in Nigeria; the African rice (*Oryza glabberrima)* and Asian rice (*Oryza sativa*) (Oko et al., 2012). In recent times, however new rice varieties have also been introduced including the West African Rice Development Association's (WARDA) hybrid rice varieties e.g. New rice for Africa (referred to as NERICA) which are inter specific hybrid between the African and the Asian rice.

Of the biotic and abiotic stresses that pose constraints to rice production, weeds are the most prominent of them across the ecologies in terms of yield reduction, labour demand and cost of control (Akinyemiju and Igori 1986; Pandey, 2009). Oyebanji and Oluyemisi (2018) reported that about 20% of production costs incurred by farmers are attributed to weed control during growing season. In sub-Saharan Africa, 2.2 million tonnes of rice yield is lost annually as a result of uncontrolled weeds (Oyebanji and Oluyemisi 2017). About 28-74% of rice yield is lost due to uncontrolled weed growth in transplanted lowland rice, while 48-100% loss in upland ecosystems (Rodenburg and Johnson 2009).

Weeds are real constraints to rice production (Kwesi and De Datta, 1991). Improved weed control can increase rice yields by 15-23% depending on the agro-ecosystem (Rodenburg and Johnson 2009). As an alternative to hand weeding and other methods of controlling weeds among farmers, herbicides offer a practical and economical option for reducing crop losses and production cost (Akinyemiju and Igori, 1986; Akobundu, 1987, Kolo, 2004). The use of herbicides in rice cultivation is gaining widespread acceptance among rice farmers worldwide including Nigeria. The conventional method of weed control in rice, i.e. hand weeding is very laborious, expensive and inefficient. Chemical weed control can be considered as a better alternative (Singh, and Singh 1993). Use of chemicals to control weed has been found to be effective and economical (Singh and Mani, 1981).

Post emergence herbicides are a major tools used to control weeds in rice. The growth stage of weed species may have an effect on herbicide efficacy by influencing uptake and metabolism of herbicides (Singh and Singh, 2004). Diclofop, for example, was more effective on green foxtail (*Setaria viridis* (L.) Beauv.) and wild oat (*Avenafatua* L.) when applied at an early growth stage (Friesen *et al*., 1976). Conversely, trifloxysulfuron was more effective on yellow nut sedge (*Cyperus esculentus* L.) at late application stages (Singh and Singh 2004). Generally, the herbicide efficacy is lower when applied on bigger weeds. The herbicide degradation rate may be faster in big plants, and herbicide rates may need to be increased to achieve the desired level of control (Singh and Singh, 2004). Therefore, optimum time of herbicide application and range of herbicides may help control these weeds effectively (Gopal *et al*. 2010).

Weeds are recognised as major biological constraints that hinder the attainment of optimal rice productivity and quality (Kumar and Ladha, 2011, Rao and Nagamani, 2013). It is estimated that every year, weeds cause yield losses from 15 to 76% in rice crop (Singh *et al.,* 2004, Mondal *et al*., 2005, Rao and Nagamani 2010, Mishra *et al*., 2012, Mandal *et al.,*2013). Direct yield loss has been estimated to range from 16 – 86% depending on type of rice culture, cultivars, weed species and density, duration and time of weed infestation, climatic and environmental conditions (Duary *et al*., 2004, Kolay 2007). It is well established that weeds remove considerable quantities of nutrients from rice crop field. Estimate showed that weeds can deprive the rice crops by 47% N, 42% P, 50% K, 39% Ca and 24% Mg of their nutrient uptake thereby reduce the yield potential of the crop (Balasubramaniyan and Palaniappan 2001). Hence timely and effective weed control is essential for obtaining higher yield of rice (Sathyamoothy *et al*., 2004, Kumar *et al*., 2007). Nutrient removal by weeds has been reported to be about 21 – 42kg N, 10 – 13.5kg P and 17 – 27 kg K ha^{-1} in transplanted rice depending upon the soil, condition of cropping and location of growing rice (Sudhalakshmi *et al.,*2005, Puniya *et al.,*2007b, Gowda *et al.,*2009). In rain-fed lowland rice, a period of 30-60 days after sowing was considered as critical period for crop weed competition to avoid grain yield losses (Moorthy and Saha 2005). Therefore, weed control measures must be instituted before this period of time to avert economic yield loss in rice.

Chemical weed control is a practical and economic alternative to hand weeding. The conventional method of weed control in rice, i.e. hand weeding is very laborious, expensive and inefficient. Chemical weed control can be considered as a better alternative (Singh, and Singh 1993). Use of chemicals to control weeds in rice, has been found to be effective and economical (Singh and Mani, 1981). Brar and Mishra (1989) reported that chemical weeding is easier, saves time and economical as compared to hand weeding alone. Weed control using herbicides offers an advantage to save labour and money. Weed infestation causes reduction in crop yield and grain quality (De Datta, 1979). Akobundu (1989) reported that uncontrolled weeds can cause up to 80-100% yield losses in Nigeria. Weed control is one of the major labour demanding farm operations in rice production; the labour requirement is very costly and may not be available at the time of need (Yawale *et al.,* 2019). Although no single weed control method can give effective and satisfactory weed control in all ecologies, however, chemical weed control may provide a better alternative, because it is fast, cheap, easy and more effective, Lagoke, *et al.* (1991). The aim of the study was to evaluate three selected postemergence herbicides for weed control in rice varieties.

MATERIALS AND METHOD

Experimental Site

Experiment was conducted during the dry season of 2019/2020 in the Screen house of Teaching and Research Farm of Kebbi State University of Science and Technology Aliero located at Jega (lat. 12^0 18.64'N: long.04^0 29.85', 262 m above sea level). The area is characterized with erratic and scanty rainfall that lasts for about 5 months (May –

September) and long dry period (October – April). The climate of the area is semi-arid with average rainfall of 550650mm per annum. The relative humidity ranges from 21- 47% and 51- 79%during the dry and rainy seasons respectively. Temperature averages between 14 – 30 ^{0}C during dry season and 27-41^{0}C during the rainy season (NNN, 2012).

Treatments and Experimental Design

Treatments consisted of two rice varieties (Faro 44 and Faro 52), three herbicides namely BRACER(Bispyribac sodium, chemical name 2,6-bis{(4,6-dimethoxy-2-pyrimidinyl)oxy}benzoic acid 100g a.i./ha), BRACERPLUS(chemical name 2,6-bis{(4,6-dimethoxy-2-pyrimidinyl)oxy}benzoic acid (40g a.i./ha) -4% and cyhalofop (chemical name (R)-2-[4-cyano-2-fluorophenoxy] propanoic acid)- butyl(120g a.i./ha)-12% and NOMINEEGOLD(Bispyribag sodium, chemical name 2,6-bis{(4,6-dimethoxy-2-pyrimidinyl)oxy}benzoic acid 100g a.i./ha). Each of the herbicides was applied at three levels; BRACER 250ml(25g a.i./ha), 275ml(27.5g a.i./ha) and 300ml (30g a.i./ha), BRACERPLUS 129ml(20.64g a.i/l.),142ml(22.72 g a. i./ha) and 155ml(24.8 g a.i./ha) NOMINEEGOLD 200ml(20.0 g a.i./ha), 300ml(30 g a. i./ha) and 400ml(40 g a.i./ha); with hand weeding at 4 and 8WAS and weedy check imposed as control. The treatments were laid out in a completely randomized design with three replications.

Cultural Practice

Seed sowing: Three seeds each was sown directly into five holes (that are 15 cm from one another) drilled into each plastic pot. Ten days after germination, the fifteen seedlings were thinned to five plants per pot. Supplying was done where poor germination of rice seedlings was observed.

Watering: Watering was done using a 10-litre watering can. Irrigation was done at as when due.

Hand weeding: Hand weeding was done at 4 and 8Weeks After Sowing (WAS) according to treatment. Weeds were washed cleaned air dried and fresh weight was recorded and subsequently oven dried at 70 ^{0}C weighed until a constant weed dry matter weight was achieved.

Fertilizer application: Application of 100:50:50 kg ha^{-1} NPK was done in split doses. The first half application of N (50 kg), and full dose of P_2O_5 and K_2O (50 kg) were applied at the basal stage. The second half of N was applied at maximum tiller stage and at panicle initiation stage using urea (46%) as source.

Herbicide application: Each of the herbicides was applied at three levels; BRACER 250ml ha^{-1}, 275ml ha^1 and 300ml ha^{-1}, BRACERPLUS 129mlha^{-1},142mlha^{-1} and 155mlha^{-1}; NOMINEEGOLD 200mlha^{-1}, 300mlha^{-1} and 400mlha^{-1}according to treatment at 6- weeks after sowing. Application was done once only during the cultivation period. This was done by arranging the pots with similar treatment together and herbicide was then applied after calibration.

Harvesting: The rice crop was harvested manually by carefully uprooting the crops after a soaking watering to avoid loosing the roots.

Data Collection

Weed dry matter: Weed dry matter was taken after application of treatment at six weeks after sowing and at 10 WAS when the affected weeds were completely dry and at harvest to determine weed biomass.

Plant establishment count: Plant establishment count was taken at 10 (ten) days after sowing (DAS). Resupplying was done where poor germination of rice seedlings was observed.

Crop dry matter at 10WAS: The straw yield or crop dry matter was taken from the five plants of each pot at 10 WAS and means were calculated.

Data Analysis

Data generated was subjected to analysis of variance procedure (ANOVA) as described by Steel and Torrie (1984) and differences between treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability as described by Gomez and Gomez (1984). The relationships between characters were determined through simple correlation analysis as described by Little and Hills (1978).

RESULTS

Plant Establishment Count

Plant establishment count of rice as affected by weed control treatments and variety at Jega is presented in Table 1. The result showed that the highest number of established plants was from hand weeded treatment which was followed by both applications of Bracerplus at 0.142 l ha^{-1} and 0.155 l ha^{-1}, then Bracer at 0.275 l ha^{-1}, Bracer at 0.3 l ha^{-1} and Bracerplus at 0.129 l ha^{-1}. The least number of established plants were the weedy check.

Table 1: Effect of weed control treatments and variety on plant establishment count, crop injury score and crop dry matter @10WAS at Jega 2019/2020

Treatment	Rate (l ha^{-1})	Plant establishment Count	Crop Injury Score	Crop Dry matter 10WAS (g)
Weed control treatments Bracer-1	0.250	73.33	1.33ab	20.91cd
Bracer-2	0.275	75.56	1.17ab	24.68bcd
Bracer-3	0.300	72.22	1.50a	22.71bcd
Bracerplus-1	0.129	72.22	1.16ab	26.25bcd
Bracerplus-2	0.142	76.67	0.50ab	34.83b
Bracerplus-3	0.155	76.67	0.83ab	32.31b
NomineeGold-1	0.200	70.00	1.50a	25.4bcd
NomineeGold-2	0.300	68.89	1.00ab	24.00bcd
NomineeGold-3	0.400	67.78	1.83a	15.91d
Handweeded	-	81.11	0.00b	58.10a
Weedy check	-	68.69	0.00b	31.30bc
SE±		7.397	0.413	3.693
Significance		NS	*	*

Variety			
Faro 44	59.59b	0.57b	33.65a
Faro 52	86.46a	1.39a	23.87b
SE±	3.144	0.175	1.569
Significance	*	*	*
Interaction			
W x V	NS	NS	NS

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT
NS= non significant

Crop Injury Score

Rice crop injury score as affected by weed control treatments and variety at Jega is presented in Table 2. Application of Nomineegold at 0.4 l ha^{-1}resulted to the highest crop injury though not statistically different from all other herbicides control treatments. The result showed that crop injury on all the herbicide treatment was comparable but there was significant difference between the herbicide treatment and hand weeded and weedy check treatments. Both hand weeded and weedy check recorded null injury because no herbicide was applied to both treatments. There was significant difference between the rice varieties on crop injury. The effect of the treatment was significantly higher on Faro 52 than Faro 44, this may suggest that Faro 52 was more susceptible to the effect of the herbicide over Faro 44. There was no interaction between weed control treatments and rice varieties in crop injury score during the study period.

Crop Dry Matter at 10WAS

Rice crop dry matter as affected by weed control treatments and variety at Jega is presented in Table 3. The result showed a significant difference in dry matter among the treatments. The hand weeded treatment produced significantly higher crop dry matter than any of the weed control treatments and the control. However, applying Bracerplus at 0.142 l ha^{-1} produced the highest dry matter among the post emergence herbicide treatments but statistically comparable to applying Bracerplus at 0.155 l ha^{-1}. Application of Bracer at 0.275l ha^{-1}, 0.300l ha^{-1}, Bracerplus at 0.129l ha^{-1}, Nomineegold at 0.200 and 0.300l ha^{-1}, were all statistically similar but at par with the hand weeded treatment. There was significant difference in crop dry matter between the herbicide treatments, and hand weeded treatment. There was a significant difference observed between the varieties in crop dry matter produced. Faro 44 significantly produced higher crop dry matter compared to Faro 52. There was no significant interaction between weed control treatments and variety in plant establishment count, crop injury score and crop dry matter at 10 WAS.

Weed Dry Matter at 10 WAS

Influence of weed control treatments and variety on weed dry matter at 6 and 10 WAS, in rice during 2019/2020 dry season in Jega is presented in Table 2. The result shows significant difference between the weed control treatments and the weedy check. Bracer applied at 0.3 l ha^{-1}, produced the least weed dry matter compared to other post emergence herbicides tested while Nominee gold applied at 0.4 l ha^{-1} produced the highest weed dry matter among the post emergence herbicides applied. There was no significant difference between rice varieties in weed dry matter. There was no significant interaction between weed control treatments and variety in weed dry matter at 10 WAS.

Table 2: Effect of Weed control treatments and variety on Weed dry matter 6WAS, weed dry matter at 10 WAS and Weed Control Efficiency, at Jega 2019/2020 dry season

Treatment	Rate (l ha^{-1})	Weed DM6WAS (g)	Weed dry matter10 WAS (g)

Weed Control Treatments			
Bracer-1	0.250	0.55	8.13bc
Bracer-2	0.275	1.07	8.96b
Bracer-3	0.300	0.97	2.53cd
Bracerplus-1	0.129	0.63	9.81b
Bracerplus-2	0.142	0.87	7.43bc
Bracerplus-3	0.155	1.08	6.36bc
NomineeGold-1	0.200	1.20	9.68b
NomineeGold-2	0.300	1.38	8.30bc
NomineeGold-3	0.400	1.30	11.75b
Hand weeded	-	1.45	0.00
Weedy check	-	0.00	18.85a
SE±		0.395	1.876
Significance		NS	
Variety			
Faro 44		0.95	8.45
Faro 52		1.09	8.23
SE±		0.168	0.797
Significance		NS	NS
Interaction			
W x V		NS	NS

Means followed by the same letter(s) in a treatment group are not significantly different at 5% level of significance using DMRT.
NS= Non significant

DISCUSSION

Among the postemergence herbicides applied, bracerplus applied at 0.142 l ha^{-1} produced the highest crop dry matter similar to dry matter produced when bracerplus was applied at 0.155 l ha^{-1}. Although hand weeded treatment produced the highest crop dry matter among the weed control methods, bracerplus applied at 0.142 l ha^{-1} and applied at 0.155 l ha^{-1} produced higher crop dry matter than the weedy-check treatment. In Brasil, Langaro *et al.*(2018) reports from his findings that the herbicide bispyribac-sodium causes the greatest injury and the greatest reduction in rice plant height. Bhagirath *et al* (2011) also mentioned that: Bispyribac-sodium at 0.030 and 0.045 kg ha^{-1}was applied to four rice varieties ('IR64', 'IR72', 'RC09', and 'RC18'), which were grown in saturated and aerobic (30% of saturation) soils. Control treatments, where no herbicides were applied, were also included in the study. Shoot and root biomass, and height of rice plants were measured 14 days after application. Bispyribac-sodium reduced rice shoot biomass by 9 to 17% at 0.030 kg ha^{-1} in aerobic soil and 23 to 37% in saturated soil. Kumaran *et al.,* (2015) in their studies asserts that: Similar to grain yield, straw yield was also influenced significantly by different weed management practices.

The highest weed dry matter at 6 weeks after sowing was obtained from hand weeded treatment while application of Nomineegold at 0.3 l ha^{-1}produced the highest weed dry matter among the chemical weed control methods fb Nomineegold at 0.4 l ha^{-1}fbNomineegold at 0.2 l ha^{-1}. The least weed dry matter from the chemical weed control was obtained from the application of Bracer at 0.25 l ha^{-1}. At 10 WAS, weed dry matter was at par between the chemical weed control methods, but significantly different from the weedy check which produced the highest weed dry matter than any of the chemical weed control treatment. This could be as a result of weed infestation.This weed infestatiom leads to production of more weed dry matter while crop dry matter decreases as a result of competition between rice crop plant and the weeds. Among the herbicide treatments,bracer at 0.300 l ha^{-1} produced the least weed dry matter, while Nomineegold at 0.400 l ha^{-1} produced the highest weed dry matter during this period of the study. It is fb bracerplus at 0.129 l ha^{-1}fbNomineegold at 0.200 l ha^{-1}. Atheena (2016) reported that cyhalofopbutyl

+ pyrazosulfuron-ethyl recorded the least weed dry matter production while among various sequential application of herbicides, the lowest weed dry matter accumulation was noted in cyhalofop-butyl followed by (fb) Almix and both were statistically comparable.

The hand weeded treatment recorded the least weed dry matter in the study; This was as a result of the removal of weeds that was done twice (4 and 8 WAS) in the pots that lives few weeds in the treatment, this was in agreement with the findings of Chandu (2017) who reported that significantly lowest total weed dry matter production was recorded under the weed free treatment followed by hand weeding twice at 30 and 45 DAS, which was significantly superior over other treatments.

CONCLUSION

From the evaluation of the three selected post emergence herbicides for weed control in rice under different rates, based on the objectives lined up in this study it is concluded that among the herbicide treatments, bracer at 0.300 l ha^{-1} produced the least weed dry matter of 2.53g, while Nomineegold at 0.400 l ha^{-1} produced the highest weed dry matter of 11.75g during the period of study.

Faro 44 had the highest crop dry matter of 33.65g, while bracerplus applied at 0.142 l ha^{-1} produced the highest crop dry matter of 34.83g, Nomineegold applied at 0.400 l ha^{-1} recorded the least weed dry matter of 15.91g.

Nomineegold at 0.4 l ha^{-1} and Bracerplus at 0.142 l ha^{-1} are recommended to be used for weed control in rice

in the study area, while Faro 44 variety is recommended for cultivation in the study area.

REFERENCES

Akinyemiju, O. A. And Igori, O. A. (1986). An evaluation of some herbicides for pre-emergence control of weeds in direct seeded upland rice. *Nigerian Journal of Biological Sciences* 1:3-11.

Akobundu I. O. (1987). *Weed Science in the Tropics: Principles and Practices*. Chichester: John Wiley and Sons.

Anonymous (2012): NNN:Nigeria National News(2012). A news report by Nigeria National News(NNN). retrieved from http:// nnn.com.ng.

Anonymous (2018a): Rice-Statistics and Facts. Retrieved from https://www.statista.com/topics/1443/rice/7/12/2018

Brar, L.S. and Mishra. S. P. (1989). Weed control in groundnut with pre-and postemergence herbicides. *Indian Journal of Weed Science* 21(1, 2): 16-21.

Chauhan, B. S. Kumar, V. and Mahajan G.(2014). Research needs for improving weed management in rice. *Indian Journal of Weed Science 46 (1):1-13.*

De Datta, S. K. and Haque M. Z.. (1982). Weeds, weed problems and weed control in deepwater rice areas. In: Proceedings of the International Deep-water Rice Workshop, International Rice Research Institute held in Manila, Philippines. pp. 427-442.

Desrosiev, H. (1999). Gelatinization Temperature of Cereal Crops, *Agricultural Biotechnology*, 3rd Edition, Wiley and Sons, New York231-234.

Duary B. and Mukhopadhyay, S.K. (2004). Biotechnology and Herbicides- the new tools to combat the weeds – the major cause of biotic stress in Agriculture, pp. 24-28. In; Extended Abstract of Seminar on Biotic Stress on Agro-ecosystems. *West Bengal Academy of Science and Technology Section of Agricultural and Forestry Sciences*. VisvaBharati, Santiniketan.

Gopal R., Jat R.K, Malik R.K., (2010). International Maize and Wheat Improvement Center; Direct dry seeded rice production technology and weed management in rice-based systems. Tech. Rep. New Delhi, India

Gowda, P. T. Govindappa, M. Murthy K.N.K. Shankaraiah, C. and Janessa, A.C. (2009). Effect of herbicides and cultural treatments on uptake of major nutrients by crop and Weeds under aerobic rice cultivation. *Journal of Crop and Weed 5(1):pp. 326-329.*

Kolay, S. (2007). Weed management in transplanted Kharif rice and ecophysiological studies on competition between rice and Ludwigiaparviflora (Roxby.). Ph.D. thesis. Department of ASEPAN, Institute of Agriculture, VisvaBharati, Sriniketan.

Kumaran S .T., Kathiresan, G. Murali Arthanari P., Chinnusamy C. and Sanjivkumar V. (2015)Efficacy of new herbicide (bispyribac sodium 10% SC) against different weed flora, nutrient uptake in rice and their residual effects on succeeding crop of green gram under zero tillage.

Kumar, V. and Ladha, J. K. (2011). Direct-Seeded rice: recent developments and future research needs. *Advances in Agronomy 111: 297- 413*.

Lagoke, S.T.O Adejonwo, K. O., Ahmed, M. K. and Karikari, S. K. (1991). Chemical weed control in irrigated okra in the Nigerian Suand Savanna zone. Tropical Pest Management. 37 {1}: 91-95.

Langaro, A.C. Agostinetto, D. Oliveira, C. Franco, J.J. Zandoná, R.R. Vargas, L. (2018): Influence of Nitrogen Fertilization on Herbicide Selectivity in Rice Planta Daninha*Print version* ISSN 0100-8358*Online version* ISSN 1806-9681.Planta daninha vol.36 Viçosa 2018 Epub Oct 29, 2018 https://doi.org/10.1590/s0100-83582018360100120.

Little, T. M. and Hills, F. J.(1978) *Agricultural Experimentation Design and Analysis.* John Wiley and sons inc. New York pp. 350.

Mohanty S. (2013). Trends in Global rice consumption. Rice Today pp. 44-45.

Oko, A. O. Ubi, B. E. Efisue, A. A. (2012). A Comparative study on Local and newly introduced Rice Varieties in Ebonyi state of Nigeria based on Selected Agronomic Characteristics. *International Journal of Agriculture and Forestry 2012 2(1):11-17* DOI:10.5923/j.ijaf.20120201.03.Retrievedfrom:http://article.sapub.org/10..5923/j.ijaf.20120201.03.html.

Oyebanji O A. and Oluyemisi A A. (2018).Weed Management Practices by Lowland Rice Farmers in the South West of Nigeria.*Adv Crop Sci Tech 2018, Vol6(3): 372* DOI: 10.4172/2329-8863.1000372.Retrieved from https://www.omicsonline.org/open-access/weed-management-practices-by-lowland-rice-farmers-in-thesouth-west-of-nigeria-2329-8863-1000372-102817.html 08:10a. m. 20/11/19.

Pandey S. (2009). Effect of weed control on Rice cultivars under the system rice intensification (SRI). Unpublished Thesis. Tribhuvan University Institute of Agriculture and animal Science Rampur, Chitwan, Nepal.

Puniya, R. Pandey, P. C. Bisht, P. S. and Singh D.K. (2007b). Nutrient Uptake by crop and weeds as influenced by trisulfuron, trisulfuron + pretilachlor and bensulfuron-methyl in transplanted rice (*Oryza sativa* L.), *Indian Journal of Weed Science 39 (3&4):239*-240.

Rajendra Kumar. B.(2003). Studies on weed management in anaerobic tolerant rice cultivars under direct wet seeded condition. M.Sc. Thesis. Tamil Nadu Agric. Univ., Coimbatore.

Rao, A. N. and Nagamani, A. (2010). Integrated Weed Management in India-revisited. *Indian Journal of Weed Science 42:1-10.*

Reddy, G.S. (2010). Integrated weed management in drum seeding and direct planting system. M.Sc. ///////////////……………………………………………………………………………………002E(Ag.) Thesis. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Risi,C. Arcangeli, G. Cantoni, A. Gasso R (2002). – Mode of Action of Bispyribac Sodium Atti-delle Giornate, - agris.fao.org.

Rodenburg, J.and Johnson, D. E. (2009). Weed management in Rice-based cropping systems in Africa. *Advances in Agronomy*103:149-218.

Satyamoorphy, N. K. Mahendran S, Babu, R. and Ragavan, T.(2004). Effect of Integrated Weed Management Practices on total dry weight, nutrient removal of weeds in rice-rice wet seeded system. *Journal of Agronomy 3(4): 263-267.*

Sharma, S. K. and Bhunia, S. R. (1999). Weed management in transplanted rice (*Oryzasativa)* under Ghaggar flood plains of North-West Rajasthan. *Indian Journal of Agronomy 42(2): 326-330.*

Singh, G. and Singh, O. P.. (1993). Chemical weed control in lowland transplanted rice under .puddled condition. Annals of Agricultural Research 14: 229-231.

Singh, S. P. and Mani.V. S. (1981). Chemical weed control in rice-wheat rotation. In:Proceedings of Indian Society of Agronomy National Symposium held in Hisar, India 14-16 March 1981. pp. 62-67.

Singh, V. P. Singh, G. and Singh, M. 2004. Effect of fenoxaprop-pethyl on transplanted rice and associated weeds.

Indian Journal of Weed Science 36(3&4): 190-192.

Steel, R. D. and Torrie J. W. (1984). *Principles and Procedures of Statistics. A Biometric Approach.*McGraw hill international books Auckland pp. 663

Sudhalakshmi, C. Velu, V. and Thiyagarajan, T. M. (2005). Weed management options on the Dynamics of nitrogen fractions in the rhizosphere soil of rice hybrids. *Madras Agricultural Journal 92(7-9):444-448.*

Yawale, M.A., Hussaini M.A., Garko, M. S. Lado A. and Muhammad A. (2019). Predicting Critical Period of Weed
Control for Optimum Yield of Upland Rice (*Oryzasativa* L.) in the Sudan savanna of Nigeria. *Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue*
9 Ser. I (September 2019), PP 69-74 Retrieved from www.iosrjournals.org

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EFFECT OF RATES OF METOLACHLOR AND WEEDING REGIME ON THE YIELD OF SWEET POTATO (*Ipomoea batatas* L.) AT NORTHERN SAVANNA

J.E. Essien[1]*, B. Uzza[1], R. Mohammed[1] and T.T.A. Adeogun[1]

Department of Crop Production, Federal College of Forestry Mechanization, Afaka, Kaduna.
Corresponding Email: *essienjoy87@gmail.com*

ABSTRACT

Field experiment was conducted at the experimental site of Crop Production Technology Department, Federal College of Forestry Mechanization, Afaka, Kaduna during the 2019 rainy season to study the effect of rates of metolachlor and weeding regime on the yield of sweet potato (Ipomoea batatas L.).The trial consisted of four weeding regimes, 12 weeks after planting (WAP), 9 WAP, 6WAP, and 3 WAP, two rates of metolachlor (3.0 kg a.i./ha and 2.0 kga.i./ha), hoe weeded control at 4 and 8 WAP weed free treated and weedy check plots. The treatments were factorially arranged and laid out in a Randomized Complete Block Design (RCBD) replicated three times. The weed dry weight values were as follows: 9.80, 7.97, 6.40, 10.83, 6.87, 7.33, 4.40, 8.67, 6.83, 5.03, and 11.80. These results obtained from the analysis showed that the weedy check plots recorded the highest weed dry weight (11.80). The least weed dry weight was produced by plots treated with metolachlor at 2.0 kga.i./ha plus weeding regime at 9 WAP (4.40) and the weed free treated plots (5.03). The highest crop vigour score mean value (8.67) and the highest vine length mean value (87.73) were recorded by the weed free treated plots, and the highest marketable yield mean value (19.33) was produced by the weed free treated plots and this was followed by plots treated with metolachlor at 3.0 kga.i./ha plus weeding regime at 6 weeks after planting (13.67) and the hoe weeded control plots (13.67).

Keywords: Effect, metolachlor, weeding regime, sweet potato

INTRODUCTION

Sweet potato (*Ipomoea batatas*) is one of the most important food crops worldwide and is used for animal feed, human consumption, and various processed products. Weed interference with the crop can cause significant yield reductions and inferior product quality (Monks *et al.,* 2019). Sweet potato is native to the tropical regions of the Americas. The origin and domestication of sweet potato occurred in either Central or South America (Petit and Excoffier, 2009). According to Food and Agriculture Organization (FAO, 2009) Statistics, World Production in 2004 was 127 million tonnes. Majority comes from China, with a production of 105 million tonnes. About half of the Chinese food is used for livestock feed. About 20,000 tonnes (20,000,000 kg) of sweet potatoes are produced annually in New Zealand. In 2020, global production of sweet potatoes was 89 million tonnes, led by China with 53% of the world total. Secondary producers were Malawi, Tanzania and Nigeria (Leksrisompong *et al.*, 2012). Potato farming in Nigeria has the potential to generate billions of Naira (millions of USD) annually. A baseline survey in 2012 reveals that Nigeria produces about 1.5 million tons of potato per year and has a per capita consumption of about 7kg per year. Weed competition decrease dry matter accumulation, leaf area index, crop growth rate, leaf area index duration, light absorption, light extinction efficient and radiation use coefficient (RUE) of potato. Weed reduces the potential yield by 54.8 percent. Weed infestation decrease the quality and quantity of potato tubers via decreasing size, weight and number of tubers (Arnold *et al.*,1998). Crop yield will decrease significantly by weed interference. Chemical weed control is an important part of sweet potato production systems because mechanical cultivation is restricted to the initial stages of the crop due to the prostrate growth habit of sweet potato and labour for manual weed control has become scarce and expensive. The herbicide metolachlor is used in sweet potato weed management systems because it effectively controls or suppresses a wide spectrum of grass and small – seeded broadleaf weeds. In addition, it is the only herbicide that is labeled to control or suppress yellow nutsedge in Beauregard sweet potato (Abukari *et al.,* 2015). Therefore, effective weed management dependents on knowledge about the effect of competition on yield and yield components (Elkoca *et al.*, 2005). This study was therefore conducted to evaluate the effects of different rates of metolachlor and weeding regime on weeds and yield of sweet potato.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the experimental site of Crop Production Department in 2019. It is located at Latitude 10° 37' N and Latitude 70 21'E within the Northern Guinea Savanna agro ecological zone.

Soil Sampling Analysis

The soil sample was collected randomly. The soil sample was bulked, mixed thoroughly and air dried for one week, put in a sealed envelope for analysis. The analysis was to determine the physical and chemical properties of the soil (1:2 dilution method)

Experimental Treatments and Design

The experimental treatments consisted of our weeding regimes, 12 WAP, 9 WAP, 6 WAP and 3WAP, two rates of metolachlor (3.0 and 2.0 kg a.i./ha.), hoe weeded control at 4 and 8 WAP weed free and weedy check plots. The treatments were factorially combined and laid out in a randomized complete block design (RCBD), replicated three times. The size of the experimental plot is 3m x 3m (6m^2) while the net plot was 3m x 1.5m (4.5m). The spacing between each replicate was 1m and within plots was 0.5m.

Land preparation

The experimental site was cleared of debris, ploughed, and harrowed twice. The harrowed land was made into beds of 3mx3m separated from each other by 1.0m pathway.

Test crop: The variety of sweet potato planted was white delight (pure water) and was obtained from Kaduna state Development Project (KADP), Kaduna. It has white reddish colour.

Planting: The sweet potato vine was the planting material used for planting. The vines were planted at intrarow spacing of 30cm and inter-row spacing of 75cm.

Herbicide application: The herbicide metolachlor was applied pre-emergence (one day after planting), using a knapsack sprayer with a green deflector nozzle at a swathe width of 75cm, kept at a pressure of 2.1 kg/m^2 to give a spray volume of 250L/ha.

Hoe weeding: Weeding was done at 4 and 8 WAP based on the allocation of hoe weeding treatments.

Harvesting: Sweet potato was matured at 3 months after planting. A big crack on the pile of soil surrounding the base of the crop and the yellowing of the sweet potato leaves were indications of maturity. Harvesting was done by thoroughly wetting the soil a day before harvesting and using a cutlass to remove the soil surrounding the root of the tubers for easy pulling of the potato tubers carefully from the soil, to avoid damage.

Data Collection and Analysis

Data collected for assessment include weed dry weight, crop vigour score, vine length and marketable yield.

All data collected were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967). The significant differences among the means were compared using Duncan Multiple Range Test (DMRT)

RESULTS AND DISCUSSION

Soil Analysis

From the result of the soil analysis (Table 1), the soil of the experimental site was sandy loamy. The percent soil organic carbon was 0.38%, total Nitrogen was 0.02, and cation exchange capacity (C.E.C) was 1.35. The soil from the experimental site was not a fertile soil.This was due to frequent cultivation of the soil. This report is in line with the work of Mahadi *et al*. (2013) who reported that Savannah soils of Nigeria are derived from old parent materials that are deficient in nutrient-bearing minerals. Also, according to Dual (2002); Yusuf and Iwuafor (2005) these soils are subjected to incessant nutrient mining due to intense cropping, erosion, desertification, bush burning among others.

Table 1: Physical and Chemical Properties of the 0 – 30cm Depth of the Soil at the Experimental Site During 2019 Rainy Season at Afaka

Soil Characteristics Chemical Characteristics	2019
pH (H_2O)	6.40
Electrical conductivity (ds/m)	0.09
Total nitrogen (%)	0.02
Organic matter (%)	0.65
Organic carbon (%)	0.38
Available phosphorus (Cmol/kg)	256.00ppm
Calcium (Cmol/kg)	0.71
Magnesium (Cmol/kg)	0.06
Sodium (Cmol/kg)	0.05
Potassium (Cmol/kg)	0.025
Exchangeable acidity (Cmol/kg)	0.50
ECEC	1.35
Physical Characteristics	
Sand (%)	80.40
Clay	3.60
Silt (%)	16.00
Textural class	Sandy loam

Weed Flora Composition at Afaka, Kaduna

The most common weed species observed at the experimental site and their intensity of occurance is shown in (Table 2). The most dominant weed species were grasses such as *Imperatacylindrical,Cynodondactylon* Linn, *Enchinochioacruspavonis*, *Eleusineindica*, *Axonopuscompressus*. This was followed by broadleaf weeds such as *Amaranthus spinosus* Linn, *Ipomeacornea*, *Tridaxprocumbens* Linn, *Sidaacuta* and the least were sedges such as *Cyperusesculetus*, *Cyperusdifformis* Linn and *Cyperusiria*. All the other weeds not mentioned had a low infestation rate.

Table 2: List of Common Weed Species at the Experimental Site in Afaka, during 2019 rainy season.

Types of weeds	Level of Infestation

Grasses	
Imperata cylindrical	***3
Cynodondactylonlinn	**2
Enchinochioacruspavonis	***3
Eleusineindica L	***3
Axonopuscompressus	***3
Sedges	
Cyperusesculetus	**2
Cyperusdifformis Linn	**2
Cyperusiria	*1
Broad Leaved weeds	
Amarenthusspinosus Linn	**2
Ipomea cornea	*1
Tridaxprocumbens Linn	***3
Sidaacuta	**2

Level of infestation

3 - High infestation; 2 - Moderate infestation; 3 – Low infestation

Effect of Metolachlor and weeding regime on weed dry matter of Sweet Potato during 2019 rainy season

The weed dry weight was significantly influenced by rates of metolachlor and weeding regime (Table 3). The weedy check recorded the highest weed dry weight mean values (11.80) as compared to the other treatments. The plots treated with metolachlor at 2.0 kg a.i./ha plus weeding regime at 9 WAP (4.40) and the weed free treated plots (5.03) produced the least weed dry weight mean values as compared to other treatments.The weedy check plots recorded the least crop vigour score mean value (5.67), the least vine length mean values (57.93) and the least marketable yield mean values (7.67).This result is in accordance with the work of Brandenberger *et al*. (2005) who reported that the presence of weeds leads to a decrease in vegetable production, an increase in the cost of controlling weeds and poses difficulty during harvest,and reduces quality and yield. Weed competition with sweet potato under weedy check was quite much and that was responsible for the low crop vigour score mean values, low vine length mean values and the low marketable yield mean values in the weedy check plots.

Effect of Metolachlor and weeding regime on Crop Vigour Score of Sweet Potato during 2019 rainy season

Crop vigour score was significantly influenced by rates of metolachlor and weeding regime as shown in (Table 3). The weed free treated plots recorded significantly highest crop vigour score values (8.67) but were statistically similar to each other, except the weedy check with the least significant crop vigour score values (5.67). The significantly highest crop vigour score mean value recorded by the weed free treated plots, could be as a result of the avoidance of weed competition and the avoidance of detrimental mechanical effects of hand weeding that usually causes crop disturbance. This report is in line with the work of Levett (2009), who reported that in order to avoid weed competition and the detrimental mechanical effects of hand weeding an optimum hand – weeding programme for sweet potato in the tropical lowlands will probably involve (1) keeping the crop weed free for the first 14 – 21 days after planting (DAP); (2) no crop disturbance during the period of maximum tuberous root initiation from 21 – 28 DAP, until 42 – 56 DAP; (3) clean weeding at 56 DAP; and (4) minimal or no weeding after 56 DAP.

Table 3: Effect of rate of metolachlor and weeding regime on weed dry weight and crop vigour score of sweet potato during 2019 rainy season at Afaka, Kaduna.

Treatments	Rate (kg a.i./ha)	Weed dry weight (g/m^2) 2019	Crop vigour score 2019
Metolachlor at 3.0 kg a.i./ha + weeding regime at 3 WAP	3.0	9.80ab	7.67ab[1]

Metolachlor at 3.0 kg a.i./ha + weeding regime at 6 WAP	3.0	7.97bc	7.00bc
Metolachlor at 3.0 kg a.i./ha + weeding regime at 9 WAP	3.0	6.40c	7.33bc
Metolachlor at 3.0 kg a.i./ha + weeding regime at 12 WAP	3.0	10.83ab	7.33bc
Metolachlor at 2.0 kg a.i./ha + weeding regime at 3 WAP	2.0	6.87c	6.67bcd
Metolachlor at 2.0 kg a.i./ha + weeding regime at 6 WAP	2.0	7.33bc	7.00bc
Metolachlor at 2.0 kg a.i./ha + weeding regime at 9 WAP	2.0	4.40d	7.33bc
Metolachlor at 2.0 kg a.i./ha + weeding regime at 12 WAP	2.0	8.67b	7.33bc
Hoe weeded control at 4 and 8 WAP	-	6.83c	7.00bc
Weed free	-	5.03d	8.67a
Weedy check	-	11.80a	5.67d
SE±	-	1.765	0.225

[1]Means in the same column of treatments followed by unlike letter(s) are significantly different at $p \leq 0.05$ using Duncan Multiple Range Test.

Effect of Metolachlor and weeding regime on Vine length of Sweet Potato during 2019 rainy season

Vine length was significantly influenced by rates of metolachlor and weeding regime at harvest (Table 4). The weed free treated plots recorded significantly longest vine length (87.73a) than all the other treatments. This could be due to good weed control that ensured availability of growth factors which was reported by Akobundu (1987).This result is also in line with the work of Pandey *et al.* (2000), who reported that the tallest plants was found in weed free treated plots, followed by farmers weeded plot and the unweeded treatment plot receiving the shortest plants. Plant height is important in competition for light. Absence of light makes the plant unable to produce its need of assimilates.

Effect of Metolachlor and weeding regime on Marketable Yield of Sweet Potato during 2019 rainy season

Rates of metolachlor and weeding regime had significant effect on marketable yield of Sweet Potato (Table 4). The weed free treated plots recorded significantly highest marketable yield (19.33) as compared to the other treatments. Plots with weed free treatments (19.33) recorded the highest marketable yield, though statistically similar with record obtained from plots administered with metolachlor at 3.0 kg a.i./ha plus weeding regime at 6 WAP and metolachlor at 2.0 kg a.i./ha plus weeding regime at 3 WAP. This high marketable yield expressed by these treatments is synonymous to the result obtained by Korieocha (2021), who reported that application of atrazine/metolachlor at 2.5 kg a.i./ha with manual weeding at 8 weeks after planting (WAP), enhanced season long weed suppression on sweet potato and also gave the highest root yield of 30.01t/ha and 31.08t/ha in Umudike and Otibi respectively.

Table 4: Effect of weed control treatments and weeding regime on vine length and marketable yield of sweet potato at 2019 rainy season at Afaka, Kaduna.

Treatments	Rate (kg a.i./ha)	Vine length (cm) 2019	Marketable yield (t/ha) 2019
Metolachlor at 3.0 kg a.i./ha + weeding regime at 3 WAP	3.0	74.20ab	16.67b

Metolachlor at 3.0 kg a.i./ha + weeding regime at 6 WAP	3.0	79.80ab	13. 67ab
Metolachlor at 3.0 kg a.i./ha + weeding regime at 9 WAP	3.0	76.27ab	11.00bc
Metolachlor at 3.0 kg a.i./ha + weeding regime at 12 WAP	3.0	80.33ab	10.67c
Metolachlor at 2.0.kg + weeding regime at 3WAP	2.0	78.67ab	13.67ab
Metolachlor at 2.0 kg a.i./ha + weedingregime at 6 WAP	2.0	74.27ab	12.00b
Metolachlor at 2.0 kg a.i./ha + weeding regime at 9 WAP	2.0	69.73bc	11.67bc
Metolachlor at 2.0 kg a.i./ha + weeding regime at 12 WAP	2.0	64.93bc	10.00c
Hoe weeded control at 4 and 8 WAP	-	78.93ab	13 67ab
Weed free	-	87.73a	19.33a
Weedy check	-	57.93c	7.67cd
SE±	-	2.802	0.521

[1]Means in the same column of treatments followed by unlike letter(s) are significantly different at $p \leq 0.05$ using Duncan Multiple Range Test.

CONCLUSION

Application of Metolachlor and the use of different weed control contributed to weed suppression and yield of sweet potato. Weed species of the grass family were the predominant in the experimental field. Crop vigour score, Vine length and Marketable yield were influenced by the use of weed free, though result of the parameters mentioned were at par with metolachlor.

REFERENCES

Abukari, I.A; Shankle, M.W and Reddy, K.R. (2015). S-Metolachlor and rainfall effects on sweet potato (Ipomoea batatas L. (LAM) growth and development Scientia Horticulturea volume 185, pages 98 -104.

Akobundu, I.O. (1987). Weed science in the tropics, principles and practices. John Wiley and Sons, London, 522p.

Arnold, J.G, Gassman, P.W, Reyes M.R, Green, C.H. (1998). The Soil and water assessment tool: Historical Development, Applications and Future Research Directions. American Society of Agricultural and Biological Engineers 50(4):1211-1250.

Brandenberger, L.P, Shrefler, J.W, Webber, C.L, Talbert, R.E, Payton, M.E, Wells, L.K and McClelland, M (2005). Pre-emergence weed control in direct seeded watermelon. Weed Technology.19:706-712.

Clark, C.A, Moyer, J.W.(Eds.), 1988. Compendium of sweet potato Diseases. American Phytopathological Society, St. Paul, MN, pp.57-59.

David, W.M, Jonathan, R.S and Robert, J.M (1996). Herbicides on sweet potato (*Ipomea batatas*) Transplant Production using polyethylene Bed Covers. Weed Technology vol.10, No.2 pp 273-277.Cambridge University Press.

David, W.M, Katie M.J, Stephen, L.M and Tara, M.S. (2019). Weed control: Sustainability, Hazards and Risks in Cropping Systems Worldwide (pp.554-580).

Dittmar, P.J and Boyd, N.S.(2020).Weed management in sweet potato. Horticultural Science, University of Florida.

Dual, R. (2002). Forty years of soil fertility work in Sub. Sahara Africa. In: Valanuwe, B., Oield, J., Sanginga, N and Merckx, R. (eds). Integral plant nutrient management in Sub-Sahara Africa. From concept to practice.CAB International, Wallingford, UK, pp 9-21.

Duncan, B.D. (1955). Multiple Ranges and Multiple F-test Biometrics 11:1-4pp

Erdal Elkoca, Faik Kantar and Huseyin Zengin (2005) Weed control in lentil (Lens culinaris) in eastern Turkey, New Zealand Journal of Crop and Horticultural Science, 33:3, 223-231 Food and Agriculture Organization of the United Nations Rome, 2009.

Harrison, H.F and Jackson, D.M. (2011). Response of two sweet potato cultivars to weed interference. Crop Prot.30,1291-1296.

Korieocha, D.S. (2021). Effect of Integrating chemical and Manual Weed Control Methods on sweet potato yield and profitability in Nigeria. Agricultural Society of Nigeria.Vol.52 No.2.

LaBonte, D.R, Villordon, A.Q, Clark, C.A, Wilson, P.W, Stoddard, C.S. (2008). Murasaki-29 sweet potato.Hart Science 43, 1895-1896.

Labonte, D.R; Harrison, H.F and Motsenbocker, C.E. (1999).Crop interference and tolerance to weeds in sweet potato clones. J.A.M.Soc, Hortic.Sci.34,229-232.

Leksrisompong, P.P; Whitson, M.E; Truong, V.D; Drake, M.A.(2012). Sensory attributes and consumer acceptance of sweet potato cultivars with varying flesh colors". *Journal of Sensory Studies*.27 (1):5969.doi:10.1111/j.1745-459x.2011.00367.

Levett, M.P. (2009). Effect of various hand weeding programmes on yield and components of yield of sweet potato (Ipomoea batatas) grown in the tropical low lands of Papua New Guinea. *The Journal* of Agricultural Science, Volume 118, issue 1, Cambridge University press, pp.63-70.

Mahadi, M.A; Babaji, B.A and Isah, A.S. (2013). Influence of weed control and poultry manure on productivity of maize (*Zea mays* L.) in Savanna ecology of Nigeria. *Journal of Weed Science Society* vol.26; pp 64-76.

Meyers, S.L, Jennings, K.M, Monks, D.W. (2012). Response of sweet potato cultivars to S-Metolachlor rate and application time. Weed Technol. 26, 474-479.

Monks, D.W, Jennings, K.M, Meyers, S.L, Smith, T.M, Korres, N.E. (2019). Sweetpotato: Important weeds and sustainable weed management. In book: Weed Control: Sustainability, Hazards, and Risks in Cropping Systems Worldwide 1st edition, Chapter 31, CRC Press pp. 554-580

Obando, W.S.O. (Doctoral dissertation) 2012.Evaluation of Sacred lotus (*Nelumbo nucifera*Gaertn) as an alternative crop for phyto-remediation. Auburn University.

Pandey, A, Soccol, C.R, Nigam, P, Soccol, V.P, Vandenberghe, L.P.S, Mohan, R. (2000). Biotechnological Potential of agro-industrial residues II: Cassava bagasse, Bioresource Technology 74(1): 81-87.

Petit, R.J, Excoffier, L. (2009). Geneflow and species delimitation. Trends Ecol Evol. 24(7):386-393. Doi: 10.1016/j.tree 2009. 02.011.Epub 2009 May 4. PMID: 19409650

Senseman, S.A. (Ed.), (2007). Herbicide hand, ninth ed. *Weed Science Society of America*, Lawrence, K.S, pp. 275278.

Snedecor, G.W. and Cochran, W.C. (1967). Statistical Methods 6th Edition IOWA state Univ. press. U.S.A.

Yusuf, A. A and Iwuafor, E.N.O. (2005). Evaluation of strategies for soil fertility improvement in the Northern Nigeria and way forward. Paper (in print) presented at National Conference on prospect of Agricultural Development Research, Ahmadu Bello University Zaria Nigeria, June 29-July 2, 2005,17pp.

EVALUATION OF SOME INDIGENOUS PLANTS EXTRACTS FOR WEED CONTROL AND PERFORMANCE OF COTTON (*Gossypium hirsitum* L.) AT SAMARU IN NORTHERN NIGERIA

D.B. Ishaya[1], M. Haruna[2], D.A. Hinjari[1] and G. Luka[1]

[1]Department of Agronomy, Ahmadu Bello University, Zaria
[2]College of Agriculture, Samaru, Zaria

ABSTRACT

Field experiment was conducted during the wet season of 2021 at Samaru in Northern Guinea Savanna of Nigeria, to evaluate some indigenous plants extracts for weed control and performance of Cotton. The treatments consisted of plantsextracts of eight indigenous plants; Hypsis suaveolens, Acanthospermum hispidium, Tridax procumbens, Sida acuta, Crotalaria retusa, Phyllanthus amarus, Euphorbia hirta, Cassia occidentalis, a hoe- weeded control which received no plant extract and weedy check, making a total of ten treatments. The ten treatments were laid out in a Randomized Complete Block Design (RCBD), replicated three times. A Sample of 5Kg of each plant which included the roots, stem and leaves of the plants was taken and pounded using a pestle in a mortar. The pounded sample was then poured in a bucket and 5Litres of water was added to it and was allowed to stay overnight then filtered to obtain the extracts. Euphorbia hirta and hoe-weeded give good crop stand count. Among the plants extracts evaluated, application of Hyptis suaveolens plant extracts at the rate of 200L/ha consistently performed better because they effectively suppressed weeds, increased cotton crop vigour, number of cotton bolls per plant and cotton lint yield (Kg/ha) that were comparable to the hoe-weeded control and higher than those obtained from the application of other plant extracts. Therefore, it can be concluded that cotton farmers in Northern Nigeria can adopt the application of Hiptis suaveolens plants extracts of the indigenous plants for better weed control and performance of cotton.

Keywords: Cotton, indigenous, plant extract, weeds**,** knapsack

INTRODUCTION

Cotton (*Gossypium hirsitum* L.) is a major cash crop in Nigeria produced mainly in the northern and southern part of the country. It is an important raw material crop in textiles, animal feed and oil industries. Weed pests constitute one of the major constraints to cotton production in Nigeria (Lagoke *et.al*., 1998). Weed infestation causes serious yield loss reduction in seed and lint qualities and even malformation of the plant parts. Recently, yield losses of up to 80% have been reported in the northern Guinea savanna zone of Nigeria (kuchinda and Dadari, 2019).

The major weed control method in cotton in northern Nigeria is by manual hoe-weeding, which is tedious, labour intensive, very costly and also causes drudgery. Again a lot of crop stands are loss during manual weeding which drastically affect the final yield of the crop. The modern intensity agriculture, which has been responsible for large increases in cotton lint yield is dependent on the use of chemical herbicides to control weeds in cotton, has numerous apparent draw backs, which include soil degradation, environmental and health hazards and toxicity to plants and beneficial soil organisms (Abro *et. al*., 2003).

Therefore there is the need for a more efficient, environmentally friendly, easily affordable and healthy method of weed control in Nigeria to be invented or developed. It is in view of this, that this experiment was conducted with the objective of evaluating some non-hazardous indigenous plants extracts for weed control and performance of cotton at Samaru in Northern Nigeria.

MATERIALS AND METHODS

Field experiment was conducted during the 2021 wet season at the Research Farm of the

Institute for Agriculture Research, Ahmadu Bello University, Samaru, Zaria (11° 11'N; 07° 38' E and 686m above sea level) in the Northern Guinea Savanna Agro-Ecological Zone of Nigeria. Prior to land preparation, soil samples at a depth of 0-30 cm were collected from ten random points, using hand level auger. The soil samples at each location were bulked, dried, ground, sieved and subjected to physical and chemical laboratory analysis using standard procedure described by black(1965). The treatments consisted of plant extracts of eight different indigenous plants to Nigeria, *Hypsis suaveolens, Acanthospermum hispidium, Tridax procumbens, Sida acuta, Crotalaria retusa, Phyllanthus amarus, Euphorbia hirta, Cassia occidentalis,* a hoe- weeded control, which received no application of plant extract and a weedy check, making a total of ten treatments, laid out in a Randomized Complete Block Design (RCBD) replicated three times. The indigenous plants were uprooted and 5kg of each plant was sampled and the samples were pounded using pestle and mortar. The pounded plants samples which included the roots and stems of the plants were soaked each in 5Litres of water in a bucket and left overnight for 24hours. The mixture of the plant and the water was filtered in the morning the following day to obtain the plants extracts. The experimental field was harrowed twice to fine tilth and later made into ridges at 75cm apart. The gross plot size was six ridges and 4.5 x 4m ($18m^2$) while, the net plot was 3 x 4m ($12m^2$) making four inner ridges only. Prior to sowing the cotton seeds obtained from the seed unit of institute for Agricultural Research Samaru variety SAMCOT 23, was dressed with a seed dressing chemical Apron star TM 42 WS (thiamethoxam 20g/L + difenoconazole 2g/L + metalaxyl-m20g|L) at the rate of 10g (one sachet) per 2.5kg of cotton seeds in order to protect the seeds from soil borne diseases and pests. The cotton seeds were planted by direct seeding manually at an intra-row spacing of 50 cm and inter-row spacing of 75 cm. Five seeds were sown per hole and later thinned to 2 plants per stand at 2 WAS.

A total of 120 kg N, 60 kg P_20_5 and 60 kg k_20 of fertilizer using urea, single super phosphate (SSP) and muriate of potash (MOP) was applied to the cotton field. Half dose of the urea was applied with full doses of the P and k at 3 WAS, while the remaining half was applied at 6WAS using side dressing. The plants aqueous extracts were applied to control weeds using a knapsack sprayer CP 15 model. The extracts were sprayed to the experimental plots of the cotton according to the treatments at the rate of 200L/ha at 3 WAS. Insect pests were also controlled by spraying Uppercott (30g Cypermethrin +250g Diamethoate) at the rate of 100g per 15 litres of water starting from 6 WAS and then fortnightly.

Harvesting was done by hand picking of the cotton lint and data were collected on the following parameters:

i. **Crop Stand Count:** This was taken by counting the number of crop stands per hill in each net plot at 2 and 12 WAS and the number was recorded.
ii. **Crop Vigour Score:** This was taken at 6 and 12 WAS by visual assessment using a scale of 1 to 9, where 1 represented completely dead plants and 9 represented the most vigorous plants. The features used for this were plant size, greenness, size of the leaves and stem.
iii. **Weed Cover Score:** This was also assessed at 6 and 12 WAS by visual assessment using a scale of 1 to 9, where 1 represented no weeds and 9 represented completely weedy plot.
iv. **Cumulative Weed Dry Weight**: A quadrate of 1m x 1m was thrown randomly in each plot and the weeds inside the quadrate were sampled, washed under the tap to remove soils, packed in brown envelopes and dried in an oven to constant weight for 48 hours. After drying the weed samples were weighed on a Mettler sensitive balance 16900 Toledo model to obtain the dry weight. Then the weed dry weight taken at 6 weeks after sowing was added to that of 12 WAS and the cumulative dry weight in g/m^2 was obtained.
v. **Number of Bolls per Plant:** The number of bolls of five randomly tagged plants in each plot was counted and the average was recorded. vi. **Cotton Lint Yield (Kg/ha):** The cotton yield from each net plot was harvested by hand picking and the lint was weighed on a Mettler sensitive balance and the weight per plot was converted to per hectare basis in Kg/ha.

RESULTS

Crop Stand Count

The crop stand count of cotton as presented in Table, 1 was influenced by the application of plant aqueous extracts. At 2WAS, application of extract of 200L/ha of *Euphorbia hirta* extracts, hoe-weeded control and the weedy check all gave significantly higher crop stand count of cotton than all other plant treatments but was statistically the same with that of the *Crotalaria retusa* and *Acanthospermum hispidum* plant extract. At 12 WAS however, it was the application of aqueous extract *Hyptis suaveolens* and the hoe-weeded control treatment that gave higher number of cotton stands than all other plants extract treatments but were at par with the stand count of *Crotalaria retusa* and *Euphorbia hirta* extracts (Table 1).

Crop Vigour Score

This was significantly affected by application of plant extracts (Table 2). The results shows that the extract of *Acanthospermum hispidum* and the hoe weeded control gave higher crop vigour than extracts of *Euphorbia hirta* and *Cassia occidentalis* extracts as well as the weedy check treatment at 6 WAS but was comparable to all other treatments evaluated. At 12 WAS, *Hyptis suaveolens* and *Sida acuta* gave higher crop vigour, but statistically similar with all other treatments (Table 2).

Table 1: Effect of Some Indigenous Plants Extracts on the Crop Stand Count of Cotton at Samaru in 2021 Wet season

Treatments	Crop stand count of cotton	
	2 WAS	12 WAS
Plant extract (200L/ha)		
HypsisSuaveolens	40.33c	49.33a
Acanthospermumhispidium	47.33ab	44.33bc
Tridax Procumbens	42.33c	43.67bc
Sida Acuta	44.00bc	44.67bc
Crotalaria retusa	48.00ab	47.67ab
Phyllanthus amarus	43.33c	44.33bc
Euphorbia hirta	49.00a	48.00ab
Cassia occidentalis	41.00c	45.00bc
Hoe weeded control	50.00a	49.00a
Weedy check	49.33a	35.33d
SE±	1.278	1.366

WAS = Weeks after Sowing Means followed by unlike letters in a column of any set of treatments are significantly different at P≤ 0.05 level of probability using DMRT.

Table 2: Effect of Some Indigenous Plants Extract on the Crop Vigour Score of Cotton at Samaru in 2021 Wet Season

Treatments	Crop Vigour Score of Cotton	
	6 WAS	12 WAS
Plant extract (200L/ha)		
HypsisSuaveolens	6.00ab	8.00a
Acanthospermumhispidium	6.67a	7.00ab
Tridax Procumbens	5.67ab	7.00ab
Sida Acuta	6.00ab	8.00a
Crotalaria retusa	6.00ab	7.33ab
Phyllanthus amarus	6.33ab	7.00ab
Euphorbia hirta	5.33b	7.00ab
Cassia occidentalis	5.33b	6.33b
Hoe weeded control	6.67a	7.33ab
Weedy check	6.00ab	6.33b
SE±	0.389	0.437

WAS = Weeks after Sowing; Crop Vigour Score using a Scale of 1-9, where 1 represented completely death plants and 9 the most vigorous plants. Means followed by unlike letters in a column of any set of treatments are significantly different at P≤ 0.05 level of probability using DMRT.

Weed Cover Score

The significant effect of plant aqueous extracts on weed cover score of cotton is presented in Table 3. The result show that at 6 WAS, *Hyptis suaveolens* and the hoe-weeded control suppressed weeds better than the extract of *Tridax procumbens* and the weedy check treatments, though were comparable to other treatments evaluated at both sampling periods. At 12 WAS, (*Hyptis suaveolens* suppressed weeds better than extracts obtained from *Cassia occidentalis* and hoe weeded control treatments but were comparable to other treatments (Table 3).

Cumulative Weed Dry Matter

The cumulative weed dry weight as influenced by application of plant aqueous extracts in cotton is presented in Table 4. The results indicate that the extracts of *Hyptis suaveolens*, *Sida acuta* and hoe weeded control significantly suppressed cumulative weed dry matter in cotton than *Tridax procumbens*, *Phyllanthus amarus, Cassia occidentalis* and weedy check, but were comparable to all other treatments evaluated at 6 WAS. Similarly at 12 WAS, the same extract of *Hyptis suaveolens* and *Sida acuta* suppressed weed dry weight better than all other plant extracts evaluated in the trial, while weedy check recorded the highest cumulative weed dry matter. The weedy check treatment gave the heaviest dry weed while the hoe- weeded control had the least compared with all other treatments evaluated (Table 4).

Table 3: Effect of Some Indigenous Plants Extract on the Weed Cover Score of Cotton at Samaru in 2021 Wet Season

Treatments	Weed Cover Score	
	6 WAS	12 WAS
Plant extract (200L/ha)		
HypsisSuaveoleus	3.00b	6.00b
Acanthospermumhispidium	4.33ab	8.00a
TridaxProcubens	5.00a	8.33a
Sida Acuta	4.33ab	6.00a
Crotalaria retusa	4.67ab	8.33a
Phyllanthus amarus	4.00ab	8.00a
Euphorbia hirta	4.33ab	8.00a
Cassia occidentalis	4.67ab	7.33ab
Hoe weeded control	3.00b	6.00ab
Weedy check	5.00a	8.33a
SE±	0.423	0.269

WAS = Weeks after Sowing; Weed Cover Score using a scale of 1-9, where 1 represented no weeds and 9 represented completely weedy plot. Means followed by unlike letters in a column of any set of treatments are significantly different at P≤ 0.05 level of probability using DMRT.

Table 4: Effect of Some Indigenous Plants Extract on the Cumulative Weed Dry Weight of Cotton at Samaru in 2021 Wet Season

Treatments	Cummulative weed dry weight (g/m^2)	
	6 WAS	12 WAS
Plant extract (200L/ha)		
HypsisSuaveoleus	26.10b	46.10e
Acanthospermumhispidium	32.60ab	79.57bcd
TridaxProcubens	38.13a	81.33bcd
Sida Acuta	26.33b	46.50e
Crotalaria retusa	34.50ab	92.10b
Phyllanthus amarus	38.33a	89.33bc
Euphorbia hirta	33.23ab	69.93d
Cassia occidentalis	37.67a	73.11cd
Hoe weeded control	24.33b	39.67f

Weedy check	39.57a	179.33a
SE+	3.501	16.660

WAS = Weeks after Sowing; Means followed by unlike letters in a column of any set of treatments are significantly different at P≤ 0.05 level of probability using DMRT.

Number of Bolls per Plant

The significant effect of application of plant extracts on number of bolls per plant of cotton is presented in Table 5. The results shows that *Hyptis suaveolens* and *Sida acuta* extracts as well as hoe - weeded control produced greater number of bolls per plants than the other treatments. The weedy check produced the least number of bolls per plant (Table 5).

Table 5: Effect of Some Indigenous Plants Extract on the Number of Bolls/plant and Cotton Lint Yield (kg/ha) at Samaru in 2021 Wet Season

Treatments	Number of Bolls Per plant.	Cotton lint yield (kg/ha)
Plant extract (200L/ha)		
HypsisSuaveoleus	33.50a	4584.43ab
Acanthospermumhispidium	20.50cd	3812.11e
TridaxProcubens	24.11b	3626.00e
Sida Acuta	30.33a	4469.33b
Crotalaria retusa	23.33bc	3224.11f
Phyllanthus amarus	21.83bc	3011.67f
Euphorbia hirta	24.11b	3992.33d
Cassia occidentalis	24.33b	4056.00c
Hoe weeded control	33.67a	4907.00a
Weedy check	12.67e	899.67g
SE+	1.322	127.560

Means followed by unlike letters in a column of any set of treatments are significantly different at P≤ 0.05 level of probability using DMRT.

Cotton Lint Yield (Kg/ha)

Application of plant extracts had significant effect on the cotton lint yield (Table 5). The results shows that the hoe-weeded control recorded the highest cotton lint yield but and statistically similar to the application of aqueous extract of *Hyptis suaveolens,* but also comparable to hoe-weeded control. The weedy check gave the least cotton lint yield (Table 5).

DISCUSSION

The plant extracts evaluated influenced the growth parameters of cotton plants as shown in the results where application of the extracts of *Euphorbia hirta* and hoe-weeded control resulted in higher stand count, while crop vigour of the cotton plants was better with the application *Hyptis suaveolens* and hoe-weeded control. This is probably due to the fact that the cotton plant was more tolerant to the phytotoxicity of the extracts of these two plants. Hence, the crop was able to overcome initial effect of the toxicity of the extracts of the two plants and resumed normal growth at a later stage of the crop growth cycle. This is in line with result of Radwan *et al.* (2021) who reported that aqueous extract of *Calotropis procera* plant increased seed germination and crop vigorous growth of wheat crop. Similarly, the same extracts of *Hyptis suaveolens and* hoe-weeded control suppressed weed infestation in cotton than most of the other treatments including weedy check. That is an indication that the aqueous extract of *Hyptis suaveolens* plants contains certain allelopathic chemical substances that have the ability to control weeds in cotton, even though continuous removal of weeds significantly control weed germination. This result was also in line with the earlier report of Mekky (2019) that *Ocimum* Sp. extract inhibits germination and growth of *Amaranthus spinosus* weed seeds more than all other plants extracts evaluated in the trial.

The hoe-weeded control and *Hyptis suaveolens* produced greater number of bolls and cotton lint yield than all other plant extracts. This was probably due to the fact that the cotton plant tolerated the extract of plant extract of *Hyptis suaveolens* during the growth stage which was also manifested in the final yield. Also shebayan et al., (2015) earlier reported that *Sida cordifolia* had very strong allelopathic activity that killed all cereals and other weed plants around it in katagum, Northern Nigeria.

REFERENCES

Abro, G.H., Syed, T.S. and Dayo. Z.A. (2003). Varietal resistance of Cotton against Earias Spp. *Pakistan Journal of Biological Science* 6(21): 1837-1839.

Black, C.A. (1965). Methods of soil Analysis II Chemical and Microbiological Properties. American Society of Agronomy, Madison Wisconsin pp 1572.

Kuchinda N.C. and Dadari, S.A. (2019). Weed control in Cotton in Northern Guinea and Sudan Savannas of Nigeria. Paper presented at the 43rd National Annual Conference of Weed Science Society of Nigeria held on 4th-8th November, 2019 at Federal University of Technology, Yola, Nigeria. P 1-9.

Lagoke, S.T.O., Shebayan, J.A.Y. and Ishaya, D.B. (1998). Evaluation of Chemical Herbicides for Weed Control in Cotton at samaru, Northern Nigeria. Annual cropping Scheme report Presented at the Annual research Planning and Review Meeting of the Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria on the 15th-30th march, 1998.

Mekky, M.S. (2019). Analysis of compounds present in Ocinimum samples. Veterinary World. 12(4): 535-541.

Radwan, A.M., Sahar, K.M. and Kanawy, A.M. (2021). Study on the Effect of Different concentration of Aqueous Extract of *Calotopisprocera* on Seed germination, growth and yield of Wheat. In *Annals of Agricultural science* Vol. 66(1):97-99.

Shebayan, J.A.Y., Ishaya, D.B. and Adekpe. D.I. (2015). Survey on the Severity of *Sida cordifolia* infestation at Katagum in Bauchi state of Nigeria. A report submitted to the Institute for Agricultural Research, Ahmadu Bello University, samaru, Zaria, PP 1-34.

ASSESSMENT OF PESTICIDE RESIDUE IN SELECTED ARABLE FARMLANDS IN OGBOMOSO SOUTH LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

***G.O. Adesina, K.A. Adelasoye and B.I. Akinjide**

Department of Crop and Environmental Protection, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso
*Correspondent Author: goadesina@lautech.edu.ng

ABSTRACT

Pesticide residues in soils and farmlands have always been an important concern in Agricultural safety. The ignorance and illiteracy of untutored farmers in developing countries have greatly contributed to this. Pesticides (herbicides, Insecticides, etc.) are capable of leaving residues in the soil. The study was carried out in selected arable farms in Ogbomoso South Local Government Area of Oyo state to evaluate and determine the possibility of pesticide residues in the soils of farmers who are fond of using pesticides in crop production. A questionnaire was administered to farmers in the study area and soil samples were collected from some of the farms owned by farmers interviewed and found to have relevant pesticide usage history. Soil samples were also collected from farms with no records of pesticide usage which served as control. The soil samples were then taken to the laboratory for pesticide residue analysis. The results showed that pesticide usage leaves residues in the soil. Paraforce and Force Up recorded the highest percentage usage by farmers, while the majority of farmers use NPK 15:15:15 as a soil amendment in the area. From soil sample analysis eight pesticide residues were observed and dBHC (32.41mg/kg) in the cultivated plots and 39.27 mg/kg of the uncultivated (control) recorded the highest concentration in the soil as residues. Based on our study, we discovered that rural farmers employ mostly synthetic chemicals for the control of weeds in their respective niches. Alternatives to the use of synthetic chemicals is needed, and public education is required to enlighten farmers on the dangers associated with the use of synthetic chemicals.

Keywords: Pesticides, Residues, Crop production, Farmers, Public health

INTRODUCTION

Food is of utmost importance to man, and the demand for it has been progressively increasing. The production of food however, has been stalled and affected by other living competitors referred to as pests. They can also reduce production and decimate the crops, thereby, affecting the supply of food to meet the increasing population of man. (Garcia *et al*., 2016). The contamination of the environment and food by chlorinated organic pesticides has become a topical issue of considerable concern in many parts of the world, and has led to a lot of fatal and non-fatal cases. In 2020, a systematic review of the scientific literature published between 2006 and 2008, supplemented by mortality data from WHO was carried out. The result shows that approximately 740,000 annual cases of Unintentional Acute Pesticide Poisoning (UAPP) were reported, resulting from 7446 fatalities and 733,921 non-fatal cases. On this basis, it is estimated that about 385 million cases of unintentional acute pesticide poisoning occur annually worldwide without including around 11,000 fatalities. Based on worldwide farming population of approximately 860 million, this means that about 44% of farmers are poisoned by pesticides every year (WHO, 2020).

In 2011, studies carried out in Borno state revealed the presence of Lindane, Diazinon, and Aldrin in the prestorage bean samples, while DDT, Dichlorvos, and Endrin were present in both pre-storage and post-storage samples (Ogah, 2011). Similarly, National dailies reported that 120 students of Government Girls Secondary School, Doma in Gombe, Nigeria were rushed to the Gombe Specialist Hospital after consuming a meal of beans that was suspected to contain residues from pesticides. The result of the analysis showed that samples of the cooked beans and the uncooked beans contained outrageously high levels of an Organochlorinated pesticide. For this reason, it is therefore expedient that the pesticide used by farmers and pesticide residues in the soil on which farmers grow that which they eat and sell to secondary consumers be assessed.

Despite the good results of using pesticides in agriculture, public health consultant described their use as usually accompanied by deleterious environmental and public health effects. Pesticides hold a unique position among environmental contaminants due to their high biological activity and toxicity (acute and chronic). Although some pesticides are described to be selective in their modes of action, their selectivity is only limited to test organisms. Thus, pesticides can be best described as biocides (capable of harming all forms other than the target pest). The contamination of water bodies with pesticides can pose a significant threat to aquatic ecosystems and drinking water resources. Pesticides can enter water bodies via diffuse or via point sources. Diffuse-source pesticide inputs into water bodies are the inputs resulting from agricultural applications in the field. These are tile drain out-low, base-flow seepage, surface and subsurface runoff, and soil erosion from treated fields, Spray drift at application, and deposition after volatilization. In contrast, point-source inputs derive from a localized situation and enter a water body at a specific or restricted number of locations. These are mainly farmyard runoff, sewage plants, sewer overflows, and accidental spills. There are also point sources of pesticides from non-agricultural use, e.g. from application on roads, railways, or urban sealed surfaces such as parking lots (Reichenberger *et al.*, 2007). The specific objectives are to evaluate the extent to which farmers use pesticides in the selected farm settlement, identify types of pesticides being used on the farms in the study areas, and evaluate the level of pesticide residue in the soil of selected farms within the study area.

MATERIALS AND METHODS

Study Area

The samples were collected from the Ogbomoso south local government area of Oyo state, Nigeria, with its administrative headquarters located at Arowomole. As shown in Figure 1 below, it is bounded by Surulere, Oriire, and Ogo Oluwa town. Samples were taken from farms in Agric, Atoba, Abede, Ibapon, and Abe-Emin areas of Ogbomoso South local government.

Questionnaire Administration

Questionnaires were administered to farmers to obtain information on farm use history, type of pest being controlled (weed, insect pest), type of pesticides used and their sources, type of soil amendments/fertilizer, and other relevant information.

Soil Sampling

Soil samples were collected using bucket auger and stored inside paper sampling bags from all the selected sample sites and were appropriately labelled for laboratory analyses. Soil samples were taken systematically by diagonal method from different locations on each plot and were replicated four times. A soil auger was used to take about 2 kg of soil sample from the soil, up to 0 – 30 cm depth in four spots per plot.

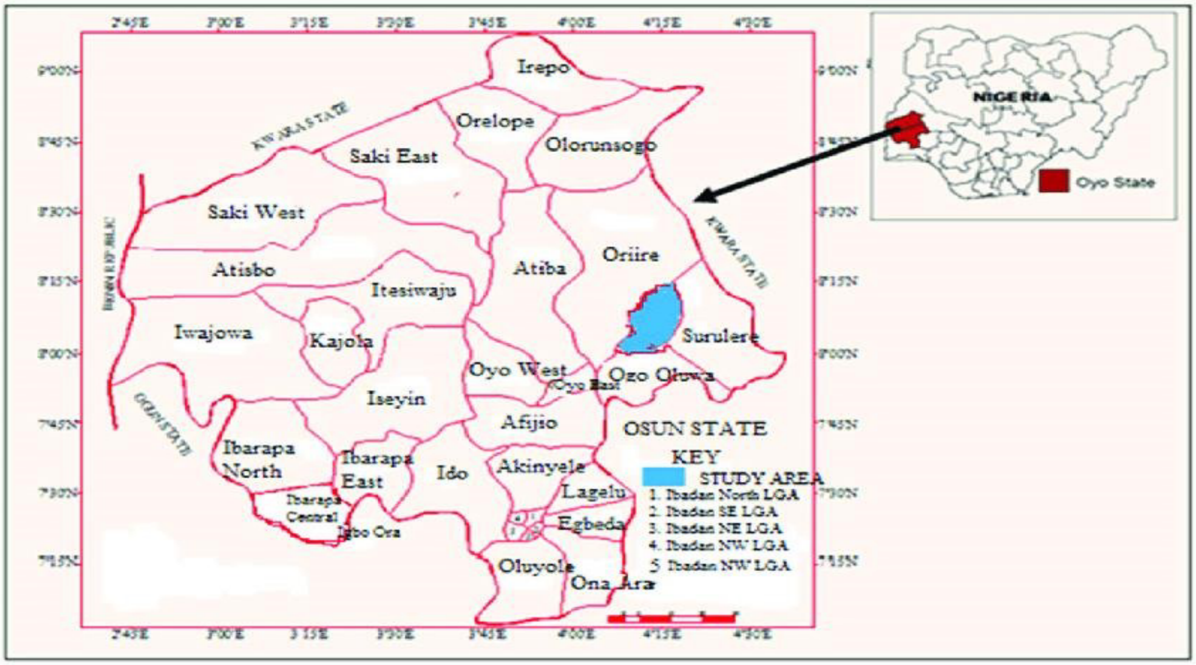


Figure 1: Map of Oyo state showing the study area (Ogbomoso South Local Government)

The soil samples were kept in labeled polythene bags, the samples collected were taken to the laboratory for pesticide residue analysis.

Control samples were taken outside the cultivated farm which serves as control for the soil samples that were taken from the cultivated farm which serves as Treatment and were put in a labeled polythene bag and were taken to the laboratory for pesticide residue analysis. Extraction of pesticide residues from soil was done according to the method developed by Khan *et al.* (2007) and Riazuuddin *et al.* (2011) with slight modifications.

RESULTS

Name and Type of Pesticides Used by the Respondents

Table 1 shows the distribution of respondents by the name of pesticides used by the arable crop farmers in the study area. The result reveals that the majority (92.4%) of the respondents use Paraforce and Force-up on their farmland respectively, 79.2% of the respondents use Atrazine on their farmland, 52.8% use Karate on their farmland, 39.6% use Weed crusher on their farmland, 19.8% use Nwura Wura on their farmland, while 6.7% use Laraforce on their farmland. The table also shows that Herbicides and Insecticides are the only types of pesticides used by the farmers in the study area.

Table 1: Names and types of pesticides used by the respondents

Name of Pesticide (Trade Name)	Type of Pesticide	Frequency* 28	Percentage
Paraforce	Herbicide		92.4
Force Up	Herbicide	28	92.4
Atrazine	Herbicide	24	79.2
Karate	Insecticide	16	52.8
Round up	Herbicide	3	10
Laraforce	Insecticide	2	6.7
Weed crusher	Herbicide	12	39.6

Nwura Wura	Herbicide	6	19.8
Total No. of Respondents		30	100

Field survey, 2022
Multiple responses*

Types of Soil Amendment/Fertilizer used by the Respondents

Table 2 shows the distribution of respondents by various type of soil amendment/fertilizer applied to their arable crops in the study area. The result revealed that most (79.2%) of the respondents make use of NPK 15:15:15 on their farmlands, 59.4% of the respondents make use of Urea on their farmlands, 23.4% of the respondents make use of pig dung on their farmlands, 19.8% make use of poultry dung and cow dung as fertilizers on their farmlands, while 16.7% of them make use of ammonia as a type of soil amendment/fertilizer applied on their farmland. This shows that all farmers in the study area make use of fertilizers in order to make up for nutrient deficiencies in the soil and consequently increase yield. Most of the farmers make use of NPK 15:15:15 which is an inorganic fertilizer.

Table 2: Type of soil amendments/fertilizers used by the respondents

Soil Amendments	Frequency*	Percentage
Cow dung	6	19.8
Urea	18	59.4
NPK 15:15:15	24	79.2
Poultry dung	6	19.8
Pig dung	7	23.4
Ammonia	5	16.7
Total No. of Respondents	30	100

Field survey, 2022
Multiple responses*

The Concentration of Pesticide Residue in the Selected Farmlands

Table 3 shows the residues of pesticides in the soil samples collected. A total of eight (8) compounds were analyzed. They include d-benzene hexachloride, Chlorothalonil, Alachlor, Aldrin, Dacthal, Heptachlor epoxide, gChlordane, and Trans-Nonachlor respectively. On average, d-BHC has the highest concentration in both the cultivated lands (32.41mg/kg) and the uncultivated lands (39.27mg/kg) compared to other pesticide residues analyzed in the soil. Chlorothalonil has the lowest concentration in uncultivated lands (1.05 mg/kg) compared to other pesticide residues (0.62 mg/kg) . On the other hand, Aldrin was not detected in any of the cultivated lands, as well as three out of the five uncultivated lands. d -BHC has a higher concentration in three of the cultivated lands compared to their respective controls. In the remaining cultivated lands (two), there is a lower concentration of d-BHC when compared to their controls. This indicates a buildup of residues in the cultivated lands due to the regular use of the pesticide by the Farmers. Chlorothalonil, Alachlor, Aldrin, Dacthal, Heptachlor epoxide, g-Chlordane, and Transnonachlor, on an average basis, all have a higher concentration in the uncultivated lands than the cultivated lands.

DISCUSSION

The use of pesticides in the Agricultural sector has increasingly become an important aspect of Agricultural technology and innovation, critical for Agricultural development, Economic growth, and poverty reduction. Globally, the use of pesticides in food production is common with many farmers using commercial pesticides for pest control to increase yield and improve quality (Lamichhane, 2017). The World Health Organization (WHO, 2009) reports that 20% of pesticide use in the world is concentrated in developing countries (Anonymous, 2012). The increase in the world's population in the 20th century could not have been possible without a parallel increase in food production and about one-third of agricultural products are produced using pesticides. Most of the farmers have been using their land for a very long time, which implies that there will be accumulation of pesticide residue which may in turn find their way into crops thereby having negative impacts on the health of consumers.

From our study, Paraforce and Force Up are the two most commonly used herbicides utilized by farmers. Paraquat and Glyphosate are the active ingredients in Paraforce and Force Up respectively. This agrees with Udensi (2020) who reported that Paraquat is among five pesticides most frequently used in Plateau State and the entire Northern Nigeria. McConnell and Hruska (1993) and Erhunmwunse *et al.*, (2012) reported that it is the most deadly chemicals used in Nigeria because they are cheaper than newer safer pesticides. Udensi *et al.*, (2020) reported the need to prohibit the use of paraquat in Nigeria, due to serious negative impacts on human health via contamination of food and water (Ogeleka *et al.*, 2017).

In our study, d-BHC has the highest concentration in both the cultivated lands (32.41mg/kg). Contrarily, Mishra *et al.*, (2009) reported that BHC levels are at an undetectable limit in their study where they evaluate the levels of two pesticides (DDT and BHC) in farmland soils irrigated with secondary treated sewage wastewater as well as their accumulation in crop plants.

Chlorothalonil has the lowest concentration in uncultivated lands (1.05 mg/kg) compared to other pesticide residues. This agrees with Baćmaga *et al.*, (2018) who stated that chlorothalonil used in the optimal dose causes no changes in the biological homeostasis of soil.

NPK 15:15:15 is the most used fertilizer in our selected sites. This agrees with Liverpool-Tasie *et al.*, (2010) who reported that the types of fertilizer commonly produced and used in Nigeria include urea, Nitrogen-PhosphorousPotassium (NPK), and Superphosphate (SSP).

It was discovered that all the compounds tested and detected left residues in the soil since they are active ingredients in synthetic pesticides which can find their way into water and food and can adversely affect human health (Hvězdová *et al.*, 2018).

CONCLUSION

Based on this study, It was discovered that rural farmers employ mostly synthetic chemicals for the control of weeds in their respective niches. However, these chemicals have direct and indirect effects on the health of humans and the environment. One major observation in this study is that the majority of the farmers lack basic education and knowledge on how to properly apply these chemicals. In addition, most of the farmers obtain their pesticides from the marketplace, which in Ogbomoso south, has no regulation and allows for all sorts of pesticides (registered and unregistered, banned and unbanned). Therefore, public education is needed to train these farmers on the dangers associated with the use of synthetic herbicides, and the alternatives to the use of these synthetic chemicals.

Table 3: Pesticide residues in soil (mg/kg)

S/N	Compound	Abede	control	Abe-Emin	Control	Ibapon	Control	Atoba	Control	Agric	Control	Farm mean	Control mean	T	Tcal	
1	d-BHC	70.76	17.81	31.49	74.11	23.93	4.25	19.09	87.59	16.79	12.58	32.412	39.27	0.25	1.86	3.36
2	Chlorothalonil	0.43	0.58	ND	0.64	0.33	1.92	1.11	ND	ND	ND	0.62	1.05	0.63	2.13	4.6
3	Alachlor	ND	ND	1.64	ND	1.02	ND	1.54	2.25	1.39	2.03	1.39	2.14	3.05	2.13	4.6
4	Aldrin	ND	ND	ND	1.8	ND	ND	ND	ND	ND	1.19	-	1.495	4.91	-	-
5	Dacthal	2.53	0.91	7.27	2.72	6.04	2.65	2.17	28.29	1.54	18.68	3.91	10.65	1.02	1.86	1.86
6	Heptachlor epoxide	6.2	9.76	5.89	3.24	2.18	3.73	6.82	15.55	6.06	5.83	5.43	7.62	0.7	1.86	1.86
7	g-Chlordane	6.59	11.61	2.83	8.97	4.91	7.6	5.31	5.07	13.77	4.14	6.68	7.47	0.25	1.86	1.86
8	Trans-Nonachlor	ND	ND	ND	3.07	5.26	ND	4.3	10.82	ND	5.31	4.78	6.4	4.02	2.35	5.84

REFERENCES

Anonymous (2012). PAN Germany. Pesticides and Health Hazards, facts and figures. Bochum:Pesticides and Gesundheitsgefahren: Daten and Fakten.

García-Barrios, L., Perfecto, I., &Vandermeer, J. (2016). Azteca chess: Gamifying a complex ecological process of autonomous pest control in shade coffee. *Agriculture, Ecosystems & Environment*, *232*, 190-198.

Hvězdová, M., Kosubová, P., Košíková, M., Scherr, K. E., Šimek, Z., Brodský, L., Šudoma, M., Škulcová, L., Sáňka, M., Svobodová, M., Krkošková, L., Vašíčková, J., Neuwirthová, N., Bielská, L., &Hofman, J. (2018).
Currently and recently used pesticides in Central European arable soils. *Science of The Total Environment*, *613–614*, 361–370. https://doi.org/10.1016/j.scitotenv.2017.09.049

Khan, I. A. T., Riazuddin, Parveen, Z., & Ahmed, M. (2007). Multi-residue determination of synthetic pyrethroids and organophosphorus pesticides in whole wheat flour using gas chromatography. *Bulletin of Environmental Contamination and Toxicology*, *79*(4), 454–458. https://doi.org/10.1007/s00128-007-9266-8

Lamichhane, J. R. (2017). Pesticide use and risk reduction in European farming systems with IPM: An introduction to the special issue. *Crop Protection*, *97*, 1–6. https://doi.org/10.1016/j.cropro.2017.01.017

Ogah, C. O. (2012). Quantification of organophosphate and carbamate pesticide residues in maize. *Journal of Applied Pharmaceutical Science*. https://doi.org/10.7324/JAPS.2012.2919

Reichenberger S, Bach M, Skitschak A and Frede HG (2007). Mitigation strategies to reduce pesticide inputs into ground and surface water and their effectiveness; A review. Science of the Total Environment 384: 1–35.

Udensi, U.E., Ekpere, J., Irtwange, S., Kolo, M.G.M., Yahaya, M.K., Ladele, A., ... & Dixon, A. (2020). A case to deregister and prohibit the use of Paraquat in Nigeria. Ibadan: IITA. (32 p.).

Riazuddin, Khan, M. F., Iqbal, S., & Abbas, M. (2011). Determination of multi-residue insecticides of organochlorine, organophosphorus, and pyrethroids in wheat. *Bulletin of Environmental Contamination and Toxicology*, *87*(3), 303–306. https://doi.org/10.1007/s00128-011-0325-9.

Udensi, U.E. 2020. Rural appraisal on the use of Paraquat in Nigeria. IITA, Ibadan, Nigeria.

Virendra K. Mishra · Alka R. Upadhyay · B. D. Tripathi. Bioaccumulation of heavy metals and two organochlorine pesticides (DDT and BHC) in crops irrigated with secondary treated waste water. Environ Monit Assess (2009) 156:99–107

Baćmaga, M., Wyszkowska, J. & Kucharski, J. The influence of chlorothalonil on the activity of soil microorganisms and enzymes. *Ecotoxicology* **27**, 1188–1202 (2018). https://doi.org/10.1007/s10646-018-1968-7

Saweda L.O. Liverpool-Tasie, Abba A. Auchan and Afua B. Banful (2010) An Assessment of Fertilizer Quality Regulation in Nigeria. Nigeria Strategy Support Program (NSSP) Report 09.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

RESPONSE OF TWO SWEET POTATO (*Ipomoea batatas* (L) LAM) VARIETIES TO WEED MANAGEMENT PRACTICES IN KADUNA, NORTHERN GUINEA SAVANNA, NIGERIA

Y.T. Magaji[1], N.C. Kuchinda[2], D.I. Adekpe[2] and R.A. Yahaya[2]
*Corresponding Author's Email Address: magaji.tagwai@kasu.edu.ng

ABSTRACT

Field experiments were conducted at the Prison farm Kaduna, Nigeria in 2016 and 2017 to assess the effect of weed control method on two orange fleshed sweet potato varieties, UMUSPO I and UMUSPO II. The treatments consisted of four weed management practices, Metolachlor 290 g/l + Atrazine 370 g/l-formulated as Primextra Gold at 1.5 kg a.i ha $^{-1}$, Fluazifop-butyl (Fusilade) at 1.0 kg a.i ha^{-1}, hoe weeding and a weedy check. The treatments were laid in a randomized complete block design and replicated three times. Weed control method had significant effect on weed characters in that they all supported low weed population compared with the weedy check. Metolachlor + Atrazine at 1.5 kg a.i ha^{-1} was outstanding among the weed control treatments as evident by increase of 76.8 and 86% tuber yield ha^{-1} than the weedy check (combined data). Thirty (30) weed species were identified in 2016 and 2017. Broad leaf weeds constituted 61.53% and grasses 38.47% in 2016 whereas in 2017, broad leaf and grasses constituted 58.33% and 41.67%, respectively. Sweet potato variety UMUSPO I produced tuber yields 22.6 and 25.0% higher than UMUSPO I1 during the period under consideration. It could be recommended that Metolachlor + Atrazine at 1.5 kg a.i ha^{-1} and UMUSPO I be used in the production of sweet potato in the northern Guinea savannah region of Nigeria.

Keywords: Yield, Sweet potato varieties, herbicides and hoe weeding

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam) is a creeping plant in the family of *Convolvulaceae* (Oggema *et al*., 2007). It is the third most important root and tuber crop after potato and cassava in the world (Anon. 2018a). Over 95 per cent of the global sweet potato crop is produced in developing countries, where it is the fifth most important food crop in terms of fresh weight (Anon. 2016a). World production figures stood at 142.6 million tonnes in year 2000. Production dropped to about 91.9 million tonnes in 2018, with China and Nigeria supplying about 94.5 and 3 % respectively of the world's production (Anon. 2018a).

Presently, Nigeria is the largest producer of sweet potato in Africa with annual output of 3.92 million metric tonnes (Anon. 2021). The main sweet potato producing States in Nigeria are, Kaduna, Kwara, Zamfara Nasarawa and Plateau. Although the majority of sweet potato varieties are high in carbohydrates, orange fleshed sweet potato (OFSP) varieties also contain significant quantities of vitamins A and C (Laban *et al*., 2015).

Yield losses caused by uncontrolled weed growth have been estimated at 42 - 65% in the country (Unamma *et al*., 1984). Akobundu, (1987) reported that chemical weed control has improved crop production and is cheaper in reducing the drudgery involved in manual weeding. The objectives of this study were therefore; to evaluate some weed management practices on sweet potato production; and to evaluate the performance of two sweet potato varieties in the northern Guinea savannah, Nigeria.

MATERIALS AND METHODS

A Field trial was conducted during the rainy seasons of 2016 and 2017 at the Prison Farm Kaduna, Nigeria. Soil of the experimental field was sandy loam and slightly acidic in both years of trials. The treatments consisted of four weed control methods (Metolachlor 290 g/l + Atrazine 370 g/l formulated as Primextra Gold at 1.5 kg a.i ha $^{-1}$, Fluazifop-butyl (Fusilade) at 1.0 kg a.i ha^{-1}, hoe weeding at 4 WAP and a weedy check) and two orange fleshed sweet potato varieties (UMUSPO I and UMUSPO II). The treatments were laid out in a randomised complete block design and replicated three times. The gross plot size was 18.0 m^2 (4.5 x 4) made up of 6 ridges, spaced at 75 cm, each 4 m long. The net-plot size was 6.0 m^2 (1.5 x 4 m) made up of two inner ridges, each 4m long. Each plot was separated by a border of 1m across and 1 ridge along the ridges. The herbicide treatments were imposed using a CP15 Knapsack sprayer as per treatments; Metolachlor+Atrazine at 1.5kg ai ha^{-1} applied as pre-emergence, Fluazifop-butyl at 1.0kgha^1 applied as post-emergence at 4 WAP and manual weeding at 4 WAP using hand hoe. Weed parameters were taken randomly using 1 m^2 quadrat. Observations on crop growth and yield related characters were taken from five randomly tagged plants in each net- plot. Tuber yield were taken from tubers which have attained a minimum size of 0.2 kg and above at harvest. The data collected were subjected to analysis of variance using F- test, and the treatment means were compared using the Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Results of the analysis for the physical and chemical properties of the soil in 2016 and 2017 are presented in Table 1. Soils of the experimental field were generally sandy loam.

Weed Dry Weight

The effect of weed control method and sweet potato varieties on weed dry weight in 2016 and 2017 wet seasons is presented in Table 2. Weed control method significantly influenced weed dry weight throughout the sampling periods in both years. Metolachlor+Atrazine gave lower weed dry weight than all other weed control treatments. The influence of crop variety on weed dry weight in the two years was significant at 8 and 12 WAP (Table 2). In each case, UMUSPO I suppressed weed dry weight compared to UMUSPO II. The significant differences observed on the effect of weed control method on weed characters suggests that weed control method differ in their effectiveness in controlling weeds. Use of herbicides supported low weed population compared to hoe weeded plots and the weedy check. This confirmed the assertion of Anon. (2018b) that 'in industrialized countries, chemical weed control has improved crop production, and it is still the cheapest means of combating weeds.

Table 1: Physical and chemical characteristics of soil samples (0-30cm depth) of the experimental sites during the 2016 and 2017 rainy seasons

Soil composition	2016	2017
Particle Size Distribution		
Sand (g kg^{-1})	726	610
Silt (g kg^{-1})	140	270
Clay (g kg) $^{-1}$	134	120
Textural class	Sandy Loam	Sandy Loam
Chemical		
Characteristics pH in 0.01M $CaCl_2$	5.67	5.68
pH in H_20	6.01	6.20
Organic Carbon (g kg^{-1})	10.12	11.46
Total Nitrogen (g kg^{-1})	0.91	1.15
Available Phosphorus (mg kg^{-1})	8.96	10.41
Exchangeable Cations (Cmol kg^{-1})		
K	0.18	0.17
Mg	0.56	0.65
Ca	3.21	3.82
Na	0.14	0.13
CEC	4.32	4.99

Table 2: Weed dry weight (g/m^2) at 12WAP as influenced by weed control method and sweet potato varieties during the wet seasons of 2016 and 2017

Treatment	Weed dry weight (g/m^2)			
	8(WAP)	12(WAP)	8(WAP)	12(WAP)
Weed Control Method(W)				
Metolachlor+Atrazine(1.5kg a.i ha^{-1})	34.91c	52.02c	35.03c	53.81b
Fluazifop-butyl(1.0kg a.i ha^{-1})	35.52c	66.03b	41.05b	53.32b
Hoe weeding	50.03b	70.60b	42.11b	54.71b
Weedy check	69.40a	90.11a	60.07a	64.10a
SE±	10.960	5.505	6.450	3.665

Variety (V)				
UMUSPO I	40.01b	64.52b	40.51b	50.07b
UMUSPO I1	55.03a	75.09a	48.52a	63.01a
SE±	3.182	1.610	4.571	2.595
Interaction				
WxV	NS	NS	NS	NS

Means followed by the same letter within a treatment group are not significantly different at 5% level of probability using Duncan Multiple range
Test (DMRT); NS= Not significant

Shoot Dry Weight

Table 3. shows that Metolachlor+Atrazine at 1.5 kg a.i ha^{-1} produced the highest shoot dry weight throughout the sampling period, except at 8 WAP in 2017 where the result was similar with by hoe weeding, lower than by Fluazifop-butyl but higher than the weedy check. The two varieties differed significantly in their effect on shoot dry weight at 8 and 12WAP in both years. UMUSPO I consistently resulted in higher shoot dry weight than UMUSPO II. There were non-significant interaction effects of weed control treatments and crop variety in both years.

Table 3: Shoot dry weight (g/m^2) of sweet potato variety as influenced by weed control method during the wet seasons of 2016 and 2017

Treatment	2016		2017	
	8(WAP)	12(WAP)	8(WAP)	12(WAP)
Weed Control Method(W)				
Metolachlor+Atrazine (1.5 kg a.i ha^{-1})	70.4a	135.7a	159.2b	181.3a
Fluazifop-butyl (1.0 kg a.i ha^{-1})	65.5b	125.0b	163.6a	184.7a
Hoe weeding	64.9b	122.2b	155.9b	178.8a
Weedy check	45.9c	75.0c	94.8c	101.1b
SE±	10.96	5.38	6.45	6.48
Variety (V)				
UMUSPO I	64.5a	117.8a	166.9a	168a
UMUSPO II	58.8b	111.1b	139.9b	155b
SE±	3.18	3.81	4.57	4.58
Interactions				
WxV	NS	NS	NS	NS

Means followed by the same letter within a treatment group are not significantly different at 5% level of probability using Duncan Multiple range Test (DMRT)
WAP = Week after planting
NS= Not significant

Leaf Area Index (LAI)

Table 4 shows that weed control treatments had significant influence on LAI at 8 and 12 WAP in both years. However, the herbicide treatments even though gave rise to similar LAI produced significantly higher LAI than the other weed treatments, except at 8WAP in 2016 where the herbicide treatments produced result that is at par with the hoe weeded plot. UMUSPO I consistently produced higher LAI than UMUSPO II in both years. The interaction effects of weed control method and crop variety were not significant in both years.

Table 4: Leaf area index of sweet potato variety as influenced by weed control method during the wet seasons of 2016 and 2017.

	2016		2017	
Treatment	8(WAP)	12(WAP)	8(WAP)	12(WAP)
Weed Control Method(W)				
Metolachlor+Atrazine (1.5kg a.i ha^{-})	4.3a	7.6a	5.2a	7a
Fluazifop-butyl (1.0 kg a.i ha^{-1})	4.3a	7a	4.9a	6.8a
Hoe weeding	4.1a	6.4b	3.3b	6b

Weedy check	1.8b	3.6c	2.6c	4c
SE±	0.13	0.38	0.10	0.14
Variety (V)				
UMUSPO I	4.8a	7.8a	4.6a	7.5a
UMUSPO II	2.5b	4.2b	3.6b	4.3b
SE±	0.07	0.27	0.09	0.09
Interactions				
WxV	NS	NS	NS	NS

Means followed by the same letter within a treatment group are not significantly different at 5% level of probability using Duncan Multiple range Test (DMRT)
WAP = Week after planting; NS= Not significant

Weed suppression enhanced crop vegetative growth. LAI would have suppressed the competitive ability of the weeds, in which case, the crop suffered less. Similar findings have been reported by (ICARDA, 1984; Salonen, 1992; Seavers and Wright, 1999) who indicated that leaf area, canopy structure and development are factors that contribute to better crop competitiveness with weed.

Marketable Tuber Yield (t ha^{-1})

Data on marketable tuber yield of sweet potato per hectare as influenced by weed control method and variety during 2016 and 2017 wet seasons is presented in Table 5. Yield and yield components were greatly affected in both years This study revealed that the yield parameters varied among weed control method, with Metolachlor+Atrazineat 1.5 a.i ha^{-1} producing the highest yield of 30.5t ha^{-1}, corresponding to 83% more than the weedy check, based on the combined data in 2016 and 2017. In general; herbicide treatments appeared to be more effective in the control of weeds than hoe weeding. This confirmed earlier report that sweet potato is one of the crops in which chemical weed control was promising and that in industrialized countries, chemical weed control has improved crop production and it is still the cheapest means of combating weeds (Akobundu, 1987).

Table 5: Marketable tuber yield (t ha^{-1}) of sweet potato as influenced by weed control method during the wet seasons of 2016 and 2017

Treatment	2016	2017	Combined
Weed Control Method(W)			
Metolachlor+Atrazine(1.5kg ha^{-1})	34.6a	26.4a	30.5a
Fluazifop-butyl (1.0kg a.i ha^{-1})	33.30a	25.80a	29.55a
Hoe weeding	28.80b	24.60b	26.7b
Weedy check	8.0c	5.1c	6.5b
SE±	1.10	0.86	0.99
Variety (V)			
UMUSPO I	28.00a	23.50a	25.75a
UMUSPO II	24.00b	17.50b	20.75b
SE±	0.78	0.63	0.70
Interactions			
W*V	NS	NS	NS

Means followed by the same letter within a treatment group are not significantly different at 5% level of probability using Duncan Multiple range Test (DMRT)
WAP = Weeks after planting NS= Not significant
NS = Significant

CONCLUSION

A field trial was conducted to investigate the effect of weed control methods on the growth, yield and yield components of two sweet potato (*Ipomoea batatas* L.) varieties during the rainy seasons of 2016 and 2017 at the Prison farm Kaduna, both in the northern Guinea savannah, Nigeria. The treatments consisted of four weed control methods (Metolachlor 290g/l + Atrazine 370g/l-formulated as Primextra Gold at 1.5 kg a.i ha^{-1}, Fluazifop-butyl (Fusilade) at 1.0 kg a.i ha^{-1})), hoe weeding and a weedy check and two orange fleshed sweet potato varieties (UMUSPO I and UMUSPO II). The treatments were laid in a randomized complete block and replicated three times. The findings in this trial revealed that Metolachlor+Atrazine 1.5 kg a.i ha^{-1} was found to be better in weed control than other weed control methods. Therefore, Metolachlor+Atrazine at 1.5 kg a.i ha^{-1} and UMUSPO I, could be used in the cultivation of sweet potato in the northern Guinea savannah region of Nigeria.

REFERENCES

Akobundu, I.O. (1987). Weed Science in the tropics; Principles and Practices. A Wiley- Inter *Science Publications*. pp. 71-105 and 364-367.

Anonymous (2016). https://en.wikipedia.org/wiki/Sweet_potato (Accessed 05-06-2016)check download

Anonymous(2018a)https://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Root_and_Tuber _Crops__Cassava__Yam__Potato_and_Sweet_Potato_.pdf. Cited 17-08-2019

Anonymous (2018b) Assessment of Root and Vine Yields of Sweet Potato ...scialert.net › fulltext › doi=ijar.2017.88.92. Cited 10-06-2018

Anonymous (2021) https://www.google.com/search?client=opera&q=sweet+potato+producing+states+in+nigeria&sourceid=opera&ie=UTF-8&oe=UTF-8

Duncan, P.B. (1955) Multiple range and multiple F-tests. Biometrics 11:1-42

ICARDA (International Centre for Agricultural Research in the Dry Areas). 1984. Annual report 1983.Allepo, Syria.pp.5-12.

Laban, T.F., Peace, K. M. Robert, K., Hellen M. and Muhumuza, J. (2015). Participatory agronomic performance and sensory evaluation of selected orange-fleshed sweet potato variety in south western Uganda. *Global J. Sci. Frontier Res.*, 15: 25-30.

Oggema, J.N., Kinyua M.G., Ouma J.P. and Owuoche J.O., (2007).Agronomic performance of locally adapted sweet potato (*Ipomoea batatas* (L.) Lam.) cultivars derived from tissue culture regenerated plants. *Afr. J. Biotechnol.*, 6: 1418-1425.

Salonen J (1992). Efficiency of reduced herbicide doses in spring cereals of different competitive ability. Weed Res.: 32: 483-491.

Seavers, G.P. and Wright, K.J. (1999).Crop canopy development and structure influence weed suppression (Anon., 2002. https://doi.org/10.1046/j.1365-3180.1999.00148.x)

Snedecor, G.W. and Cochran, W.G. (1967).Statistical Method Iowa University press.Iowa USA pp339-377.

Unamma, C.P.A., Enyinnia, J. and Emezie J.E. (1984). Critical Period of Weed Interference in Co-coyam/Maize/Sweet potato. Trop. Pest Management 31:21-23

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

YIELD COMPONENTS OF MAIZE (*Zea mays* L.) VARIETIES AS AFFECTED BY PERIOD OF WEED INTERFERENCE IN GIDANKWANO, MINNA, SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA

M.U. Tanimu [1], J. Alhassan,[2] M.S. Na Allah[1] and R.A. Tiamiyu[2]

[1]Crop Science Department, Faculty of Agriculture, Kebbi State University of Science and Technology Aliero. Kebbi State Nigeria
[2]Crop Science Department, Faculty of Agriculture, Usmanu Danfodiyo University Sokoto, Sokoto State Nigeria. *Correspondence e-mail musa.umartanimu@ksusta.edu.ng*

ABSTRACT

Field trials were carried out at the Teaching and Research Farm of Federal University of Technology Gidan Kwano, Minna, Niger State, Nigeria during 2011 and 2012 wet seasons to investigate the susceptibility of maize varieties to periods of weed interference in southern Guinea savannah zone of Nigeria. The highest crop establishment percentage during 2011 wet season was observed with 2008-DTMAYSTR (77.54) and the least was Oba-98 (66.92); while during 2012 EVDTY 2000 recorded the highest value (75.02) while Oba-98 was still observed to have the least value (73.16) of the parameter though, with a minimal difference with the other varieties Sammaz-13 (73.41) and 2008-DTMAYSTR (73.75). The average crop establishment percentage in 2011 was 72.92 while in 2012 it was 73.83; therefore, during 2011 the variety 2008-DTMAYSTR established best while EVDTY-2000 was best established in 2012. Among the varieties tested, 2008-DTMAYSTR had the highest crop establishment percentage; The hybrid variety Oba-98 recorded the highest value of cob weight. The combined data revealed that the highest weight was recorded by the Oba-98. The weed free throughout cob weight was 40.71% and 34.82% higher than the weed infested plots during 2011 and 2012 respectively. Effect of period of weed interference was significant in cob length throughout the study. Initial weed infestation for 6 WAS only was comparable to initial weed free period for 12 WAS and till harvest. Effect of period of weed interference was significant in 100 seed weight in both years of the study and the combined. Similar to what was obtained with the grain yield, where initial weed infestation for 3WAS did not significantly differ from plots kept weed free throughout the study period.

Keywords: Cob length, Cob weight, Maize varieties, Periods of weed interference.

INTRODUCTION

Maize is a member of the grass family, Poacea. It is the most widely adapted and was the most important cereal in the world in 2008 with production of 826.2million metric tonnes followed by rice and wheat (FAO, 2010). United States of America was the largest producer which accounted for 37.2% of the world's total, followed by China and Brazil that accounted for 20.1% and 7.1% respectively (FAO, 2010). Africa produced 6.7% of the world's total from 29.3million hectares. Nigeria produced 7.5 million metric tonnes which represents 0.9% of the world's total in 2008; it ranks second after South Africa in the African continent.

Maize production in Nigeria was initially restricted mainly to the forest zone but the production has now expanded to the savannah where it accounts for over 70% of the production in the country (Uyovbisere, Elemo and Tarfa (2001). Kassam *et al*. (1975) attributed the higher production of the crop in the savannah to more favourable production conditions which includes solar radiation intensities, lower night temperature and low incidence of diseases and pests. Maize was introduced into Nigeria probably in the 15th century by Portuguese (Osagie and Eka, 1998). The country`s maize crop covers about 1million hectare out of 9million hectares it occupied in Africa (Hartman, 1985).

Maize is a cereal plant that produces grains that can be cooked, roasted, fried, ground, pounded or crushed to prepare various food items like pap, tuwo, gwate, donkunu and a lot of others (Abdur Rahman & Kolawole, 2006). All these food types are readily available in various parts of Nigeria among different ethnic groups which are Hausas, Yorubas, Ibos, Ibiras, Ishas, Binis, Efits and Yalas etc. (Osagie & Eka, 1998).

Hoeing is the cultural method adopted for weed control in cereals of which maize is inclusive in the southern guinea savannah zone. It is labourious, slow, expensive and only feasible on a small holding (Lagoke.1988; Adeosun, 1990). Some weeds especially those that have close resemblance with the maize crop at the young stage e.g. *Andropogon gayanus* may however escape weeding; these will compete with maize seriously and will cause reduction in yield considerably. Hoe weeding is beneficial to the maize crop because it tends to improve aeration in the soil environment. For the hoe weeding to be successful, Proper timing and frequency of weeding are necessary.

Weeds pose a problem to the growth, development and yield of the maize crop. Like in other crops, weeds compete with maize for sunlight, water, nutrients and space. The extent of the competition depends on rate of growth of the weeds, their growth habit, their density and time at which they start to grow relative to the crop (Harper, 1988). The density of weeds, relative to that of the crop will clearly have an influence on the degree of onset of competition (Harper, 1988). The objective of this study was to assess the response of four maize varieties to periods of weed interference.

MATERIALS AND METHOD

The treatments consisted of two early maize varieties, one extra early variety and one hybrid variety and ten periods of weed interference. The treatments were laid out in a split plot design. In one set of the interference treatment, plots were kept initially weed free for 3, 6, 9 and 12 weeks after sowing (WAS) and subsequently left unweeded. In the other set of treatments, plots were left unweeded for 3, 6, 9 and 12 WAS thereafter, were left weed free until harvest. Two control treatments were maintained in which one plot was weed free while the other plot weed infested until harvest in both cases for the purpose of comparison.

Crop Varieties

The following were the maize varieties used:

(1) Oba 98 hybrid maize matures in 100-120 days and is excellent drought escape variety, its grain is white in colour and it is labelled as V_1

(2) SAMMAZ 13 (Extra early variety) maize matures in less than 80 days and is excellent drought escape variety, its grain is yellow in colour and labelled as V_2

(3) EVDT – Y2000 (Early variety) striga tolerant, matures in less than 90 days drought tolerant and can be grown in soils that have low Nitrogen. Its grain is yellow in colour. labelled as V_3

(4) 2008 DTMA – Y(STR) (Extra early variety) striga tolerant, matures in less than 90 days drought tolerant and can be grown in soils that have low Nitrogen. Its grain is yellow in colour it is labelled as V_4.

These were obtained from the seed production unit of the Institute for Agricultural Research Ahmadu Bello University, Zaria.

Cultural Practices

The seeds were sown manually at the rate of 3 seeds per hole along the ridges using an intra-rows spacing of 50cm. The plants were thinned to 2 plants per stand at ten days after planting. Cultural weeding using hoe was carried out at 3, 6, 9 and 12 WAS for both cultivation season of 2011 and 2012. Basal application of fertilizer using NPK 1515-15 was done after 2 WAS at 600g/plot and top dressed with urea after 4-5 WAS at the rate of 200g/plot by banding method. This was applied by pouring it into a hole that was made with a stick at a distance of about 5-8cm away from the maize plant and below the soil surface at the first application and the urea was applied during the second application, in both cases after the application the holes were covered with soil to avoid the fertilizer from volatilizing away.

Data Collection and Analysis

The cob length for five randomly cobs of maize plants was taken, in each plot the cob length was

measured for both years and combined was recorded. The cob weight for five randomly cobs of maize plants was taken, in each plot the cobs was weighed for both years and combined was recorded. The 100 seeds for five randomly cobs of maize plants was taken, in each plot the100 seeds were weighed for both years and combined was recorded.
Data collected were subjected to analysis of variance (ANOVA) using the F-test to estimate the significance in effects of treatments as described by Snedecor and Cochran (1967).

RESULTS

The effect of variety and period of weed interference on maize crop establishment percentage at harvest during 2011 & 2012 wet seasons is presented in Table 1. Variety did not significantly affect crop establishment in 2012, but in 2011 and the combined, Variety 2008-DTMAYSTR exhibited higher establishment percent than Oba-98 (Table 1). Period of weed interference significantly affected crop establishment percentage in both years, and the combined (Table 1). The percentage establishment was observed to decrease as plots were kept unweeded after 6WAS, till harvest during 2011 and after 3WAS till harvest in 2012 wet season and combined. Conversely, the percentage crop establishment was observed to increase to a maximum value when plots were kept weed- free initially from 3WAS till harvest. The crop establishment percentage was observed to be higher during 2012 wet season than 2011. However, keeping the crop initially weed infested for 3WAS did not differ significantly from those kept weed free for 12WAS in 2011 and combined, and those kept weed free till harvest in 2012. There was no significant interaction between the variety and period of weed interference in crop establishment throughout the study.

Table 1: Effect of Variety and periods of Weed- interference on percentage crop establishment at Gidan Kwano for 2011 and 2012 wet seasons and combined

Variety	Crop establishment		
	2011	2012	Combined
Oba-98	66.92b	73.16	70.04b
Sammaz-13	73.26ab	73.41	73.34ab
EVDTY-2000	73.47ab	75.02	74.25ab
2008DTMA YSTR	77.54a	73.75	75.65a
SE+	0.70	0.71	0.43
Significance	**	NS	**
Period of weed interference			
Initially weed infested for 3WAS[1]	85.31a	86.04b	85.68a
Initially weed infested for 6WAS	82.90a	74.48d	78.68bc
Initially weed infested for 9WAS	75.70ab	65.54f	71.62de
Initially weed infested for 12WAS	64.24bc	60.32g	62.28f
Initially weed infested till harvest	29.69d	36.95h	33.32g
Initially weed free for 3WAS	59.29c	71.19e	65.24ef
Initially weed free for 6WAS	73.94ab	79.09c	76.52cd
Initially weed free for 9WAS	84.03a	85.05b	84.54a
Initially weed free for 12WAS	85.62a	86.34b	85.95a
Initially weed free till harvest	87.24a	91.37a	89.31a
SE+	4.40	1.08	2.29
Interaction (VxW)	NS	NS	NS

*Means followed by the same letter (s) / are not significantly different at 5% level of probability (DMRT); WAS = Week after sowing; NS = Non significant

The result of the effect of variety on grain yield was significant only in 2011(Table 2). Variety 2008-DTMA-YSTR was observed to have the highest grain yield in 2011 with a value of 3.77t/ha (Table 15) followed by Sammaz13 (2.71t/ha), next was EVDT Y-2000 (2.57t/ha) and Oba-98(2.25t/ha) had the least grain yield value during the 2011 wet season.

Period of weed interference significantly affected grain yield in both years and the combined. The grain yield was observed to decrease as plots were kept initially weed infested beyond 3WAS till harvest during 2011 and 2012 wet seasons and the combined. As the plots were initially kept weed free the grain yield was observed to increase from a minimum value of 1.69t/ha 2.73t/ha and 2.36t/ha respectively for 2011, 2012 and combined to a maximum value of 3.87t/ha 6.47t/ha and 5.17t/ha respectively for 2011, 2012 and combined.

Cob Length

The result of effect of variety and period of weed interference on cob length is presented in Table 3. Effect of variety on cob length was not significant in both years of the study and the combined. Period of weed interference had significant effect on cob length in both years. Initial weed infestation for 3WAS to 9 WAS only was comparable to initial weed free period from3 WAS and till harvest. Plot kept weed infested till harvest had the least cob length in both years of the study and the combined. Plots kept weed free till harvest in both years had comparable cob lengths with that of weed infested at 3 WAS. Once the plots were kept weed free initially up to 6 WAS, no significant differences were observed among the various period and up to the harvest. Initial weed infestation beyond 6 WAS reduced the cob length progressively as the period of the weed interference delayed up to the harvest. There was no significant interaction between the variety and period of weed interference in cob length.

Table 2: Effect of Variety and Period of weed- interference on grain yield at Gidan Kwano for 2011 and 2012 wet seasons and combined

Variety	Grain yield (T/ha^{-1})		
	2011	2012	Combined
Oba-98	2.25b	4.38	3.31
Sammaz-13	2.71b	3.83	3.27
EVDTY-2000	2.57b	4.23	3.40
2008DTMA YSTR	3.77a	4.23	4.00
SE+	0.21	0.25	0.20
Significance	**	NS	**
Period of weed interference			
Initially weed infested for 3WAS[1]	3.57a	5.95a	4.76a
Initially weed infested for 6WAS	2.51bc	4.63bc	3.57cd
Initially weed infested for 9WAS	2.40bc	3.93dc	3.17ed
Initially weed infested for 12WAS	1.69c	2.97e	2.27ef
Initially weed infested till harvest	1.57c	1.79e	1.74f
Initially weed free for 3WAS	1.69c	2.73de	2.36ef
Initially weed free for 6WAS	2.00c	3.53dc	3.45d
Initially weed free for 9WAS	3.59a	4.25bc	3.96bcd
Initially weed free for 12WAS	3.67a	5.41ab	4.50abc
Initially weed free till harvest	3.87a	6.47a	5.17a
SE+	0.33	0.41	0.32
Interaction (VxW)	NS	NS	NS

*Means followed by the same letter (s) / are not significantly different at 5% level of probability (DMRT); WAS = Week after sowing; NS = Non significant

Table 3: Effect of Variety and periods of Weed- interference on percentage cob length at Gidan kwano for 2011 and 2012 wet seasons and combined

Variety	Cob length (cm)		
	2011	2012	Combined

Oba-98	14.52	12.52	13.52
Sammaz-13	14.01	12.11	13.01
EVDTY-2000	14.17	12.31	13.24
2008DTMA YSTR	13.19	11.81	12.80
SE±	0.26	0.26	0.30
Significance	NS	NS	NS
Period of weed interference			
Initially weed infested for 3WAS	14.99a	13.32a	14.16
Initially weed infested for 6WAS	14.98a	12.07a	13.98
Initially weed infested for 9WAS	14.45ab	12.55ab	13.69
Initially weed infested for 12WAS	13.39cd	11.49bc	12.39
Initially weed infested till harvest	12.40c	10.40c	11.41
Initially weed free for 3WAS	12.94c	10.94c	11.94
Initially weed free for 6WAS	14.29ab	12.38ab	13.29
Initially weed free for 9WAS	14.29b	12.39ab	13.29
Initially weed free for 12WAS	14.69a	12.78a	13.69
Initially weed free till harvest	14.84a	12.84a	13.84
SE±	0.41	0.41	0.48
Interaction (VxW)	NS	NS	NS

*Means followed by the same letter (s) / are not significantly different at 5% level of probability (DMRT); WAS = Week after sowing; NS = Non significant

Cob Weight

The effect of variety on cob weight was significant only in 2011(Table 4). During 2012 period, although not significant, the hybrid variety Oba-98 recorded the highest value of cob weight. The combined data revealed that the highest cob weight was recorded by the variety Oba-98 (Table 4). In 2011, there were no significant differences between Sammaz-13, EVDTY-2000 and 2008-DTMAYSTR (Table 4).

Period of weed interference significantly affected cob weight in 2011, 2012 and the combine (Table 4). Initial weed infestation for 3WAS was comparable to initial weed free from 6WAS till harvest in cob weight in 2011 and combined. Once the plots were initially kept weed free up to 9WAS and the harvest, no significant difference was observed in cob weight amongst the various weeks of interference. Initial weed infestation for 3WAS did not significantly reduce cob weight compared with those plots initially weed free from 6WAS till harvest in 2011 and the combine. Generally, in 2011 and the combine, initial infestation up to 6WAS did not differ significantly in cob weight with various initial weed free plots from 6WAS till harvest. Once plots were kept initially weed free up to 6 WAS and till harvest no significant difference was observed in cob weight in 2011 and the combined. However, in 2012 initial weed infestation for various periods resulted in significantly lower cob weight than initially weed free period from 9WAS up till harvest. The weed free throughout cob weight was 40.71% and 34.82% higher than the weed infested plot during 2011 and 2012 respectively. The interaction between variety and period of weed interference on cob weight was not statistically significant.

Table 4: Effect of Variety and periods of Weed- interference on percentage Cob weight at Gidan Kwano for 2011 and 2012 wet seasons and combined

Variety	Cob weight (t/ha)		
	2011	2012	Combine
Oba-98	4.35a	3.22	3.22
Sammaz-13	2.97b	2.10	3.09
EVDTY-2000	2.60b	2.35	2.48
2008DTMA YSTR	3.13b	2.39	2.70
SE±	0.24	1.00	0.29
Significance	NS	NS	NS

Period of weed interference			
Initially weed infested for 3WAS[1]	4.12a	2.77bc	2.96a
Initially weed infested for 6WAS	2.90a	2.51bc	2.83a
Initially weed infested for 9WAS	2.78a	2.37cd	2.65ab
Initially weed infested for 12WAS	1.95c	2.22cd	2.56ab
Initially weed infested till harvest	1.82c	1.48d	2.49b
Initially weed free for 3WAS	2.38ab	1.77d	2.83ab
Initially weed free for 6WAS	3.89ab	1.89bc	2.92a
Initially weed free for 9WAS	4.15a	3.27b	3.05a
Initially weed free for 12WAS	4.24a	3.45ab	3.26b
Initially weed free till harvest	4.47a	4.25a	3.28a
SE±	0.39	0.29	0.46
Interaction (VxW)	NS	NS	NS

*Means followed by the same letter (s) / are not significantly different at 5% level of probability (DMRT); WAS = Week after sowing; NS = Non significant

Weight of 100 seeds

The result of the effect of variety and period of weed interference on weight of 100 maize seeds is presented in Table 5. Variety significantly affected weight of 100 seeds in 2011, 2012 and the combined. EVDT Y-2000 had heavier seeds than Oba-98 in 2011, 2012 and the combined, and more than Sammaz-13 in 2011. EVDTY-2000 had similar weight of seeds in 2011, 2012 and the combined, while Oba-98 also had similar weight of seeds during the years of study and the combined.

Effect of period of weed interference on 100 maize seed weight was significant in both years and the combined. Initial weed infestation for 3-9 WAS only did not significantly differ from plot kept weed free throughout the study period. In 2011 and the combined, no significant difference was obtained between plots initially kept weed infested for 3WAS and those kept infested for 6WAS. Initial weed free for 3WAS only did not differ in weight of 100 seed from those kept weedy till harvest. The weight of 100 seeds was observed to decrease as the plots were kept unweeded to weed infested throughout. Though in 2011, from weed infested at 3WAS to 9WAS weight of seeds was similar or comparable, but in 2012 and the combined, significant difference was observed for the same period.

Throughout the study period, weight of seeds was least in the weed infested plots throughout. Conversely, as the plots were kept weed free, weight of seeds were observed to increase from weed free at 3WAS to 12WAS and till harvest.

Table 5: Effect of Variety and periods of Weed interference on weight of 100 seeds during 2011 and 2012 and combined wet seasons

Variety	100 seeds wt (g)		
	2011	2012	Combine
Oba-98	261.3b	185.3b	223.3b
Sammaz-13	265.4b	194.0ab	229.7ab
EVDTY-2000	290.1a	205.8a	247.9a
2008DTMA YSTR	261.3b	197.9ab	229.6ab
SE±	4.7	5.2	9.1
Significance			
Period of weed interference			
Initially weed infested for 3WAS[1]	287.2a	235.6ab	260.5ab
Initially weed infested for 6WAS	285.5a	206.6cd	246.8abc
Initially weed infested for 9WAS	271.5a	189.0dc	230.2bcd
Initially weed infested for 12WAS	243.7c	171.6ef	207.1dc
Initially weed infested till harvest	243.6bc	148.4f	198.6c
Initially weed free for 3WAS	248.8c	166.8ef	206.0de

Initially weed free for 6WAS	267.2ab	181.3de	225.5cde
Initially weed free for 9WAS	279.3a	190.0de	234.6bc
Initially weed free for 12WAS	280.5a	215.0bc	247.7bc
Initially weed free till harvest	283.0a	255.7a	268.9a
SE±	7.5	8.2	14.4
Interaction (VxW)	NS	NS	NS

*Means followed by the same letter (s) / are not significantly different at 5% level of probability (DMRT); WAS = Week after sowing; NS = Non significant

DISCUSSION

Weed infestation affect the grain yield throughout the study and the combined compared with weed free from 9WAS and till harvest. However, infestation beyond 6WAS drastically reduced the grain yield compared with the initial weed free periods from 9WAS till harvest. Similarly initial weed free period for 3 weeks only did not differ significantly from plots kept weedy throughout the study. Initial weed infestation beyond 6 WAS reduced the cob length progressively as the period of the weed interference delayed up to the harvest, however when the plots were initially kept weed free up to 9WAS and the harvest, no significant difference was observed in cob weight amongst the various weeks of interference. Initial weed free for 3WAS only did not differ in weight of 100 seeds from those kept weedy till harvest. The weight of 100 seeds was observed to decrease as the plots were kept unweeded to weed infested throughout.

Weed infestation throughout the crop life-cycle decreased the yield of maize variety Oba-98 by 65 and 50% in 2011 and subsequently other yield parameters were observed to reduce. Similar yield reductions between 50 and 87% of maize due to uncontrolled weeds throughout the crop life-cycle was reported by Mani *et al.* (2008). Weed infestation from 6WAS and till harvest significantly decreased these yield parameters. In the study, uncontrolled weeds throughout the life cycle of maize varieties resulted in grain yield loss of 59.43% and 72.33% respectively for 2011 and 2012 wet seasons compared to maximum obtained with weed free plots throughout the study. Weed infestation for 3WAS only did not significantly affect grain yield of maize in 2011 compared with initial weed free plots at 9WAS while weed infestation for 3WAS only was comparable to initial weed free plots up to 9WAS.

It is apparent that once the crop was kept weed free for 12WAS subsequent weed infestation until harvest did not cause any significant reduction in maize grain yield in the four varieties. Contrary to earlier reports, weeds infestation for first 3WAS caused significant reduction in maize grain yield. The yield depression by weed infestation for 3WAS may be attributed to rapid weed growth and its high infestation within 3WAS during the growing season. . This result agrees with those obtained by Carson (2010) and Kunjo (2011) who have similarly reported significant maize yield reduction when weeds were associated with the crop for 6 and 8WAS respectively. Subsequent weed removal until 12WAS did not prevent reduction in grain yield compared with weed infestation until harvest. Weed dry matter production was higher during 2011 than 2012.

The result of the combined analysis showed that maximum grain yield was obtained with plots kept weed free from 6WAS and till harvest with 2008-DTMAYSTR as well as the least grain yields on weed infested plot till harvest with Sammaz-13 during 2011 wet season. This clearly showed the variation in the ability of the varieties to compete with weed and to produce an acceptable grain yield. Ayeni and Duke (2011), earlier reported that good crop vigour influence and enhance good development of the photosynthetic capacity, prior to tasselling initiation and grain filling in maize crop as a result of better utilization of available growth resources in the absence of weeds.

CONCLUSION

A significant maize grain yield reduction was recorded when weeds associated with maize varieties for 6WAS and more. In the study, uncontrolled weeds throughout the life cycle of maize varieties resulted in grain yield loss of 59.43% and 72.33% respectively during 2011 and 2012 wet seasons compared to maximum obtained with weed free plots throughout the study. Weed infestation for 3WAS only did not significantly affect grain yield of maize in 2011 compared with initial weed free plots while weed infestation for 3WAS only was comparable to initial weed free plots up to 9WAS.

It could be recommended that a weed free period of 21-42days after sowing is required for an acceptable maize grain yield with 2008-DTMAYSTR and EVDTY-2000 varieties in the study area.

REFERENCES

Abdurrahman, A. A.; Kolawale, O.M. (2006). Traditional preparations and uses of maize in Nigeria. Retrieved from www.ethnoleaflets.com/../kolawole.htm

Adeosun, J.O. (1999). Response of upland rice (*Oryza sativa* L.) varieties to nitrogen, period of weed interference and chemical weed control at Samara, Nigeria. PhD Thesis submitted to the Dept. of Agronomy ABU Zaria. pp6. Carson, A. G.(2010). Weed competition and control in maize (*Zea mays L*). *Ghana Journal of Agricultural Sciences* 9: 161-167.

Ferrero, A. ;Scanzio. M. and Acutis M. (2010). Critical Period of Weed interference in Maize. In proceeding of the second International weed control congress Copenhagen. 171-176

Harper, F. (1988). *Principles of Arable Crop Production*. Blakwell science ltd. Osney mead, Oxford Ox2 Oel pp. 202213.

Hartman, E. A. (1985). Strategies for solving Crop Production Problems of sub Saharan Africa. IITA Ibadan

Kassam,A.H., Kowal, J; Dagg, M; Harrison M.N. (2005). Maize in West Africa and its potential in Savanna areas. *World Crops* 27(2):73-78.

Kunjo I. (2011). An evaluation of the critical period and effect of weed competition on maize (Zea Mays) PHD Thesis College of Agriculture, Ahmadu Bello University Zaria Nig. 65 pp.

Lagoke, S.T.O. (1988). Effect of intrar-row spacing, Nitrogen levels and periods of weed interference of transplanted tomato (*Lycopersicum esculentum Mill.*) in Nigerian Savanna.Samaru Journal of Agricultural Research 11: 31-42. In Susceptibility of two upland rice varieties to period of weed interference in Minna by Orogbemi, B.E.A Thesis submitted to the Department of Crop Production Federal University of Technology Minna. NAERLS, (2009).Production of drought tolerant maize in Nigeria. An Extension Bulletin Sponsored by Drought Tolerant Maize for Africa (DTMA) Project Nigeria Pp. 2,4&6.

NAERLS, (2009). Production of drought tolerant maize in Nigeria. An Extension Bulletin Sponsored by Drought Tolerant Maize for Africa (DTMA) Project Nigeria Pp. 2,4&6.

Osagie, A. U. Eka, O. U.(Eds) (1998): Nutritional Quality of Plant Foods.Post harvest Research unit Univ. Of Benin, Benin. Pp. 34-41.

Uyovbisere, E.O.,K.A.Elemo and B.D. Tarfa (2001). Effect of locust bean (*Parkiabiglobosa*) and neem (*Azadiracta indica*) on soil fertility and productivity of early maize in savannah alfisol, Pp.185-194. In Badu- Aparaku, B.; M.A.B. Fakorede, M. Quedraogo, and R. J. Carsky (eds). *Impact Challenges and prospects of Maize Research and development in West and central Africa*. Proceedings of a Regional Maize Workshop, IITACotonou Benin Republic, 4-7 May 1999.WECAMAN/IITA.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

INFLUENCE OF WEED CONTROL TREATMENTS, SOWING DATES AND METHODS ON WEED COVER SCORE, WEED SPECIES COMPOSITION AND GRAIN YIELD OF FINGER MILLET (*Eleusine coracana* (L.) Gaertn) IN SUDAN SAVANNA OF NIGERIA

T.T. Bello[1]*, M.A. Mahadi[2], A. Lado[1], E.A. Shittu[1], A.U. Adamu[3] and Y.A. Nasidi[4]

[1]Department of Agronomy, Bayero University, Kano
[2]Department of Agronomy, Ahmadu Bello University, Zaria
[3]Shelterbelt Research station, Kano, Forestry Research Institute of Nigeria
[4]Department of Crop Production, Audu Bako Collage of Agriculture, Danbatta
*Corresponding Author: +2348065883399, ttbello.agr@buk.edu.ng

ABSTRACT

Field experiment was conducted during 2016, 2017 and 2018 rainy seasons at the Research Farm of National Institute for Horticultural Research (NIHORT) Bagauda (Latitude 11° 33' N and Longitude 8° 23' E, 481m asl) Kano, in the Sudan savanna of Nigeria. The aim of the study was to determining the effect of weed control treatments, sowing date and method on weed parameters and grain yield (kgha^{-1}) of finger millet (Eleusine coracana (L.) Gaertn). The experiment consisted of six weed control treatment (atrazine at 0.8 or 1.2kg a.i.ha^{-1}, 2,4-D at 0.5 or 0.75kg a.i. ha^{-1}, two hoe weeding at 3 and 6 weeks after sowing (WAS) and weedy check), three (3) sowing date (late June, early July and late July) and three (3) sowing method (broadcasting, drilling and dibbling). These were factorially combined and laid out in a split-split-plot design and replicated three (3) times. Sowing dates were assigned to main plot, sowing methods to subplot while weed control treatments to sub-subplots. Data were collected on weed cover score, weed species composition and grain yield (kgha^{-1}). The results revealed that weeding twice at 3 and 6 WAS significantly produced lower weed cover score and higher grain yield (kgha^{-1}). Though, with regard to higher yield (kgha^{-1}), weeding at 3 and 6 WAS was at par with other chemical weed control treatments. It was also revealed that sowing between late June and early July produced significantly higher grain yield using broadcasting method of sowing. Based on the findings of this study, it can be concluded that finger millet could be sown between late June and early July by broadcasting method and two hoe weeding at 3 and 6 WAS, or by application of either atrazine at 1.2 kg a.i. ha^{-1} or 2,4-D at 0.5 kg a.i. ha^{-1} for effective weed suppression and higher grain yield (kgha^{-1}).

Keywords: finger millet, weed control, sowing date, sowing method

INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn) is a major food crop of the semi-arid tropics of Asia and Africa and has been an indispensable component of dryland farming systems (Kerr, 2014). It belongs to the family Poaceae, it is a native to Africa and was domesticated in the highlands of Ethiopia and Uganda 5000 years ago (NRC, 1996; Dida *et al.,* 2008). The crop is ranked fourth globally in importance among the millets (Gupta *et al., 2*012; Upadhyay *et al.,* 2007), and it is cultivated in more than 25 countries, mainly in Africa and Asia (Chandrashekar, 2010; Sudhishri *et al.,* 2013). However, in Africa, finger millet is second and represents 19% of millet production, after pearl millet (76%) (Obilana, 2003).

Finger millet is adapted to a wide range of environmental and climatic conditions. It is preferably grown on well drained sandy loam with pH range of 5.0 to 8.2, and can tolerate less fertile soils with poorer growing conditions such as intense heat and low rainfall (Baker, 2003). It is primarily a subsistence staple cereal food for millions of people in dry lands of East and Central Africa and Southern India (Holt, 2000; Mgonja, 2005). This plant, though not produced in large quantity in Nigeria compared to other cereals, is an important crop because of its high nutritive value. It is rich in minerals, such as calcium, iron, and phosphorus (Glew *et al.,* 2008), and essential amino acids which include methionine and tryptophan (Fernandez *et al.,* 2003). Regular consumption of finger millet is known to reduce the risk of diabetes mellitus and gastrointestinal tract disorders which helps in controlling blood sugar level in condition of diabetes (Tovey, 1994), this is due to presence of factors in finger millet's flour which lower digestibility and absorption of starch (Muninarayana *et al.,* 2010).

Finger millet production in Nigeria is constrained by several factors especially with regards to appropriate sowing date and methods as well as inappropriate weed control strategies. The low yields on farmers' field in Nigeria and elsewhere have been attributed to poor agronomic management practices such as poor weed management, inappropriate sowing date and sowing methods among others. The objective of the study was to identify the appropriate weed control treatment with the best sowing date and method on weed density, weed control efficiency and grain yield of finger millet.

MATERIALS AND METHODS

The experiment was conducted during the 2016, 2017 and 2018 rainy seasons, at the research farm of National Institute for Horticultural Research (NIHORT) Bagauda (Latitude 11° 33' N and Longitude 8° 23' E, 481m asl) Kano, in the Sudan savanna ecological zone of Nigeria. The experiment consisted of three (3) sowing dates (late June, early July and late July), three (3) sowing methods (broadcasting, drilling and dibbling) and six weed control treatments (Atrazine at 0.8 or 1.2 kg a.i. ha^{-1}, 2,4-D at 0.5 or 0.75 kg a.i. ha^{-1}, two hoe weeding at 3 and 6 WAS, and weedy check). These were factorially combined and laid out in a split-split-plot design and replicated three (3) times. The sowing dates were assigned to the main plot and the sowing methods to the subplot while weed control treatments were assigned to the sub-subplot.

In each year of the trial, the field was harrowed twice to achieve a fine tilth and made into flat beds, it was then marked into the required number of plots each of gross area of 3m × 3m ($9m^2$) and net plot size of 2m x 3m ($6m^2$). The borders between main plots, subplots, sub-subplots and replicates were 1.5m, 1m, 0.5m and 2m, respectively. The seeds were sown manually on treatment basis using a seed rate of 5 kg ha^{-1}. The late June, early July and late July sowing was done on 25th June, 9th July and 23rd July, respectively. Broadcasting was done by spreading the seeds on the soil evenly, dibbling was done by planting the seeds at 20 x 10cm inter and intra row spacing, respectively, while drilling was done by sowing the seeds at a spacing of 20cm inter row. The crop was harvested manually at physiological maturity when the panicle turned brownish in colour, confirmed by free threshing of the grains when the heads fingers were squeezed by hand.

The weed cover score was taken at physiological maturity by visual observation on a scale of 0 - 4 as described by Komboik *et al.* (2003); where 0 = no weed, 1 = moderately weedy, 2 = weedy, 3 = very weedy, 4 = highly weedy. The weeds species compositions were obtained from the 0.5 x 0.5m quadrant placed randomly in each net plot at physiological maturity. The grain yield data was subjected to analysis of variance as described by Snedecor and Cochran (1967) using GenStat software (GenStat, 2013), and the treatment means that were found to be significant were compared using Student-Newman Keuls Test.

RESULTS AND DISCUSSION

Weed Cover Score

Table 1 shows that the weedy check produced significantly more weed cover in 2016 (3.78), 2017 (3.77), 2018 (3.70) and combined (3.75) as compared to other weed control treatments in the respective years and combined, while two hoe weeding recorded the least weed cover throughout the experimental years and combined. This could be as a result of effective weeds removal, similar result was observed by Amare and Etagegnehu (2016) who observed that, the lowest weed cover and density was recorded from weeding twice at 20 and 40 days after emergence which resulted in the highest yield as compared to other control practices. In the same vein, Rao *et al.* (2007) reported the highest reduction in total weed density and weed dry weight in hand pulling over the weedy check in rice crop.

Sowing on late June significantly produced more weed cover (2.26) which was statistically similar with sowing on late July (2.20). Though, the difference between sowing on early July and late July was not significant. This can be related to the fact that crops planted earlier in the season allowed weed growth more than when planted late in the season. However, sowing method did not significantly affect the weed cover score in all the experimental years and combined. This was contrary to the finding of Nyende *et al*. (2001) who observed that planting methods indirectly influenced weed cover and density.

Weed Species Composition

Table 2 shows that the most dominant species among the narrow leaved weeds identified across the years were; *Eleucine indica*, *Cynodon dactylon, Digitaria horizontalis, Digitaria ciliaris, Eragrostic ciliaris*, *Setaria barbata* Lam., *Setaria pumila* and *Rottboellia chochinchinensis,* while among the broad leaved identified were; *Ageratum conyzoides, Amaranthus spinosus, Cleome viscose, Euphorbia prostrate* and *Leucas aspera.* The most dominant sedges identified across the experimental years were; *Cyperus esculentus* and *Cyperus rotundus.* This meant that weed species were more competitive with the crop, and therefore requires more management attentions. These were manifested by the higher weed cover score observed in the weedy check plots. Also, the reduction in total yield of the crop as observed in the weedy check plots could be attributed to the competitions that existed on water, sunlight and nutrient between the finger millet crop and weed species. Rambakudzibga *et al.* (2002) reported that weed species varies in their ability to colonized cultivated areas and some may causes severe damages than the other due to their ability to produce toxic substance which may damage the crop or they are very effective competitors for water and nutrients.

Grain Yield (kg ha^{-1})

Table 3 shows that two hoe weeding at 3 and 6 WAS produced significantly higher grain yield in 2016 (807.1kg), 2017 (1187.0kg), 2018 (1251.0kg) and combined (1085.3kg) which were statistically similar with plots treated with atrazine at 1.2kg a.i. ha^{-1} and those treated with 2,4-D at bath doses in 2016, and those treated with atrazine at both doses and 2,4-D at both doses in 2017. While the weedy check consistently recorded the least in 2018 (956.0kg) and combined (903.0kg). The result was in conformity with the findings of Kumara *et al*. (2007) who observed that weeding twice at 3 and 6 WAS and application of butachlor at 0.75 kg ha^{-1} + 2,4 D Na salt 0.75 kg ha^{-1} recorded significantly higher grain yield of finger millet as compared to unweeded control treatment. Also, Naik *et al*. (2000) observed the increases in grain yield in treated plots of finger millet due to increased yield components of the crop and reduced weed pressure. In the same vein, Tuti *et al.* (2016) reported that the grain yield of finger millet was significantly higher in plots weeded twice at 3 and 6 WAS than the other method of weed control employed.

In 2016 and 2017, crops sown on late June were at par with those planted in early July and recorded significantly higher grain yield, while those sown on late July recorded the lowest (Table 3). However, in combined, sowing on late June produced significantly higher grain yield (1135.1kg) than the other sowing date while sowing on late July produced the lowest (788.6kg). This could be due to the pact that early sown crop utilized favourable climatic condition during various crop growth stages, which reflected into better growth and higher yield and yield attribute. This was in conformity with the findings of Revathi *et al.* (2017) who indicated that finger millet sown early produced better yield attributes and grain yield than the other times of sowing. Also, Pandiselvi *et al.* (2010) revealed that, among the dates of planting finger millet, the crop planted early produced highest grain yield than the other sowing dates.

Broadcasting method consistently produced the highest grain yield in 2016 (887.3kg), 2017 (1230.0kg), 2018 (1255.0kg) and combined (1129.2kg), while dibbling and drilling methods were at par in 2016 and 2017 and recorded the lowest grain yield (Table 3). Also, in 2018 and combined, the dibbling method recorded significantly lowest grain yield than the other method of sowing. This could be related to the highest number of harvested plant in the broadcasted plot that gave more number of panicles which translated to more grain weight. Similar observation was reported by Adeyeye *et al.* (2014) which indicated that the use of broadcasting method of sowing was found to be superior to other methods used for sowing of finger millet. Similarly, Njoka *et al.* (2003) reported that the yield of rice sown using broadcasting method was significantly higher than the other method employed during the two seasons trials.

CONCLUSION

Based on this study, the farmers in the study area should adopt sowing of finger millet between late June to early July by using broadcasting method and two hoe weeding at 3 and 6 WAS for better weed control and higher grain yield. Nevertheless, application of either atrazine at 1.2 kg a.i. ha^{-1}, or 2,4-D at 0.5 kg a.i. ha^{-1} could also be used to achieve the same result.

REFERENCES

Adeyeye, A. S., Ahuchaogwu, C. E., Shinggu, C. P., Ibirinde, D. O., Musa, G. (2014). Germination and Establishment of Finger Millet Variety (*Eleusine Coracana*) As Affected by Planting Method. *The International Journal of Science and Technology*, Vol. 2 Issue 9, ISSN 2321 – 919X. www.theijst.com.

Amare, Fufa and Etagegnehu, G/Mariam (2016). Weed Control Practices and Inter-Row Spacing Influences on Weed Density and Grain Yield of Finger Millet (*Eleusine Coracana* L. Gaertn) in the Central Rift Valley of Ethiopia. *International Journal of Research in Agriculture and Forestry,* Volume 3, Issue 9, P 1-7.

Baker, R. D. (2003). Millet Production Guide. A.414.Cooperative Extension Service College of Agriculture and Home Economics, New Mexico State University.

Chandrashekar, A. (2010). Finger Millet (*Eleusine coracana*). *Advance Food Nutrition Research, 59*: 215–262.

Dida, M. M., Wanyera, N., Dunn, M. L. H., Bennetzen, J. L., Devos, K. M. (2008). Population Structure and Diversity in Finger Millet (*Eleusine coracana*) Germplasm. *Tropical Plant Biology. 1*, 131–141.

Fernandez, D. R., Vanderjagt, D. J., Millson, M., Haung, Y.S., Chuang, L.T., Pastusyn, A. and Glew, R. H. (2003). Fatty Acid Amino Acid and Trance Miniral Composition of *Eleucine corocana* (Pwana) Seeds From Northern Nigeria. *Plant Foods for Human Nutrition*, 58: 1-10.

GenStat (2013). Release 16.3DE. VSN International, 5 The Waterhouse, Waterhouse Street, Hemel Hempstead, Hertfordshire HP1 1ES, UK.

Glew, S.R.,L.T.Chuang, J.L. Roberts and R.H. Glew, (2008). Amino Acid, Fatty Acid and Mineral content of Black Finger Millet (*Eleucine coracana)* Cultivated on the Jos Plateau of Nigeria. *Food Global Science Books*, 2(2): 115-118.

Gupta, N., Gupta, A. K., Gaur, V. S. and Kumar, A. (2012). Relationship of Nitrogen Use Efficiency With the Activities of Enzymes Involved in Nitrogen Uptake and Assimilation of Finger Millet Genotypes Grown Under Different Nitrogen inputs. *Science World Journal*, 1–10.

Holt, J. (2000). Investicating into Biology Epidemiology and Blast in Low-Input Farming System in East Africa.

Kerr, R. B. (2014). Lost and Found Crops: Agrobiodiversity, indigenous Knowledge, and a Feminist Political Ecology of Sorghum and Finger Millet in Northern Malawi. *Ann. Assoc. Am. Geogr. 104*: 577–593.

Komboik, J. M., Safo, E. Y., Quansa, C. andIbana, S. (2003). Assessment of Weed Infestation and Economic Returns of Maize/Cowpea Intercrop Under Tillage System in Northern Ghana. *Ghana Journal of Agric. Science*, **36**: pp 39 - 46

Kumara, O., Basavaraj Naik, T. and Palaiah, P. (2007). Effect of Weed Management Practices and Fertility Levels on Growth and Yield Parameters in Finger Millet. *Karnataka Journal of Agricultural Sciences,* 20(2): 230-233. Mgonja, M. A. (2005). Finger Millet Blast Management in East Africa. Nairobi Kenya.(Workshop).*Asbtract*. pp.47.

Muninarayana, C., Balachandra, G., Hiremath, S.G., Iyengar, K. and Anil, N.S. (2010). Prevalence and Awareness Regarding Diabetes Mellitus in Rural Tamaka, Kolar. *International Journal of Diabetes Dev Ctries.* 30(1):18-21. doi: 10.4103/0973-3930.60005.

Naik, D. C., Muniyappa, T. V. and Kumar, M. D. (2000). Effect of Integrated Weed Management on Nutrient Uptake by Transplanted Ragi and Associated Weeds. *Karnataka Journal of Agricultural Sciences*, 13(4): 819-823.

Njoka, E. M.,Wanjugu, R. K., Kinyua, M. K., Ndirangu,C. M. and Kimani, A. W. (2003). Effects of Sowing

Methods on the Growth and Grain Yield of Irrigated Rice in National Irrigation Board Schemes. *International Journal of Agriculture and Rural Development*, Vol 4, No 1.

NRC (National Research Council) (1996). *Lost Crops of Africa*, 1st ed.; National Academy Press: Washington, DC, USA. DOI: 10.17226/2305.

Nyende, P., Tenywa, J. S., Oryokot, J. and Kidoido, M. (2001). Weed Profiles and Management Assessment for Increased Finger Millet Production in Uganda. *African Crop Science Journal, Vol. 9. No. 3, pp. 507-516.*

Obilana, A. B. (2003). Overview: Importance of Millets in Africa. In: Belton, P. S.; Taylor, J. P. N. (Eds). Afripro, Workshop on the proteins of sorghum and millets: Enhancing nutritional and functional properties for Africa. Pretoria, South Africa, 2-4th April 2003.

Pandiselvi, T., Narayanan, A. L. and Karthikeyan, R. (2010). Evaluation of Optimum Time of Sowing of Finger Millet (*Eleusine coracana* G.) varieties in Karaikal Region. *International Journal of Agricultural Science,* 6(1): 94-96.

Rambakudzibga, A. M., Makanganise, A. and Mangosho, E. (2002). Competitive influence of *Eleucine indica* and other weeds on the performance of maize grown under controlled and opened field conditions. *African Crop Science Journal,* 10 (2):157 – 162.

Rao, A. N., Johnson, D. E., Sivaprasad, B., Ladha J. K. and Mortimer, A. M. (2007). Weed Management in Direct Seeded Rice. *Advances in Agronomy,* 93(1): 124 – 130.

Revathi, T., Sree Rekha, M. and Pradeep Kumar, S. (2017). Growth and Yield of Finger Millet (*Eleusine coracana*) at Different Sowing Date in Coastal AP. *An International Quarterly Journal of Life Science*, Special issue, Vol. 10; 85-91.

Snedecor, G. W. and Cochran, W. G. (1967). Statistical Methods Sixth Edition: Iowa University, Press, Iowa, USA 606 – 607.

Tovey, F. I. (1994). Diet and Duodenal Ulcer. *Journal of Gastroenterol Hepatol* 9:177–185.

Tuti, M. D., Singh, S., Pandey, B. M., Bisht, J. K. and Pattanayak, A. (2016). Weed Management in Rainfed Finger Millet. *Indian Journal of Weed Science* 48(1): 74–75. DOI: 10.5958/0974-8164.2016.00017.4

Upadhyay, H. D., Gowda, C. L. L., Gopal Reddy, V. (2007). Morphological Diversity in Finger Millet Germplasm Introduced From Southern and Eastern Africa, SAT e-Journal. *Journal of SAT Agricultural Research*, 3 (1).

Table 1: Effects of Sowing Date, Sowing Method and Weed Control Treatment on Weed Cover Score in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.59d	0.70d	0.74d	0.68d
Atrazine at 0.8kg a.i. ha^{-1} PE	2.63b	2.63b	2.82b	2.69b
Atrazine at 1.2kg a.i. ha^{-1} PE	2.56b	2.52b	2.59b	2.56b
2,4-D at 0.5kg a.i. ha^{-1} POE	1.85c	1.70c	1.93c	1.83c
2,4-D at 0.75kg a.i. ha^{-1} POE	1.82c	1.56c	1.70c	1.69c
Weedy check	3.78a	3.77a	3.70a	3.75a
Probability level	<.001	<.001	<.001	<.001
SE±	0.079	0.090	0.118	0.056
Sowing Date (D)				
Late June	2.26a	2.15	2.28	2.23
Early July	2.15b	2.14	2.19	2.16
Late July	2.20ab	2.14	2.27	2.21
Probability level	0.033	1.000	0.600	0.205
SE±	0.019	0.029	0.070	0.026

Sowing Method (M)				
Dibbling	2.24	2.17	2.24	2.22
Drilling	2.22	2.19	2.20	2.20
Broadcasting	2.15	2.09	2.30	2.18
Probability level	0.629	0.728	0.790	0.861
SE±	0.071	0.086	0.095	0.049
Interaction				
D x M	0.613	0.196	0.970	0.381
D x W	0.133	0.968	0.834	0.717
M x W	0.043	0.932	0.713	0.104
D x M x W	0.055	0.136	0.312	0.091

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 21: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Species Composition in Finger Millet at Bagauda in 2016, 2017 and 2018 Rainy Seasons.

Weed Species	Level of Occurrence		
	2016	2017	2018
Narrow leaf species			
Cynodon dactylon	**	**	**
Digitaria horizontalis	**	**	***
Digitaria ciliaris	**	**	**
Echinochloa colona L.	*	*	*
Eleucine indica	***	***	***
Eragrostic ciliaris L.	-	-	**
Panicum maximum	*	*	*
Pennisetum pedicellatum	**	**	**
Rottboellia cochinchinensis	**	**	***
Setaria barbata Lam.	-	**	-
Setaria pumila	*	-	-
Broad leaf species			
Achanthospermum hispidum	*	*	-
Ageratum conyzoides	**	**	**
Amaranthus spinosus	-	-	*
Senna obtusifolia	*	*	*
Senna occidentalis L.	*	*	*
Cleome viscosa L.	-	-	*
Corchorus oltorius L.	-	*	*

Cummelina benghalensis	*	*	-
Desmodium tortuosum	**	*	*
Euphorbia hirta L.	*	*	*
Euphorbia prostra	*	-	-
Leucas aspera	*	-	-
Physalis minima L.	*	*	*
Portulaca oleracea	*	*	**
Tridex procumbens L.	**	-	*
Sedges species			
Cyperus esculentus	***	***	***
Cyperus rotundus	***	***	***

- = absent, * = low occurance (1 – 39%), ** = Moderate occurance (40 – 59%), *** = high occurance (60 – 100%)

Table 3: Effect of Weed Control Treatment, Sowing Date and Sowing Method and on Grain Yield (kgha^{-1}) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	807.1a	1187.0a	1251.0a	1085.3a
Atrazine at 0.8kg a.i. ha^{-1} PE	645.6c	1119.0ab	1058.0b	954.7c
Atrazine at 1.2kg a.i. ha^{-1} PE	777.7ab	1149.0ab	1123.0b	1021.6b
2,4-D at 0.5kg a.i. ha^{-1} POE	763.5ab	1145.0ab	1095.0b	1006.7b
2,4-D at 0.75kg a.i. ha^{-1} POE	743.3ab	1123.0ab	1100.0b	989.7bc
Weedy check	688.1bc	1059.0b	956.0c	903.0d
SE±	25.00	24.37	25.90	14.50
Sowing Date (D)				
Late June	1062.0a	1217.0a	1125.0	1135.1a
Early July	989.0a	1134.0a	1047.0	1056.6b
Late July	161.3b	1040.0b	1120.0	788.6c
SE±	25.40	21.69	18.90	12.96
Sowing Method (M)				
Dibbling	634.8b	1069.0b	960.0c	890.1c
Drilling	690.6b	1092.0b	1077.0b	960.9b
Broadcasting	887.3a	1230.0a	1255.0a	1129.2a
SE±	32.30	31.90	34.20	18.98
Interaction				
D x M	0.006	0.942	0.949	0.069
D x W	<.001	0.005	0.001	<.001
M x W	0.295	0.307	0.520	0.019
D x M x W	0.447	0.294	0.289	<.001

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

INFLUENCE OF ORGANIC AND INORGANIC FERTILIZERS AND WEED CONTROL TREATMENTS ON GROWTH AND YIELD OF WET SEASON MAIZE (*Zea mays* L.) IN ALIERO KEBBI STATE, NIGERIA

M.S. Na-Allah, I.Y. Jega, A.G. Nafi'u, and M.U. Tanimu

Department of Crop Science, Kebbi State University of Science and Technology, Aliero
Corresponding author email address: mustaphanaallah@gmail.com

ABSTRACT

Research work was carried out in the wet *season of 2022 at the Research Farm Kebbi State University of Science and Technology; Aliero. The research was designed to study the appropriate fertilizer combination and weed control method for higher maize production. The experiment was layout in a split-plot design and replicated three times. The main plot treatment consisted of four fertilizer treatments viz. (Poultry dropping applied at 2500 kg/ha, Poultry dropping 1750 kg/ha + 75% RDN, Poultry dropping 1750 kg/ha + 100% RDN and Poultry dropping 1550 kg/ha + 125% RDN). The sub-plot treatments were five weed control treatments viz. (Atrazine applied at 800g/ha, atrazine 800g/ha + pendimethalin 100ml/ha, tembotrione at 100ml/ha, live mulch (Cowpea), and weedy check). Application of poultry dropping 1.55 t/ha + 125% RDN significantly outperformed the rest of the treatments. In addition to these higher values of yield attributes viz, cob weight, cobs per plant, and grain yield per hectare were also recorded in post-emergence application of tembotrione 100ml/ha. The study reveals that poultry dropping at 1550 kg/ha + 125% RDN and post-emergence application of tembotrione at 100ml/ha is most effective for weed control and better yield of maize.*

Keywords: Tembotrione maize, weeds, atrazine, pendimethalin, poultry dropping

INTRODUCTION

Maize (*Zea mays* L.), known as corn, is one of the most important cereal crops of the world. It belongs to grass family Poaceae. It is highly productive, cheap, less rigorous to produce and adapts to wide range of agroecological zones (Babatunde *et al*., 2008). According to FAO report 2019 (FOA 2019), globally maize occupies a total cultivated land of 197 mega hectares with a yield of 1134 metric tons per year and a productivity of 5.75 tons per hectare. In 2021 the Nigeria's agricultural sector produced a total production of 11.6 million metric tons. The observed value was compared with the recorded quantity of 10 million metric tonnes in the year 2020 (USDA 2021). The states of Borno, Kaduna, Niger Plateau, and Oyo are the most important producers of maize in Nigeria; collectively, these four states contribute for around 64% of the nation's total maize production. Each portion of the crop has monetary value: the seeds, shoot, head and kernel which can be synthesized to produce a large diversity of food and non-food products. Corn is consumed in developed nations as a second-cycle product in meat, eggs, and dairy products. The crop is eaten directly in third world nations and is staple nutrition for around 200 million people (Anon, 2003). Corn is a principal meal for an estimated 50% of the people in Africa's sub-Saharan region. It is high in carbohydrates, protein, iron, vitamin B, and minerals. Despite the high yield potential of this crop, the yield obtained in the farmer's field in Nigeria is 1.4 t ha^{-1} and is significantly lower when compared to the potential yield of maize varieties that ranges from 3.0 to 6.5 t ha^{-1} (Anon, 2015). The low yield of maize obtained was due to numerous factors such drought, pests, diseases, weeds infestation, and soil fertility problems, among others, in which weeds and fertility problems become a serious threat to crop productivity. In Nigeria, significant yield losses ranging from 51% to 100% have been reported in maize cultivation as a result of weed competition (Akobundu and Ekeleme, 2000). The primary approach to weed control in crops among peasant farmers in Nigeria is manual hoe-weeding. However, this method is characterized by its labor-intensive nature, slow pace, and limited effectiveness. It can be burdensome and tedious for farmers to engage in this activity on their farms. Additionally, there may be instances where manpower is not readily accessible when needed, resulting in increased costs (Lagoke, 1991). In order to mitigate these limitations associated with manual weed management the use of selective herbicides on maize, such as atrazine, pendimethalin, and tembotrione or their combinations, is necessary for better crop productivity. The availability of chemical fertilizers for the purpose of soil fertility restoration is limited and their acquisition incurs significant costs. The concerns regarding the quantity requirement and transportation cost of organic manure have led to the exploration of alternative approaches, such as the combination of poultry manure and nitrogen fertilizers. This approach aims to enhance the balance of soil nutrients and mitigate the negative consequences associated with the prolonged utilization of chemical fertilizers.

MATERIALS AND METHODS

Experimental site and design

This research work was carried out at the Kebbi State University of Science and Technology; Teaching and Research Farm, Aliero during the 2022 season. The experiment was laid out in a split-plot design and replicated three times.

Experimental treatments

The main plot treatment consisted of four fertilizer treatments, viz a viz. 1) Poultry dropping applied at 2500 kg/ha, 2) Poultry dropping 1750 kg/ha + 75% RDN, 3) Poultry dropping 1750 kg/ha + 100% RDN and 4) Poultry dropping 1550 kg/ha + 125% RDN. The five weed control treatments used in the sub-plots were atrazine applied at 800g/ha, atrazine at 800g/ha + pendimethalin 100Ml/ha, and tembotrione at 100ml/ha PoE, live mulch (cowpea), and weedy check.

Agronomic practices

The experimental area was harrowed and ridged at intervals of 60 cm. The area was then split up into plots and replications. Additionally, there were 1m between replications and 0.5m between each of the five plots. Before planting the crop, poultry dropping was spread in split applications within the furrows per treatment basis. The first dose of nitrogen, phosphorus, and potassium was applied before sowing using DAP, SSP, UREA, and MOP. At 20DAS, urea (46 percent N) was used to supply the remaining N, and seeds were manually sown at a spacing of 60x20cm. When the plants had reached physiological maturity, and the seed had a moisture content of about 20%, the ear was manually harvested. Water canals were built to ensure that water was delivered efficiently to each furrow during irrigation.

Data collection

Data on weeds such as control efficiency was measured at different sampling periods. Yield and yield components (cobs per plant, grain yield) were assessed after harvest.

Data analysis

Data Collected were subjected to analysis of variance (ANOVA) using SAS software. Duncan multiple test range was used to separate means at 5% level of significance.

RESULTS

Table 1 Present the chemical composition of the poultry dropping used Percentage nitrogen (2.60 %) and available phosphorus (1.6 %) were found to be moderate while potassium (1.25 %), calcium (0.17 %) and magnesium (0.01 %) were low.

Table 1: Chemical composition of poultry manure used

Chemical composition	Values (%)
Nitrogen (N)	2.34
Phosphorus (P)	1.37
Potassium (K)	1.29
Calcium (Ca)	0.68
Magnesium (Mg)	0.01

Analysed in the soil science department kebbi state university of science and technology, Aliero

Weed control efficiency (%)

The influence of organic and inorganic fertilizers and weed control treatments on weed control efficiency on wet season maize is presented in (2). At 60 and 90 DAS the highest weed control efficiency was recorded in the application of 125% RDN + 1550 kg/ha poultry dropping, and the lowest was found in the 2500 kg/ha poultry dropping. And there was no significant effect of treatments on weed control efficiency at harvest. The weed control effect was also significant at all the sampling stages. The highest weed control efficiency was recorded in the postemergence application of tembotrione at 100ml/ha across all the sampling stages. While the unchecked plots recorded the least The interactions between the two factors were not significant in all sampling periods.

Table 2. Effect of nutritional sources and weed control treatments on the weed control efficiency (%) on wet Season Maize

Nutritional sources (N)	60DAS	90DS	Harvest
Poultry dropping @ 2500 kg/ha	52.14b	38.85c	32.16
Poultry dropping @ 1750kg/ha + 75% RDN	63.69a	43.68b	36.16
Poultry dropping @ 1750kg/ha + 100% RDN	64.10a	42.34b	35.05
Poultry dropping @ 1550kg/ha + 125% RDN	66.46a	49.33a	40.84
SEm (±)	0.180	0.221	0.201
CD (0.05%)	4.101	3.223	NS
Weed control methods (W)			
Atrazine@800g/ha	54.04c	37.20d	30.79d
Atrazine@800g/ha + pendimethalin 100ml/ha	69.31b	44.38c	36.74c
Tembotrione@100Ml/ha	93.28a	73.64a	60.96a
Live mulch (Cowpea)	67.62b	62.54b	51.77b
Weedy check (control)	0.00d	0.00e	0.00e
SEm (±)	0.271	0.295	0.268
CD (0.05%)	4.783	3.853	3.776
Interaction (NxW)	NS	NS	NS

Means followed with the same letters with column are statistically similar at (0.5) level. t ha^{-1}= tons per hectare, RDN= recommended dose of nitrogen, ml/ha= mil per hectare, SEm ± =standard error mean, CD= critical difference, NxW= interaction between nutritional sources and weed control.

Cob Length (cm)

The effects of organic and inorganic fertilizer and weed control treatments on the cob length of wet season maize. poultry dropping and 125 % RDN recorded a significantly highest cob length, followed by poultry dropping and 100 % RDN, poultry dropping and 75 % RDN and poultry dropping 2500kg/ha. The effects of weed control treatments, post-emergence application of tembotrione at 100ml/ha recorded the longest cob, followed by pendimethalin and atrazine combination, which are at par with atrazine and live mulch but significantly differed with the weedy check The interaction between the two factors on cob length was not significant.

Cob diameter (cm) and Test weight (g)

The use of poultry dropping at 1,550 kg/ha + 125% RDN and poultry dropping at 1750 kg/ha + 100% RDN resulted in statistically similar cob diameter and test weight that was heavier than that of poultry dropping at 1,750kg/ha + 75% RDN and poultry dropping at 2500 kg/ha. The effect of weed control on the cob diameter and test weight of maize was also significant. Tembotrione applied plots had the highest diameter and weight that was at par with live mulch and combined spray of pendimethalin and atrazine (100ml/ha + 800g/ha) but differed significantly from atrazine (800g/ha) and weedy check. The interaction between the factors on cob diameter and test weight was not significant.

Grain yield (t/ha)

Grain yield of wet season maize per hectare as influenced by nutritional sources and weed control treatments is presented in table 3. Grain yield significantly responded to nutritional sources treatments. Plots treated with poultry dropping at 1,550 kg/ha + 125% RDN recorded the highest grain yield, followed by plots that received poultry dropping at 1,750 kg/ha + 100% RDN, poultry dropping at 1,750 t/ha + 75% RDN and the poultry dropping at 2500 kg/ha had the least grain yield. In weed control methods, the tembotrione treated plots gave the maximum grain yield, accompanied by live mulch, atrazine, and pendimethalin (800g/ha + 100ml/ha). The weedy check recorded the least grain yield. The interaction between the factors was not significant.

Table 3. Effect of nutritional sources and weed control treatments on cob weight, cob length and lines per cob and cob diameter, test weight and grain yield of wet Season Maize

Nutritional sources (N)	Cob length (cm)	Cob diameter (cm)	Test Weight (g)	Grain yield (t/ha)
Poultry dropping @ 2500 kg/ha	12.05[c]	7.10[b]	26.96[b]	3.40[d]
Poultry dropping @ 1750kg/ha + 75% RDN	13.60[b]	7.45[b]	28.16[b]	4.29[c]
Poultry dropping @ 1750kg/ha + 100% RDN	15.02[b]	8.18[a]	30.38[a]	4.58[b]
Poultry dropping @ 1550kg/ha + 125% RDN	18.19[a]	8.67[a]	32.13[a]	4.84[a]
SEM (±)	0.326	0.899	0.825	0.035
CD (0.05%)	1.151	0.536	2.909	0.122
Weed control methods (W)				
Atrazine@800g/ha	14.48[c]	7.89[b]	30.51[b]	4.52[c]
Atrazine@800g/ha + pendimethalin 100ml/ha	16.24[b]	8.06[b]	31.60[a]	4.97[b]
Tembotrione@100Ml/ha	18.18[a]	8.77[a]	33.56[a]	5.69[a]
Live mulch (Cowpea)	15.09[b]	8.09[b]	31.33[a]	4.50[c]
Weedy check (control)	9.33[d]	6.34[c]	20.03[c]	1.55[d]
SEM (±)	0.536	0.681	0.881	0.028
CD (0.05%)	1.552	0.522	2.549	0.080
Interaction (NxW)	NS	NS	NS	NS

Means followed with the same letters with column are statistically similar at (0.5) level. t ha^{-1}= tons per hectare, RDN= recommended dose of nitrogen, ml/ha= mil per hectare, SEm ± =standard error mean, CD= critical difference, NxW= interaction between nutritional sources and weed control.

DISCUSSION

Response of maize to nutritional sources

The increased cob length, cob diameter and test weight of maize in poultry dropping + RDN applied plots was statistically higher than that in poultry dropping plots at all the sampling periods. The higher mean values observed in 125% RDN + 1,550 kg/ha poultry dropping could be attributable to more accessible nitrogen and other key mineral nutrients from urea and poultry dropping. This enhanced the soil's moisture retention, resulting in more vigorous plants. This study is consistent with the findings of (Bhatt et al. 2020), who found that the availability of essential minerals, particularly nitrogen, was an important factor in determining the number of grains per cob. The higher grain yield of maize obtained in the poultry dropping at 1,550 kg/ha + 125% RDN was due to higher mean values recorded in most of the yield attributes combined with a timely supply of nitrogen and other essential mineral nutrients from organic and inorganic sources, resulting in an increase in maize productivity. This result corresponds with that of (Negassa et al. 2001 and Bhatt et al. 2020). They found the highest maize grain production due to enhanced cob and grain weight from combining organic and inorganic fertilizers.

Effect of weed control treatments on weed infestations

The result of these findings indicates that the post-emergence application of tembotrione at 100ML/ha provided better weed control than the pre-emergence spray atrazine 800g/ha and atrazine + pendimethalin (800g/ha + 100ML/ha), live mulch and weedy check. The possible reason could be that there was good weed control in the tembotrione applied plot. Likewise, the increase in weed control efficiency observed as a result of faster foliar absorption of tembotrione by the weeds in a plot is not surprising because there is fast foliar absorption of the herbicide by the weeds, which results in a drastic reduction of weed density and dry weight. This work corroborates with [Kumar et al. (2015) Triveni *et al.* (2016), Sonali Biswas (2018) and Mahesh Kumar (2019)]. They reported higher weed control efficiency in the post-emergence application of tembotrione 50 grams per hectare + atrazine 500 grams per hectare (93.6 and 96.6%) over other treatments at 40 days after sowing. The lower weed control efficiency observed in weedy check plots resulted from intense competition for limited environmental resources, which resulted in a reduction in crop performance. All the weed control treatments significantly enhanced yield and yield attributes of maize compared to the weedy check. The positive response of most of the yield components such as cob length, cob weight, 100-grain weight straw, biological and grain yield to weed control treatments in both seasons could also be attributed to effective weed control management and the ability for weed control measures applied to control weeds beyond the level that can have a harmful effect on the performance of maize crops. This result concurs with that of Kandasamy *et al.* (2018). They reported a significant increase in cob length, diameter, number of seeds per cob, cob weight, and maize seed yield in herbicide-treated plots over the weedy check.

REFERENCES

Akobundu, I. O.and Ekeleme F. (2000). EFFECT OF *Iperata cylinderica* management on maize grain yield in the dried savannah of south western Nigeria. *Weed Research* 40:335-341

Anonymous. (2003). Department of agriculture-Republic of South Africa (DARSA). Maize production. Retrieved from http://www.nda.agric.za/publications

Babatunde, R. O., Fakayode, S. B., & Obafemi, A. A. (2008). Fadama maize production in Nigeria: case study from Kwara State. *Research Journal of Agriculture and Biological Sciences*, *4*(5), 340-345.

Bhatt, K. R., Bhattachan, B. K., Marahatta, S., & Jagat, B. (2020). Growth and profitability of maize (Zea mays L.) under sole and combined applications of different organic and inorganic nutrient management at Rampur,
Chitwan, Nepal. *Journal of Biology and Today's World*, *9*(2), 1–6.

FAOSTAT. (2019). Retrieved from http://www.fao.org/faostat/en/data/Qc

Kandasamy, S. (2018). Studies on weed management in irrigated maize. *Journal of Agricultural Research*, *3*(1), 1–
3.

Kumar, A., Kumar, J., Puniya, R., Mahajan, A., Sharma, N., & Stanzen, L. (2015). *Weed Management in*

Maizebased Cropping System (pp. 254–266).
Lagoke, S. T. O., D. O. Katana and O. A. Ogungbile (1981). Potential for improved weed control practices in field
crop production in the savannah zone. Paper presented at the first seminar on Green Revolution in Nigeria.
Negassa, W., Negisho, K., Friesen, D. K., Ransom, J., & Yadessa, A. (2001). Determination of Optimum farmyard Manure and NP Fertilizers for Maize on farmers Field. In Seventh Eastern and Southern Africa regional maize conference, *11*.
Sonali, B., Debnath, S., Abhijit, S., & Benukar, B. (2018). Weed management in maize system in new alluvial zone of West Bengal, India. *International Journal of Current Microbiology and Applied Sciences*, *7*(4), 1344– 1350.
Triveni, U., Rani, Y. S., Patro, T. S. S. K., & Bharathalakshmi, M. (2017). Effect of different pre-and postemergence herbicides on weed control, productivity and economics of maize. *Indian Journal of Weed Science*, *49*(3), 231–235. doi:10.5958/0974-8164.2017.00061.2
USDA (2021) https://quickstats.nass.usda.gov.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

YIELD RESPONSE OF SOME SELECTED SOYBEAN (*Glycine max* [L.] Merrill) VARIETIES TO VARYING WEEDING REGIMES IN GUSAU NORTHERN GUINEA SAVANNAH, NIGERIA

A.I. Take-tsaba and Mannir Farilu

Department of Agricultural Science Education, School of Secondary Education (Vocational), Federal College of
Education (Technical), Gusau, P.M.B. 1088, Zaria Road Gusau, Zamfara State, Nigeria
*Corresponding author (taketsaba1@gmail.com)

ABSTRACT

A field experiment was conducted during 2020 rainy season at the Teaching and Research Farm of the Department of Agricultural Science Education, School of Secondary Education (Vocational), Federal College of Education (Technical), Gusau to study the performance of four soybean varieties (three improved varieties 'TGX 1448-2E', 'TGX 1904' and 'SAMSOYA 2' and one local variety 'Danbulagi') to different weeding regimes. The experiment was a factorial combination of variety and weeding regimes in a split plot design in randomized complete block arrangement with three replications. The three weeding regimes [no weeding (control), one hoe weeding at 3 weeks after sowing (WAS) and two hoe weeding interventions one at 3 WAS and one at 6 WAS] were allocated on the main plot level and four varieties of soybean (TGX 1448-2E, TGX 1904, SAMSOY 2 and Danbulagi) on the subplot level. At harvest data were collected on number of pods plant^{-1}, pod weight plant^{-1}, number of seeds plant^{-1}, 100-seed weight, soybean dry weight, harvest index, soybean seed yield, relative grain yield loss and weed competitive index. The competing weeds were also identified, sampled, counted, dried, weighed and recorded at 3, 6 WAS and at harvest. Relative density and relative dry weight and summed dominance ratio of the weed species were also determined at harvest. The results showed significant ($P<0.05$) differences among weeding regimes on number of pods and seeds plant^{-1}, pod weight plant^{-1}, seed yield and plant biomass while a highly significant ($P<0.01$) difference among the varieties in all the traits studied except harvest index. The results also showed significant ($P<0.05$) differences among weeding regime × variety interaction on weed dry weight at harvest and cumulative, number of pods and seeds plant^{1}, pod weight plant^{-1}, grain yield and plant biomass. Weeded once gave the highest seed yield (1.95 tons ha^{-1}) while 'TGX 1904' variety gave the highest (1.85 tons ha^{-1}) seed comparable with SAMSOYA 2 (1.79 tons ha^{-1}). The result of this study showed that there were varietal differences among the varieties. Varieties TGX 1904 and SAMSOYA 2 performed better than other varieties tested. Also, 'SAMSOYA 2' weeded twice gave the highest (2.27 tons ha^{-1}) seed yield comparable with all the other varieties across various weeding regime except Danbulagi weeded twice (1.12 tons ha^{-1}), SAMSOYA 2 in weedy check plots (1.13 tons ha^{-1}) and 'TGX 1448-2E' in weedy check plots (0.95 tons ha^{1}) which were comparable to each other. The results also showed that weedy check plots and weeded twice inevitably had the highest yield reduction in all the varieties except 'TGX 1904' variety that performed similar across the weeding regimes. Among the varieties, TGX 1904 gave the highest weed competitive index (1.18) while Danbulagi gave the lowest (7.10 and -28.57) relative seed yield loss in weeded once and weeded twice respectively. Therefore, for higher yields, varietiesTGX 1904' and 'SAMSOYA 2', weeding 'SAMSOYA 2' variety twice is recommended to farmers in the northern Guinea Savanna agro ecological zone of Nigeria.

Keywords: Soybean; weeding regimes; legumes; variety.

INTRODUCTION

Soybean is an annual *herbaceous* leguminous crop which belongs to the family Fabaceae, subfamily Faboideae, genus Glycine and subgenus Soja (Asiegbu and Okpara, 2002; Singh *et al.*, 2003). Soybean (*Glycine max* (L.) Merril) known as Chinese beans originated from North-eastern China and has been cultivated for the past three millennia (Simmond *et al*., 1999). Soybean is the most important grain legume crop in the world in terms of total production and international trade (Simmond *et al*., 1999). The crop has the highest protein content of 30-50% of all food crops and is equivalent to protein of animal products and used to fortify various foods in order to improve their nutritional quality (Kwarteng and Towler, 1994; IITA, 1990). It is second only to groundnut in terms of oil content (20%) among food legumes on a dry matter basis which is 85% unsaturated and cholesterol-free (Fouilleux *et al*., 1996; Dugje *et al*., 2009).

Soybean performance during cultivation is a function of crop genetic composition and environmental factors; hence both abiotic and biotic factors must be optimum. One of the most important aspects of soybean production is weed management. Uncontrolled weeds could reduce yield of soybean by up to 5% depending on the density and variety (Nathanael *et al*., 2013). Uncontrolled weeds not only reduce soybean yields through their competition for light, nutrients, and moisture, but they can also severely reduce harvest efficiency (Norris, 1999). The most effective weed management programs in soybeans uses a combination of cultural, mechanical, and chemical control strategies (Grichar *et al*., 2004). Cultural practices improve weed control by enhancing the competitive ability of the crop. Hand weeding has remained the most widely practiced cultural weed control technique in the tropics perhaps because of the prohibitive cost of herbicides, fear of toxic residues and lack of knowledge about their use. It is unethical to cultivate soybean without weeding operation carried out from the time of sowing to harvest, or engage in daily weeding. Some farmers weed their plots twice before crop maturity, considering the cost of labour, others, three times, all to ensure optimum yield. However, the frequency and sequence of such weeding are usually at the farmer's discretion and may not be economical (Iremiren, 1988). Use of aggressive cultivars can be effective cultural practice for weed growth suppression (Wicks *et al*., 2004; Mennan, and Zandstra, 2005). A potential method for reducing herbicide application is development of competitive crop cultivars. Lemerle *et al*. (1996) suggested these crop cultivarsan act to increase the efficiency of partially weed suppressive like mechanical weeding or reduced-rate of herbicide applications and achieve better performance from integrated control. The competitive ability of crops can be expressed in two ways. First is the ability of the crop to compete with weeds, reducing weed seed and dry matter production. The second possibility is having crops tolerate competition from weeds while maintaining high yields. Numerous crops exhibited cultivars differences in competitive ability (Munger *et al*., 1987).

The objective of the study, therefore, was to evaluate the performance of some varieties of soybean cultivated under different weeding regimes to know which treatment and treatment combination would suppress weed in this agro ecology as well as estimate soybean traits associated with total seed yield.

MATERIALS AND METHODS

Experimental Site Description

A field experiment was conducted during 2020 rainy season at the teaching and research farm of the Department of Agricultural Science Education, School of Secondary Education (Vocational), Federal College of Education (Technical), Gusau Northern Guinea Savanna ecological zone of Nigeria. In Gusau, the farm is located on latitude 12º 9' 46.25" N and longitude 6º 40' 28.22" E and at an altitude of about 495.98 m above sea level (asl), characterized by moderate annual rainfall distribution and total of 1160 mm most of which fall between May and October in the year 2020 (ZADP, 2020).

Sources of Soybean Seeds

Three varieties of improved soybean (TGX 1448-2E, TGX 1904 and SAMSOY 2) seeds were obtained from seed unit of (Institute for Agricultural Research, Ahmadu Bello University (IAR, ABU) Samaru, Zaria and one local variety (*Danbulagi*) from a farmer in the localities were used in this study.

Experimental Design and Treatments

The experiment was a factorial combination of variety and weeding regimes in a split plot design in randomized complete block arrangement with three replications. The three weeding regimes (no weeding (control), one hoe weeding at 3 WAS and two hoe weeding interventions, one at 3 WAS and one at 6 WAS) were allocated on the main plot level and four varieties of soybean (*Danbulagi*, TGX 1448-2E, TGX 1904 and SAMSOY 2) on the subplot level.

Crop Management Practices

Land preparation was done by working the existing vegetation mechanically into the soil using a tractor implement plough followed by harrowing to achieve a good soil tilth. Plots measuring 2.5 m × 4.5 m (11.25 m^2) were demarcated and ridged at 75 cm inter-row spacing with 1.0 m spacing between blocks and 0.50 m spacing between plots. The total experimental area measured 20.25 m × 27.5 m (556.875 m^2) containing three blocks of 37.4 m × 6 m (224.4 m^2). The three blocks (columns: north-south direction), and each was sub-divided into three (3) main plots measuring 2.5 m × 19.5 m (48.75 m^2) each containing four (4) sub-plots measuring 2.5 m × 4.5 m (11.25 m^2) (rows: east-west direction) making a total of 32 plots. The gross plot sizes were 4.5 m × 2.5 m (11.25 m^2) and net plot sizes were 2.0 × 3.0 m (6.0 m^2). Each plot consisted 6 ridges of 2.5 m length and 4 ridges of 2 m length in the gross and net plot respectively constituting 6 rows with ten (10) hills row^{-1} in the gross plots and 4 rows in the net plots with 8 (eight) hills row^{-1} respectively giving a total of 60 and 32 hills $plot^{-1}$ in the gross and net plot respectively. In order to protect the seeds from soil borne diseases and pests, the seeds were dressed with Apron- star at the rate of 10 g of the chemical per 2.0 kg of seed before sowing. Sowing was done on 6th July 2020 at the spacing of 75 cm inter-row and 25 cm intra-rows. Six soybean seeds were sown at the depth of 3-5 cm by dibbling and were thinned down to 3 seedlings at 14 days after sowing (DAS).

Weeding was carried out manually using a hand hoe at 3 and 6 WAS according to treatments. Compound fertilizer (NPK 15:15:15) was applied uniformly at the rate of 250 kg ha^{-1} in split doses at 3 and 6 weeks after sowing by burying the fertilizer material in trenches dug at 5 cm away from the hill. Insecticide Sharp Shooter (Profenofos 40% + Cypermethrin 4% EC) was applied at the rate of 660 g a.i. ha^{-1} at 3 WAS followed by 10 days interval up to harvest. Fungicide (Mancozeb) was applied at the rate of 2.5 kg a.i. ha^{-1} to curtail insect attack and disease incidence on young plants. At the end of growing season, all plants in 2 m length of 4 inner rows were harvested and weighed in each plot; to evaluate the crop yield and weed biomass, while the outer rows of the gross plot was discarded. Harvesting was done on 4th November, 2020 manually by cutting the entire plants at ground level.

Data Collection

Data were collected on number of pods $plant^{-1}$, pod weight $plant^{-1}$, number of seeds $plant^{-1}$, 100-seed weight, soybean dry weight (plant biomass), harvest index, soybean seed yield, relative grain yield loss and weed competitive index. The competing weeds were also identified, sampled, ounted, dried, weighed and recorded at 3, 6 WAS and at harvest. Relative density and relative dry weight and summed dominance ratio of the weed species were also determined at harvest. The dominant or major weed species were determined by computing SDR values as follows:

$$\text{SDR of a species} = \frac{\text{Relative density} + \text{Relative dry weight}}{2}$$

Relative density and relative dry weight were determined as follows:

$$\text{Relative density of a species} = \frac{\text{Absolute density of a species}}{\text{Total absolute density of all species}} \times 100$$

$$\text{Relative dry weight of a species} = \frac{\text{Absolute dry weight of a species}}{\text{Total absolute dry weight of all species}} \times 100$$

Absolute density of a species was equal to the total number of plants of that species in the sampled plot and absolute dry weight of a species was the total dry weight of that species in the sampled plot.

Harvest index (HI) (%)

Harvest index is the proportion of grain in the total biomass of the plant and was obtained by taking the ratio of the weight of seeds to the total dry plant materials. This was calculated by using the following formula:

$$\text{Harvest index (HI)} = \frac{\text{Seed yield (tons ha}^{-1}\text{)}}{\text{Total biomass (Seed yield + haulms yield) (tons ha}^{-1}\text{)}} \times 100$$

Relative seed yield loss (RSYL) (%)

The relative grain yield loss (%) was calculated using the formula of Haefele *et al.* (2004):

$$\text{Relative seed yield loss} = \frac{\text{Weeded twice yield} - \text{treatment yield}}{\text{Weed twice yield}} \times 100$$

Weed competitive index

Crop competitiveness was measured as weed competitive index (WCI) and was calculated as follows:

$$WCI = \frac{\left(\frac{V_{infest}}{V_{mean}}\right)}{\left(\frac{W_i}{W_{mean}}\right)},$$

Where V_{infest} is a yield of variety (i) in terms of weed infested, V_{mean} is the average yield of all varieties in the presence of weed, W_i is the weed biomass of varieties i, W_{mean} is average weed biomass in mixed with all varieties.

Data Analysis

Data collected were analyzed using the PROC GLM procedure in SAS software (SAS 9.4, SAS Institute, Cary, North Carolina, USA) in order to determine any significant differences among the treatments and the means for the main effect of the two factors were separated using Duncan's New Multiple Range Test (DNMRT) (Duncan, 1955), as outlined in the SAS (2004) procedure (version 9.4).

RESULT AND DISCUSSION

Weed Species Composition at the Experimental Site after Treatments

Analysis of the weed vegetation at the experimental site after treatments indicated a mixed weed composition spreading over ten (10) families (Table 1). A total of eighteen (18) weed species were identified consisting of ten (10) broad leaves, five (5) kinds of grass and three (3) sedges. The weed flora dominantly consisted of five (5) kinds of broad leaves with total relative density of 63.46% and relative dry weight of 62.38%, followed by one (1) grass with a relative density of 14.71% and of relative dry weight 12.92%. In terms of their relative density and relative dry weight, about 64.93% (relative density) and 62.49% (relative dry weight) of the weed species were represented by four (4) species. Three (3) out of the four (4) species were represented by broad leaf and one (1) grass. Based on their relative density and relative dry weight, three (3) species were found to dominate the site. These were *Bidens pilosa* Linn., *Commelina bengalensis* L. (broad leaf species), *Paspalum scrobiculatum* Linn. (Grass species). Compared to other species present, *Bidens pilosa* Linn.had the highest relative density (23.3%) and relative dry weight (25.58%), followed by *Commelina bengalensis* L. with a relative density (17.53%) and relative dry weight (17.81%) then followed by *Paspalum scrobiculatum* Linn. with a relative density (14.71%) and relative dry weight (12.92%). The least dominant species were *Cyperus esculentus* Linn.with relative density 0.79% and relative dry weight 0.48%, *Eleusine indica* Gaertn with 0.45% relative density and 0.42% relative dry weight.

The high broadleaf composition of the weed flora was attributed to the favourable abiotic factors of temperature, rainfall, light and nutrient as well as cultivation practices, which provides ideal environmental conditions for weed growth and weed species composition is always associated with the crop species (Akobundu, 1987). Despite the fewer number of grasses observed, they create serious physiological threats to soya bean and farm management practices. Grass species particularly

Table 2: Weed species composition, relative density, relative dry weight and summed dominance ratio in field of
Soybean during 2020 rainy season in Gusau Northern Guinea Savannah

Scientific name of weed species	Common name	Family	Relative density (%)	Relative dry weight (%)	Summed dominance ratio
Broadleaves					
Ageratum conyzoides Linn.	Billy goatweed	Astraceae	9.39	6.18	7.79
Ammannia baccifera L.	Blistering Ammania	Lythraceae	1.92	2.38	2.15
Bidens pilosa Linn.	Cobblers pegs	Astraceae	23.3	25.58	24.44
Chamaecrista mimosoides (L.) Greene	Japanese tea	Leguminosae: C aesalpinioidea e	1.24	1.06	1.15
Commelina bengalensis L.	Wandering jew	Commelinacea e	17.53	17.81	17.67
Cyanotis lanata Benth.		Commelinacea e	0	0	0
Euphorbia hyssopifolia Linn.	Hyssop leaf sandmat	Euohorbiaceae	2.6	3.36	2.98
Ludwigia decurrens Walt.	Water promise	Onagraceae	5.77	8.71	7.24
Mitracarpus villosis (Sw.) DC.		Rubiaceae	7.47	4.1	5.78
Sida acuta Burn. f.	Broom weed	Malvaceae	1.81	1.19	1.5
Vigna Luteola (Jacq.) Benth		Leguminosae	1.81	2.88	2.35
Grasses					
Eleusine indica Gaertn.	Goose grass	Poaceae	0.45	0.42	0.44
Eraggrostis trmula Hochst. ex Steud	Love grass	Poaceae	2.6	3.78	3.19
Paspalum scrobiculatum Linn.	Ditch millet	Poaceae	14.71	12.92	13.81
Rottboellia					

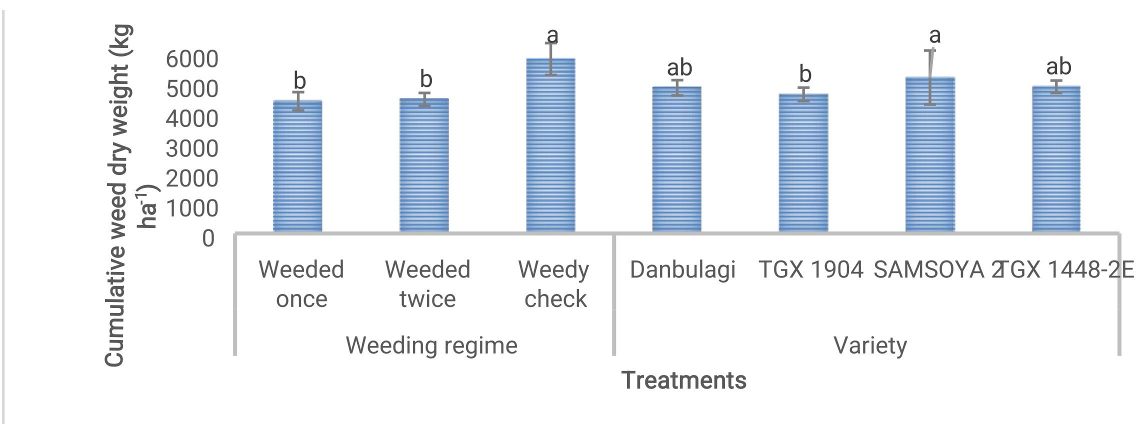
cochinchinensis (Lour.) Clayton	Corn grass	Poaceae	3.85	5.28	4.56
Thelepogon elegans Roth ex Roem. & Schult		Poaceae	1.47	0.97	1.22
Sedges					
Cyperus amabilis Vahl	Foothill flatsedge	Cyperaceae	2.26	1.74	2
Cyperus esculentus Linn.	Yellow nutsedge	Cyperaceae	0.79	0.48	0.63
Schoenoplectus senegalensis (Hochst. Ex. Steud)		Cyperaceae	1.02	1.17	1.1

Rottboellia cochinchinensis (Lour.) Clayton, *Thelepogon elegans* Roth ex Roem. & Schult, *Paspalum scrobiculatum* Linn. and *Eleusine indica* Gaertn. were observed to be very difficult to control in soya bean crop production systems, due to stubbornness nature of their seedlings and upright growth then soya bean and their highly efficient mode of carbon fixation (Akobundu, 1987).

The summed dominance ration of broadleaves, grasses and sedges at the experimental site at harvest were 73.05, 23.22% and 3.73 respectively.

Weed Dry Weight (kg ha^{-1})

The effect of weeding regimes, variety (Figure 3) and weeding regimes × variety interactions on weed dry weight during 2020 cropping season is presented in Figure 1.



D

Figure 1: Effect of weeding regimes and variety on cumulative weed dry weight in weedy plots of soybean in Gusau Northern Guinea Savannah

Note: WAS = weeks after sowing. Different letter(s) above bars under each factor indicate a significant difference at $p<0.05$ according to Duncan's new multiple range test (DNMRT). Error bar is SE values.

Effect of weeding regimes: The results shows that there was highly significant ($P<0.01$) different effect of weeding regimes on cumulative weed dry weight of soybean. Weedy check plots recorded the heaviest (5836.20 kg ha^{-1}) weed dry weight differently from other weeding regime which adversely affected yield. This is probably because it has been observed that higher weed competition brings about intense competition for light which lowers the photosynthetic strength as well as number of stomata of the crop and hence, the yield (Fabro and Rhodes, 1980; Iyagba *et al.*, 2013). This is probably due to regular and sufficient weeding.

Effect of soybean variety: The results (Figure 3) shows that there was no significant (P>0.05) different effect of variety on weed dry weight of soybean at all sampling periods except at 6 WAS. SAMSOYA 2 gave the heaviest (13.11 kg ha^{-1}) weed dry weight at 6 WAS comparable with the other varieties except *Danbulagi* (9.33 kg ha^{-1}).

Effect of weeding regimes × variety interactions: The result (Table 2) shows that there was highly significant (P<0.001) different effect of weeding regimes × variety interactions on cumulative weed dry weight. SAMSOYA 2 in weedy check plots recorded the heaviest (8694.67 kg ha^{-1}) weed dry weight differently from the other varieties subjected to various weeding regimes. Similarly, SAMSOYA 2 weeded once gave the lightest (2821.33 kg ha^{-1}) cumulative weed dry weight also different from all the other varieties.

Table 3: Interaction effect of weeding regimes × variety on cumulative weed dry weight (kg ha^{-1}) of soybean in Gusau northern guinea savannah zone of Nigeria.

Variety	Weeding regimes		
	Weeded once	Weeded twice	Weedy check
Danbulagi	4794.67c	4138.67c	5693.33b
SAMSOYA 2	2821.33d	4142.67c	8694.67a
TGX 1904	5406.67b	4069.33c	4496.00c
TGX 1448-2E	4672.67c	5595.33b	4460.67c
SE (±)	263.254		
LSD	782.195		

Means within row and column under each parameter followed by the same letter are not significantly different at P=0.05 using least significant difference (LSD), WAS = weeks after sowing

Number pods, seeds, pod weight plant^{-1} and 100-seed weight

The effect of weeding regimes, variety and interactions of weeding regimes × variety on number pods, seeds, pod weight plant^{-1} and 100-seed weight during 2020 cropping season is presented in Table 3.

Effect of weeding regimes: The results shows that there was no significant (P>0.05) different effect on 100seed weight but there was significant (P<0.05) different effect on number of pod, number of seeds and pod weight plant^{-1}. Weeded once produced the highest (60.04, 127.28 and 29.46g) number of pod, seeds and pod weight plant^{-1} respectively different from weedy check on number of pod but different from the other weeding regime on number of seeds and pod weight plant^{-1}. This could be attributed to frequent weeding adequate to check down weeds growth which conformed to the findings of Dugie *et al.* (2009) who reported that weeding suppressed or minimized the growth, development and competitive capacity of weeds thereby enhancing optimum pods formation. Nangju (1980) also reported that weeding of soybean field ensures availability of nutrients such as phosphorus, potassium, nitrogen and other micro-nutrients which promote rapid and more pod formation. Weedy check plots produced the least (46.15, 99.86 and 22.27g) number of pods, seeds and pod weight plant^{-1} respectively at par with the other weeding regime except weeded once on all these traits This is due to high competition by weeds for nutrients stated above as well as moisture, light, space and other growth factors over the plant, which lead to less pod formation and development. This was in line with the study conducted by Odeleye *et al*, (2007) which suggest that plots with better weeds control also result into higher fruits yields. It is a known fact that weed competition with crops more than necessary has always led to yield reduction in crops.

Effect of soybean variety: The result shows that there was a highly significant (P<0.001) different effect on number of pods, seeds and pods weight plant^{-1}. On number of pods, TGX 1448-2E produced more (60.57) number of pods plant^{-1} differently from other varieties. Danbulagi recorded the least (44.08) number of pods plant^{-1} differently from other varieties. On number of seed and pod weight plant^{-1}, SAMSOYA 2 produced more (124.20 and 30.51g) number of seeds and pod weight plant^{-1} different from the other varieties. Danbulagi produced the least (87.97 and 22.50g) number of seeds and pod weight plant^{-1} different from the other varieties on all traits except on pod weight in which it was comparable with TGX 1448-2E. This might be due to genetic capacity possess by plant. This agrees with the report of (Aduloju *et al*., 2009; Mudibu *et al*., 2011) the differential performance of varieties can be attributed to the inherent genotypic variations.

Table 3: Effect of weeding regime, variety and interactions of weeding regimes × variety on number pods, seeds, pod weight plant^{-1} and 100-seed weight of soybean in Gusau northern guinea savannah zone of Nigeria

Treatments	Number of pods plant^{-1}	Number of seeds plant^{-1}	Pods weight plant^{-1} (g)	100-seed weight (g)
Weeding (W)				
Weeded once	60.04a	127.28a	29.46a	15.21 a
Weeded twice	52.82ab	100.24b	23.42b	14.93 a
Weedy check	46.15b	99.86b	22.27b	14.13 a
Significance level	*	***	**	Ns
SE (±)	2.033	1.482	0.520	0.304
Variety (V)				
Danbulagi	44.08c	87.97d	22.50c	17.25 a
TGX 1904	54.99b	109.36c	24.42b	14.30 b
SAMSOYA 2	52.37b	124.20a	30.51a	15.56 b
	***	***	***	Ns
	2.532	2.383	0.894	0.767
TGX 1448-2E	60.57a	114.97b	22.76c	11.91 c
Significance level	***	***	***	***
SE (±)	1.462	1.376	0.516	0.443
Mean	53.00	109.12	25.05	14.76
CV (%)	8.27	3.78	6.18	9.00
Interaction (W × V)				
Significance level				
SE (±)				

Means in a column for each factor followed by the same letter(s) are not significantly different at P=0.05 using Duncan's new multiple range test (DNMRT), *, *** represent significant at P≤0.05 and P≤0.001 respectively

Effect of weeding regimes × variety interactions: The results in Table 4 shows highly significant (P<0.001) different effect of interaction on number of pods, seeds and pod weight plant^{-1}.

Table 4: Interaction effect of weeding regimes × variety on number of pods, seeds and pod weight plant^{-1} of soybean in Gusau northern guinea savannah zone of Nigeria

Variety	Weeding regimes		
	Weeded once	Weeded twice	Weedy check
Number of pods plant^{-1}			
Danbulagi	46.34c	36.34d	49.55c
SAMSOYA 2	53.51c	64.97b	38.63d
TGX 1904	66.90a	51.90c	46.18c
TGX 1448-2E	73.41a	58.07bc	50.23c
SE (±)	2.532		
LSD	7.523		

Number of seeds plant^{-1}			
Danbulagi	90.14e	65.48g	108.28d
SAMSOYA 2	127.67c	135.93b	108.99d
TGX 1904	136.87b	96.07e	95.16e
TGX 1448-2E	154.42a	103.49d	87.00f
SE (±)	2.383		
LSD	7.080		
Pod weight plant^{-1}			
Danbulagi	25.49c	17.31f	24.71d
SAMSOYA 2	30.05b	35.84a	25.65c
TGX 1904	29.89b	21.18e	22.20d
TGX 1448-2E	32.43b	19.36e	16.50f
SE (±)	0.894		
LSD	2.656		

Means within row and column under each parameter followed by the same letter are not significantly different at P=0.05 using least significant difference (LSD)

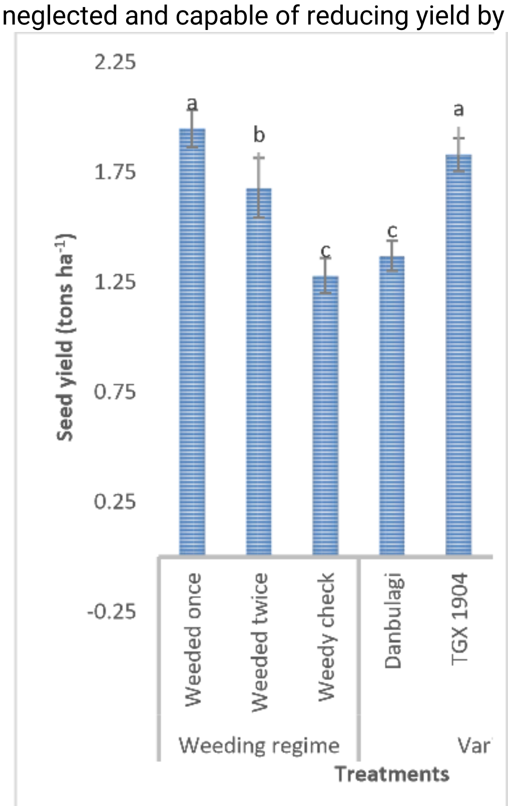
TGX 1448-2E weeded once recorded more (73.41) number of pods plant^{-1} comparable with TGX 1904 weeded once (66.90), while Danbulagi weeded twice recorded (36.34 plant^{-1}) least number of pods comparable with SAMSOYA 2 (38.63 plant^{-1}). On number of seeds, TGX 1448-2E weeded once record more (154.42 plant^{-1}) number of seeds differently from the other varieties across the various weeding regime. Danbulagi weeded twice recorded the least (65.48) number of seeds plant^{-1} also differently from the other varieties across the various weeding regime. On pod weight, SAMSOYA 2 weeded twice recorded the heaviest (35.84 g plant^{-1}) pod weight different form the other varieties, while TGX 1448-2E in weeded twice and weeded check plots recorded the lightest (19.36 g plant^{-1} and 16.50 g plant^{-1}) comparable with all the other varieties except TGX1904 weeded once, TGX 1448-2E weeded once, SAMSOYA 2 weeded twice and weeded once. This might be due to absent of weeds in these plots that can inhibit growth of plants. This agrees with Dugje *et al*. (2009) who noted that weeding reduce the growth, development and competitive ability of weeds by that improving optimum pod formation and development. Lamptey *et al*. (2015) quoted that weeding of soybean field would make some nutrients such as Phosphorus, Nitrogen, Potassium and other micro-nutrients readily available which of course promote fast and prolific pod formation.

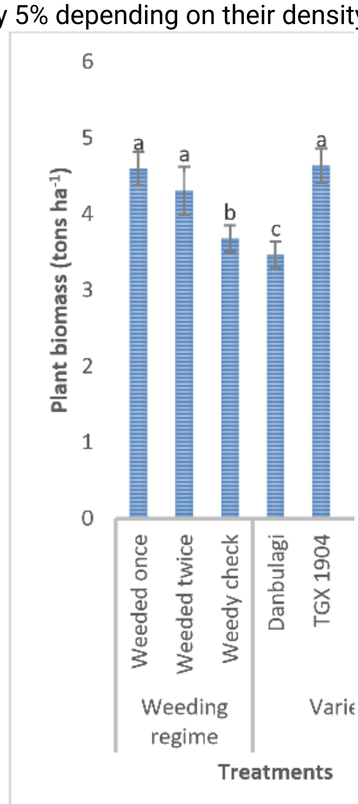
Seed yield, plant biomass (tons ha^{-1}) and harvest index (%)

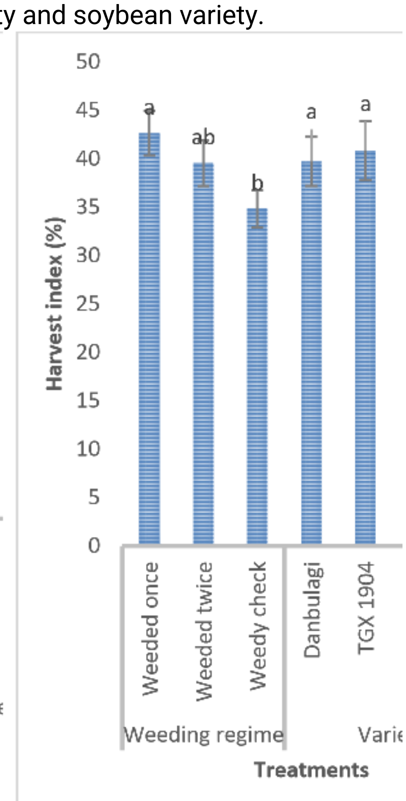
The effect of weeding regimes and variety on seed yield, plant biomass and harvest index during 2020 cropping season is presented in Figure 2.

Effect of weeding regimes: The results shows that there was highly significant (P<0.001) different effect on seed yield and plant biomass and no significant (P>0.05) different effect on harvest index. Weeded once produced the highest (1.95 tons ha^{-1} and 4.60 tons ha^{-1}) seed yield and plant biomass respectively different from the other weeding regime on seed yield but comparable with weeded twice on plant biomass. According to Pedersen and Lauer (2004), weed control enhanced adequate flowering through the length and quality of light needed by the soybean plant which had great impact on its grain yield. Moreover, the availability of adequate soil moisture, nutrients and other growth factors due to less weed competition also contributed to optimum soybean yield which is similar to the study conducted by Reddy (2002). Weedy check record the lowest (1.28 tons ha^{-1} and 3.68 tons ha^{-1}) seed yield and plant biomass different from the other weeding regimes due to high density, growth and competition of weeds. Weeds such as *Senna obtusifolia*, *Paspalum srobiculatum* and *Rottboellia cochinchinensis* grew and plant biomass respectively different from the other weeding regime on seed yield but comparable with weeded twice on plant biomass. According to Pedersen and Lauer (2004), weed control enhanced adequate flowering through the length and quality of light needed by the soybean plant which had great impact on its grain yield. Moreover, the availability of adequate soil moisture, nutrients and other growth factors due to less weed competition also contributed to optimum soybean yield which is similar to the study conducted by Reddy (2002). Weedy check record the lowest (1.28 tons ha^{-1} and 3.68 tons ha^{-1}) seed yield and plant biomass different from the other weeding regimes due to high density, growth and competition of weeds. Weeds such as *Senna obtusifolia*, *Paspalum srobiculatum* and *Rottboellia cochinchinensis* grew tall which tend to shade most of the soybean plants thereby reducing the optimum amount of sunlight needed for photosynthesis as reported by Nice *et al*. (2001). Similarly, weeds such as *Cyperus rotundus*, *Ludwingia decurrens*, *Acanthospernum hispidu*m are deep rooted which tend to compete with the soybean plant for nutrients, water and other growth factors available in the soil. According to Nathanael *et al*. (2013) weed is a major pest which reduced yield of soybean by 5% depending on the density and variety.

Effect of variety: The results shows that there was highly significant (P<0.001) different effect on seed yield and plant biomass and no significant (P>0.05) different effect on harvest index. TGX 1904 recorded the highest (1.85 tons ha^{-1} and 4.64 tons ha^{-1}) seed and plant biomass respectively comparable with SAMSOYA 2. *Danbulagi* recorded the lowest (1.34 tons ha^{-1} and 4. 04 tons ha^{-1}) seed and plant biomass respectively different from the other varieties. **Effect of weeding regime × variety interactions:** The results (Table 5) shows that there was highly significant (P<0.001) different effect on seed yield and plant biomass but shows no significant (P>0.05) different effect on harvest index. On seed yield, SAMSOYA 2 weeded twice recorded the highest (2.27 tons ha^{-1}) comparable with all the other varieties across various weeding regime except Danbulagi weeded twice (1.12 tons ha^{-1}), SAMSOYA 2 in weedy check plots (1.13 tons ha^{-1}) and TGX 1448-2E in weedy check plots (0.95 tons ha^{-1}) which were comparable to each other. On plant biomass, TGX 1448-2E weedy once recorded the highest (5.46 tons ha^{-1}) plant biomass comparable with TGX 1904 weeded twice (5.24 tons ha^{-1}), SAMSOYA 2 in both weeded once and weeded twice plots (4.89 tons ha^{-1} and 5.29 tons ha^{-1}). TGX 1448-2E in weedy check plots recorded the lowest (3.04 tons ha^{-1}) plant biomass comparable with *Danbulagi* weeded twice (3.07 tons ha^{-1}). In all the combination the result shows weedy check recorded less, this means that plant subjected to weedy check will not give higher yields and plant biomass due to weed competition on that plots. This agrees with athanel *et al*. (2013) stated that weed is a major pest of soybean which is mostly neglected and capable of reducing yield by 5% depending on their density and soybean variety.







A B C

Figure 2: Effect of weeding regime and variety on: (A) seed yield, (B) plant biomass and (C) harvest index of soybean in Gusau Northern Guinea Savannah

Note: Different letter(s) above bars under each factor indicate a significant difference at p<0.05 according to Duncan's new multiple range test (DNMRT). Error bar is SE

Table 5: Interaction effect of weeding regime × variety on seed yield and plant biomass of soybean in Gusau northern guinea savannah zone of Nigeria

Variety	Weeding regimes		
	Weeded once	Weeded twice	Weedy check
Seed yield (tons ha^{-1})			
Danbulagi	1.55c	1.12d	1.44c
SAMSOYA 2	1.98b	2.27a	1.13d
TGX 1904	2.05ab	1.84bc	1.60c
TGX 1448-2E	2.21a	1.47c	0.95d
SE (±)	0.091		
LSD	0.271		
Plant biomass (tons ha^{-1})			
Danbulagi	3.52dc	3.07d	3.81c
SAMSOYA 2	4.89ab	5.29a	3.75c
TGX 1904	4.55b	5.24ab	4.12bc
TGX 1448-2E	5.46a	3.63c	3.04d
SE (±)	0.237		
LSD	0.703		

Means within row and column under each parameter followed by the same letter are not significantly different at
P=0.05 using least significant difference (LSD)

Weed competitive index and relative seed yield loss (%)

TGX 1904 produced the highest weed competitive index (1.18) (Table 6) while *Danbulagi* produced the lowest weed competitive index (0.85). TGX 1448-2E and SAMSOYA 2 produced the highest (57.01 and 50.22) relative seed yield loss in weeded once and weeded twice respectively, while *Danbulagi* produced the lowest (7.10 and -28.57) relative seed yield loss in weeded once and weeded twice respectively.

Table 6: Weed competitive index and relative yield loss

Variety	Weed competitive index	Relative seed yield loss	
		Weeded once	Weeded twice
Danbulagi	0.85	7.10	-28.57
TGX 1904	1.18	21.95	13.04
SAMSOYA 2	1.03	42.93	50.22
TGX 1448-2E	0.94	57.01	35.37

CONCLUSION

This study has given significant indications on the adequate weeding regimes and suitable variety for a better output per hectare in the soybean grown in Gusau. The results indicated that weeding regimes at various levels influenced growth and yield parameters of soybean, the optimum weeding regime was weeded once while 'TGX 1904' variety out yielded the other varieties, 'SAMSOYA 2' weeded twice gave the highest seed yield comparable with all the other varieties across various weeding regime except Danbulagi weeded twice, SAMSOYA 2 and 'TGX 1448-2E' in weedy check plots. Based on the results of study it may be concluded that weeding twice the field of 'SAMSOYA 2' variety is economically suitable for the cultivation of soybean in Gusau northern guinea savannah agro ecological zone of Nigeria.

The significant effect of different weeding regimes, variety and weeding regimes × variety interactions on the overall performance of soybean observed in the study, it is proposed that more exploration lengthwise this route desires to be carried out transversely in different site to discover which of the weeding regimes, variety, weeding regimes and variety interactions employ weighty effect on the growth and yield of soybean.

REFERENCES

Aduloju, M. O., J. Mahamood and Y. A. Abayomi (2009). Evaluation of soybean (*Glycine max* [L.] Merrill) genotypes for adaptability to a southern Guinea savanna environment with and without P fertilizer application in north central Nigeria. *African Journal of Agricultural Research*, 4 (6): 556-563.

Akobundu, I. O. (1987). *Weed Science in the Tropics: Principles and Practices*. A Wiley-Interscience Publication. John Wiley & Sons. Chichester-New York- Brisbane-Toronto-Singapore, 522 pp.

Asiegbu, J. E. and D. A. Okpara (2002). Soybean production in marginal soils of southeastern Nigeria. In: *Proceedings of 36th Annual conference of the Agricultural Society of Nigeria*. Owerri, Nigeria, 20th-24th October, Federal University of Technology, 104-107.

Dugje, I. Y., L. O. Omoigui, F. Ekeleme, R. Bandyopadhyay, P. Lava Kumar and A. Y. Kamara (2009). *Farmers' Guide to Soybean Production in Northern Nigeria*. Ibadan, Nigeria: International Institute of Tropical Agriculture.

Duncan, D. B. (1955). Multiple range and multiple F tests. *Biometrics* 11: 142.

Fabro, L. E. and R. C. Rhodes (1980). On farm trials on weed control in legumes. *Weed Science Report*, 1979-80. Lagara: Department of Agronomy University of Philippines, 62-66.

Fouilleux, G., C. Revellin, A. Hartman and G. Catroux (1996). Increase of *Bradyhizohium japanicum* numbers in soils and enhanced nodulation of soybeans (*Gycine max* [L] Merrill) using granular inoculants amended with nutrients. FEMS. *Microbiology Ecology*, 20: 173-183.

Grichar, W. J., B. A. Bessler and K. D. Brewer (2004). Effect of row spacing and herbicide dose on weed control and grain sorghum yield. *Crop Protection*, 23: 263-267.

Haefele, S. M., D. E. Johnson, D. M. M'bodj, M. C. S. Wopereis and K. M. Miezan (2004). Field screening of diverse rice genotypes for weed competitiveness in irrigated lowland ecosystems. *Field Crops Research*, 88, 39-56.

IITA (1990). International Institute of Tropical Agriculture. Annual report of the International Institute of Tropical Agriculture. Ibadan Nigeria, 45-47.

Iremiren, G. O. (1988). Frequency of weeding okra (*Abelmoschus esculentus* [L.] Moench) for optimum growth and yield. *Experimental Agriculture*, 24 (2): 247-252. DOI: https://doi.org/10.1017/S0014479700015994.

Iyagba, A. G., B. A. Onuegbu and A. E. Ibe (2013). Growth and yield response of okra (*Abelmoschus esulentus* [L.] Moench) to NPK fertilizer rates and weed interference in South-eastern Nigeria. *International Research Journal of Agricultural Science and Soil Science*, 3 (9): 328-335. DOI: http://dx.doi.org/10.14303/irjas.2013.098

Kwarteng, J. A. and M. J. Towler (1994). *West Africa Agriculture. A textbook for schools and colleges*. Published by Macmillan Press Ltd. 144-116 pp.

Lamptey, S., S. Yeboah, K. Sakodie and A. Berdjour (2015). Growth and yield response of soybean under different weeding regimes. *Asian Journal of Agriculture and Food Sciences*, 3 (2): 155-163.

Lemerle, D., B. Verbeek and N. E. Coombes (1996). Interaction between wheat (*Triticum aestivum*) and diclofop to reduce the cost of annual ryegrass (*Lolium rigidum*) control. *Weed Science*, 44: 634-639.

Mennan, H. and B. H. Zandstra (2005). Effect of wheat (*Triticum aestivum*) cultivars and seeding rate on yield loss from *Galium aparine* (cleavers). *Crop Protection*, 24: 1061-1067.

Mudibu, J., K. K. C. Nkongolo and A. Kalonji-Mbuyi (2011). Morphovariability and agronomic characteristics of soybean accessions from the Democratic Republic of Congo (DR-Congo) gene pool. *Journal of Plant Breeding and Crop Science*, 3 (11): 260-268.

Munger, H. M., J. C. Chandler and F. M. Hons (1987). Soybean (*Glycine max*) velvetleaf (*Abutilon theophrasti*) interspecific competition. *Weed Science*, 35: 647-653.

Nangju, D. (1980). Effect of plant density, spatial arrangement, and plant type on weed control I cowpea and Soybean.

In: I. O. Akobundu (Ed.), Weeds and their control in the humid and sub-humid tropic, p. 188-199. International Institute of Tropical Agriculture, Ibadan.

Nathanael, D. F., M. B. Chris and E. S. David (2013). Soybean yield loss potential associated with early-season weed competition across 64 site-years. *Weed Science Society of America*, 61 (3): 500-507. DOI: https://doi.org/10.1614/WS-D-12-00164.1.

Nice, G. R., N. W. Buehring and D. R. Shaw (2001). Sicklepod (*Senna obtusifolia*) response to shading, Soybean (*Glycine max*) row spacing, and population in three management systems. *Weed* Technology, 15: 155-162.

Norris, R. F. (1999). Ecological implications of using thresholds for weed management. p. 31–58. In D. D. Buhler (Ed.) *Expanding the Context of Weed Management. Food Products*. Press, New York. http://dx.doi.org/).

Odeleye, F. O., O. M. O. Odeleye and O. A. Dada (2007). The performance of soybean (*Glycine max* [L.] Merrill) under varying weeding regimes in south western Nigeria. *NotulaeBotanicaeHortiAgrobotanici Cluj-Napoca*, 35 (1): 27-36. DOI: https://doi.org/10.15835/nbha351247.

Pedersen, P. and J. G. Lauer (2004). Soybean growth and development in various management systems and planting dates. *Crop Science*, 44:508-515. DOI: https://doi.org/10.2135/cropsci2004.5080.

Reddy, K. N. (2002). Weed control and economic comparisons in soybean planting systems. *Journal of Sustainable Agriculture*, 21 (2): 21-35.

SAS (2004). *The SAS system for windows*, Version 9.4. SAS Inst. Inc., Cary, NC, USA.

Simmonds, N. W., J. Smartt, S. Millen and W. Spoor (1999). *Principles of Crop Improvement, 2nd edition*. Published Longman Group Ltd. Pp 252-256.

Singh, C., P. Singh and R. Singh (2003). *Modern Techniques of Raising Field Crops*. New Delhi: Oxford and IBH publishing Co. PVT Ltd.

Wicks, G. A., P. T. Nordquist, P. S. Baenziger, R. N. Klein, R. H. Hammons and J. E. Watkins (2004). Winter wheat cultivar characteristics affect annual weed suppression. *Weed Technology*, 18: 988-998.

ZADP (2020). Zamfara Agricultural Development Project, Gusau. Meteorological data unit

EFFECT OF DIFFERENT LEVELS OF BIOCHAR AND WEED CONTROL METHODS ON THE PERFORMANCE OF MAIZE (*Zea mays* L) IN ALIERO, KEBBI STATE, NIGERIA

M. Ibrahim, M.A. Augie, I. Ahmed and S.S. Noma

Department of Soil Science Kebbi State University of Science and Technology, Aliero
Corresponding author email address: kamsdogo01@gmail.com

ABSTRACT

In order to determine the effect of biochar and weed control methods on maize production. A field trial was conducted during the wet *season of 2021 at the Kebbi State University of Science and Technology, Aliero, Teaching and Research Farm. The treatments consisted factorial combination of four levels of biochar (2t/ha, 1.5t/ha, 1.0 t/ha and 0.0t/ha) and three weed control treatments (atrazine at 750g/ha, 500g/ha and weedy check). And arranged in a randomized complete block design replicated three times. Plots treated with a combination of 2.0 t/ha and 750 g/ha significantly produced the highest values for plant height, number of leaves per plant, shoot dry weight, cob diameter, cob per plant and grain yield in conparison with the rest of the treatments. The study concludes that the application of biochar at 2.t/ha + atrazine at 750g/ha can be adopted for higher yield of maize in the study area.*

Keywords: atrazine maize, weeds, atrazine, biochar, replication

INTRODUCTION

Maize (*Zea mays* L.) is one of the world staple crops, belonging to the grass family known as poaceae. It is a warm season crop that requires temperature between 28-30°C for optimum growth and development. Maize is one of the most important cereal crop worldwide (Ashraf *et al*., 2016a). The crop can be grown on wide range of soils provided there is adequate drainage. According to (FAO, 2012) United States, China and Brazil contribute 63% to the global maize production whilst Mexico, Argentina, India, Ukraine, Indonesia, France, Canada and South Africa are also major maize producing countries. Maize contains protein, crude fiber; either extract or carbohydrate. Maize provides a large amount of energy in the diet of man and animal (livestock). Maize has a variety of uses. Its grain is a rich source of starch, vitamins, proteins, and minerals. One hundred gram of fresh grain contains 361 calories of energy, 9.4g protein, 4.3g fat, 7.4g carbohydrate, 1.8g fibre, 1.3g ash, 10.6 percent water, 140mg vitamins, 9mg calcium, 290mg, phosphorus and 2.5mg iron. In the green state, maize can be parched, baked, roasted, boiled or steamed on the cob. Maize flour has a very mild flavor and is used for making breads and as a thickening agent in foods such as custards and jellies. Popcorn is kernels of certain maize that burst when heated, forming fluffy pieces that are eaten as snacks. The starch extracted from maize grain is used in making confectionery and noodles. Corn syrup from maize contains high fructose and act as sweetener and retains moisture when added to certain foods edible oil is extracted from maize seeds, which is an all-purpose culinary oil, maize can be used as forage feed for livestock and making silage after fermentation of corn stocks. (khawar *et al.* 2007). Maize yield obtained in Nigeria is relatively low when compared to other maize producing countries. This was due to many factors like soil fertility, imbalanced nutrition, disturbed soil properties, cultivars being grown weed infestation etc. in which soil fertility and weed infestation become a serious threat to the crop productivity. In Nigeria farmers used synthetic fertilizers to get higher crop productivity, but over reliance on chemical fertilizers is associated with decline in some soil properties and crop yields over time (Hepperly *et al.*, 2009). Similarly, the increasing cost of this fertilizers make farmers to shy away from using it and look for alternative such as organic manure. Organic manures are used by the farmers to enhanced sustainable crop production. Although farmers are more familiar with organic manures such as farm yard manure, compost, poultry manure, cow dung etc. for soil amendment. Biochar is charcoal obtained from biomass meant to be in cooperated into the soil. It is produced from organic materials releases several essential plant nutrients to the soil solution that significantly determine rate of crop growth and yield in combination with other growth controlling factors (Lehman, 2006). Biochar contained essential plant nutrients which are relatively higher than that of other organic manures, (Purakayastha *et al.* 2016). In Nigeria savannah farmers use manual weeding to control weeds which is tedious, time consuming and sometimes labor is not available. This necessitates the use of selective herbicide such as Atrazine control stubborn weeds in maize as primary treatment. It is line with above challenges this study was carried out to determine the effect of biochar and weed control treatments on the productivity of maize.

MATERIALS AND METHODS

A field trial was conducted during the *wet* season of 2021 at the Kebbi State University of Science and Technology, Aliero, Teaching and Research Farm. The treatments consisted factorial combination of four levels of biochar (2t/ha, 1.5t/ha, 1.0 t/ha and 0.0t/ha) and three weed control treatments (atrazine at 750g/ha, 500g/ha and weedy check). And arranged in a randomized complete block design replicated three times. The experimental field was plowed to a fine soil tilth and leveled manually before planting. Maize seed was planted at a distance space of 25cm and 75cm within a row and between rows, respectively. Two seeds were planted, and one week after emergence, it was thinned out to one plant. Biochar was applied one week before planting on treatments basis and post emergence application of atrazine was also done at 3WAS as per treatments basis. Data on plant height, number of leaves per plant, shoot dry weight were taken at 30, 60, 90 DAS and harvest. Cob diameter, cob per plant and grain yield were also recorded. The data collected was subjected to analysis of variance (ANOVA) using SAS software package and least significance difference was used to separate means that are significant.

RESULTS

Plant Height (cm)

The effect of biochar levels and weed control treatment on plant height of maize is presented in Table 1. There was significant effect of treatments on plant height at all the stages of sampling. At 30DAS application of biochar at 2.0t/ha recorded the tallest plants which was followed by 1.5t/ha that was at par with 1.0t/ha but significantly differed with the control. At 60DAS plots that received higher dose of biochar produced the highest mean values that differed significantly with that of 1.5t/ha, 1.0t/ha and the least mean value was recorded in the control. Like-wise a similar trend was observed at 90DAS. These observations might be due the positive effect of mineral nutrients in biochar for vigorous vegetative growth of maize. In addition, nutrients released from biochar increased soil pH which enhances plant nutrient uptake and utilization leading to production of more vegetative growth of plants particularly plant height. (Schnitzer *et al*. 1997), reported increased height of maize plant treated with biochar compared to plot underutilized with biochar. Moreover, (Syuhada *et al.* 2016) observed increased maize height by 2.45cm for every g/kg of biochar added. However, in weed control methods there was also significant effect of treatments on plant height at all sampling periods where application of Atrazine at higher dose recorded the tallest plants while the shortest plants were found in the weedy check. The observed outcome can be attributed to the effective management of weeds in the plots treated with herbicides, leading to enhanced utilization of growth resources and ultimately resulting in increased vegetative growth of the plant.

Table 1: Effect of biochar levels and weed control treatment on plant height of maize.

	Plant height (cm)		
	30 DAS	60 DAS	90 DAS
Biochar level (t/ha)			
0.0	67.07^{c}	86.11^{d}	89.00^{d}
1.0	78.12^{b}	145.34^{c}	172.56^{c}
1.5	81.00^{b}	162.09^{b}	186.11^{b}
2.0	87.22^{a}	174.18^{a}	196.28^{a}
LSD	5.44	11.34	9.21

Weed control (g/ha)			
Atrazine @ 750	89.22[a]	182.21[a]	193.33[a]
Atrazine @ 500	73.90[b]	158.67[b]	170.18[b]
Weedy check	54.27[c]	68.55[c]	74.00[c]
LSD	3.81	7.83	6.51

Mean followed by different letter (a,b,c) differed statistically (0.05%) level, t/ha= tons per hectare, LSD= least significance difference, Days after sowing.

Leaf Area Index

The influence of biochar and weed control on leaf area of maize is shown Table 2. There was significant effect of biochar levels on leaf area index of maize at all the stages of sampling where application of biochar at 2.0 t/ha recorded the highest LAI that was comparable with the 1.5t/ha but significantly differed with 1.0 t/ha and the least LAI value was recorded in the control at 30, 60, and 90DAS respectively. This could be related to the direct effect of biochar in releasing more amount of plant nutrients and timely available nitrogen, which may be highly responsible for vigorous plant growth as compared to other treatments. (Khan *et al*. 2008) reported increase in LAI with increased application of levels of biochar. A similar result is found by reference (Agegnehu *et al*. 2016) who reported increased leaf area index with main availability of nitrogen fertilizer throughout the life cycle of maize crop. On the other hand, the weed control treatment significantly affects LAI of maize at all the sampling periods where application of Atrazine at 750g/ha consistently recorded the highest mean value while the least value was found in the weedy check. The observed phenomenon can be attributed to the effective management of weeds in the plots treated with herbicides, which therefore enhances light absorption and promotes the formation of abundant photosynthates. As a result, there is a notable rise in the dry weight of the shoots.

Table 2: Effect of biochar levels and weed control treatment on Leaf area index of maize.

Treatments	Leaf area index		
Biochar level (t/ha)	30 DAS	60 DAS	90 DAS
0.0	0.28[c]	1.08[c]	1.10[c]
1.0	0.54[b]	2.62[b]	2.78[b]
1.5	0.66[a]	3.60[a]	3.74[a]
2.0	0.82[a]	3.86[a]	3.95[a]
LSD	0.21	0.46	0.43
Weed control (g/ha)			
Atrazine @ 750	0.53[a]	3.33[a]	3.66[a]
Atrazine @ 500	0.48[a]	3.01[a]	3.21[b]
Weedy check	0.22[b]	1.10[b]	1.15[c]
LSD	0.15	0.33	0.31

Mean followed by different letter (a,b,c) differed statistically (0.05%) level, t/ha= tones per hectare, LSD= least significance difference, Days after sowing.

Shoot dry weight (g), Cob length (cm), Cob diameter (cm), and Grain yield (kg/ha)

The effect of treatments on shoot dry weight, cob length, cob diameter and grain yield are presented in Table 3. The plots that received 2.0t/ha of biochar consistently recorded the highest mean values for these parameters while the control had the least value. This could be attributed to biochar abilities to supply nutrients, better water holding capacity, carbon sequestration, nutrient used efficiency, increase CEC and improved condition for microbial organisms which in-turn has positive and direct effect on growth and development of crop, resulting in increased grain yield. The result concurs with the findings of Yamato *et al*. (2006) who reported on increase in maize grain yield. In weed control treatments application of atrazine at higher rate recorded the highest mean values in all the parameters mention and the lowest mean values were recorded in the weedy check. This was due to efficient control of weeds in the herbicide treated plots that result in better utilization of available growth resources which translate in the final yield of the crop. This result is in agreement with the finding of (Sohi *et al*. 2010) who reported significant increase in maize yield when herbicide is applied to them.

Table 3: Effect of biochar levels and weed control treatment on Shoot dry weight (g), Cob length (cm), Cob diameter (cm), and Grain yield (t/ha)of maize

Treatments	Shoot dry weight (g)	Cob length (cm)	Cob diameter (cm)	Grain yield (t/ha)
Biochar level (t/ha)				
0.0	178.82^{b}	14.50c	3.72^{c}	1.16^{c}
1.0	252.75^{a}	19.28^{b}	4.87^{b}	2.51^{b}
1.5	295.33^{a}	21.14^{a}	5.10^{a}	3.28^{a}
2.0	308.18^{a}	22.94^{a}	5.23^{a}	3.47^{a}
LSD	62.50	1.66	0.19	0.45
Weed control (g/ha)				
Atrazine @ 750	289.00^{a}	21.98^{a}	5.21^{a}	3.33^{a}
Atrazine @ 500	267.70^{a}	20.13^{a}	4.40^{b}	3.01^{a}
Weedy check	144.15^{b}	15.00^{b}	2.81^{c}	0.98^{b}
LSD	44.55	1.16	0.61	0.32

Mean followed by different letter (a,b,c) differed statistically (0.05%) level, t/ha= kilogram per hectare, LSD= least significance difference, Days after sowing, cm=centimeter, g=gram

CONCLUSION

The study concludes that application of biochar at 2.0 t/ha can be used for higher maize yield in the study area.

REFERENCES

Agegnehu, G., A. M. Bass, P. N. Nelson, and M. I. Bird (2016). Benefits of biochar, compostband biochar –compost for soil quality, maize yield and greenhouse gas emission in tropical agricultural soil. *Science of the Total Environment.* Vol. 543, pp.295-306

Ashraf, U., Salim, M. N., Sher, A., Sabir, S. R., Khan, A., Pan, G., and Tang, X. (2016a). Maize growth, yield formation and water- nitrogen usage in response to varied irrigation and nitrogen supply under semi- arid climate. Turk. *J. Field Crops* 21(1), 87-95 FAO. (2012). FAOSTAT, Production, 12, 2014.

Foster E. J, Hansen N, Wallenstein M, Cotrifo M. F. (2016). Biochar and manure amendment impact soil nutrients and microbial enzymatic activities in semi-arid irrigated maize cropping system. *Agriculture, Ecosystems and Environment*. 233: 404-414

Hepperly, Y. P., Lotter, D, Ulsh, C. Z., Siedel, R., Reider, C. (2009). Compost, manure and synthetic fertilizer influences crop yield, soil properties nitrate leaching and crop nutrient content. *Compost Sci. Utili.* 17, 117126

Khan, H. Z., M. A. Malik, and M. F. Saleem (2008). Effect of rates and sources of organic material on the production potential of spring maize. *Pakistan Journal of Agricultural Sciences*, Vol. 45(1):pp.40-43

Khawar Jabran, Dr Zahid Ata, and Dr Muhammad Farooq (2007). Maize: cereal with a variety of uses. Technical report April 2007

Lehman J, Gaunt J, Rondon M. (2006). Biochar sequestration in terrestrial ecosystem: a review. *Meeting Adapt Strategy Global change* 11: 403-427

Masahide yamato, Yasuyuki Okimori, Irhas Fredy Wobiwo, Saifuddin Anshori and Makota Ogawa (2006). Effects of the application of charred bark of acacia mangium on the yield of maize, cowpea and peanut, and soil chemical properties in southern Sumatra, Indonesia. *Soil Science and Plant Nutrition* 52, 489-495

Purakayastha, T.J., K.C. Das, J. Gaskin, K. Harris, J. Smith, and S. Kumari, (2016). Effect of pyrolysis temperatures on stability and priming effects of C3 and C4 biochar applied to two different soils. *Soil and Tillage Research*, vol. 155, pp. 107-115

Schnitzer M. R. and H.R. Schulten. (1997). Chemistry of Soil Organic nitrogen: a review. *Biology and Fertility of Soils* 26, 1-15

Sohi S.P, Krull E, Lopez-Capel E, and Bol R. (2010). A review of biochar and its use and functions in soil. *Advances in Agronomy* 105: 47-82

Syuhada, A.B., J. Shamshuddin, C. I. Fauziah, A. B. Roseneni, and A. Arifin (2016). Biochar as soil amendment:

Impact on chemical properties and corn nutrient uptake in a podzol. *Canadian Journal of Soil Science*, Vol. 96:4, pp.400-412

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

CRITICAL PERIOD OF WEED CONTROL AT DIFFERENT GROWTH STAGE IN COWPEA (*Vigna unguiculata* L.) PRODUCTION IN MINNA, NORTH CENTRAL NIGERIA

A.Y. Mamudu[1*], A.A. Muhammad[2], K.I. Chisom[1] and A.A. Doka[2]

[1]Department of Crop Production, Federal University of Technology P. M. B. 65, Minna, Niger State, Nigeria
[2]Department of Agronomy, Ahmadu Bello University, Zaria
Corresponding Author: a.mamudu@futminna.edu.ng

ABSTRACT

Field trial was conducted to study the critical period of weed control at different growth stage in cowpea at the Teaching and Research Farm of the Federal University of Technology, Minna (latitude 90 371 N and longitude 60 331 E) located in the Southern Guinea Savanna ecological zone of Nigeria during 2019 wet season. The experiments consisted of eight treatments which are weeding at second, fourth and sixth trifoliate, weeding at first flowering, podding, seeding, weed-free and weedy plot laid out in a Randomized Complete Block Design (RCBD) and replicated three times Results showed that weed dry weight was significantly (p<0.05) lower on weed-free plot and weeding at second trifoliate, cowpea 4plant height was higher on weed-free plot, weeding at second and fourth trifoliate, higher number of cowpea pod on weed-free plot and weeding at sixth trifoliate and higher grain yield on weed-free plot and weeding at sixth trifoliate. The practical implication of this study is that weed-free plot throughout growth stages gave better growth and yield performance of cowpea.

Keywords: Cowpea, Growth Stage, Weed Control.

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) is one of the widely cultivated crops in tropical and subtropical regions, being a staple food. It is a source of employment and income for the people of these regions (Lima *et al*., 2013). Nigeria is the largest cowpea producer in the world and accounts for over 2.5 million tons grain production from an estimated 4.9 million ha (FAO, 2014). The competition of weeds with crops has been considered one of the main biotic factors that cause productivity losses (Délye *et al*., 2013). Weed interference results in low productivity since it harms crops directly due to the competition for essential factors, and indirectly, as weeds can host pests, diseases, and release allelopathic substances that interfere with seed germination and growth of cultivated plants, in addition to increasing production costs (Freitas *et al*., 2009; Mirshekari *et al*., 2010). Weed interference in cowpea can reduce yield by 64% to 90% (Freitas *et al*., 2009; Adigun *et al*., 2014; Osipitan, 2017; Yadav *et al*., 2018), depending on management, weed species and environmental conditions. Cowpea covers the largest area of any grain legume in Africa and is especially important in West Africa, with Nigeria and Niger alone accounting for over 75% of the total cowpea production (Walker *et al*., 2014). It is an important food legume and essential component of cropping systems in sub-Saharan Africa where it is grown as a sole crop, relay, or inter cropped in various combinations with millet, sorghum and maize (Singh et al., 2002; Alene and Manyong, 2006; Kamara et al., 2010; Boukar *et al*., 2011). Nigeria is the largest cowpea producer in the world and, with about 25% of the population of
Sub-Saharan Africa. It is also the largest consumer and importer of cowpea in the region (Langyintuo *et al*., 2003; Mishili *et al*., 2009). The gap between potential and actual yields obtained is attributed to weed infestation among other factors. The competition does not occur when the growth factor is abundant. However, it starts immediately when growth factors fall short in supply. In similar way, the critical period of weed competition might have originated from the belief that weeds are not equally damaging throughout the crop period. There may be ~~at~~ certain stage in crop growth period when weeds are more harmful to crop growth and yield. Because of its initial slow growth weeds takes advantage to utilise more growth resources and dominate over crops. Weeds compete with crop whole life cycle but its effect does not remain same during all stages of crop growth. The short time span in the life cycle of crop when

weed causes maximum reduction in ~~its~~ crop yield is known as critical period of crop weed competition. In other words, it is period when weed control measure if adopted may fetch near maximal or maximum acceptable crop yield It is therefore, simply the specific duration of weed free situation of a crop resulting into near maximal yield. This study was conducted to determine the critical period among cowpea growth stages in the study area.

MATERIALS AND METHOD

Field experiment was conducted during 2019 wet season at the Teaching and Research Farm of Federal University of Technology, Minna (latitude 90^0 371 N and longitude 60^0 331 E) located in the Southern Guinea Savanna ecological zone of Nigeria. Treatments consisted of eight weed control strategies laid out in a Randomized Complete Block Design (RCBD) and replicated three times. These T1= cowpea + weeding at second trifoliate and left weedy to the end (CWST), T2=cowpea + weeding at fourth trifoliate and left weedy to the end (CWFT), T3=cowpea + weeding at sixth trifoliate to the end (CWST), T4=cowpea + weeding at first flowering to the end (CWFF), T5=cowpea + weeding at podding to the end (CWPD),T6=cowpea + weeding at seeding to the end (CWSD), T7=cowpea + weedy to the harvest (CW), T8=cowpea + weeding from the beginning to the end (weed free). The seeds were sown on 15^{th} of August at the depth of 2cm at the rate of 2 seeds per hole with plant intra-row spacing of 25cm and inter-row spacing of 75 cm, Cowpea variety Ife Brown was used. Fertilizer (NPK 15:15:15) was applied at 2weeks after planting at recommended dose using side placement method, Hexalonazole 5% pesticide with the aid of knapsack sprayer (15lit) was also applied at 2, 6, and 8WAS (weeks after sowing) at the rate of 10mls in 1000mls of water to control insects attack.. Manual weeding was carried out according to experimental treatment using hoe. The Pods were harvested at maturity at about 15% moisture content according to treatment, it was sun dried, deshusked and weighed in gram and converted to kilogram per hectare.

Data collected were on fresh weed weight, Weed dry weight, Cowpea Plant height, Number of pods per plant, Cowpea grain yield. Data collected were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS) procedure, 2010 model to test significance of treatment effects and treatment means were separated using new Duncan multiple range tests (DMRT) method at 5% probability level (Duncan, 1955).

RESULTS AND DISCUSSION

The effect of critical period of weed control on fresh weight was significantly ($p<0.05$) different throughout sampling periods (Table 1). At 2, 4, and 6WAS, treatment with weedy (weed infested) plots produced the highest fresh weed weight (76.56g, 89.92g, and 122.80g respectively) compared to weed free plot which recorded lowest weed fresh weights (44.96g, 30.83g, and 31.30grespectively). The lower fresh weed weight observed in treatment with cowpea and weed-free plot, could be as a result of the controlling ability of the treatments to reduce the presence of weeds which in turn reduces detrimental effect of weed on growth of plant compared to other treatments. This is in agreement with Adigun *et al* (2014) who reported that delaying weed removal for up to 14 Days after emergence reduced cowpea yield by 4-15%. The effect of critical period of weed control on weed dry weight was significantly ($P<0.05$) different at all sampling periods (Table 1).

Table 1: Effects of weed control method on weed fresh and dry weights on cowpea growth stages in cowpea during 2019 wet season at Minna

Treatment	Fresh weed dry weight(g)			Weed dry weight(g)		
	2WAS	4WAS	6 WAS	2WAS	4WAS	6 WAS
T1	57.23ab	35.92c	71.10c	28.61ab	17.96c	35.53b

T2	60.91ab	62.80b	35.30d	30.45ab	31.40b	29.03b
T3	44.96b	80.07a	113.15ab	23.45b	40.00a	56.56a
T4	57.59ab	84.85a	111.11ab	28.79ab	42.42a	55.56a
T5	65.69ab	88.40a	105.12ab	33.84ab	44.19a	52.56a
T6	65.25ab	77.91ab	112.34ab	32.62ab	38.94ab	56.17a
T7	76.56a	89.92a	122.80a	38.28a	44.96a	61.39a
T8	52.27ab	30.83c	31.30d	26.13ab	15.41c	15.65c
SE	2.87	4.84	7.32	1.43	2.42	3.33

Means followed the same letters in the same column are not significantly different according to Duncan multiple range test (DMRT) at 50% level of probability.
WAS – Weeks after sowing.
T1=CWST – Weeding at second trifoliate and left weedy to the end
T2=CWFT – Weeding at fourth trifoliate and left weedy to the end
T3=CWST – Weeding at sixth trifoliate to the end
T4=CWFF – Weeding at first flowering to the end
T5=CWPD – Weeding at podding to the end
T6=CWSD – Weeding at seedling to the end
T7=CW – Weedy to the end

Plots left weedy recorded highest weed dry weights (38.28g, 44.96g and 61.39g respectively) followed by treatments with weeding at sixth trifoliate to the harvest compared to lowest dry weed weights observed in treatment with weed free plot which recorded (26.13g, 15.41g and 15.65g respectively). Treatment with cowpea weeding at second trifoliate, fourth trifoliate, first flowering, podding and weeding at seeding which recorded weed dry weights of 28.61g, 30.45g, 28.79g, 33.84g and 32.62g respectively were statistically similar to the treatment that had highest dry weight (Table 1). The lower weed dry weight observed in treatment with cowpea and weed-free plot could be attributed to the effectiveness of the treatment to lower the population of weeds thereby reducing their interference. This is in accordance with report of Parasuraman (2000) who stated that hand weeding at 30 Days after sowing resulted in significant reduction in weed population and weed dry matter and increase in crop yield in rain-fed cowpea.

Number of pods per plant were significantly (P<0.05) different on critical periods of weed control (Table 2).
Highest pods were recorded on treatment with weed free plot and weeding at sixth trifoliate to the end (176.00 and 165.00 respectively) compared to lowest pods recorded on treatment with weedy plot (104.00) and other treatments. The higher number of pod observed in treatment with weed-free plot could be attributed the ability of the treatment in suppressing the population of weed infestation and creating a favorable growth condition for crop growth over weed in terms of sunlight, water, space and nutrient which translated into a higher number of pods. This is in agrees with Osipitan *et.al.* (2016) who stated that frequently weeding of plot within 4-6 WAS for most legumes gave crop yield comparable advantage over weed. Grain yield were significantly (P<0.05) affected by critical period of weed control (Table 2). Treatment with weed free plot recorded the highest grain yield (1101.00kg) followed by weeding at sixth trifoliate to the end (947.00kg) compared to lowest observed at treatment with weedy plot (271.00kg). The higher grain yield observed in weed-free plot could be as a result of taller plant heights and increased pod number which contributed to better yield. This is in accordance with Norsworthy and Oliveira, (2004) who stated that cowpea sown in summer season is infested by number of weed species that compete with crop right from germination to harvest, affecting the crop yield adversely.

Table 2: Effects of weed control method on cowpea plant height (cm), pod number and grain yield (kg ha^{-1}) on cowpea growth stages in cowpea during 2019 wet season at Minna

Treatment	plant height (cm)			Pod number	Grain yield kg ha^{-1})
	2WAS	4WAS	6 WAS		
T1	17.17a	28.17ab	53.17bc	117.00b	294.00b
T2	17.20a	26.10bc	57.27ab	130.00b	417.00b

T3	17.57a	24.40c	54.87bc	165.00	947.00ab
T4	18.27a	24.27c	52.30bc	123.00b	389.00b
T5	16.17a	24.53bc	52.40bc	120.00b	377.00b
T6	17.10a	25.53bc	54.87bc	120.00b	313.00b
T7	16.03a	23.73c	50.70c	104.00b	271.00b
T8	18.30a	30.00a	62.40a	176.00a	1101.00a
SE±	0.31	0.52	1.31	5.43	305.36

Means followed the same letters in the same column are not significantly different according to Duncan multiple range test (DMRT) at 50% level of probability.
WAS – Weeks after sowing.
T1=CWST – Weeding at second trifoliate and left weedy to the end
T2=CWFT – Weeding at fourth trifoliate and left weedy to the end
T3=CWST – Weeding at sixth trifoliate to the end
T4=CWFF – Weeding at first flowering to the end
T5=CWPD – Weeding at podding to the end
T6=CWSD – Weeding at seedling to the end
T7=CW – Weedy to the end

CONCLUSION

In conclusion, treatment with cowpea and weed-free plot and weeding at sixth trifoliate to the harvest could substantially prevent yield losses associated weed interference.

It could be recommended that farmers should continuously keep their farm weed free throughout the growth stage for better cowpea growth and yield.

REFERENCES

Adigun, J.; Osipitan, A. O.; Lagoke, S. T.; Adeyemi, R. O.; Afolami, S. O. Growth and yield performance of cowpea (Vigna unguiculata (L.) Walp) as influenced by row-spacing and period of weed interference in South-West Nigeria. *Journal of Agricultural Science,* v. 6, n. 4, p. 188-198, 2014. https://doi.org/10.5539/jas. v6n4p188.

Alene, A. and Manyong, V. 'Endogenous technology adoption and household food security: The case of improved cowpea varieties in northern Nigeria', *Quarterly Journal International Agriculture*, Vol. 45, (2006) pp. 211–230.

Boukar, O., Massawe, F., Muranaka, S., Franco, J., Maziya-Dixon, B., Singh, B. and Fatokun, C. 'Evaluation of cowpea germplasm lines for protein and mineral concentrations in grains', *Plant Genetic Resources*, Vol. 9, (2011) pp. 515–522.

Délye C, Jasieniuk M, Le Corr V. Deciphering the evolution of herbicide resistance in weeds. *Trends Genet.*2013:29(11):649-58.

Duncan, D.B. (1955). Multiple Range and multiple F-test. *Biometrics* II: 1-42

FAO. (2014). Statistical Data Base. Food and Agricultural Organization of the United Nations. Retrieved from http://www.fao.org

Freitas, F.C.L. Silva, M.G.O Nascrirnento, P.G.M.L. Nunes, G.H. 2009, weed interference in cowpea. Planta Daninha, 27:241-247, 2009

Kamara, A. Y., Ellis-Jones, J., Ekeleme, F., Omoigui, L., Amaza, P., Chikoye, D. and Dugje, I. Y. 'A participatory evaluation of improved cowpea cultivars in the Guinea and sudan savanna zones of north east Nigeria', *Archives of Agronomy and Soil Science*, Vol. 56, (2010) pp. 355–370.

Langyintuo, A. S., Lowenberg-DeBoer, J., Faye, M., Lambert, D., Ibro, G., Moussa, B., and Ntoukam, G. (2003). Cowpea supply and demand in West and Central Africa. *Field Crops Research,* 82(2), 215-231. https://doi.org/10.1016/S0378-4290(03)00039-X

Lima JR, Antonino AC D, Hammecker C. Water and energy flux measurements in rainfed cowpea cultivated in
Northeast Brazil. *Rev Bras Cienc Agr*. 2013;8(2):297-304. https://doi.org/10.5039/agraria.v8i2a2090

Mishili, F.J., Fulton, J., Shehu, M., Kushwaha, S., Marfo, K., Jamal, M., Kergna, A. and Lowenberg-DeBoer, J. 'Consumer preferences for quality characteristics along the cowpea value chain in Nigeria, Ghana, and Mali', *Agribusiness*, Vol. 25, (2009) pp. 135.

Mirshekari B, Javanshir A, Arbat HK. Interference of redroot pigweed (*Amaranthus retroflexus*) in green bean (*Phaseolus vulgaris). Weed Biol Manage*. 2010;10(2):120-5.

Norsworthy, J. K., and Oliveira, M. J. (2004). Comparison of the critical period for weed control in wide and narrow row corn. *Weed Science*, 52, 802-807. https://doi.org/10.1614/WS-03-165R

Osipitan, O. A., and Dille, J. A. (2017). Fitness Outcomes Related to Glyphosate Resistance in Kochia (Kochia scoparia): What Life History Stage to Examine? *Frontiers in Plant Science,* 8, 1090. https://doi.org/ 10.3389/fpls.2017.01090

Singh, B. B, J.D. Ehlers, B. Sharma, F.R. Freire-Filho (2002). Recent progress in cowpea breeding. In: Fatokun, C.A., Tarawali, S. A., Singh, B. B., Kormawa, P. M., Tamo, M. (Eds), Proceedings, WorldN Cowpea Conference III, Challenges and Opportunities for Enhancing Sustainable Cowpea Production. IITA, Ibadan, Nigeria, pp.
22–40

Walker, T., Alene, A., Ndjeunga, J., Labarta, R., Yigezu, Y., Diagne, A., Andrade, R., Muthoni Andriatsitohaina, R., De Groote, H., Mausch, K., Yirga, C., Simtowe, F., Katungi, E., Jogo, W., Jaleta, M. and Pandey, S. Measuring the Effectiveness of Crop Improvement Research in Sub-Saharan Africa from the Perspectives of
Varietal Output, Adoption, and Change: 20 Crops, 30 Countries, and 1150 Cultivars in Farmers' Fields (Rome, Italy, Standing Panel on Impact Assessment (SPIA), CGIAR Independent Science and Partnership Council (ISPC), 2014).

Yadav, T.; Chopra, N.K.; Chopra, N.K.; Kumar, R.; Soni, P.G. Assessment of critical period of crop-weed competition in forage cowpea (*Vigna unguiculata*) and its effect on seed yield and quality. *Indian Journal of Agronomy,* v. 63, n. 1, p. 124-127, 2018 http://www.indianjournals.com/ijor.aspx?target=ijor:ija&volum e=63&issue=1&article=023. 07 Jan. 2019.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

RESPONSE OF MAIZE (*Zea mays* L.) VARIETIES TO WEED CONTROL TREATMENTS AT SAMARU IN NORTHERN GUINEA SAVANNAH ZONE NIGERIA

D.R. Sanda, M.A. Mahadi, A.I. Sharifai, A.A. Muhammad and Y. Adamu

Department of Agronomy, Ahmadu Bello University, Zaria.
Corresponding Author: dahirusandarumah@gmail.com

ABSTRACT

Field trial was conducted during 2020 wet season at research farm of Institute for Agricultural Research, Samaru Zaria (11º 11′ N, 7º 38′ and 686m above sea level) in Northern Guinea Savanna of Nigeria to assess effect of weed control treatment on maize varieties. Treatments were six weed controls (Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6WAS, Nicosulfron at 0.7 kg ai ha^{-1}, Nicosulfron at 0.7 kg ai ha^{-1} plus hoe weeding at 6WAS, two hoe weedings at 3 and 6WAS, and weedy check) with three varieties (SAMMAZ 17, SAMMAZ 29 and SAMMAZ 54) combined and laid in Randomized Complete Block Design replicated four times. Dominant weed species observed were Ageratum conyzoides, Cyperus rotundus, Digitaria horizontalus W which have 35 to 75% and 40 to 75% level of occurrence. All weed control treatments enhanced performance of maize varieties, even though application of Nicosulfron at 0.7 kg ai ha^{-1} performed better and resulted reduced weed density and dry weight. Plots treated with Nicosulfron at 0.7 kg ai ha^{-1} resulted in higher leaf area index, maize shoot dry weight, cob weight and grain yield followed by application of Nicosulfron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding which gave 40% yield increase over weedy check. Varieties differed significantly in all parameters assessed but SAMMAZ 17 resulted in higher value for measured growth and yield parameters. and highly. Application of Nicosulfron at 0.7ai kg. ha^{-1} resulted in better weed control, SAMMAZ 17 produced higher yield. Combination of Nicosulfron at 0.7 kg ai ha^{-1} or Nicosulfron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6WAS with SAMMAZ 17 gave higher grain yield.

Keywords: Weed Control, Variety, Weed Dry weight.

INTRODUCTION

Maize farmers face production constraints among which is weed competition (Opaluwa et al., 2015). Weeds compete with maize for soil nutrients and other environmental resources. Maize is said to be highly susceptible to weed competition particularly at the early stages of growth (Evans et al., 2003) and it should be kept weed-free between planting and 6 weeks after planting which is the critical period of weed interference, for optimal yield (Imoloame and Omolaiye, 2017). Farmers in Nigeria spend more time in controlling weeds than on any other aspects of crop production. Control of weeds in maize is, therefore, very important for obtaining higher productivity. Maize yield is widely affected by weed competition. Reduction in yield due to weed resulted from competition for light, water, nutrition and other potential yield limiting factors (Aluko, 2019). To minimize ~~the weeds~~ losses due to weed infestation, several methods are available such as mechanical, cultural, biological and chemical control methods. Chemical control method is quick, more effective, time and labour saving method than others. Chemical weed~~s~~ control method is recommended by many researchers (Pannacci and Covarelli, 2009, Toloraya *et al.*, 2001 and Juhl, 2004) for maize production. Herbicides are an important alternative to manual weeding because it is cheaper, faster and gives better weed control (Kumar *et al.*, 2017). A number of herbicides have been recommended for effective weed control in maize. This study was conducted to evaluate rates of Atrazine and Nicosulfuron in combination with hand weeding on maize varieties

MATERIALS AND METHODS

Field trial was conducted during ~~the~~ 2020 wet season at the Research Farms of the Institute for Agricultural Research, Samaru Zaria (110 11' N, 70 38' E and 686m above sea level) in Northern Guinea Savanna Ecological Zone of Nigeria. The area has distinct rainy and dry seasons (Sambo et al., 2014). Rainfall establishes between mid –may to early June, and is concentrated between July and August, while the dry season starts from mid-October to end of April (Sambo et al., 2013). The experimental site was previously cropped to maize in Samaru during 2019 respectively. Treatments consisted of six (6) weed control treatments Atrazine at 2.0 Kg ai ha^{-1} (applied pre-emergence), Atrazine 2.0 Kg ai ha^{-1} pus hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1}, Nicosulfuron at 0.7 kg ai ha^{-1} + hoe weeded at 6 WAS, 2 hoe weeded at 3 and 6 WAS and weedy check) and three varieties of ~~M~~aize (SAMMAZ 17, SAMMAZ 29 and SAMMAZ 54). The treatment factors were combined and laid out in randomized complete block design and replicated four times. The gross plot consisted of 4 ridges each measured 4m long and 3m wide ($4m×3m=12m^2$) while the net plot was taken from two inner ridges 1.5m×1.5m=2.25m2 constituted the net plot. The experimental area was harrowed to a fine tilth and ridged 75cm apart. The land was then marked in to plots and replications. A space of 0.5m between plots and 1.5m between replicates was maintained for assessing plots. Two seeds per hole were sown on 4th July, 2020 manually depth of 3cm and spacings of 75cm×25cm. The emerged seedlings were later thinned down to one plant per stand at two weeks after sowing. The pre-emergence herbicide (atrazine at 2.0 kg ai ha^{-1}) was applied immediately after sowing while Nicosulfuron at 0.7 kg a.i ha^{-1} was applied 3 WAS using CP3 knapsack sprayer fitted with a green deflector nozzle and set at a pressure of 2.1 kg m^2 to deliver 250L per hectare of spray solution. The spraying was done in the morning when the weather was calm to avoid drift. Hoe weeding was done manually using hoe according to treatment basis at 3 and 6 WAS. Recommended rate of 90kg N, 45 kg P2O5 and 45 kg of K2O per hectare for extra early varieties was split applied. The half dose of N and whole of P and K were applied at 3 WAS using NPK 15:15:15 to supply 45,45,45 kg of N, P2O5 and K2O respectively. The remaining half of N kg ha^{-1} second dose was applied 6 WAS using urea (46%N) as source. The recommended rate of 100 kg N, 50ssss kg P2O5 and 50 kg K2O for medium maturing variety was split applied. The half dose of N and the hole of P and K was applied at 3WAS using NPK 15:15:15 to supply 50,50,50 kg of N, P2O5 and K2O respectively. The remaining half of N kg. ha^1 second dose was applied 6WAS using urea (46%N) as source. Application was by placement at about 3cm depth and 5-8 cm away from the plant. There was incidence of insect pest infestation (stem borer) at 5-6 WAS which was treated with application of mixture of cypermethrim+ dimethoate at the rate of 1.0 L ha^{-1} to control the pest. Harvesting was done when the plants attained physiological maturity as the cobs turn yellowish brown and grains have hardened. The cobs were sundried, weighed and later threshed and winnowed to obtain clean grain.

Samples of weeds are collected from 50× 50 cm quadrant area at random in each plot and were done at 4,8 and 12 WAS. The weeds were removed, cleaned free from soil and oven dried at 70^0 c to a constant weight and thereafter weighed for dry matter determination using a mettle balance Toledo SB 16001 model. ~~D~~ata collected on weed density, weed dry weight, leaf area index,maize shoot dry weight, cob weight and grain yield. These were subjected to statistical analysis of variance using General Linear Model (GLM) procedure of the Statistical Analysis Software (SAS) package (SAS,1990) version 9.4. Treatments means were compared using Duncans Multiple Range Test (Duncan,1955) at 5% level of probability.

RESULTS AND DISCUSSION

The weed density of ~~M~~ maize varieties as affected by weed control treatments during the 2020 wet season at Samaru is presented on Table 1. At 4 WAS ~~in Samaru~~ plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced least weed density but statistically comparable to plots treated with Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS, hoe weeded at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check plots significantly produced ~~the~~ highest weed density in all sampling periods. This could be due to the efficacy of the herbicide which destroyed most of ~~the~~ weed seed bank as well as ~~the~~ emerged weeds. This is in line with the findings of Alberto *et. al.*, (2012) who attributed reduced weed density, weed cover score and weed dry weight in maize to the effectiveness of Nicosulfuron herbicides.). The lowest weed density was recorded in plots treated with hand weeding and hoeing followed by Nicosulfuron whereas the maximum was recorded in weedy check. Least weed dry weight ~~of weeds the minimum~~ was observed

in hand weeding and hoeing followed by Nicosulfuron (Tesfay *et al.*, 2014). According to Fariba *et al.* (2013) Nicosolfuron + Weeding decreased weed Field bind weed dry weight as compared to Weedy check treatment by 77.78 % and decreased weed Field bindweed density as compared Weedy check treatment by 91.66%. Table 1 contained data on weed dry weight. At 4 WAS plots weeded twice at 3 and 6 WAS and plots treated with Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS significantly produced least weed dry weight (Table 1) which was statistically similar to plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1} and Nicosulfuron at 0.7 kg ai ha^{-1}. The weedy check consistently recorded highest weed dry weight in all sampling periods. At 8 WAS~~ in Samaru~~ plots treated with Atrazine at 2.0 kg ai ha-1 plus supplementary hoe weeded at 6 WAS, Nicosulfuron at 0.7 kg ai ha^{-1}, hoe weeded at 3 and 6 WAS and Nicosulfuron at 0.7 kg ai ha^{-1} and supplementary hoe weeded at 6 WAS significantly produced least weed dry weight which was followed by plots that received Atrazine at 2.0 kg ai ha^{-1}. The effect of variety on weed dry weight was not significant at all the sampling period. Treatments' effects on leaf area index was significant at all the sampling period. At 4 WAS all weed control treatments produced statistically similar leaf area index with the exception of plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} that recorded highest leaf area index. However, at 8 WAS plots that received
Nicosulfuron at 0.7 kg ai ha^{-1} produced significantly higher leaf area index but was statistically comparable with plots treated Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeding at 6 WAS, Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6WAS and was followed by plots weeded twice at 3 and 6 WAS. The weedy check recorded ~~the~~ lowest leaf area index.

Table 1: Effect of weed control treatments on weed density, weed dry weight and leaf area index of maize varieties at Samaru, 2020 wet season

Treatment	Weed density per ($0.5m^2$)		Weed dry weight (g)		L.A.I.	
	4WAS	8WAS	12WAS	4WAS	8WAS	12WAS
Weed control (W)						
Atrazine at 2.0 kg ai ha^{-1}	12.42ab	15.17b	7.68bc	21.16b	1.64b	1.89ab
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	12.75ab	10.25cd	4.74d	12.28c	1.42b	1.91ab
Nicosulfron at 0.7 kg ai ha^{-1}	11.83b	13.17bc	9.32b	12.97c	1.99a	2.34a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at s6WAS	12.58ab	7.08d	5.90cd	11.51c	1.56b	2.15ab
Hoe weeding at 3 & 6WAS	14.00ab	10.92c	4.63d	14.17c	1.67b	1.78b
Weedy check	14.83a	23.83a	36.86a	53.83a	1.37b	1.22c
SE±	0.91	1.22	0.96	2.40	0.12	0.15
Variety (V)						
SAMMAZ 17	13.13	13.62	4.13	23.73	1.71	2.03a
SAMMAZ 29	12.87	12.75	3.91	23.05	1.61	1.99a
SAMMAZ 54	13.21	13.83	3.85	22.32	1.48	1.62b
SE±	0.64	0.86	0.22	1.28	0.09	0.10
Interaction						
W × V	NS	NS	NS	NS	NS	NS

Means followed by same letter(s) within column are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT)
NS = Not Significant WAS = Weeks After Sowing SE = Standard Error

The effect of weed control treatments on shoot dry matter of maize varieties during 2020 wet season at Samaru is presented at Table 2. At 4 WAS all weed control treatments produced similar shoot dry weight except plots treated with Nicosulfuron at 0.7 kg ai ha^{-1} that recorded highest shoot dry weight. However, at 8 WAS plots that received Nicosulfuron at 0.7 kg ai ha^{-1} significantly recorded heavier shoot but statistically comparable to plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and was followed by plots weeded twice at 3 and 6 WAS, application of Atrazine at 2.0

kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. The weedy check recorded the lowest shoo dry weight. The effect of variety on shoot dry weight was significant at all the sampling period. SAMMAZ 17 produced higher shoot dry weight which was statistically at par with SAMMAZ 29 and SAMMAZ 54 that were statistically comparable in all sampling period. Weed control treatments had significant effect on cob weight per plot. Plots that received Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6WAS and those treated with Nicosulfuron at 0.7 kg ai ha^{-1} significantly produced heavier cobs per plot but were statistically similar with plots weeded at 3 and 6WAS, Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS and Atrazine at 2.0 kg ai ha^{-1} plus supplementary hoe weeded at 6 WAS. It was however followed by Atrazine at 2.0 kg ai ha^{-1}. The weedy check recorded the lowest. Table 2 shows effect of weed control treatments on grain yield in tonne per hectare of maize varieties during 2020 wet season at Samaru. Plots that received Nicosulfuron at 0.7 kg ai ha^{-1} and those treated with Nicosulfuron at 0.7 kg ai ha^{-1} plus hoe weeded at 6 WAS produced higher grain yield which was statistically similar to plots that received Atrazine at 2.0 kg ai ha^{-1}, Atrazine at 2.0 kg ai ha^{-1} plus hoe weeding at 6WAS and hoe weeded at 3 and 6 WAS. The lowest grain yield was recorded in weedy check plots. The positive responses to application of Nicosulfuron at 0.7 kg ai ha^{-1} on most as observed above could have been due to its efficacy and weed suppression ability at that rate This implies it can control weeds beyond levels that can have significant effect on crop. According to Armindo *et al.* (2019) spraying of Nicosulfuron herbicide to suppress forages growth in intercropping with maize resulted in significant increase in grain weight per ear (GWE) and maize grain yield. This result is in line with the findings of Pamplona et al (1990) who reported that increase in yield component and grain yield of maize because the crop was free from weeds during its critical period of weed interference. This is-in line with Lum *et. al.*, (2005) who reported that Nicosulfuron increased maize yield at Alabata by 96 % in 2000, 100 % in 2001 and 34 to 54 % in 2002 and in Ilorin by 79 to 83 % in 2001 and 60 to 69 % 2002 when compared with non-weeded control. All varieties used during this study responded positively to weed control treatments but SAMMAZ 17 outperformed others varieties in leaf area index, shoot dry weight and yield parameters assessed (grain yield and cob weight per plot). This could be due to inherent genetic makeup that differed among them. These findings conform to result obtained by Mani et al (2002) who observed a significant increase in plant height and grain yield among varieties. Namakka (2002) reported non-significant differences in some growth, yield component and yield of two varieties. Also, Sani *et al* reported that all maize varieties exhibited close similarity in performance which was above average. None of the varieties yielded less than 50% of the potential yield of hybrid maize in the ecological area of evaluation. Farmers are thus advised to ensure strict compliance with recommended production practices in order to attain higher maize grain yields.

Table 2: Effect of weed control treatments on shoot dry weight, cob weight and grajn yield of maize varieties at Samaru, 2020 wet season.

Treatment	Shoot dry weight (g)		Cob weight per plot (kg)	Grain yield (t ha^{-1})
	4WAS	8WAS		
Weed control (W)				
Atrazine at 2.0 kg ai ha^{-1}	4.18b	23.80bc	2.77bc	5.19ab
Atrazine at 2.0 kg ai ha^{-1} + hoe weeding at 6WAS	4.71b	21.56bc	3.07ab	4.77ab
Nicosulfron at 0.7 kg ai ha^{-1}	5.93a	30.93a	3.12a	5.41a
Nicosulfron at 0.7 kg ai ha^{-1} + hoe weeding at 6WAS	4.20b	26.46ab	3.13a	5.63a
Hoe weeding at 3 & 6WAS	4.54b	22.91bc	3.04ab	4.61ab
Weedy check	4.67b	20.34c	2.61c	4.09b
SE±	0.26	1.68	0.11	0.36
Variety (V)				
SAMMAZ 17	6.28a	27.63a	3.08a	5.36a
SAMMAZ 29	3.93b	23.05b	2.95a	5.07ab
SAMMAZ 54	3.91b	22.32b	2.83b	5.07ab
SE±	0.19	1.41	0.08	0.26

Interaction				
W × V	NS	NS	NS	NS

Means followed by same letter(s) within column in each treatment group are not significantly different at 5% probability level according to Duncans multiple Range Test (DMRT) NS = Not Significant ; WAS = Weeks After Sowing SE = Standard Error

CONCLUSION

Based on results obtained, it can be concluded that application of Nicosulfuron at 0.7 kg ai ha^{-1} suppressed weeds better and outperformed other weed control treatments in maize growth and yield and SAMMAZ 17 resulted in effective weed control and highest grain yield of maize than other varieties in the study area

REFERENCES

Ahmad, A. (2016). Effect of Nicosulfuron and poultry manure on productivity of irrigated extra early maize (*Zea mays* L.) in the Nigerian savanna. M.S.c thesis summited to the school of postgraduate studies, Ahmadu Bello University, Zaria.

Aluko, O.A. (2019). Comparative Study of Herbicides for Pre Emergence Weed Control in Maize (*Zea mays* L.) in Derived Savanna of Nigeria. *Journal of Experimental Agriculture International,* 37(1): 1-11.

Armindo, N.K., Luiz, C.F.S., Ademar, P.S. and Roberto, G.A. Yield of maize grain and tropical grass species under intercropping management system using nicosulfuron herbicide in off-season cultivation, *Australia Journal of Crop Science,* 13(11):1756-1763.as Influenced by Periods of Weed Interference. *Advances in Crop Science and Technology*. 5: 267. doi: 10.4172/2329-8863.1000267.

Duncan, D.B. (1955). Multiple range and Multiple F-test. *Biometrics*, 11:1-42.

Evans SP, Knezevic SZ, Lindquist JL, Shapiro CA, Blankenship EE (2003) Nitrogen Application Influencing the Critical Period for Weed Control in corn. *Weed Science* 51: 408- 417.

Fahad, B., Muhammad, A.N., Asif, T. and Tasawer, A. (2015). Impact of row spacing and reduced herbicide doses along with adjuvant on weeds in maize (*Zea mays* L.) *Current Science Perspectives* 1(4) 112-118

Fariba, R., Abdoreza, A. and NourAli, S. (2013). The Influence of mechanical and chemical methods on Weeds Control in Maize. *Technical Journal of Engineering and Applied Sciences*, 3: 3858-3863.

Imoloame EO, Omolaiye JO (2017) Weed Infestation, Growth and Yield of Maize (Zea mays L.)

Johnson, W. G., M. S. Defelice and C. S Holman. (1997). Application timing affects weed control with metolachlor plus atrazine in no-till corn (*Zea mays* L.). *Weed Technology.*, 11: 207-2011. *Journal of Agricultural and crop Research* 1 (3) :36 -45

Juhl,O. (2004). Maister the mostbroad spectrum herbicide for maize in Denmark. Denske Plantekongres Plantebeskyttelse, Murkbrug. No. 99,

Kumar, B., Prasad, S., Mandal, D. and Kumar, R. (2017). Influence of integrated weed management practices on weed dynamics, productivity and nutrient uptake of *rabi* maize (*Zea mays* L.). *Intern. J. Curr. Microb. Appl. Sci.* 6: 1431-1440.

Mani, H., Ado, S. G., Hussaini, M. A., Shebayan, J. A. Y., Adamu, R. and P. S. Marley (2002). Effect of variety and sowing date of early maturing maize. In 2001/2002 cropping scheme meeting report on cereals research programme, I. A. R. Samaru, 2002. 72 – 73

Namakka, A (2002). Effect of sowing date and nitrogen levels on yield and yield components of Extra-Early Maize (*Zea mays* L.) in Sudan Savanna of Nigeria. Unpublished MSc. Thesis, submitted to Postgraduate School Ahmadu Bello University, Zaria. Pp. 3 - 7

Opaluwa, H. I., Ali, S. O. and Ukwuteno, S. O. 2015. Perception of the Constraints Affecting Maize Production in the Agricultural Zones of Kogi State, North Central, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*. 7(2): 1-6

Pannacci, E., Covarelli, G., (2009). Efficacy of mesotrione used at reduced doses for post-emergence weed control in maize (*Zea mays* L.). *Crop Protection* 28, 57-61.

Sambo, B. E., Odion, E. C., Aliyu, L. and Labe, D. A. (2013). Cowpea (vigna unguiculata (L.) Walp) clipping management technology 1: A potential for fodder production, sustained growth and food security in the Savannah regions of Nigeria.

Sani, B. M., Jaliya, M. M., and Ibrahim, I. K. (2011). Agronomic evaluation of four commercial hybrid maize varieties. *Proceedings of Agricultural society of Nigeria.* 314-317.

SAS (2014), *SAS Certification Prep Guide: Base Programming for SAS* 9.SAS publishing P:564.

Tesfay A, Amin M, Mulugeta N (2014) Management of Weeds in Maize (*Zea mays* L.) through Various Pre and Post Emergency Herbicides. *Advanced Crop Science Technology* 2: 151. doi:10.4172/2329-8863.1000151.

Toloraya, T.R., V, P. Malakanova and M.G Akhtyrtsev (2001). Effectiveness of dates, methods and dozens of applying Zinc Sulphate and its combination with the selective herbicides (Titus) in maize sowings. Kukuruza-ISerge. No.2:5-7.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

GROWTH, YIELD AND YIELD ATTRIBUTE OF LOWLAND RICE (*Oryza sativa* L.) AS INFLUENCED BY PLANTING METHODS AND WEED CONTROL IN LAFIA AND BADDEGI, NIGERIA

A.O. Lawal*[1], A.J. Ibrahim[2], I.J. Mangwa[1] and A.B. Mohammed[3]

*[1]Department of Agronomy, Nasarawa State University Keffi, Nasarawa State, Nigeria. [2]Department of Agronomy, Federal University Lafia, Nasarawa State, Nigeria.
3Department of Horticulture, Federal University of Technology Minna, Niger State, Nigeria.
*Corresponding Author: Lawalabdulafeesolasupo@gmail.com Phone: 07087474496

ABSTRACT

A multi-locational field experiment was conducted during the cropping seasons of 2022 at the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi Shabu-Lafia Campus and at the National Cereals Research Institute Baddegi Niger state, Kusotachi experimental site to study the influence of planting method, weed control and timing herbicide application on growth and yield on rice. The experiment was a split-split plot design consisted of two planting methods (pregerminated seeds and transplanting), six methods of weed control (Weedy check, Hoe weeding at 3 and 6 WAS, cyhalofop-butyl + MCPA, quinclorac + pyrazosulfuron-ethyl, MCPA 2 chloro 4 diphenoic acid, pretilachlor + pyribenzoxim) and two timing (Lafia and Badeggi) laid out in a Randomized Complete Block Design (RCBD) with three replications. Location was assigned to main plot, planting method was allocated to the sub plot and weed management was assigned to the sub-sub plot. The results in both locations revealed that at harvest, significantly maximum plant height, higher yield attribute such panicle weight per plant, 1000 seed weight and highest grain yield of about 3.46% were all recorded in Badeggi location. The use of transplanting method also contributed to growth, yield attributes and 15.16% increase on yield of rice where also recorded. Plots with weed management had higher growth and yield of rice than the weedy check although, application of MCPA performed better than the other herbicide tested. Hence, rice farmers should adopt transplanting method of planting rice in conjunction with early and late applications of MCPA as best weed management practice for improved growth; yield and yield component of rice.

Keyword: Rice, herbicide, planting methods, pre-germinated seeds, weed control, multi-locational.

INTRODUCTION

Rice (*Oryza sativa* L.) belongs to family Poaceae and its constitute major staple foods in many parts of the world. According to Yadav *et al.* (2010) rice supply more of carbohydrates, proteins, fats and also minerals vital needed for survival and healthy life compared to other grains. In Nigeria, the demand for rice assumed a regular increase for the past decades compared to sorghum and millet which fluctuate annually (NRDS, 2009). Transplanting is the most common method of planting rice, while dibbling and broadcasting are reported to be picking-up gradually (Gill *et al.*, 2014). Akhgari *et al.* (2011) defined dibbling (direct seeding) of rice as the process of establishing a rice crop from seeds sown in the field rather than by transplanting rice seedlings from the nursery, it assist rice farmers to have a reduced production cost. Weed being one of major pests in agriculture, having ability to compete with crops for nutrients through rapid growth and development. Hence, good weed management program is essential throughout the growing period of crops to overcome various types of weeds challenges (Neog *et al.,* 2015). The period required for weeds to be hand pull thus, have the ability to compete with the growing crop and reduced yields. Although, hoe weeding and hand weeding have similar disadvantages. It is, however a faster means of weed management thus can be carried out at an earlier stage in the growth cycle of rice crop and is more effective when weeds within the row are removed by hand at the same time (Cates, 1969). Herbicides offer easy, economical and quick control of weeds if applied in proper dose and at proper stage of crop growth (Bhullar *et al.,* 2018). Among all measures taking in rice weed control, chemical weed control is commonly used to overcome weeds infestation and it is reliable, easy, quick, time saving, and cost effective. There is no or little attention given by the rice growers in Nigeria on the use of metsulforun methyl, cyhalofop-butyl + MCPA, quinclorac pyrazosulfuron-ethyl, MCPA 2 chloro 4 diphenoic acid, pretilachlor + pyribenzoxim herbicides in controlling of weed in rice production due to paucity of information about the herbicides. However, this study is aiming at evaluating the effects of these herbicides application under various timing (early and late) and planting methods (pre-germinated seed and transplanting) on rice production at Lafia and Badeggi locations. The objective of this study therefore is to determine the effect of location, planting methods and different weed management practice on, growth, yield and yield attribute of lowland rice.

MATERIALS AND METHODS

The experiment was performed at two locations during 2023 cropping seasons. The field experiments are situated at the Teaching and Research Farm (Latitude 08.33^{0}N, Longitude 08.33^{0}E) of the Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University Keffi, Nasarawa State, Jayeoba, 2013. And at National Cereals Research Institute (NCRI) Baddeji, Niger State at experimental site Kusotachi latitude 9°3'24.58"N, Longitude 6°8'36.31"E) Ojohomon *et al*., 2006. The experiment is a 2 x 6 x 2 factorial combination of two planting methods (Dibbling and transplanting), six methods of weed control (Weedy check, Hoe weeding at 3 and 6 WAS, cyhalofop-butyl + MCPA, quinclorac + pyrazosulfuron-ethyl, MCPA 2 chloro 4 diphenoic acid, pretilachlor + pyribenzoxim) and two location (Lafia and Badeggi) arranged ina randomized complete block design (RCBD) replicated three times. The gross plot size was 3 m x 4 m (12 m^2) while the net plot size was 1.5 m x 4m (6 m^2). The field was cleared using a land preparation herbicide (Glyphosate a.i 360g/L) at 3 L/ha. The soil was ploughed and the site was marked into plots and replications. One meter unplanted boarder were maintained between plots, while 0.5 m unplanted boarder was maintained between each replication.

The nursery was prepared in dry soil conditions on 3 by 4 m wide seed bed, was filled with top most soil to a height of 10 cm level. A layer of half burned paddy husk was distributed on the nursery bed to facilitate uprooting. 80 kg/ha of seed was used for the sowing covered with mulch, watering the beds at regular basis (morning and evening). Transplanting of vigorous healthy seedlings where done after 14-21days of germination. Five pre-germinated seeds were sown (direct seeding) and thinned to two plants per stand. For transplanting method,
14-21 days old seedlings were transplanted from nursery bed to permanent field. One seedling per hole at a space of 20 cm by 20cm between and within the plant where maintained. Same plant spacing for transplanting was maintained for pre-germinated seed planting methods. Seed rate of 80 kg/ha where used for pre-germinated seeds while 40 kg/ha for transplanting. Fertilizer application was done using side placement in all the plots at the rate of 46 kg P_2O_5/ha and 64 kg N /ha. Phosphorus in the form of single super phosphate (SSP) was applied at the time of sowing and transplanting. Whereas, N in the form of UREA was applied in three splits (one third during sowing and transplanting and the remaining two third was apply in two splits at 4 and 8 WAS.

The required quantity of herbicides were applied with manually operated knapsack sprayer fitted with flat-fan nozzle using spray volume 400 L water/ha.The following data were collected at appropriate crop stages. Data was taken from the five randomly selected tagged plants during growth period at 4, 6, 8, 10 and 12 WAS. Plant height was taken by measuring the height of the plants from the base to the tip at 4, 6, 8, 10 and 12 WAS with the aid of meter rule and the mean recorded. The panicle weight (g) from the five tagged plants was counted and the mean recorded. The 1000 seeds was counted and weighed from each of the plots, this was repeated twice and the mean recorded. The net plots were harvested manually, grain collected, dried to 13.5% moisture content, and weight recorded.

$$\text{Grain yield} = \frac{\text{Seed yield per net plot}}{\text{Net plot area}} \times 10{,}000$$

The experimental data collected were analyzed by adopting analysis of variances (ANOVA) using Statistix Software while Least Significant Difference (LSD) was used to separate treatment means at 5 % level of probability.

RESULTS AND DISCUSSION

The plant height increased significantly thus differed across all the sampling periods, with respect to location, planting method and weed control as shown in (Table1) below. Statistically, based on location, Badeggi location produced tallest plants at 12WAS than Lafia location which consistently recorded the shortest plants throughout the sampling periods in this study. Planting method had a significant effect on plant height at 10 and 12 WAS. Transplanting consistently produced significantly taller plants than the Dribbling method which consistently produced the shortest plants.

Weed control had a significant effect on plant height of rice throughout the sampling periods of the study. The weedy check, early and late applications of Cyhalofop + MCPA produced statistically similar plants taller than the other weed controls which recorded shorter plants at 4 WAS. At 6 WAS. Early application of Metsulforun methyl, produced significantly taller plants that were not statistically different from weedy check, early application of Cyhalofop + MCPA and early application of Pretilachlor + Pyribenzoxium compared with late application of MCPA which recorded the shortest plants. At 8 WAS, weedy check recorded taller plants statistically similar with 2 HW at (3 + 6 WAS), early and late applications of Metsulforun methyl, early and late applications of Cyhalofop butyl + MCPA and early application of Pretilachlor + Pyribenzoxium while late application of Pretilachlor + Pyribenzoxium recorded the shortest plants. At 10 WAS, the use of 2 HW at (3 + 6 WAS), early applications of Metsulforun methyl and late application of Pretilachlor + Pyribenzoxium produced significantly similar plants taller than all the other weed controls compared with early and late applications of MCPA which recorded statistically similar shorter plants. At 12 WAS, late application of Pretilachlor + Pyribenzoxium produced significantly taller plants than all the other weed controls compared with late applications of Cyhalofop butyl + MCPA which produced the shortest plants.

Table 1: Effect of location, planting methods and weed control on plant height.

Treatment	Plant height (cm)				
	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Location (L)					
Lafia	21.92a	28.70b	32.54b	49.92b	66.34b
Badeggi	37.76a	54.91a	59.35a	69.81a	79.48a
LSD (0.05)	0.578	1.954	3.071	0.883	1.304
Planting method (PM)					
Dibbling	29.78a	41.69a	46.28a	59.52b	72.56b
Transplanting	29.89a	41.93a	45.61a	60.21a	73.29a
LSD (0.05)	0.473	0.274	2.159	0.382	0.232
Weed management (WM)					
Weedy check	30.27a	42.87ab	47.55a	59.55bc	73.86b
2 HW (3 + 6 WAS)	29.20b	42.31b	46.86ab	61.49a	73.28b

		c			c
Metsulforun Methyl (E)	29.19b	43.34a	47.28ab	61.33a	72.58de
Metsulforun Methyl (L)	29.64b	41.54de	46.56ab	59.41c	73.90b
Cyhalofop buthyl + MCPA (E)	30.31a	42.67ab	47.17ab	58.60d	72.44e
Cyhalofop buthyl + MCPA (L)	30.46a	40.30fg	47.03ab	59.68bc	70.94g
MCPA (E)	29.58b	40.94ef	45.60abc	57.48e	72.44e
MCPA (L)	29.28b	39.98g	43.68bc	57.22e	71.95ef
Pretilachlor + Pyribenzoxium (E)	29.55b	42.63ab	45.74abc	60.24b	71.61f
Pretilachlor + Pyribenzoxium (L)	29.28b	41.80cd	42.02c	61.98a	76.68a
LSD (0.05)	0.585	0.740	3.83	0.706	0.654
Interaction					
L × PM	NS	NS	NS	NS	NS
L × WM	NS	NS	NS	NS	NS
PM × WM	NS	NS	NS	NS	NS
L × PM × WM	NS	NS	NS	NS	*

Figure 1 below, represent the Interaction between location, planting method and weed managements on plant height at 12 WAS of rice. At 12 WAS, the combination of Badeggi location and transplanting method significantly produced the tallest plants after early application of MCPA than all the other combinations compared with the combination of Lafia location with dibbling and transplanting methods which recorded statistically similar shorter plants.

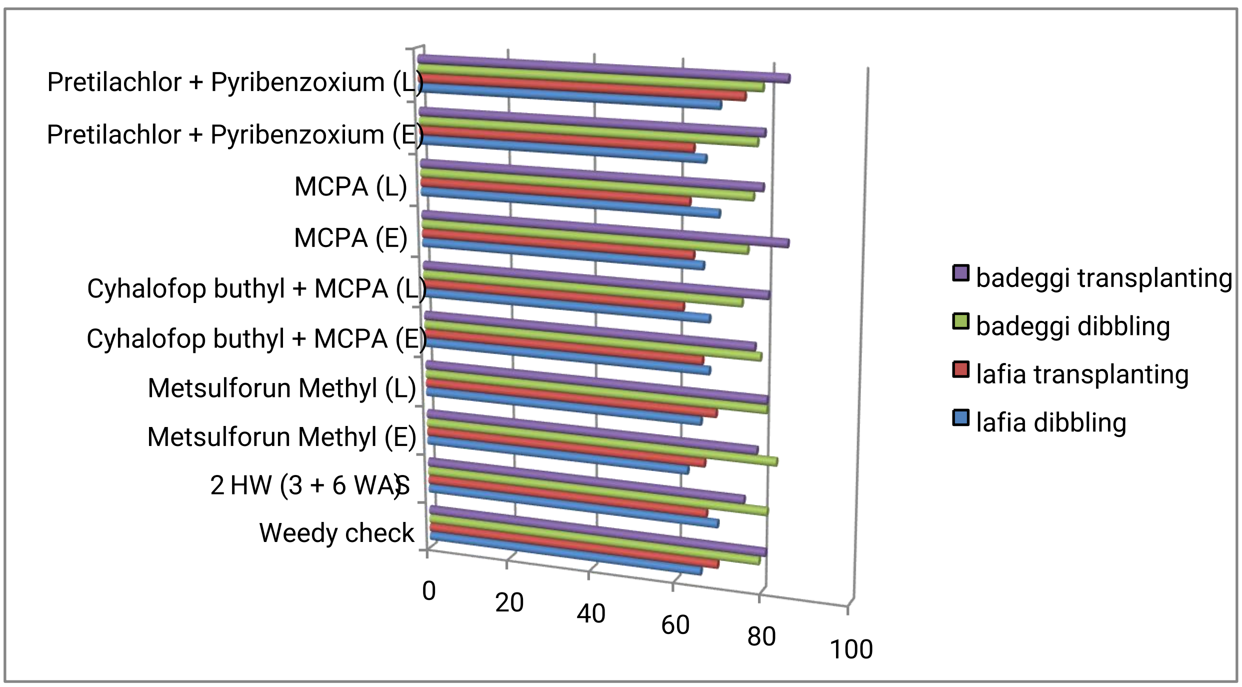


Figure 1: Interaction between location, planting method and weed managements on plant height at 12 WAS of rice.

The effect of location, planting method and weed control on panicle weight per plant, 1000 seed weight and grain yield per hectare on rice is presented in Table 2 below. Lafia location significantly produced heavier panicles per plant than Badeggi location. Planting method affected panicle weight per plant significantly thus use of transplanting method resulted to heavier panicles per plant than dibbling method which produced the lowest values. Weed control had a significant effect on panicle weight per plant. The use of 2 HW at (3 + 6 WAS); early Metsulforun methyl, and early Cyhalofop butyl + MCPA *applications significantly* produced similar panicles per plant heavier than all the other weed managements compared with the weedy check; early MCPA and early Pretilachlor + Pyribenzoxium applications which recorded similar lighter panicles in this study. Location also affect 1000 seed weight significantly as Lafia location produced heavier 1000 seeds than Badeggi location which recorded the lightest 1000 seeds. Planting method had no significant effect on 1000 seed weight. Under the weed management practices, It was observed that, the use of early and late applications of Pretilachlor + Pyribenzoxium significantly produced the heaviest 1000 seeds than all the other weed controls compared with the weedy check, and 2 HW at (3 + 6 WAS) which recorded statistically similar lighter 1000 seeds. The effect of location, planting method and weed control on grain yield, indicated that, location affected grain yield significantly. Badeggi location significantly produced higher grain yield than Lafia location. Planting method also had a significant effect on grain yield. The use of transplanting method significantly produced the highest grain yield than the use of dibbling method at both locations. Weed control significantly affected grain yield. Early and late applications of MCPA significantly produced similar highest grain yield than all the other weed controls compared with the weedy check which recorded the lowest grain yield.

Table 2: Effect of location, planting methods and weed management on number of panicles per plant, number of seeds per panicle and grain yield per hectare

Treatment	Panicle weight per plant	1000 seed weight	Grain yield per hectare
Location (L)			
Lafia	21.25b	23.69b	4164.6b
Badeggi	48.19a	45.51a	4313.8a
LSD (0.05)	0.29		124.34
Planting method (PM)			
Dibbling	32.23b	34.28a	3891.5b
Transplanting	37.21a	34.91a	4586.8a
LSD (0.05)	0.24		22.08
Weed management (WM)			
Weedy check	26.75d	32.81e	1533.7j
2 HW (3 + 6 WAS)	42.91a	33.04e	3519.6h
Metsulforun Methyl (E)	43.09a	33.53de	5457.9b
Metsulforun Methyl (L)	35.05c	34.52c	5268.7c
Cyhalofop buthyl + MCPA (E)	43.74a	35.35b	4519.6e

Cyhalofop buthyl + MCPA (L)	35.45c	33.47de	4615.0d
MCPA (E)	27.33d	35.53ab	6089.6a
MCPA (L)	36.97b	35.65ab	6056.3a
Pretilachlor + Pyribenzoxium (E)	27.44d	36.09a	3868.8f
Pretilachlor + Pyribenzoxium (E)	37.29b	36.12a	4577.1d
LSD (0.05)	0.86	0.65	54.47
Interaction			
L × PM	NS	NS	NS
L × WM	NS	NS	NS
PM × WM	NS	NS	NS
L × PM × WM	NS	NS	NS

DISCUSSION

The higher plant height, heavier panicles, heavier 1000 seed and highest grain yield were observed under Badeggi location and transplanting method. Umair *et al.,* (2022) also recorded higher growth and grain yield in transplanted lowland rice that was managed under various herbicides weed control thus observed less weed competition with planted rice for nutrient, moisture and sunlight in the field. The higher grain yield in transplanting method of rice could be attributed to better crop growth and development which resulted into higher value of yield components which had direct impacts on grain yield of rice (Suryavanshi *et al.,* 2012).

Poor growth, yield and yield attributes of rice was recorded in the weedy check plot and in dibbling method. Umair *et al.,* (2020) in his research on different weed management on rice, observed a delay in weed control lead to weeds absorption of the necessary growth factor thus reducing crop growth, yield and yield attributes. Chauhan and Opeña (2013), also reported that, under dibbling method of planting in rice cultivation, manual weeding should be repeated three to five times for complete eradication of weeds in a field.

CONCLUSION

The results revealed that taller plants, heavier panicles, heavier1000 seeds and higher grain yield per hectare were all recorded under Badeggi location. Transplanting method also contributed to higher growth, yield and yield attributes. For the different weed management practices, best results were obtained among plots with weed management compared to weedy check thus early application of MCPA proved to be best in controlling weeds among the herbicides applied.

From the it could be recommended that the use of transplanting method at Badeggi with early and late application of MCPA herbicide will give better growth and yield performance of lowland rice.

REFERENCES

Akhgari, H., and Kaviani, B. (2011). Assessment of direct seeded and transplanting methods of rice of rice cultivars in the northern part of Iran. *African Journal of Agriculture Research, 6(31),6492-6498.*

Berhanu, A.A. (2015). Effect of Planting Density on Growth, Yield and YieldAttributes of Rice (*Oryza sativa* L.). *Tigray Agricultural Research Institute* (TARI), Alamata Agricultural Research Centre, Alamata, Ethiopia.

Bhullar, M. S., Singh, S., Kumar, S., and Gill, G. (2018). Agronomic and economic impacts of direct seeded rice in Punjab. *Agric. Research. J*, *55*(2), 236-242.

Cates, A.H. (1969). Weed control in dryland and irrigated rice in the tropics. *Asian-Pacific Weed Science. Society. Proceedings, 2, 84-90.*

Chauhan, B. S., and Operia, J. (2013). Weed management and Grain Yield of Rice Sown at low Seeding rates in Mechanized Dry-seeded systems. *Field Crops Research. 141, .9-15.*

De Datta, S.K. Sernasor, P.C. and Malabuyo, J.A. (1973). Paper presented at International Rice Research Conference, 23-27 April 1973.*International Rice Research. Institute. Los Banos, Philippines.*

Ejebe, C. K. (2013). Parboiling characteristics of selected rice varieties from Nigeria', Masters thesis's, University of McGill, Viewed 17 Feb 2016.

Gill, J.S., Walia, S. S., and Gill, R. S. (2014). Direct seeded rice: an alternative rice establishment technique in north-west India: a review. *International Journal of Advanced Research*, *2*(3), 375-386.

Jayeoba, O. J. (2013). Suitability of soil qualities for arable Agriculture using geoinformatics in Nasarawa State, Nigeria, Ph.D Thesis Nasarawa State University, Keffi. 287pp.

Manisankar, G., Ramesh, and Solvaraji, R. (2021). Evalution of Different Weed Management on Yield and Yield attributes on Transplanted rice. *International Journal of Current Microbiology and Applied Science*, 10(5) 390 – 399.

Mobasser, H.R., Delarestaghi M. M, Khorgami, A., Tari, B.D., and Pourkalhor, H. (2010). Effect of Planting Density on Agronomical Characteristics of Rice (*Oryza sativa* L.) Varieties in North of Iran. *Pak. J. Biol. Sci.*10(18):3205-3209.

National Rice Development Strategy [NRDS], (2009), "A Working Document prepared for the Coalition for African Rice Development" May 2009. Pp. 54.

Neog, P., Dihingia, P. C., Sarma, P. K., Sankar, G. R., Sarmah, D., Sarmah, M. K., and Mishra, P. K. (2015). Different Levels of Energy Use and Corresponding Output Energy in Paddy Cultivation in North Bank Plain Zone of Assam, India. *Indian Journal of Dryland Agricultural Research and Development*, *30*(2), 84-92.

Ojehomon, V. E. T., Abo, M. E., Ojehomon, O., andUkwungwu, M. N. (2006). Adoption of recommended management practices in the lowland rice ecology of Niger State, Nigeria. *Tropicultura*, *24(2)*, 82.

Parthipan, T., and Subramanian, E. (2013). Rice and its Residual Effect on Succeeding Black gram. *Journal of Agronomy*. 12 (2): 99-103.

Suryavanshi, P., Singh, Y.V., Singh, K.K., and Shivay, Y.S. (2012). Relative Efficiency of Methods of Crop establishment in Rice *(Oryza sativa* L*). Indian Journal of Agronomy. 57(3):76–78.*

Umair, R., Tayyaba, S., Sidra-tul-mutaha, Haaris, A. A., Zulqernain,N., Sehrish, K. (2020). Weed Management in Rice. For Research Bahawalpur-63100, Government of Punjab, Pakistan.

Yadav, S.K., Suresh, B.G., Pandey, P., and Kumar, B. (2010). Assessment of Genetic Variability, Correlation and Path association in Rice (*Oryza sativa* L.). *Journal of Biological Science.* 2010; 18(1): 1-8.

Yosida, H., and Horie, T. (2010). A model for Stimullating N Accumulation, Growth and Yield of Dicerse Rice Genotypes grown under Different Soil and Climatic Condition. *Filed Crop Research* 117, 122-130.

Yosida., S. (1981). *Foundamentals of Rice Crop Science*. The international Rice Research Institute. Los Banos Manilla, Philippines.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

BASELINE SURVEY OF FARMERS TO ASSESS PRODUCTION AND WEED MANAGEMENT ON SWEET POTATO WITHIN SOUTHERN ZONE OF NASARAWA STATE

A.J. Ibrahim[1], I.H. Bello[1], I. M. Ogara[2] and A.D. Mwoltit[3]

[1]Federal University Lafia, Faculty of Agriculture, Department of Agronomy, P.M.B. 146, Lafia. Nasarawa state.
[1]Federal University Wukari, Faculty of Agriculture, Department of Crop Production and Protection, P.M.B. 1020, Wukari, Taraba State.
[2]Nasarawa State University Keffi, Faculty of Agriculture (Shabu-Lafia Campus), Department of Agronomy, P.M.B. 135, Lafia, Nasarawa State.
[3]Agricultural Development program, Jos, Plateau State.
Corresponding Author's Email: ibnibrahim@gmail.com

ABSTRACT

A preseason survey was carried out within four Local Government Areas [LGAs] (Lafia, Obi, Awe and Doma) of Nasarawa State in June to July 2020 comprised of Adogi, Baure, Rukubi, Andoma, Agyragu Tofa, Agyragu Koro, Adudu districts, with the aim of assessing the production and weed management practices on sweet potato through conducting field survey research. The survey was based on variables: (i) Distribution of respondents according to socio-economic characteristics on sweet potato production. (ii) Scouting and identification of common weeds and various weed control methods within the study area. (iii) Constraints to sweet potato production within the study area. Thirty- five (35) households were interacted with during the survey, the coordinates of 35 farm locations were collated to create map for the studied areas of the survey showing the four Local governments. Sweet potato has gain popularity in Nasarawa State Nigeria due to its ability to give satisfactory yield under adverse climatic and soil conditions as well as under low or to use of external inputs. The results indicated that most popular method amongst the sweet potato farmers was the used of hoe (hand weeding) method to control weeds.

Keywords: Weed management, Hand weeding, Sweet potato, Survey.

INTRODUCTION

Weeds are plants growing where they are not wanted, competing for water, light, space and nutrients and affect the crop growth (Rao *et al.,* 2015). Weed infestation imposes serious constraints in realizing higher yields causing 30 – 40 % loss in seed yield and the harmful effects of weeds are very severe to livestock and human (Mahere *et al.*, 2000), Weeds release into the soil inhibitor or poisonous substance (Allelopathy), which interact with the growth of plants and constitute a biotic resistance against plant invasion, human and livestock (Christina *et al.*, 2015). Weeds are controlled by hand weeding or hoe weeding which can be labourious, therefore the use of herbicides for weed control method seems very effective. Some herbicides are extensively used as pre-emergence herbicide and some as post-emergence for weed control methods in crops, weeds may be resistant to specific herbicides due to the soil type, moisture regime, and types of weed flora (selective or non-selective) (Owen, 2005). Therefore, for effective control of weeds in crops selected herbicide is needed depending on a particular crop with the integration of multiple complementary methods, for example, mechanical and cultural control (Liebma *et al.*, 2016).

Sweet potato is a potential crop with relatively high-yielding. Storage root production and quality can be limited by weed interference and soil fertility depletion (Meyers *et al.,* 2010a; Seem *et al.,* 2003). Sweet potato serves as a form of insurance in drought season or during food scarcity and plays a critical role in rural diet during shortage of grains (Wabanechi, 2014). The use of chemical weed control in sweet potato crops indicated that there are many management methods, high genetic variability between genotypes, herbicide selectivity, as well as root contamination by herbicides. Some studies however have shown that chemical weed control is recommended, as it has been found to increase of crop production (Harker and O' Donovan, 2013). The objectives of this study was to assess production and weed management practices by farmers in the study area on sweet potato with the aim of conducting a field experiment research on sweet potato production.

MATERIALS AND METHODS

The study area was purposefully selected based on the severity of problems associated with sweet potato production in the areas. Data were collected through self-administrative questionnaire (n= 35) administered to Farmers Association and participant observation. Multistage cluster sampling was used to select survey respondents. Initially, the LGAs of Awe, Doma, Obi and Lafia were purposely selected. In the second stage, 1 village in Awe LGA(Baure), 2 villages in Doma LGA (Rukubi and Andoma), 1 village in Obi LGA (Adudu) and 3 villages in Lafia LGA(Adogi, Agyragu Koro and Agyragu Tofa) respectively. For the survey, 30% of the household heads were selected randomly from each village.

The entire questionnaire addresses prevalent biotic constraints in sweet potato production and their management strategies, impact of these constraints in sweet potato production, household and demographic characteristics of the respondents and routine crop management practices adopted. Data were collected during the survey from the different sites through the application of participatory research appraisal tools and techniques, such as individual interviews and field visits, using a questionnaire.

A total of thirty-five (35) farmers' fields were surveyed across the four LGAs (Awe, Doma, Obi and Lafia LGA). The coordinates of each surveyed sites were recorded using GPS (Garmin Colorado 400c handheld Global Positioning System). The measurable data from the GPS was incorporated into The Surfer® 6 Binary Version 6 (GOLDEN SOFWARE 2000) to provide the probability or predict its likely geographical distribution.

Descriptive statistics analysis was used to analyze the socio-economic characteristics of the farmers, management practices and the propensity of weed population occurrence with the surveyed area.

RESULTS

The preliminary survey of production and weed management practices on sweet potato in Nasarawa State, Nigeria in Table 1 shows a total result of 35 farmers' fields representing some sweet potato farms across the zone were sampled during June 2020, in the following villages: Adogi, Baure, Agyaragu Tofa, Agyaragu Koro, Andoma, Rukubi and Adudu. The geo-reference coordinates and level of weed density of the locations are as shown in Fig1.

Table 1: Household District Characteristics Respondent surveyed

S/No	Names of Villages	District	LGA	Numbers of Farmers
1	Adogi	Adogi	Lafia	3
2	Agyaragu Tofa	Agyaragu	Lafia	12
3	Agyaragu Koro	Koro	Lafia	11
4	Andoma	Sarki Dawaki	Doma	4
5	Rukubi	Madaki	Doma	2
6	Baure	Tunga	Awe	1
7	Adudu	Ayero	Obi	2
Total Number of Farmers				35

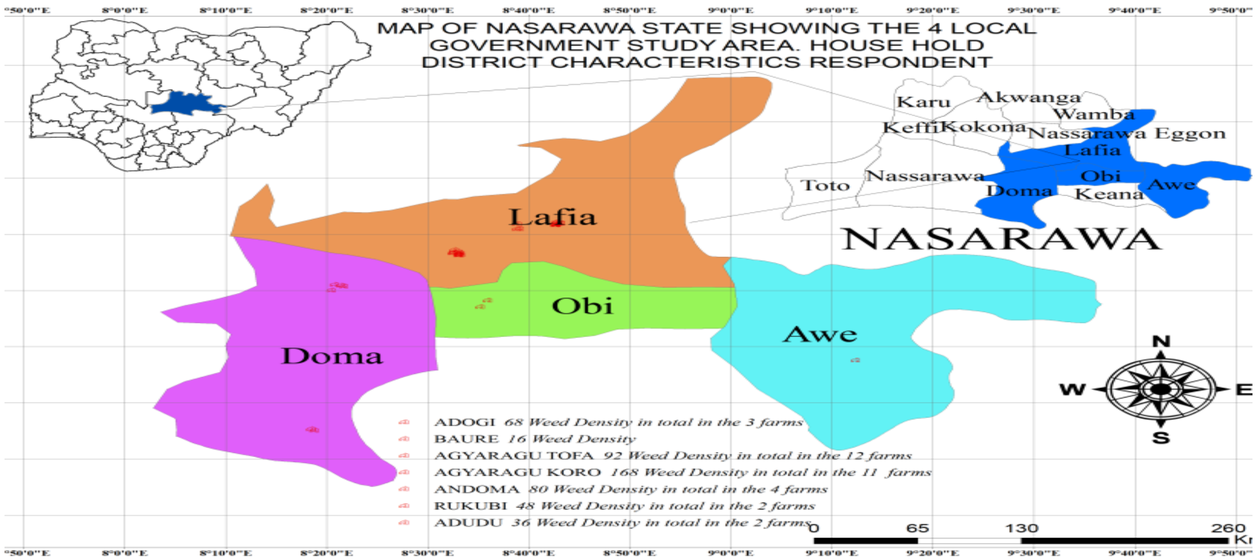


Fig 1: Map of the locations showing the density of weeds in the sampled areas under the sweet potato cultivation.

The result shows that majority of farmers interviewed during the survey (Table 2) are within the age of 36 years (range 20 – 50 years). The highest proportion (43.0%) of sweet potato farmers within the age of 30 -39 years and least category was those within 50 years and above constituting 11.4 % of the farmers. It implied that young people were mostly involved in sweet potato production in the study area. The results shows that majority (94.0 %) of sweet potato farmers were male while 6.0 % were female (Table 2). This indicated that more men were engaged in sweet potato production than the female within the surveyed area of Nasarawa state. The sweet potato farmers with the highest percentage of 43.0 % within the study area had primary school education. However, secondary education and vocational education scored 34.3 and 29.0 %, respectively. Whereas, tertiary education was 14.3 % and lowest percentage among others was non-formal education with 6.0 %.

The results on marital status of the respondents (Table 2) shows that the majority of the farmers were married with percentage status of 66.0 %. Only 29.0% of the respondents were singled, while the widowed were 6.0%, among others. Based on the results presented in Table 2, majority of the household within the study areas of sweet potato farmers (74.2 %) had household size of 6-10 persons.

The majority of the respondents were engaged in farming (Table 2). About 43.0 % of the respondents had 6 -10 years farming experience, while those who are within the range of 11-15 years farming experience were only 29.0 % of the respondents. The least category was those within the range of 16 years and above farming experience and those within the range of 1-5 years farming experience with 8% and 20.0 % of the respondents respectively. The mean sweet potato farming experience was 8.0 years.

Table 2: Distribution of Respondents According to Socio-Economic Characteristics (n=100)

Socio-economic variable	Frequency	Percentage (%)	Mean (ẋ)
Age (years)			
20-29	10	29.0	
30-39	15	43.0	36 years
40-49	6	17.1	
50 and above	4	11.4	
Gender			
Male	33	94.0	
Female	2	6.0	

Educational level			
Primary	15	43.0	
Secondary	12	34.3	
Tertiary	5	14.3	
Non-Formal Education	2	6.0	
Vocational	10	29.0	
Marital Status			
Married	23	66.0	
Single	10	29.0	
Widow	2	6.0	
Household size (numbers)			
1-5	7	20.0	
6-10	26	74.2	7.0
11-15	2	6.0	
Farming Experience(years)			
1-5	7	20.0	
6-10	15	43.0	
11-15	10	29.0	8.0 years
16 and above	3	8.0	

Table 3 shows the results of field infested with weeds in the study area scouted by visual observation and ratings of the weed infestation on the field carried out with appropriate level of infestation of light 30%, moderate 60% and severe 100%. The field with light infestation of weed had 30%, all fields with moderate infestation of weed had 60% and all field with severe infestation of weed had 100%.

The most populous methods of weed control recorded among the respondents was the use of hoe weeding (91.4 %), which was followed by mixed cropping (48.6 % %), while hand pulling and crop rotation were practiced by 17.1 % and 17.6 % of the respondents respectively (Table 3). The use of herbicide to control pre-emergence and post emergence weeds was not practiced by the farmers. However, use of pre-planting application of herbicides showed that 34.3 % of the respondent farmers practice it.

Table 3 further shows that the application of fertilizer at 4-6 WAP was practiced by the farmers, where 71.4 % of the respondent farmers use NPK 15: 15: 15 but the rates of application was different. 42.8 % of the farmers use organic manure as a supplement to boost their production. Sweet potato farmers within the study area applied inorganic fertilizers in little quantities to boost the yield of their crop.

Table 3: Response of Weed Control on Sweet Potato Production

Weed control variable	Frequency	Percentage (%)
Weed control method		
Hoe weeding	32	91.4
Hand pulling	6	17.1
Mixed cropping	17	48.6
Crop rotation	6	17.6
Herbicides control		
Pre-planting Application	12	34.3
Pre-emergence Application	0	-
Post-emergence Application	0	-
Fertilizer Application		
NPK 15:15:15	25	71.4
Organic Manure	15	42.8

Weed infestation level		
Light	7	30
Moderate	14	60
Severe	28	100

Source: Field survey 2020 Multiple Response

Common weeds encountered within the study area were identified as major weeds in sweet potato fields across the districts during the survey. Table 4 shows that *Biden pilosa* Linn. (black jack), *Tridax procumbens* (cobblers peg) were the major weeds identified. Other dominant weeds observed and identified were *Amaranthus, Cyperaceae* spp and *ipomoea spp*. (Table 4).

Weed species	Family	Common Name	Occurrence	Comment
Amaranthus spinosus Linn.	Amaranthaceae	Pigweed, redroot, spiny amaranth, palmer amaranth	***	Pigweed was very severe in most of the field. Palmer amaranth were severe
Celosia isertii (auth)	Amaranthaceae	Wool flowers, horsewhip	**	
Aspilla africana (auth)	Asteraceae	Haemorrhage plant or wild sunflower.	**	Severe in some of the field surveyed.
Bidens pilosa lnn.		Black jack, cobblers peg		
Tridax procumbens (auth)		Coat buttons or tridax daisy	***	Very severe.
Convolvulus arvensis (auth)	Convolvulaceae	Bindweed or morning glory	*	Not so severe in most of the field
Striga hermonthica (Del.) Benth	Scrophulariaceae	Pink witch weed.	*	Not so severe
Commelina benghalensis (auth)	Commelinaceae	Spider wort	*	Not so severe in most of the field
Cyperus esculentus L.	Cyperaceae	Yellow nutsedge	**	Severe
Cyperus rotundus L.		Purple nutsedge	***	Very severe
Cyperus compresus (auth)		Crab grass	**	Severe

Note: * not severe, ** severe, *** very severe.

DISCUSSION

From the results obtained, distribution of respondents according to socio economic characteristics during the pre-season survey of sweet potato production in different local government areas of Nasarawa state, shows that the mean age was 36 years which implied that young people were mostly involved in sweet potato production within the study area, reason being that they are strong enough to cultivate a large portion of land in a short period of time than the older people. This finding agrees with Olagunju *et al,* (2013) who noted that majority of sweet potato farmers in southern zone of Nasarawa state were in the active productive years (36years). Majority of the farmers were married with highest proportion of 66.0 %, while majority of the sweet potato farmers were male with highest proportion of 94.0 % farmers. This is in agreement with Mgbakor *et al.* (2014) who reported that males usually head the farm households in Nigeria. The farmers were literate with highest proportion of 43.0 % having primary education and 34.3 % of had secondary education. This result shows that farmers within the study area were appreciably knowledgeable and were well equipped with skills when they are off farm. This is in line with Oni, *et al.* (2005), who opined that the level of education attended by a farmer not only increases his/her farm productivity but also enhances his/her ability to accept and understand new innovations than illiterate farmers thus, being literate increase their productivity and enhance farm returns.

The results shows that there were more married sweet potato farmers within the study areas, with average household size of 74.2 % and the mean of 7 persons which agrees with findings of (Ezeh, 2013) that marriage encourages synergy among farm families and division of labour among farm families thus reducing the cost of labour resulting in profit maximization. The level of farming experience is an important factor as it is a major managerial determinant for a tapering point. The result shows that farmers of sweet potato had enough farming experience that could improve agricultural production. The result therefore agrees with the assertion of (Ezeh, 2013) which shows that obtaining higher marginal income in agricultural production is an incentive to increase productivity.

Hoe weeding had the highest proportion 91.4 % on weed control method compared to the use of herbicides within the study area as hoe weeding are traditional ways and due to some certain believes of the farmers within the study areas. The result is line with work of Joshua and Gworgwor (2000) and Adigun and Lagoke (2003) who reported that traditional manual weeding is the most popular method of weed control in Nigeria, this is, however, time consuming, labour–intensive, strenuous and generally expensive. The application of herbicides was only being used as pre-planting during the land clearing. However, as reported by Monks *et al*. (2018) sweet potato farmers do use non-selective herbicides prior to transplanting or pre-planting herbicides in combination with plowing, cultivation and mechanical weed control as methods of weed management.

Fertilizer NPK 15:15:15 was applied in little quantities or no fertilizer application in sweet potato farms within the study area due to the scarcity or insufficient funds by farmers to purchase the fertilizer. This is in line with the report of Agwu (2000) who noted that fertilizers are expensive to farmers due to diversion from source of need to the neighboring states and black markets thereby making fertilizers expensive for farmers.

Weeds identification was done during the survey. Most of the weeds identified (Akobundu and Agyakwa, 1987) during the survey and field experiments were *Biden pilosa* L. (black jack) and *Tridax procumbens* (cobblers peg) as the major weeds in sweet potato fields. Other dominant weeds identified were *Amaranthus* and *Cyperaceae* spp. Pigweed (*Palmer amaranth*) and vining weed (*Ipomoea* spp.) were low growing weeds that have ability to grow over the canopy of sweet potato plant where they also compete with resources available for the main plant. These weeds were also reported by Harrison and Jackson (2011a) to be among obnoxious weeds that interfere with the production of sweet potato.

CONCLUSION

From the results of this study, it could be concluded that majority of sweet potato farmers in southern zone of Nasarawa State were in the active productive years males and married. Traditional manual weeding is the most popular method of weed control in the study area. Application of herbicides was only being used as pre-planting during the land clearing. The survey identified the socioeconomics constraints associated with sweet potato production and areas where sweet potato is majorly cultivated within the southern zone (Awe, Doma, Lafia and Obi LGA) of Nasarawa State.

REFERENCES

Adigun, J. A. and Lagoke, S. T. O. (2003). Weed control in transplanted rain and irrigated tomatoes in the Nigerian savanna. *Nigerian Journal of Weed Science,* 16: 23 – 29.

Agwu, A. E. (2000). Diffusion of Improved Cowpea Production Technologies among Farmers in the North-East Savanna zone of Nigeria. Ph.D. Thesis, Dept. of Agricultural Extension, University of Nigeria, Nsukka.

Akobundu, I. O. and Agyakwa, C.W. (1987) *A Handbook of West African Weeds*. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Christina, M., Rouifed, S., Puijalon, S., Vallier, F., Meiffren, G., Bellvert, F. and Piola, F. (2015). Allelopathic effect of a native species on a major plant invader in Europe. *Naturwissenschaften,* 102 (3-4):12. doi:
10.1007/s00114-015-1263-x.

Ezeh, A. N. (2013) Access and application of information and communication technology (ICT) among farming households of south-east Nigeria. *Agriculture and Biology Journal of North America*. ISSNPrint:2151-7517.

Harker, K. N. and O'donovan, J. T. (2013). Recent Weed Control, Weed Management, and Integrated Weed Management. *Weed Technology*, 27(1)1: 1 - 11. https://doi.org/10.1614/ WT-D-12-00109.1.

Harrison, H. and Jackson, D. (2011a). Response of two sweet potato cultivars to weed interference. *Crop Protection*, 30: 1291-1296. 10.1016/j.cropro.2011.05.002.

Joshua, S. D. and Gworgwor, N. A. (2000). Effect of weeding regime on crop performance in millet-cowpea

Intercrop in the semi-arid zone of Nigeria. *Nigerian Journal of Weed Science* 13: 63 – 68.

Liebman, M., Baraibar, B., Buckley, Y., Childs, D., Christensen, S., Cousens, R., Eizenberg, H., Heijting, S., Loddo, D. and Merotto, J. A. (2016). Ecologically sustainable weed management: How do we get from proof-ofconcept to adoption? *Ecology Applied*, 26, 1352 – 1369.

Mahere, J., Yadav, P. K. and Sharma, R. S. (2000). Chemical Weed Control in Linseed with Special Reference to *Cuscuta*. *Indian Journal of Weed Science*, 32(3&4): 216 - 217.

Meyers, S. L., Jennings, K. M., Schultheis, J. R. and Monks, D. W. (2010a). Interference of Palmer Amaranth (*Amaranthus palmeri* S. Wats.) in sweet potato. *Weed Technology*, 58: 199 - 203. https://doi.org/10.1614/WS-D-09-00048.1.

Mgbakor, M.N, Uzendu,P.O and Usifor,I.J (2014). Effect of rural-urban migration by youths on Agricultural labour in Aniocha South Local Govt Area Delta state, Nigeria. *Journal of Research in Agriculture and Animal Science* (2)16 pp. 14 – 22.

Monks, D. W., Jennings, K. M., Meyers, S. L., Smith, T. P. and Korres, N. E. (2018). Sweet potato: Important Weeds and Sustainable Weed Management. In: *Weed Control.* 1st Edition. Chapter 31. Pub. CRC Press. pp. 554 – 580.doi:10.1201/9781315155913-31.

Olagunju, F. I., Fakayode, S. B., Babatunde, R. O. and Ogunwole-Olapade, F. (2013). Gender analysis of sweet potato production in Osun State, Nigeria*. Asian Journal Agricultural. Extension, Econ. and Sociology* 2(1):1

Oni, O. A., Oladele, O. I., Oyewole, I. K. (2005). Analysis of factors influencing loan default among poultry farmers in Ogun State, Nigeria. *Journal of Central Europe Agriculture*, 6(4): 619-624.*Global Journal of Agricultural Research*, Vol.2, No.4, pp.19-26.

Owen, M. D, and Zelaya, I. A. (2005). Herbicide-resistant crops and weed resistance to herbicides. *Pest Management Science*, 61: 301 – 311.

Rao, A. N., Wani, S. P., Ramesha, M. and Ladha, J. K. (2015). Weeds and weed management of rice in Karnataka state, India, *Weed Technology*, 29(1): 1 – 17.

Seem, J. E., Creamer, N. G. and Monks, D. W. (2003). Critical weed-free period for Beauregard sweet potato (*Ipomoea batatas*). *Weed Science,* 17: 686 - 695.

Wabanechi, S. (2014). Effect of planting Density on growth and yield of sweet potato (*Ipomoea batatas* (L.) Lam) varieties in Habru District, Northern Ethopia. M.Sc. Thesis submitted to the School of Plant Science, Harmaya Univ., Ethiopia. 82 p.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EFFECT OF SOME WEED MANAGEMENT PRACTICES ON GROWTH COMPONENTS OF TOMATO (*Solanum lycopersicum* L.) IN YOLA NORTH-EASTERN NIGERIA

A.B. Mustapha and H.A. Jalo

Department of Crop Production and Horticulture, Faculty of Agriculture, Modibbo Adama University Yola.
abmustapha@mau.edu.ng

ABSTRACT

Field trial was conducted during the 2020 dry season at the experimental farm site of the Department of Crop Production and Horticulture, Modibbo Adama University, Yola to evaluate the Effect of some weed management practices on growth components of Tomato (Solanum lycopersicum L.) in Yola northeastern Nigeria. The experiment was laid in a Randomize Complete Block Design (RCBD) with a split plot arrangement having (5) treatments of T_1 = Zero weeding (Control), T_2 = Weedy check T_3 = Maize straw at 1.0 kg m^{-1}, T_4 = S-metolachlor at 1.5 kg and T_5 = Pendimethalin at 1.44 kg ha^{-1} replicated three (3) times. Row spacing of 40cm, 60cm and 80cm were assign to main plot while the weed treatments were assigned to sub-plot. Each replication consists of fifteen (15) sub-plots, and were measured 140cm, 190cm and 250cm by 150cm per sub-plot, a boundary of 15cm was maintained within sub-plot and a pathway of 75cm between main plot and replication having 4.8m x 4.5m experimental site. The result shows significant differences on plant height of tomato. Weedy check and 40cm row spacing recorded the tallest tomato plants of (18.54) at 2WAT in 2020 while the tallest plant, was recorded at the interaction between weedy check and 60cm row spacing of (22.58cm). The highest number of branches was recorded at the interaction between 40cm row spacing and weedy check treatment of (7.17) and (11.50), compared with Pendimenthalin that recorded the lowest tomato plant height, number of branches of (1.00) and (2.00) at 4 & 5WAT. Similarly, the result for weed parameters also indicated that weedy check and 40cm row spacing had the lowest weed density m^{-2} of (1.84) at 30 days after application compared to Zero weeding plot and 80cm row spacing that recorded the highest weed density of (7.04) in 2020 experimental year, also with the percentage of weed dry matter. Weedy check also recorded highest weed control efficiency and weed index compared with remaining treatments. Therefore, weedy check treatment and 40cm row spacing were the best among weed management practices and row spacing and are recommended for use as an alternative to use of herbicide and 60cm row spacing for effective weed control and maximum yield output of the tomato production in Yola, Nigerian.

Keywords: Tomato, weed management, spacing, growth attributes

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a major vegetable crop produced worldwide. It is usually grown outdoors to be used fresh or processed (Lucier *et al.* 2000). It is a popular and nutritive vegetable crop ranking next to potato in world's vegetable production. It is warm season crop, resistance to heat, drought and grows on wide range of soil and climatic conditions. Nigeria is the fourth largest producing country of tomato in Africa and largest in West Africa sub-region with an estimated output of 1.8 million metric tonnes and average yield of 10 tonnes/ha (FAO, 2012). The shortest supply is attributed to average yields of tomato in Nigeria are only about half of those in world leading countries like China (25.3 tonnes/ha) Kalu (2013). Nigeria is unable to meet its growing requirement of tomato and tomato products. Consequently, the country reverted to importation of tomato products which resulted in unnecessary pressure on foreign reserve. Between 2009 and 2010, Nigeria imported a total of 105,000 metric tonnes of tomato paste valued at over 16 billion Naira to bridge the deficit gap between demand and supply in the country (FAO, 2012). Several reasons are responsible for the low yields of tomato among which weed infestation and spacing are primary (Adigun, 2005). Unrestricted weed growth throughout the crop life cycle resulted in 92 to 95% reduction in tomato fruit yield (Adigun, 2002).

Weeds are the major constraint that limits crop production and most deleterious effect and ultimately causing the yield reduction of tomato by 53 to 67% (Sanok, *et al.* 1979). Present study was undertaken with a view to reduce the losses of economic production through effective weed control and minimize the scarcity of labors. Weed reduce yields by competing for space, light, water and nutrients, weakening crop stand and reduce harvest efficiency (Abbasi, *et al*. 2013). However, the yield loss in agricultural production is becoming increasingly important because of decrease in agricultural lands as well as the population growth. The most important part of losses in plant production is caused by weeds. Though herbicides are commonly used for control of weeds, however, use of herbicides negatively affects human health and environment, and chemical residues are left in the soil, water, air and products.

Mulching is a recent and important non-chemical weed control method. It is necessary to cover the soil surface with different materials to obtain high biological activity, retain soil moisture and to achieve a good control of weeds. Row spacing affects light interception and also influences the space available for weeds to grow. Row spacing can also affect the plant canopy (tomato) shape and branching, thereby influencing flowering and fruiting as well as crop competitiveness with weeds. Row spacing is often determined by the type of planting and harvesting equipment available, and will result in different crop yields and can influence overall economic return.

Attempts to reduce the yield losses caused by weeds for smallholder farmers have been focused on hoe weeding and chemical weed control (Mashingaidze and Chivinge, 2005). Apart from the high cost of hoe weeding, severe labour bottlenecks are common during peak weeding, resulting in delayed weeding in large portions of the planted crops, well after they have suffered significant damage from weeds (Adigun and Lagoke, 2003) Most available herbicide, on the other hand does not give a season long weed control effect. Moreover, the sole dependence on herbicides may lead to development of herbicide resistant weeds (Osipitan and Dille, 2017). Weed management places greater attention on the reduction of weed emergence in a crop and minimizing weed interference with the crop through the integration of techniques, knowledge and management skills.

The strategic weed management practices such as mulching and row spacing has potential to produce a healthy crop with aggressive competition against weeds and therefore reduce the burden of hoe weeding and chemical herbicide in tomato. There is need, however, to systematically integrate this weed management tactics into the production practice of smallholder farmers to tackle problems caused by weeds in a sustainable manner within the context of Weed Management Practices. High cost of chemical herbicide to provide the much-needed weed control for plant growth means that alternatives and possible new management practices have to be explored. At proper rate and time however, weeds can be controlled by reducing chemical herbicide and introducing mulches material. Delay in weed emergence provided by application of mulching materials could further give tomato advantage against weeds, subsequently resulting in improved fruit yield.

The study was designed to investigate the feasibility of using mulch materials and herbicides as a weed control approach and varying row spacing for controlling weeds in tomato in Yola, Adamawa State. Therefore, the aim of the research was to investigate the feasibility of using mulch materials and herbicides as a weeds control approach and varying row spacing for controlling weeds in tomato. The objective was to evaluate effect of mulch and herbicide on growth of tomato.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of Crop Production and Horticulture Department, Modibbo Adama University, Yola during 2020 dry season. The Experimental site lies between Latitude $9^{0}35^{!}38"$ and 9.353817 and longitude $12^{0}50'45.3"$ and 12.504533 (Anonymous, 2017). The experimental materials consisted of tomato seed "Roma" and the treatments used were T_1 = Zero weeding (Control), T_2 = Weedy check T_3 = Maize straw at 1.0 kg m^{-1}, T_4 = S-metolachlor at 1.5 kg ha^{-1} and T_5 = Pendimethalin at 1.44 kg ha^{-1}. Laid on a Randomize Complete Block Design (RCBD) with a split plot arrangement having (5) treatments, replicated three (3) times. Row spacing of 40cm, 60cm and 80cm was assigned to main plot while weed control treatment was assigned to sub-plot. Each replication consists of fifteen (15) sub-plots, and was measured 140cm, 190cm and 250cm by 150cm per sub-plot, a boundary of 15cm was maintain within sub-plot and a pathway of 75cm between main plot and replication having 4.8m x 4.5m experimental site.

RESULTS AND DISCUSSION

Effect of different treatments on plant height of tomato

The row spacing and some weed management treatments affected the height of tomato significantly. However, there was no significant difference with the spacing treatment at 2, 4, and 6 weeks after transplanting (Table 1). This might be due to the plenty of growth factor in weed free plot that allowed the plant to attain its maximum and the competition between weed and crop for the light helped it to grow to its maximum height. The plant height changes with row spacing form a maximum of 19.92 and 31.67 in 60cm row spacing to a minimum of 13.08 and 12.41 at 2 weeks after transplanting with 31.24 and 27.69 at 4 weeks after transplanting but with increase of the weeks the plant height at 40cm row spacing recorded the maximum height of 53.81cm at 6 weeks compared to a 60cm row spacing that recorded maximum plant height at 4 weeks. This result agreed with the findings of other researchers (Olaniyi and Fagbayide, 2009; Fogg, 1967), who found that the plant showed growth in height beginning rather slowly, increasing to a maximum then slow down again so that the graph obtained by plotting height against time is like an oblique 'S' in shape.

Among the subplot treatments the plant was highly significant at 2, 4, and 6 weeks after transplanting to a maximum average plant height of 65.58cm recorded by weedy check at 6weeks whereas minimum plant height of 11.62cm was observed in Pendimenthalin at two weeks after transplanting. Similarly, in weedy check, inter-specific competition between plants made them become taller in such environments (Tamana. and Ijaz , 2014). Table 1 also shows that maximum plant height of 40.37 was recorded at 4 weeks after transplanting whereas at 2 weeks' maize straw at 1.0kgm^{-1} (Mulch Material) was recorded with the minimum plant height of 15.39cm followed by the weed free check. A minimum plant height of 10.73, 19.17 and 37.19 was recorded with S-mentalachor at 1.5kgha^{-1} at 2, 4, and 6 weeks after transplanting.

The interaction table shows that there was a significant difference between row spacing and weed management treatments on the plant height at 2WAT. The interaction between 40cm and weedy check recorded the highest plant height of 18.54cm (Table 2). Followed by the interaction between the row spacing of 60cm with Maize straw at 1.0 kg m^{-1} treatment at 2WAT.

Table 1: Plant Height (PH) of Tomato as affected by different treatments

Main plot spacing	PH2 WAT	PH4 WAT	PH6 WAT
40 cm	13.08^{b}	31.24^{b}	53.81^{a}
60 cm	13.92^{b}	31.67^{a}	53.56^{a}
80 cm	12.41^{b}	27.69^{b}	48.53^{a}
F pr.	0.137	0.067	0.217
Lsd	1.618	3.586	7.727
Sig. Level	Ns	*	Ns
Sub plot diff. Weed management			
Zero weeding (control)	13.21^{bc}	31.44^{b}	53.05^{c}
Weedy check	15.39^{a}	40.37^{a}	65.58^{a}
Maize straw at 1.0kgm^{-1}	14.73^{b}	32.72^{b}	59.78^{b}
S-mentolachlor at 1.5kgha^{-1}	10.73^{d}	19.71^{d}	37.19^{d}
Pendimethalin at 1.44kg ha^{-1}	11.62^{c}	26.74^{c}	44.23^{e}
Grand mean	13.14	30.20	51.97
F pr.	<.001	<.001	<.001
Lsd	1.665	4.351	5.552
Sig. Level	**	**	**

Interaction F pr.	0.004	0.105	<.001
Lsd	2.826	7.195	10.370
Sig. Level	*	Ns	*

Weedy check= (weeding to two weeks' intervals), WAT= Weeks After Transplanting, NS= Not Significant ** = Significantly Different

The least plant height of 9.22cm was recorded at the interaction between 80cm row spacing and Smetolachlor at 1.5 kg ha^{-1}. Furthermore, the interaction between row spacing of 40cm, 60cm with weedy check also recorded the highest plant height of 63.69 and 60.54cm (Table 3). The least plant height of 28.58cm was recorded at the interaction between 60cm row spacing and S-metolachlor at 1.5 kg ha^{-1} compared to the interaction in (Table 2) that shows the least 9.22cm at 40cm row spacing at 2WAT.

Table 2: Interaction between Spacing and Weed management treatments on Plant Height of Tomato at 2(WAT)

	Weed Management Treatments				
Row Spacing	T_1	T_2	T_3	T_4	T_5
40cm	10.92	18.54	12.90	11.64	11.40
60cm	14.28	14.70	16.98	11.33	12.33
80cm	14.44	12.93	14.33	9.22	11.11
SE (±)			1.379		

Table 3: Interaction between Spacing and Weed management on Plant Height at of Tomato 6(WAT)

	Weed Management Treatments				
Row Spacing	T_1	T_2	T_3	T_4	T_5
40cm	49.47	63.69	56.22	52.00	46,44
60cm	48.42	60.97	57.43	28.58	47.23
80cm	61.28	72.08	65.69	31.00	39.00
SE (±)			5.011		

Effect of different treatments on number of branches for tomato plant

The number of branches at various weeks for tomato is presented on Table 4. Although, there was no significant difference for the combination of the main plots (Factor A) and sub plots (Factor B) treatments. Among the main effects, i.e. varying row spaces, at 4 weeks shows that there was a significant difference as the highest number of branches of 3.89 was recorded at 40cm row spacing followed by 3.16 and 3.10 at 60cm and 80cm respectively. This shows no significant difference at 60cm and 80cm but significant at 40cm with the probability value of less than 0.045. Among weed management treatments in subplots, the analysis of the data showed the effect of the different applications of treatments on number of branches of the tomato plant that indicated a highly significant difference. Across all the weeks' weed free check recorded the highest number of branches of 1.22, 3.61, 6.01, 9.53 and 10.92 at 2, 3, 4, 5 and 6 weeks respectively. This maximum number of branches per plant in weed free plot at these weeks may as a result of low density and dry weight of weeds and more space to produce as compared to others. Tamana and Ijaz, (2014) observed that weed free treatment recorded the highest number of primary branches per plant at 30, 60 and 90 days after transplanting. whereas at 2 weeks after transplanting maize straw at 1.0kgm^{-1} recorded 0.72, Pendimenthalin at 1.44kg ha^{-1} and Zero weeding recorded 0.44 and 0.37 had no significant difference, compared to S-mentalachor at 1.5$kgha^{-1}$ which recorded the minimum branches of 0.17 that was significantly different to Maize straw at 1.0kgm^{-1} and weed free check but not significant to Pendimenthalin at 1.44kg ha^{-1} and Zero weeding.

Table 4: Number of Branches (NB) of Tomato as affected by different treatments.

Main plot spacing	NB2WAT	NB3WAT	NB4WAT	NB5WAT	NB6WAT
40cm	0.40[a]	2.15[a]	3.89[a]	6.03[a]	6.70[a]
60cm	0.40[a]	1.89[a]	3.16[b]	4.92[a]	5.53[a]
80cm	0.96[a]	2.10[a]	3.10[b]	5.21[a]	6.45[a]
F pr.	0.354	0.616	0.045	0.315	0.348
Lsd	1.078	0.634	0.637	1.816	2.046
Sig. Level	NS	NS	*	NS	NS
Sub plot diff. Weed management l Zero weeding (control)	0.37[bc]	1.58[c]	2.69[c]	4.13[c]	4.67[c]
Weedy check	1.22[a]	3.61[a]	6.01[a]	9.53[a]	10.92[a]
Maize straw at 1.0kgm^{-1}	0.72[b]	2.51[a]	4.44[b]	6.97[b]	7.86[b]
S-mentolachlor at 1.5kgha^{-1}	0.17[c]	1.13[cd]	1.69[c]	2.75[c]	3.47[c]
Pendimethalin at 1.44kg ha^{-1}	0.44[bc]	1.41[cd]	2.09[c]	3.56[c]	4.22[c]
Grand mean	0.59	2.05	3.38	5.39	6.23
F pr.	0.004	<.001	<.001	<.001	<.001
Lsd	0.521	0.634	0.870	1.423	1.650
Sig. Level	**	**	**	**	**
Interactio n F pr.	0.538	0.267	0.021	0.026	0.154
Lsd	1.183	1.124	1.418	2.581	2.967
Sig. Level	NS	NS	NS	NS	NS

Weedy check= (weeding to two weeks' intervals), WAT= Weeks After Transplanting, NS= Not Significant ** = Significantly Different

At 3 weeks after transplanting, Weed free check, Maize straw at 1.0kgm^{-1} and Zero weeding were all significantly different to each other and all the treatments except Zero weeding that had no significant difference with Pendimenthalin at 1.44kg ha^{-1} and S-mentalachor at 1.5kgha^{-1}. At 4, 5 and 6 weeks (Table 4) shows similar results among Weedy check, Maize straw at 1.0kgm^{-1} and Zero weeding, Pendimenthalin at 1.44kg ha^{-1} and S-mentalachor at 1.5kgha^{-1} was recorded. But no significant difference between Zero weeding, Pendimenthalin at 1.44kg ha^{-1} and Smentalachor at 1.5kgha^{-1} recorded.

Effect of different treatments on weed density for tomato farming

Weed density m^{-2} at 30 days after transplanting as depicted in Table 5, the effect of row spacing and weed control management treatment was significant (p<0.05) and highly significant, respectively; however, at the interaction, the effect of row spacing and weed management treatments on weed density, recorded an increase in weed density of 4.76, 6.68 and 7.04 weeds m^{-2} for the interaction of 40, 60 and 80cm row spacing with the control treatment respectively which was the highest weed density cover recorded followed by Maize straw at 1.0kgm^{-1} at 40cm and Smentolachlor at 1.5kgha^{-1} at 60cm while Pendimenthalin at 1.44kg ha^{-1} at 8cm row spacing. The lowest weed density was recorded at the interaction of weedy check and all the row spacing which was 1.84, 2.48 and 7.04 weed m^{-1}. The effect of row spacing was also significant. After subjecting the means to LSD test for effect of row spacing on weed density, there was an increase in weed density of 3.51, 4.27 and 4.54 weeds m^{-2} for 40, 60 and 80 row spacing respectively. Tamana and Ijaz, (2014), also observed an increase row spacing increased weed density of 3.39, 4.19 and 4.53 weeds m^{-2} for 40, 60 and 80 row spacing respectively. A high weed density of 6.16m^{-2} was recorded in Zero weeding (Control), followed by Pendimenthalin at 1.44kg ha^{-1}, Maize straw at 1.0kgm^{-1} and S-mentolachlor at 1.5kgha^{-1} where Weedy check was recorded with the minimum weed density of 2.29. This result is in line with those reported by Monks *et al.,* (1997) and Tamana and Ijaz, (2014) who concluded that weedy check and some mulches provided satisfactory weed control. Zafar *et al.* (2010) also reported that there was an increase in weed-crop competition period.

Similarly, maximum number of weed density was observed in plot where weeds were allowed to compete with crop for full growing season whereas the minimum was observed in weed free plot (Tesfaye *et al.*, 2015).

Table 5: Weed density m^{-2} at 30 days after application of different treatments in tomato

Treatments	Row spacing			Treatments means
	40cm	60cm	80cm	
Zero weeding (control)	4.76	6.68	7.04	6.16[a]
Weedy check	1.84	2.48	2.55	2.29[d]
Maize straw at $1.0kgm^{-1}$	3.64	3.95	4.10	3.90[c]
S-mentolachlor at $1.5kgha^{-1}$	3.58	4.20	4.38	4.05[bc]
Pendimethalin at 1.44kg ha^{-1}	3.47	4.04	4.63	4.19[b]
Row spacing mean	3.51[b]	4.27[a]	4.54[a]	

$LSD_{0.05}$ (Row spacing) = 0.300, $LSD_{0.05}$ (Treatments) = 0.208, Interaction effect= 0.394

Effect of different treatments on weed biomass of tomato

The result in table 6 showed that the effects of different treatments on weeds biomass for this research was significantly different with the row spacing as the weed increases with increase in row spacing where the highest weed biomass was recorded at 80 days after transplanting. At 40 and 60 days after transplanting the weed biomass was not significantly different as it recorded 33.35 and 36.71 (Table 6).

Effect of different treatments on weed biomass was significant at the end of this research. Zero weeding treatment recorded the highest total weed density/m^2 (966.52) which was significantly different among all the other treatments, whereas weedy check treatment produced the lowest total weed density/m^2 of (16.49). which is also significantly different with Farmer's weeding, S-mentolachlor and Pendimethalin. However, maize straw at $1.0kgm^1$, S-mentolachlor at $1.5kgha^{-1}$ and Pendimethalin at $1.44kgha^{-1.}$ were not significantly different (Table 6). This result is agreement with the work of Gosheh *et al.* (2010). Who reported that weed biomass was much higher in weedy plots. Similarly, Tesfaye *et al.* (2015) observed that the effect of different weed crop completion period on weed dry weight was significant as weedy plot produced highest weed dry weight (1093.20) whereas the minimum was recorded from weed free plot up harvest (0.0). This indicated that increment of weed free period was increased; there was significant reduction in weed biomass. This may be due to lowest weed density and short time weed crop association to accumulate weed dry weight. Weed dry weight was influenced markedly due to different durations of crop-weed competition. Weed dry weight decreased with increase in duration of weed-free condition, whereas the weed dry matter accumulation increased with increase in weedy duration. Ved and Srivastva (2006) reported that the lowest weed dry weight was noted in the plots kept weed-free up to harvest and was similar to those plots kept weed-free up to 75, 60, 45 OAT and weedy till 15 OAT. This was attributed to repeated weeding. Weed dry weight increased progressively when the weedy period extended from 15 to 45 OAT due to continued dry matter accumulation in weeds. Weedy condition beyond 45 DAT till harvest produced less weed dry weight significantly.

Table 6: Average Fresh and Dry weed biomass recoded as Dry matter

Treatments	Row spacing			Treatments means
	40cm	60cm	80cm	
Zero weeding (control)	49.03	65.60	84.93	66.52[a]
Weedy check	16.40	18.10	14.97	16.49[c]
Maize straw at $1.0kgm^{-1}$	46.80	37.23	25.63	36.56[b]

S-mentolachlor at 1.5kgha^{-1}	23.80	26.10	35.20	28.37^{b}
Pendimethalin at 1.44kg ha^{-1}	30.73	36.50	38.73	35.32^{b}
ROW SPACING MEAN	33.35^{b}	36.71^{b}	39.89^{a}	

$LSD_{0.05}$ (Row spacing) = 3,680, $LSD_{0.05}$ (Treatments) = 10.053, Interaction effect= 15.767

Effect of different treatments on weed control efficiency of tomato

There was no significant difference among row spacing on weed control efficiency at 40, 60 and 80cm spacing of tomato plant. (Table7). However, the effect of other treatments in the sub-plot was highly significant on weed control efficiency. The weedy check treatment recorded the highest weed control efficiency of 81.01 while Smentolachor produced the lowest apart from the zero weeding which was used as the control to measure the weed control efficiency of the research work. Weedy check treatment shows significantly different to maize straw and highly significantly different to Pendimethalin and S-mentolachor. The maize straw treatment also significant to Pendimethalin and S-mentolachor. While Pendimethalin and S-mentolachor were not significant to each other. Interaction between row spacing and weed management treatments on weed control efficiency was not significant.

Table 7: Weed control efficiency (%) up to Harvest

Treatments	Row spacing			Treatments means
	40cm	60cm	80cm	
Zero weeding (control)	0.00	0.00	0.00	0.00
Weedy check	77.99	82.90	82.13	81.01^{a}
Maize straw at 1.0kgm^{-1}	70.93	73.34	69.50	71.26^{b}
S-mentolachlor at 1.5kgha^{-1}	63.94	55.29	49.12	56.12^{c}
Pendimethalin at 1.44kg ha^{-1}	54.50	42.54	43.84	49.96^{c}
ROW SPACING MEAN	53.47^{a}	50.81^{a}	48.92^{a}	

$LSD_{0.05}$ (Row spacing) = 11.065, $LSD_{0.05}$ (Treatments) = 14.285, Interaction effect= 24.743

Effect of different treatments on weed index of tomato

Row spacing had no significant difference on the weed index for control of weed in tomato at 40, 60 and 80cm spacing. (Table 8). However, the effect of other treatments in the sub-plot also had no significant different on weed index. The S-mentolachor. treatment recorded the highest weed index of 22.22 follow by Pendimethalin that recorded 20.08, the maize straw and zero weeding that recorded the lowest apart from the weedy check which was used to determine the weed index.

Interaction between row spacing and weed management treatments on weed index was not significant at probability value of 0.449 and the lest significant difference of 15.975.

Table 8: Weed index (%) up to Harvest

Treatments	Row spacing			Treatments means
	40cm	60cm	80cm	
Zero weeding (control)	20.97	20.01	11.05	17.34^{a}
Weedy check	0.00	0.00	0.00	0.00
Maize straw at 1.0kgm^{-1}	10.69	28.54	13.02	17.44^{a}
S-mentolachlor at 1.5kgha^{-1}	22.73	18.45	25.49	22.22^{a}
Pendimethalin at 1.44kg ha^{-1}	22.86	19.81	17.56	20.08^{a}
ROW SPACING MEAN	15.45^{a}	17.81^{a}	13.43^{a}	

$LSD_{0.05}$ (Row spacing) = 7.144, $LSD_{0.05}$ (Treatments) = 9.223, Interaction effect= 15.975

CONCLUSION

Based on the findings in this study, it could be concluded that weedy check achieved the tallest plants and highest number of branches. Weedy check treated plot was also noted with highest weed control efficiency and weed index, likewise the lowest weed density m^{-2} and weed dry matter was recorded in weedy check treated plot.

As per effect of some weed management practices on growth components of tomato, weedy check secured effective weed control with tallest plants and highest number of branches, as well as weed control efficiency and weed index. The row spacing 40cm and 60cm were the best spacing for effective maximum growth of tomato.

REFERENCES

Abbasi, N.A., L. Zafar, H.A. Khan and A.A. Qureshi. (2013). Effects of naphthalene acetic acid and calcium chloride application on nutrient uptake, growth, yield and post-harvest performance of tomato fruit. Pakistan Journal Botany, 45(5): 1581-1587.

Adigun, J.A. (2002). Chemical weed control in transplanted rain fed tomato (Lycopersicon esculentum Mill) in the forest-savanna. Transition zone of south western Nigeria. Agricultural Environment, 2(2): 141-150.

Adigun J.A. (2005) critical period of weed interference in rain fed and irrigated tomatoes in the Nigerian Savanna Agriculture. Tropical Subtropical, 38, pp. 73-80

Adigun J.A. and Lagoke S.T.O (2003) Weed control in transplanted rain and irrigated tomatoes in the Nigerian savanna Niger. Journal of Weed Sciences, 16, pp. 23-29 Anonymous (2017). Etrex GPS Observation, Yola, Nigeria.

FAO (2012) FAOSTART Global Tomato Production, Food and Agriculture Organization of the United Nations. FAOSTAT Database. Rome, Italy: http://faostat3.fao.org/home/E.

Ghosheh, H. M. al-Kawamleh, I. Makhadmeh (2010) Weed Competitiveness and Herbicidal Sensity of Grafted Tomato (Solanum lycopersicon Mill.) Journal of Plant Protection Research Volume 50, Number 3.

Kalu, S. (2013) The Great Tomato Waste in Nigeria http://kalusam.wordpress.com/2013/09/11

Lucier G., Biing-Hwan L., Jane A., Linda K. (2000). Factors Affecting Tomato Consumption in the United States. USDA's Economic Research Service, November 2000: 26–32.

Mashingaidze A.B, Chivinge O.A. (2005). Weed control using reduced herbicide dosages: a theoretical framework Trans. Zimbabwe Science Association., 69, pp. 12-19

Monks, C.D., D. W. Monks. T. Basden. A Selders. S. Poland and E. Rayourn. (1997). Soil temperature, soil moisture, weed control, and tomato (Lycopersicon esculentum) response to mulching. Weed Tech., 11 (3): 561-566.

Osipitan O.A. and Dille J.A (2017) Fitness outcomes related to glyphosate resistance in Kochia (Kochia scoparia): what life history stage to examine? Front. Plant Science, 8 , p. 1090, 10.3389/fpls.2017.01090

Sanok W. J, Shelleck G. W, Greighton J. F. (1979). Weed problems and phytotoxicity with herbicides in five tomato varieties. Production of the North Eastern Weed Science Soc. Department of Rort. University of Maryland, College Park 20742, USA 33: 332 – 335.

Tamana, B. and Ijaz, A. K., (2014). Weed control in tomato (Lycopersicon esculentum Mill.) through mulching and herbicides. Pakistan Journal Bot., 46(1): 289-292

Tesfaye, A, Frehiwot, S. and Hamza I. (2015). Effect of weed interference period on yield of transplanted Tomato (Lycopersicon esculuntum Mill.) in Guder West Shewa-Oramia, Ethiopia. Journal of Food and Agricultural Science. Vol. 5(3), pp. 14-20.

Ved, P., Srivastava A (2006). Crop-weed competition studies in tomato (Lycopersicon esculentum L.) under MidHills of North-West Himalayas. International Journal of Weed Science 38(1 & 2): 86-88.

Zafar, M. Tanveer, A, Cheema, Z. A, Ashraf, M. (2010). Weed-crop competition effect on growth and yield of sugarcane planted using two methods. Pakistan Journal Bot. 42(2):815-823.

Weed Management in Horticulture

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EFFECTS OF MULCH MATERIALS OF VARYING TISSUE CHEMICAL COMPOSITIONS ON WEED CONTROL IN SWEET PEPPER (*Capsicum annuum* L.) IN A RAINFOREST ENVIRONMENT OF SOUTHWESTERN NIGERIA

M.A.K. Smith [1] and G.T. Omotoye[2]

Department of Crop, Soil & Pest Management, The Federal University of Technology, Akure, Nigeria.
[1]*Corresponding author email: masmith@futa.edu.ng*, muphthasmith@gmail.com

ABSTRACT

Sweet pepper (Capsicum annuum L.) exhibits a slow seedling growth and suffers severe early weed competition in the tropical rainforest agro-ecozone of Nigeria. Cultural weed control with straw mulch reduces weeding frequency in Nigerian vegetable cropping systems, but not adequately exploited. Field experiments were therefore, carried out in early 2016 and 2017 seasons to evaluate the effectiveness of air-dried mulch materials, viz. Fallow weed mulch (FWM, 15 t.ha^{-1}), Panicum maximum clippings (PAM, 15 t.ha^{-1}), PAM + FWM, PAM + Calopogonium mucunoides clippings (CAM, 18 t.ha^{-1}), and Tectona grandis leaves (TGM, 24 t.ha^{-1}) on weed control and short-term weed succession. Unmulched, unweeded (MoWo) and unmulched, weed free (MoWf) served as controls. A randomized complete block design was used with three replications. Weed flora composition, density, occurrence, dominance and diversity were recorded from two random 0.5 x 0.5 m quadrates per plot. In both seasons, the weed flora comprised 25 weed taxa spread over 10 plant families. The Poaceae followed by the Asteraceae, and annual broadleaves dominated the weed flora. More weeds were encountered during pepper establishment (6 weeks after treatment, WAT) in 2016 than in 2017. Ageratum conyzoides and Amaranthus spinosus in 2016, and A. conyzoides, Euphorbia heterophylla, Amaranthus hybdridus, Paspalum scrobiculatum, Eleusine indica and Commelina diffusa in 2017, exhibited low dominance at 3 WAT in spite of low density and rare occurrence. Subsequent high weed densities and occurrences did not confer relative dominance across seasons. In both seasons, mulch materials distinctly and consistently suppressed weed growth, especially during pepper establishment, contrasting unmulched plots. However, FWM was less effective than MoWf in suppressing weed emergence from 9-12 WAT in 2016. Mulch effectiveness in suppressing weed growth decreased in the order TGM> PAM + FWM> PAM>PAM + CAM> FWM in 2016, and TGM> PAM + FWM> PAM + CAM>PAM> FWM in 2017. TGM is therefore, recommended for complete (full-season) weed control spanning 9-12 WAT across seasons, closely followed by PAM + FWM. Differences in mulch effectiveness in weed suppression could be attributed to tissue lignin, organic carbon and polyphenol contents. **Keywords:** Vegetables, mulching, weed succession, mulch persistence

INTRODUCTION

Weed interference is a major factor limiting growth and fruit yield in pepper in the rainforest ecozone of Nigeria, due to excessive weed growth under the high rainfall and temperature conditions and slow initial seedling establishment after pepper emergence which aggravates early weed competition. Uncontrolled weed growth causes up to 91% loss in pepper fruit yield (Adejonwo *et al.*, 1989). Diverse mulching materials, including weed and grass clippings, paddy straw, bark, sawdust and plastic, have given effective weed suppression, in addition to soil conservation, in vegetable cropping systems (Aiyelaagbe and Fawusi, 1986; Clough *et al.*, 1990; Yakubu and Adewale, 1994; Okhiria *et al.*, 1995; Agele *et al.*, 2000; Kamara *et al.*, 2000; Olabode *et al.*, 2006, 2007;Smith and Akinseye, 2005; Smith *et al.*, 2006; Smith, 2008). However, there is a paucity of research information on the effectiveness of grass and legume mulch materials in weed control in pepper, and their associated growth and yield response of sweet pepper (*Capsicum annuum* L.). Therefore, the specific objective of this study was to evaluate weed growth response and weed control efficiency of fallow weed mulch, grass and legume weed mulch, and leaf mulch on short-term weed succession in sweet pepper (*C. annuum*).

MATERIALS AND METHODS

Field experiments were carried out at the Crop-Type Museum of the Federal University of Technology, Akure (327 metre above sea level; Long. 5^0 12´E, Lat. 7^0 16´N), south western Nigeria in the early 2016 and 2017 cropping seasons. The experimental plot was a 2-year fallow, and the soil was a clay -loam, slightly acidic (pH 4.82) and contained 2.96% organic matter, 0.43% N, 0.26 mg/kg P, 0.03 cmol/kg K, 2.0 cmol/kg Ca, 2.1 cmol/kg Mg, 0.31 cmol/kg Na, 7.42 cmol/kg CEC, 5.23 cmol/kg exchangeable acidity and 1.19 g/cm^3 bulk density. The fallow vegetation was manually cleared and plant debris removed to facilitate seedbed preparation. Seedbeds (2 x 1.5 m) were manually constructed and pulverized to facilitate the establishment of nursery seedlings (7-10 cm tall, 3-4 true leaf-stage) transplanted at a spacing of 50 x 50 cm. The seven treatments applied were unmulched unweeded (MoWo) control, unmulched + hand weeded at 3+6 weeks after transplanting, WAT (MoWf), air-dried fallow weed mulch (FWM) at 15 t/ha, *Panicum maximum* mulch (PAM) at 15 t/ha, PAM + *Calopogonium mucunoides* (CAM) mulch at 15 +18 t/ha, PAM + FWM at 15 + 15 t/ha and teak (*Tectona grandis*) leaf mulch (TGM) at 24 t/ha. The chemical composition of the mulch materials is shown in Table 1. The treatments were arranged using a randomized complete block design (RCBD) and replicated three times. Mulch materials were uniformly applied over the seedbeds making sure no established pepper seedling was either covered or shaded. Weed samples were collected from each seedbed using two 0.50 m^2 quadrate to determine weed flora composition, density, frequency of weed occurrence (F), dominance (relative importance value, RIV) and diversity (H') at 3, 6, 9 and 12 WAT. RIV was computed from weed density according to Wentworth *et al*. (1984), using the equation RIV%= (RD + RF) x 100/2, where RD= relative density and RF= relative frequency of weed occurrence (F). Weed control efficiency (WCE)was calculated from weed density according to Subramanian *et al*. (1991), using the equation WCE%= (WDC-WDT) x 100/(WDC), where WDC= weed density in control plots and WDT= weed density in treated plots. Weed H' was computed from weed density according to Pielou (1969), using the equation $H' = -\sum p_i \ln p_i$, where p_i=number of individuals of weed species and ln= natural logarithm. Relevant data were analysed using the analysis of variance and means separated using the Least Significant Difference (LSD) test at p= 0.05. Only widespread weed occurrence (F≥ 50%) and weed RIV values
≤10% were discussed.

RESULTS

Table 1 shows that PAM had distinctly higher lignin content, followed in decreasing order by FWM, CAM and TGM. However, CAM had distinctly higher polyphenol content, followed by FWM and TGM which were similar, and the lowest in PAM. Also, FWM had distinctly higher C/N ratio, followed by PAM, TGM and the lowest in CAM. On the other hand, CAM had distinctly higher P and Ca contents, followed by PAM and FWM which were similar, and the lowest in TGM. FWM and TGM had similar K contents, and these were considerably higher than those in both PAM and CAM, which were equal. Generally, all mulch materials were similar in Mg contents.

Table 1: Chemical composition of selected mulch materials before application.

Mulch type	Lignin (%)	Polyphenol (mg/kg)	C/N ratio	P	K	Ca	Mg
				----------------(mg/kg)-----------			
Fallow weed mulch	19.5	1.1	3.75	10.5	17.7	3.4	0.6
Panicum maximum clippings	25.1	0.4	2.25	12.0	13.3	3.1	0.5
Calopogonium mucunoides clippings	17.0	2.6	0.28	16.1	13.3	5.8	0.6
Tectona grandis leaves	15.9	1.3	1.71	8.1	16.6	1.4	0.5

Table 2 shows that weed growth was considerably poor under mulch materials, contrasting that in MoWotreated plots during crop establishment (3-6 WAT) in 2016. Thereafter till 12 WAT, weed growth under both PAM and FWM was appreciably high. In the long term (9-12 WAT) however, TGM prevented weed growth most, followed closely by PAM + FWM, and then, PAM + CAM which had a highly widespread weed occurrence. Also, in spite of the appreciably high weed occurrence and diversity, MoWf prevented full-season weed growth more effectively than MoWo. Similar results were recorded on the effects of mulch materials on weed growth in 2017 (Table 3). However, in spite of the high weed occurrence, weed growth in 2017 was considerably lower in MoWf, FWM and PAM than in 2016. Table 4 shows that weed density was consistently and significantly ($p \leq 0.05$) higher in MoWo than in MoWf and under mulch materials during the entire crop growth period in both seasons. Similarly, all mulch materials completely prevented weed emergence at 3 and 6 WAT, except FWM which had appreciable weed emergence at 6 WAT in both seasons. In addition, TGM completely prevented weed emergence further at 9 WAT. Thereafter in both seasons, differences in weed density did not follow any consistent patterns with mulch and no-mulch treatments. Although weed density under FWM increased spontaneously after 6 WAT in 2016, weed emergence was generally low and similar to that in MoWf under mulch materials during this late crop growth in both seasons. Specifically, weed density was consistently and distinctly lower under TGM than in all treated plots in both seasons.

Table 2: Effects of mulch treatment on weed growth characteristics at specified weeks after transplanting (WAT) sweet pepper (*Capsicum annuum*) in the 2016 cropping season[1].

Sampling time	Mulch treatments						
	MoWo	MoWf	FWM	PAM	PAM + FWM	PAM + CAM	TGM
3 WAT							
Mean density (no./m^2)	44.5	55.3	-	-	-	-	-
Weed occurrence (%)	53.3	73.3	-	-	-	-	-
Diversity index (*H´*)	1.96	2.27	-	-	-	-	-
6 WAT							
Mean density (no./m^2)	208.2	33.6	-	-	-	-	-
Weed occurrence (%)	95.7	73.9	-	-	-	-	-
Diversity index (*H´*)	2.91	2.66	1.76				
9 WAT							
Mean density (no./m^2)	116.2	-	38.4	-	-	-	-
Weed occurrence (%)	100.0	72.0	60.0	52.0	-	-	-
Diversity index (*H´*)	2.80	2.81	2.60	2.36	1.83	1.97	-
12 WAT							
Mean density (no./m^2)	141.4	32.7	45.9	30.6	-	-	-
Weed occurrence (%)	100.0	80.0	76.0	72.0	-	64.0	-
Diversity index (*H´*)	3.04	2.88	2.92	2.42	2.31	2.66	1.86

[1]Based on rating of weed density: 51->500/m² (very abundant), 31-50/m² (abundant); weed occurrence 50-60% (widespread), 61-80% (highly widespread), and 81-100% (distinctly widespread); weed *H´*: ≥2.1 (very high diversity), 1.6-2.0 (high diversity), and 1.1-1.5 (moderate diversity).

Table 3: Effects of mulch treatment on weed growth characteristics at specified weeks after transplanting (WAT) sweet pepper (*Capsicum annuum*) in the 2017 cropping season[1].

Sampling time	Mulch treatments						
	MoWo	MoWf	FWM	PAM	PAM + FWM	PAM + CAM	TGM
3 WAT							
Mean density (no./m^2)	35.3	31.6	-	-	-	-	-
Weed occurrence (%)	71.4	71.4	-	-	-	-	-
Diversity index (*H´*)	2.17	2.25	-	-	-	-	-
6 WAT							
Mean density (no./m^2)	76.9	34.7	-	-	-	-	-
Weed occurrence (%)	91.3	60.9	-	-	-	-	-
Diversity index (*H´*)	2.81	2.44	1.76	-	-	-	-
9 WAT							
Mean density (no./m^2)	72.7	-	-	-	-	-	-
Weed occurrence (%)	95.8	66.7	70.8	-	-	-	-
Diversity index (*H´*)	2.68	2.62	2.83	2.31	2.54	2.22	-
12 WAT							
Mean density (no./m^2)	71.7	-	-	-	-	-	-
Weed occurrence (%)	100.0	84.0	88.0	72.0	76.0	60.0	-
Diversity index (*H´*)	2.92	2.78	2.95	2.55	2.42	2.53	1.95

[1]Based on rating of weed density: 51->500/m² (very abundant),31-50/m² (abundant); weed occurrence50-60% (widespread),61-80% (highly widespread), and 81-100% (distinctly widespread); weed *H'*: ≥2.1 (very high diversity), 1.6-2.0 (high diversity), and 1.1-1.5 (moderate diversity).

None of the weed species encountered on the treated plots was widespread in occurrence (F< 50%) during pepper growth in both seasons. However, *Ageratum conyzoides* was the most dominant (based on weed RIV) weed during early pepper establishment (3 WAT) in both seasons (Table 5), followed closely by *Amaranthus spinosus* in 2016. In 2017, *A. conyzoides* dominance was followed in decreasing order of dominance by *Euphorbia heterophylla*, *A. spinosus*, *Paspalum scrobiculatum*, and *Commelina diffusa*. Specifically, *A. conyzoides* and *A. spinosus* were both consistently co-dominant in both seasons. Unlike weed RIV, late emerging weeds were considerably and highly widespread across treatments (Table 6). However, there were considerably more highly widespread weeds on treated plots in 2017 than in 2016. Also, common late weeds increased appreciably from 9-12 WAT in both seasons, although the increase was slightly higher in 2016 (36.84%) than in 2017 (27.27%). *A.conyzoides*, *Aspilia africana* and *Tithonia diversifolia* were consistently the most distinctly widespread late weeds at 12 WAT in both seasons. *Chromolaena odorata* late occurrence increased distinctly at 12 WAT from 2016 to 2017. In 2016, *Mormodica charantia* (annual broadleaf) and *Sida acuta* (perennial broadleaf) showed a spontaneous increase from widespread occurrence to highly or distinctly widespread occurrence at 12 WAT. *A. spinosus* (annual broadleaf), *E. heterophylla* (ephemeral broadleaf) and *C. diffusa* (perennial spiderwort) showed the same spontaneous increase in occurrence in 2017. Slightly more late weeds showed spontaneous increases from less widespread occurrence in 2016 (9 species) than in 2017 (7 species). These latter groups of late weeds covered virtually all weed growth forms, viz. annual broadleaf (*E. heterophylla*, *Spigeli aanthelmia*), perennial broadleaf (*C.odorata*), annual grasses (*Eleusine indica*, *Setaria barbata*), perennial grass (*Panicum maximum*), perennial sedges (*Kyllinga bulbosa*, *Mariscus umbellatus*), and perennial spiderwort (*C. diffusa*) in 2016. Contrarily, only three growth forms, viz. annual broadleaves (*Tridax procumbens*, *Mormodica charantia*, *Calopogonium mucunoides*, *C. caeruleum*), annual grass (*Rottboellia cochinchinensis*), and perennial sedges (*Cyperus haspan*, *M. umbellatus*) were recorded in 2017.*E. heterophylla* and *C. mucunoides* (annual broadleaves) which were both widespread earlier at 9 WAT in 2016 became less widespread in occurrence at 12 WAT. *S. acuta* (perennial broadleaf) followed the same trend in 2017.

Table 4: Effects of mulch treatments on weed density (no. m^{-2}) at specified weeks after transplanting (WAT) sweet pepper (*Capsicum annuum*) in the 2016 and 2017 cropping seasons[1].

Mulch treatment[2]	WAT			
	3	6	9	12
2016				
MoWo	87.1 a	217.3 a	123.4 a	142.3 a
MoWf	83.3 b	68.3 b	46.1 c	44.9 cd
FWM	0.0 c	48.3 c	78.6 b	71.2 b
PAM	0.0 c	0.0 d	41.9 c	53.8 c
PAM + FWM	0.0 c	0.0 d	43.3 c	40.1 d
PAM + CAM	0.0 c	0.0 d	55.6 c	61.4 d
TGM	0.0 c	0.0 d	0.0 d	19.6 e

[1] Based on weed RIV ≥ 10%.

In 2016, WCE was distinctly (p≤ 0.05) higher in all mulch treatments than in MoWf at 3 and 6 WAT (Table 7), except FWM which showed significantly lower WCE than MoWf at 6 WAT. Thereafter, TGM consistently gave distinctly higher WCE than other mulch materials and MoWf. However, WCE was also consistently comparable in PAM, PAM + FWM, MoWf and FWM. The lowest WCE was recorded in MoWf at 3 WAT, and thereafter in FWM till 12 WAT. As in 2016, mulch materials showed distinctly higher WCE at both 3 and 6 WAT in 2017 than in FWM

2017				
MoWo	75.5 a	109.5 a	101.9 a	94.3 a
MoWf	47.7 b	56.4 b	40.9 b	44.7 b
FWM	0.0 c	38.7 c	41.3 b	42.6 bc
PAM	0.0 c	0.0 d	36.1 bc	40.8 c
PAM + FWM	0.0 c	0.0 d	24.8 c	25.3 d
PAM + CAM	0.0 c	0.0 d	32.3 bc	37.7 c
TGM	0.0 c	0.0 d	0.0 e	17.6 e

[1]Means in the same column followed by the same letter(s) are not significantly different at p≤ 0.05 by Tukey test.
[2]MoWo= unmulched unweeded (control), MoWf= unmulched weeded once at 3+6 weeks after transplanting; FWM= 15 t. ha^{-1} Fallow weed mulch, PAM= 15 t. ha^{-1} *Panicum maximum* mulch, PAM + FWM= 15 t. ha^{-1} PAM + 15 t. ha^{-1} FWM, PAM + CAM= 15 t. ha^{-1} PAM + 15 t. ha^{-1} *Calopogonium mucunoides* mulch, TGM= *Tectona grandis* leaves.

Table 5. Dominant early weeds (at 3 weeks after transplanting sweet pepper, *Capsicum annuum*) in the 2016 and 2017 cropping seasons.

Cropping season	Dominant early weeds[1]
2016	*Ageratum conyzoides* (12.3)
	Amaranthus spinosus (10.1)
2017	*Ageratum conyzoides* (11.2)
	Amaranthus spinosus (10.7)
	Commelina diffusa (10.1)
	Euphorbia heterophylla (10.9)
	Paspalum scrobiculatum (10.5)

and MoWf. However, contrary to 2016, FWM showed significantly higher WCE than MoWf at 6 WAT. Also, TGM consistently gave distinctly higher WCE than other mulch materials and MoWf thereafter. PAM + FWM consistently showed significantly higher WCE than other mulch materials and MoWf from 9-12 WAT. PAM + CAM and PAM + FWM at 9 WAT, and PAM + CAM at 12 WAT had moderately high WCE but these were not significantly higher than in MoWf from 9-12 WAT. On the average, MoWf gave the lowest WCE during the entire pepper growth period in both seasons.

Table 6. Common late weeds of experimental plots at specified weeks after transplanting (WAT) sweet pepper (*Capsicum annuum*) in the 2016 and 2017 cropping seasons[1].

Weed species	2016		2017	
	9 WAT	12 WAT	9 WAT	12 WAT
Amaranthus hybridus	71.4	71.4	71.4	85.7
Amaranthus spinosus	-	-	57.1	71.4
Ageratum conyzoides	72.4	100	71.4	100
Aspilia africana	71.4	100	85.7	100
Chromolaena odorata	-	85.7	85.7	100
Tridax procumbens	71.4	85.7	-	85.7
Tithonia diversifolia	71.4	100	85.7	100
Mormodica charantia	57.1	71.4	-	85.7
Euphorbia heterophylla	-	71.4	57.1	71.4
Euphorbia hirta	57.1	-	71.4	71.4
Calopogonium mucunoides	57.1	-	-	85.7
Calopogonium caeruleum	-	-	-	71.4
Spigelia anthelmia	-	57.1	71.4	71.4
Sida acuta	57.1	85.7	57.1	-
Eleusine indica	-	71.4	71.4	71.4
Panicum maximum	-	85.7	71.4	85.7
Paspalum scrobiculatum	71.4	85.7	71.4	71.4
Rottboellia cochinchinensis	-	-	-	85.7

Setaria barbata	-	71.4	71.4	71.4
Cyperus haspan	-	-	-	57.1
Kyllinga bulbosa	-	85.7	-	-
Mariscus umbellata	-	57.1	-	71.4
Commelina difusa	-	71.4	57.1	85.7
No. of weed species	10	17	15	21

[1]Based on frequency of weed occurrence > 50%.

Table 7. Effects of mulch treatments on weed control efficiency (%) at specified weeks after transplanting (WAT) sweet pepper (*Capsicum annuum*) in the 2016 and 2017 cropping seasons[1].

Mulch treatments[2]				
2016				
MoWo				
MoWf	4.3 b	77.8 ab	62.6 bc	68.4 b
FWM	100.0 a	66.7 b	36.3 d	50.0 c
PAM	100.0 a	100.0 a	66.0 b	62.2 b
PAM + FWM	100.0 a	100.0 a	64.9 b	71.8 b
PAM + CAM	100.0 a	100.0 a	54.9 c	56.9 bc
TGM	100.0 a	100.0 a	100.0 a	86.2 a
2017				
MoWo	-	-	-	-
MoWf	36.8 d	48.5 d	59.8 c	52.6 c
FWM	100.0 a	64.7 c	59.5 c	54.8 c
PAM	100.0 a	100.0 a	64.6 bc	56.7 c
PAM + FWM	100.0 a	100.0 a	75.6 b	73.2 b
PAM + CAM	100.0 a	100.0 a	68.3 bc	60.1 bc
TGM	100.0 a	100.0 a	100.0 a	81 4 a

[1]Means in the same column followed by the same letter(s) are not significantly different at p≤ 0.05 by Tukey test. [2]MoWo= unmulched unweeded (control), MoWf= unmulched weeded once at 3+6 weeks after transplanting; FWM= 15 t. ha^{-1} Fallow weed mulch, PAM= 15 t. ha^{-1} *Panicum maximum* mulch, PAM + FWM= 15 t. ha^{-1} PAM + 15 t. ha^{-1} FWM, PAM + CAM= 15 t. ha^{-1} PAM + 15 t. ha^{-1} *Calopogonium mucunoides* mulch, TGM= *Tectona grandis* leaves.

DISCUSSION

The findings recorded in this study strongly confirm previous reports on the effectiveness of residue mulching in weed control, especially during crop seedling establishment in diverse vegetable cropping systems, including *Basella alba*, *Abelmoschus esculentus*, *Amaranthus cruentus*, pepper, *Telfairia occidentalis,* tomato and onion (Aiyelaagbe and Fawusi, 1986; Okugie and Ossom, 1988; Clough *et al*., 1990; Yakubu and Adewale, 1994; Okhiria *et al*., 1995; Kamara *et al*., 2000; Smith and Akinseye, 2005; Smith *et al*., 2006; Olabode *et al*., 2006, 2007; Smith and Onamadi, 2007; Smith, 2008; Smith, 2017).This accounts for the considerably and consistently poor full-season weed growth, low weed occurrence and diversity under plant residues than in unmulched plots of sweet pepper in both cropping seasons (Smith *et al*., 2006). The complete absence of weed growth during crop seedling establishment strongly confirms the effectiveness of plant mulch in early weed control (Smith, 2008, 2017; Smith and Onamadi, 2007).

On the average, TGM consistently and distinctly suppressed weed growth most in both seasons, followed by PAM + FWM, PAM, PAM + CAM and FWM in 2016, and PAM + FWM, PAM + CAM, PAM and FWM in 2017, concomitant with the WCE profiles of different mulch materials (Smith, 2017). Differences in mulch WCE can be attributed to mulch type, tissue quality/chemical composition and persistence/decomposition. The superiority of TGM can be primarily attributed to the highly persistent (full-season) mechanical impedance of weed seedling and sprout emergence by the leaf mulch (Akinseye, 2005; Smith and Onamadi, 2007). TGM persistence derives largely from its superior tissue lignin and organic carbon, and moderate polyphenol contents, relative to PAM + FWM, PAM + CAM and PAM. CAM had the highest polyphenol content, and this suggests its potential growth-inhibiting effect on weed seed germination and/or emergence. However, it had the lowest tissue organic carbon, lignin and C/N contents and therefore, decomposed rapidly (Tian *et al*., 1994; Smith *et al*., 2006). In addition, its high tissue organic matter and nutrient contents, coupled with the low polyphenol content of PAM, seemingly rendered the mulch combination (PAM + CAM) inherently less effective in weed control. Smith (2008) demonstrated that grass clippings (PAM) are more effective residue mulch for early weed management than legume clippings (CAM) in *B. alba*. Contrarily, FWM had moderate amounts of polyphenol, lignin, organic carbon and considerably higher C/N ratio relative to CAM, and this apparently enhanced the WCE of PAM when combined (PAM + FWM). Stoklosa *et al*. (2008) demonstrated the appreciable contribution of moderately high lignin and polyphenol contents in oats, barley and mustard mulches to effective weed suppression. The partial contributions of cropping season and associated soil moisture differential, especially as related to safe sites for weed growth and growth-inhibitory effect of phenolic compounds (Smith and Akinseye, 2006; Stoklosa *et al*., 2008; Smith, 2008), is also indicated from the differential mulch WCE in the current study. Generally, the mulch materials can be ranked in the following order based on lignin and organic carbon contents (TGM>PAM>FWM>CAM), polyphenol content (CAM>TGM>FWM>PAM), and organic carbon (TGM>PAM>FWM>CAM).

Similarly, data recorded on weed RIV, *H´* and frequency of occurrence of late-emerging weeds in the current study confirm the reports of Smith (2008, 2017) on the variable effects of *C. mucunoides* (legume) and *Digitaria horizontalis* (grass) residue mulch materials on ecological weed growth in *Basella alba*. However, in the current study, early (primary) Asteraceae dominance was closely followed by the Euphorbiaceae, Amaranthaceae, Poaceae and Commelinaceae. Stoklosa *et al*. (2008) suggested that the decrease in primary weed infestation level in maize on plots treated with oats, barley and mustard mulches was due to greater inhibitory effect of plant mulches against monocotyledonous weeds than on dicotyledonous weeds. Specifically, the consistent early *A. conyzoides* dominance in both years, *A. conyzoides* and *A. spinosus* co-dominance in 2016 and *E. heterophylla* co-dominance in 2017 in the current study deserve critical consideration. *A. conyzoides* produces large populations of light-sensitive seeds (Madumadu, 1991), *A. spinosus* has high seed output, *E. heterophylla* is ephemeral, has high seed output and capable of short-distance seed dispersal by explosive mechanism (Akobundu, 1987), *P. scrobiculatum* is a semi-tufted straggling perennial grass while *C. diffusa* is a creeping perennial spiderwort which reproduces from seeds as well as prostrate or erect stem shoots (Akobundu *et al*., 2016). Smith and Akinseye (2005) listed *E. heterophylla* as one of the most persistently important weeds in both the early- and late-season okra. In addition, the distinctly widespread late occurrences of *A. conyzoides*, *A. africana*, *T. diversifolia* and *C. odorata* in both seasons, coupled with those late weeds spread over virtually all weed growth forms, which showed spontaneous resurgences at season-end, especially *A. spinosus*, *E. heterophylla*, *M. charantia*, *S. anthelmia*, *Tridax procumbens* (annual broadleaves), *S. acuta* (perennial broadleaf), *R. cochinchinensis* (annual grass), *P. maximum* (perennial grass), *M. umbellatus* (perennial sedge) and *C. diffusa* (perennial spiderwort), portend noxious weed resurgence in fallow vegetations and subsequent cropping cycles of sweet pepper in this location (Smith and Akinseye, 2005).The widespread variations in ecological growth characteristics of weeds, especially the widespread spontaneous resurgence of late weeds, may be attributed to reduced mulch persistence and associated contribution of safe site conditions to weed emergence at the soil surface, decomposed organic matter, and possible appreciable divergent inhibitory effects of allelopathic decomposition compounds such as phenols (Smith and Akinseye, 2005; Macias *et al*., 2007; Stoklosa *et al*., 2008).

CONCLUSION

The plant mulch materials used in this study effectively suppressed weed growth during sweet pepper establishment and development. Mulch materials differed distinctly in WCE due to varying type, tissue chemical composition and persistence. TGM was consistently the most distinctly effective in full-season weed suppression, closely followed by PAM + FWM in both seasons, and other mulch materials with highly satisfactory WCE. The WCE of mulch materials could be further limited by the dominant early weeds which, along with late weeds, persisted with high to distinct widespread occurrence before sweet pepper harvest.

It is most desirable to use TGM which was distinctly superior to other mulch materials, especially in consistent suppression of full-season weed growth, dominance and occurrence in sweet pepper.

Alternatively, PAM + FWM can be used where the fallow vegetation has high residue persistence and moderate nutrient status for sweet pepper production. Increased mulch rate, supplementary manual weeding, other non-chemical weed control measures, or a combination of these strategies, can be used to prevent noxious spontaneous resurgence of post-harvest dominant and prohibitively widespread weed species in this location.

ACKNOWLEDGEMENTS

The corresponding author acknowledges the TETFund Conference Attendance (CA) Intervention for sponsoring his attendance, participation and presentation of this article at the 49th Weed Science Society of Nigeria (WSSN) Conference in Usmanu Danfodiyo University, Sokoto, from October 29 to November 2, 2023.

REFERENCES

Adejonwo, K.O., Ahmed, M.K., Lagoke, S.T.O. and Karkari, S.K. 1989. Effects of variety, nitrogen and periods of weed interference on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *Nigerian Journal of Weed Science* 21, 21-28.

Agele, S., Iremiren, G. and Ojeniyi, S.O. 2000. Effects of tillage and mulching on the growth, development and yield of late-season tomato (*Lycopersicon esculentum*) in the humid south of Nigeria. *Journal of Agricultural Science* 134, 55-59.

Aiyelaagbe, I.O.O. and Fawusi, M.O.A. 1986. Growth and yield response of pepper to mulching. *Biotronics* 15, 2529.

Akinseye, C. 2005. Influence of fertilizer application and mulching on weed control, yield and proximate composition of okra (*Abelmoschus esculentus* (L.) Moench). Master of Agricultural Technology Thesis, The Federal University of Technology, Akure, Nigeria. 54 p.

Akobundu, I.O. 1987. Weed Science in the Tropics. Principles and Practice. John Wiley & Sons, Inc. Chichester, United Kingdom. 522 p.

Akobundu, I.O., Ekeleme, F., Agyakwa, C.W. and Ogazie, C.A. 2016. A Handbook of West African Weeds. Third Edition. International Institute of Tropical Agriculture (IITA), Oyo Road, Ibadan, Nigeria. 381 p.

Clough, G.H., Locascio, S.J. and Olson, S.M. 1990. Yield of successively cropped polyethylene mulched vegetables as affected by irrigation methods and fertilization management. *Journal of American Society of Horticultural Science* 115, 884-887.

Kamara, A.Y., Akobundu, I.O., Sanginga, N. and Jutzi, S.C. 2000. Effect of mulch from selected multipurpose trees (MPTs) on growth, nitrogen nutrition and yield of maize (*Zea mays* L.). *Journal of Agronomy & Crop Science* 184, 73-80.

Macias, F.A., Molinillo, J.M.G., Varela, R.M. and Galindo, J.C.G. 2007. Allelopathy- a natural alternative for weed control. *Pest Management Science* 63, 327-348.

Madumadu 1991. Vegetables for Domestic and Export Markets. In: Proceedings of the 17th East Africa Biennial Weed Science Conference, Harare, Zimbabwe. 27-29 September. p 65-71.

Okhiria, J.I., Ogunyemi, S., Oni-Edigin, E. and Adeleke, R.L.A. 1995. Evaluation of dry mulches for weed suppression in leaf amaranth production. In: Program of the 22nd Annual Conference, Weed Science Society of Nigeria, IITA, Ibadan, Nigeria. 6-10 November. 16 p.

Okugie, D.N. and Ossom, E.M. 1988. Effect of mulch on the yield, nutrient concentration and weed infestation of the fluted pumpkin (*Telfairia occidentalis*). *Tropical Agriculture* 65, 202-204.

Olabode, O.S., Ogunyemi, S. and Awodoyin, R.O. 2006. Response of okra (*Abelmoschus esculentus* (L.) Moench) to weed control by mulching. *Ghana Journal of Agricultural Science* 39, 35-40.

Olabode, O.S., Ogunyemi, S.O. and Adesina, G.O. 2007. Response of okra (*Abelmoschus esculentus* (L.) Moench) to weed control by mulching. *Journal of Food, Agriculture and Environment* 5, 324-326.

Pielou, E.C. 1969. Ecological diversity. John Wiley & Sons, Inc. New York. 165 p.

Smith, M.A.K. 2008. Residue mulching for weed control in *Basella alba* L. in southwestern Nigeria. In: Proceedings of the 4th Annual Conference of the School of Agriculture & Agricultural Technology, The Federal University of Technology, Akure, Nigeria. p 208-213.

Smith, M.A.K. 2017. Influence of residue mulching on ecological weed growth and marketable yield in Indian spinach (*Basella alba* L.) in a humid tropical environment. In: Proceedings of the European Weed Research Society (EWRS) Workshop on physical and cultural weed control and Crop-weed Interactions. 2-5 April. Nyon, Switzerland. p 18.

Smith, M.A.K., Adebiyi, S.A. and Kayode, B.O. 2006. Evaluating the weed control efficiency and yield-improvement benefit of fertilizer-fortified *Calopogonium mucunoides* mulch in *Basella alba*. In: Proceedings of 2nd Annual Conference of the School of Agriculture & Agricultural Technology, The Federal University of Technology, Akure, Nigeria. p 60-65.

Smith, M.A.K. and Akinseye, C. 2005. Influence of mulching and fertilizer application on weed distribution and diversity in okra. In: Proceedings of the 1st International Conference on Science & Technology, The Federal University of Technology, Akure, Nigeria. p 323-327.

Smith, M.A.K. and Onamadi, M.D. 2007. Effects of residue mulch on weed growth, pod yield and nutrient contents in okra (*Abelmoschus esculentus* (L.) Moench) in a humid tropical zone of southwestern Nigeria. In: Proceedings of the European Weed Research Society (EWRS) Workshop on Physical and Cultural Weed Control. Salem, Germany. 11-14 March. p 175.

Stoklosa, A., Hura, T., Stupnicka-Rodzynkiewicz, E. Dabkowska, T. and Lepiarczyk, A. 2008. The influence of plant mulches on the content of phenolic compounds in soil and primary weed infestation of maize. *Acta Botanica* 61, 205-219.

Subramanian, S, Alli, A.M. and Kumar, R.J. 1991. All about weed control. Kalyashi Publishers, New Delhi-110 002, India. 115 p.

Tian, G., Kang, B.T. and Brussaard, T. 1994. Mulching effect of plant residues with chemically contrasting composition on maize growth and nutrients accumulation. *IITA Research* 9, 7-11.

Wentworth, T.R., Conn, J.S., Skroch, W.A. and Mrozek, E. Jr. 1984. Gradient analysis and numerical classification of apple orchards' weed vegetation. *Agriculture, Ecosystems and Environment* 11, 239-251.

Yakubu, A.I. and Adewale, D.W. 1994. Mulching for weed control in onion production. In: Programme and Book of Abstracts, 21st Annual Conference, Weed Science Society of Nigeria, Agricultural Resources Management Training Institute (ARMTI), Ilorin, Nigeria. 4-8 December. Abstract No. 5, p 3.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

INFLUENCE OF WEED CONTROL TREATMENTS AND INTRA – ROW SPACING ON PRODUCTIVITY OF OKRA (*Abelmoschus esculentus* L.) AT AFAKA, KADUNA STATE OF NIGERIA

J.E. Essien, T.T.A. Adeogun, R. Mohammed and S. Omodona

Department of Crop Production, Federal College of Forestry Mechanization, Afaka, Kaduna State, Nigeria.
Corresponding Email: essienjoy87@gmail .com

ABSTRACT

The field experiment was conducted at the demonstration farm of Federal College of Forestry Mechanization, Afaka, Kaduna to determine the effect of weed control treatments and intra – row spacing on the productivity of okra. The treatments consisted of 3 rates of butachlor 3.5, 2.5 and 1.5 kga.i./ha, supplementary hoe weeding at 6 weeks after sowing (WAS), hoe weeded control at 3 and 6 WAS, weedy check and three intra – row spacing at (60 x 15cm, 60 x 30cm and 60 x 45cm). The treatments were arranged in a randomized complete block designed (RCBD) replicated three times. The result obtained showed that weed dry weight, crop vigour, stem girth and seed yield were significantly influenced by weed control treatments. Intra – row spacing had significant effect on stem girth and seed yield. It was therefore suggested that farmers in the study area should adopt the application of butachlor at 2.5kga.i./ha and hoe weeded control plots with intra – row spacing of 60 x 30cm for okra production in the study area.

Keywords: Influence, Intra – row spacing, Okra, productivity and weed control.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is a fruit vegetable belonging to the family Malvaceae (Awurum and korie, 2011). Originated from Africa. It is an important vegetable cultivated in the tropical and subtropical region of the world. It can be found in almost every market in Africa (Schippers, 2000). It is now widely distributed in the tropics including Nigeria. It is an important vegetable crop occupying a land area of 277,000 hectares with a production of 731,000 metric tons world wide and productivity of 2.63t ha^{-1} in Nigeria. Okra is also believed to be found in its wild state in the alluvial banks of the Nile and the Egyptians were the first to cultivate in the basin of the Nile (12^{th} century BC) (Kochlar,1986). It is a good source of minerals, calories and amino acid found in seeds and compared favourably with those in poultry, egg and soybean (Thompson, 1949; and Schippers, 2000). The crop is used as soup thickener which may also be served with rice and other food types (Eke *et al*., 2008).

Heavy infestation of weeds is a major constraint in cultivation of okra due to the wide spacing adopted and slow initial growth (Shamla *et al*., 2017). Crop – weed competition remains maximum during the early growth stage which shows initial growth rate of the crop and consequently causes poor competitive ability. The uncontrol weeds exert severe competition for nutrients, water, and light resulting in reduced pod yield of okra by 73 – 75% (Imoloame and Muinat, 2018, 78 – 85%, (Sah *et al*., 2018) and 61.99% (*Dhivya et al*., 2021), depending on the type of weed flora, their intensity and stages. Hand - weeding is a predominant weed - control method used by farmers. However, it is very tedious, sometimes inefficient, time – consuming and associated with high labour demands (Adigun *et al*., 2018; Patel *et al*., 2020). Besides, unavailability of labour for manual weeding is scare and often too expensive (Adigun *et al*., 2017). Hence, use of herbicides in sequence or in combination with other weed management practices is more advisable for farmers for season - long weed control.

Plant spacing is another important agronomic factor which can cause substantial increase or decrease in yield of most crops. Hence, appropriate plant spacing is vital for the interception of adequate sunlight necessary for optimum photosynthesis. Appropriate spacing must be employed to achieve maximum yield goal (Arunah *et al*., 2009). The experiment was design to come up with suitable weed control rates and spacing interval for adoption by farmers in the study area.

MATERIALS AND METHODS

The study was carried out at the Federal College of Forestry Mechanization experimental site, located at Afaka, Kaduna (Latitude $10^0$37N and Longitude $7^0$17E). The physical and chemical properties of the soil at the experimental site were taken for analysis prior to land preparation. The treatments consisted of three rates of butachlor 3.5kga.i./ha, 2.5 kga.i./ha, and 1.5kga.i./ha, supplementary hoe weeding at 6 weeks after sowing (WAS), hoe weeded control at 3 and 6 WAS, weedy check and three intra – spacings (60 x 15cm, 60 x 30cm and 60 x 45cm). The treatments were arranged in a randomized complete block design (RCBD), replicated three times. The gross and net plot sizes were 4.05m^2 (1.8 x 2.25m) and 1.35m^2 (1.8 x 0.75m) respectively. The experimental site was made into beds of 1.8m x 2.25m, the beds were separated from each other by a 1.0m spacing. The variety of okra used was baby bubba hybrid, obtained from seed production unit, I.A.R, A.B.U, Zaria, Nigeria. The okra seeds were planted in situ, according to the different intra – row spacings of 60 x 15cm, 60 x 30cm and 60 x 45cm. With two to three seeds per hole. The herbicide butachlor was applied pre – emergence (a day after planting), using a knapsack sprayer with a green deflector nozzle at a swath width of 75cm, kept at a pressure of 2.1kg/m^2 to give a spray volume of 250l/ha. Weeding for the hoe weeded control plots was done at 3 and 6 WAS. Harvesting of okra started two months after planting when the pods were still soft for consumption and were done every five days. This also helped to stimulate more pods. This process was done carefully to avoid bruises, because at this stage the pods were still tender. Data collected for assessment include weed dry weight, crop vigour, stem girth and seed yield. A relatively large number of weed species were observed during the trial (Table 2). Broadleaf weeds such as *Amaranthus spinosus Linn, Euphorbia heterophylla Linn, Ipoma cornea, Ageratum conizodes Linn, Euphorbia hirta, Sida acuta, Ludwigia abysinia, cannabis sativa, Solanum nigrum, Avena ludoviciana, Physalis minima, Eclipta alba*, *Commelina benghalensis* and grasses such as *Elevine indica, Imperata cylindrical, Physalis minima*, *Boeharhaira diffusa, Cynodon dactylon* Linn (pers) and Sedges such as *Cyperus difformis* Linn, *Scriperus esculentus, Setaria pomica*. Broadleaf weeds infested the okra plots more grasses and sedges. This indicated that none of the treatments evaluated were able to control broadleaf weeds which were also adopted to the environment. Imoloame and Omolaiye (2016) reported the same about weed species on maize farm. They discovered that the weed species with the highest relative importance value on maize were *Paspalum scobiculatum* and *Digitaria horizontalis* (broadleaf weeds). All data collected were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967). The significance differences among the means were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

From the result of the soil analysis (Table 1), the soil of the experimental site was sandy loamy. The percent organic carbon was 0.376 %, total nitrogen was 0.028% and cation exchange capacity (C.E.C) was 1.352.

Table 1: Physico – chemical properties of the soil (0 – 15cm) depth at the experimental site during 2022 raining season at Afaka, Kaduna

Composition	Values
Physical properties	
Sand (%)	74.3
Silt (%)	22.1
Clay (%)	3.6
Textural class	Sandy clay
Chemical properties	

Ph (H_2O)	6.4
Electrical conductivity	0.088
Total nitrogen (%)	0.028
Organic matter (%)	0.65
Organic carbon (%)	0.376
Calcium (Cmol/kg)	0.711
Magnesium (Cmol/kg)	0.055
Sodium (Cmol/kg)	0.05
Potassium (Cmol/kg)	0.025
Exchangeable acidity (Cmol/kg)	0.501
ECEC	1.352

Source: Federal Department of Land Resources (FDLR)

Weed Dry Weight

Weed dry weight was significantly influence by weed control treatments and intra – row spacing had no significant effect on weed dry weight (Table 3). Butachlor at 1.5kga.i/ha recorded the least weed dry weight mean values than all the other weed control treatments. Weedy check plots recorded the highest weed dry weight mean values than all the other weed control treatments. Intra – row spacing had no significant effect on weed dry weight.

Adekpe (2006), reported similar result on garlic (*Allium sativum* L.). That the weedy check plots resulted in higher weed dry weight mean values than the hoe weeded control plots and the other weed control treatments. And also reported that intra – row spacing had no significant effect on weed dry weight.

Table 2: List of common weed species and level of infestation at the experimental site at Afaka, Kaduna during the raining season of 2022

Types of weeds	Level of infestation
SEDGES	
Cyperus difformis Linn	**[2]
Cyperus esculentus	**
Sataria pomica	**
GRASSES	
Elevine indica	*[1]
Imperata cylindrical	*
Physalis mimica	**
Boerharhaira diffusa	*
Cynodon dactylon Linn (pers)	**
BROAD LEAVED WEEDS	
Amarantus spinosus Linn	**
Euphobia heterophya Linn	***[3]
Ipoma cornea	**
Ageratum conizodes Linn	**
Euphorbia hirth	**
Sida acuta	*
Ludwigia abysinia	***
Cannabis sativa	**
Solanum nigrum	**
Avena Ludoviciana	**
Physalis minisa	**

Eclipta alba	**
Commelina benghalensis	***

Level of infestation: 1 – Low infestation; 2 – Moderate infestation; 3 – High infestation

Table 3: Effect of weed control treatments and intra – row spacing on weed dry weight and crop vigour of okra during raining season of 2022 at Afaka, Kaduna.

Treatments	Rate (kga.i./ha)	Weed dry weight	Crop vigour[2]
Weed control treatments			
Butachlor	3.5	32.89bc[1]	7.33a
"	2.5	49.86b	7.33a
"	1.5	21.08bc	6.00b
Hoe weeded control	-	19.42c	7.67a
Weedy check	-	96.32a	6.44b
SE(±)	-	7.319	0.209
Intra – row spacing			
60 x 15cm		53.11a	7.57a
60 x 30cm		35.97a	6.93a
60 x 45cm		42.97a	02.87a
SE(±)		5.669	0.160

[1] Means in the same column of treatments followed by unlike letter(s) are significantly different at p≤ 0.05 using Duncan Multi ple Range Test (DMRT).
[2] Crop vigour score using a scale of 1 – 9 (1 represents the least vigorous crops and 9 the most vigorous crops).

Crop Vigour

Crop vigour was significantly influenced by weed control treatments. Intra – row spacing had no significant effect on crop vigour (Table 4). Butachlor at 3.5 and 2.5kga.i/ha and hoe weeded control plots recorded the most vigorous crops compared with the other weed control treatments that were statistically similar to each other. This result could be as a result of the increase in herbicide dosage, which complies with the findings of Adekpe (2006), who reported that herbicides exhibit their herbicidal effect with increase in dosage which result not only in the drastic reduction on susceptible plants but also in decrease dry matter accumulation through photosynthetic inhibition.

Table 4: Effect of weed control treatments and intra – row spacing on stem girth and seed yield of okra during raining season of 2022 at Afaka, Kaduna

Treatments	Rate (kga.i./ha)	Stem girth	Seed yield
Effect of weed control treatments			
Butachlor	3.5	12.53c[1]	19.05b
"	2.5	15.36ab	21.27b
"	1.5	14.68bc	31.10b
Hoe weeded control	-	17.63a	44.67a
Weedy check	-	12.52c	25.03b
SE(±)		0.627	3.514
Intra – row spacing			
60 x 15cm		15 .58a	22.39b
60 x 30cm		15.47b	43.35a
60 x45cm		12.58b	19.00b

SE(±)	0.485	2.722

Means in the same column of treatments followed by unlike letter(s) are significantly different at $p \leq 0.05$ using Duncan Multiple Range Test (DMRT).

Stem Girth

Weed control treatments and intra – row spacing had significant effect on stem girth. Hoe weeded control plots produced the highest significant stem girth than all the other weed control treatments. This was followed by butachlor at 2.5kga.i/ha. The least significant stem girth was recorded by butachlor at 3.5kga.i/ha and weedy check plots, which were statistically at par to butachlor at 1.5kga.i./ha. Intra – row spacing of 60 x 15cm and 60 x 30cm recorded the highest significant stem girth. This findings signifies that the narrow the spacing, the higher the yield. This findings is similar to the findings of Mahadeen (2008), who reported in his research findings that narrow inter – row spacing produced higher yield.

Seed Yield

Seed yield was significantly influenced by weed control treatments and intra – row spacing. Hoe weeded control plots recorded the highest significant seed yield than all the other treatments that were statistically similar to each other. Intra – row spacing of 60 x 30cm produced the highest significant seed yield than the other inter – row spacings that were statistically similar to each other. Similar findings from Moniruzzaman *et al*., 2001 mentioned that plant spacing of 60 x 30cm obtained increased seed yield per hectare.

CONCLUSION

From the result obtained in the study at the experimental site of crop production department at Federal College of Forestry Mechanization, Afaka, Kaduna, on influence of weed control treatments and intra – row spacing on productivity of okra (*Abelmoschus esculentus* L.) Application of butachlor at 2.5kga.i/ha and hoe weeded control plots with intra – row spacing of 60 x 30cm should be suggested to farmers in the study area for production of okra.

REFERENCES

Adekpe, D.I. (2006). Effect of weed control treatments, date of planting and intra – row spacing on weeds and performance of irrigated garlic (*Allium sativum* L.) Ph.D dissertation, A.B.U, Zaria.

Adigun, J.A., Adeyemi, O.R., Daramola, O.S., Odueme, P.U., Fadeyi, O.J. (2017). Growth and yield performance of groundnut (*Arachis hypogaea* L.) as affected by row spacing and weed control methods in the Nigerian forest – savannah transition zone. *Nigerian Journal of Ecology* 16: 22 – 35.

Adigun, J.A., Daramola, O.S., Adeyemi, O.R and Ogungbesan, A. (2018). Impact of nitrogen levels and weed control methods on growth and yield of okra (*Abelmoschus esculentus* L. Moench) in the Nigerian Forest Savanna. *Journal of Experimental Agriculture International* 20:1 – 11.

Arunah, U.L., Aliyu, L., Odion, E.C., Mahdi, M and Sherifai. (2009). Productivity of watermelon as influenced by nitrogen fertilizer and intra – row spacing at Samaru, Nigeria (HORTSON) held at Royal Tropicana Hotel, Kano,11th – 16th October, 2009.

Awurum, A.N and Okerie, I.B. (2011).Control of field fungal disease of okra using extract of some plants. *Nigerian Agricultural Journal*, 24:311 – 321.

Dhivya, S., Kalpana, R., Murali, A.P and Senthil, A. (2021). Effect of non – chemical weed management practices on weed dynamics and yield in organic okra (*Abelmoschus esculentus* L.) *The Pharma Innovation Journal* 10 (10): 1,417 – 1,421.

Duncan, B.D. (1955). Multiple Ranges and Multiple F- Test. *Biometrics* 11 : 1 – 4pp.

Eke, K.A., Essiens, B.A and Ogbu, J.U. (2008). Determination of optimum planting time for okra in the derived Savannah. PNC of the 42[ND] conf. of ASN at Abakiliki 17[th] – 23[rd] Oct, 2008 pp, 242 – 245.

Imoloame, E.O and Omolaiye, J.O. (2016). Impact of different periods of weed interference on the growth and yield of maize (*Zea mays* L.). *Trop. Agric*. 93 (4): 245 – 257.

Imoloame, E.O and Muinat, U. (2018). Weed biomas and productivity of okra (*Abelmoschus esculentus* L. Moench) as influenced by spacing and pendimethalin based weed management. *Journal of Agricultural Science* 63: 379 – 398.

Kochlar, S.L. (1986). Okra (Lady's finger) in: *Tropical crops, A Text Book of Economic Botany*. Editor, S.L, Kochlar.

Mahadeen, A.Y. (2008). Effect of planting date and plant spacing on onions (*Allium cepa* L.) yield under rain fed in semi – arid conditions of Jordan. *Bull Faci Agricultural*, 59: 237.24.

Moniruzzaman, M., Uddin, M.Z., Choudhury, A.K. (2007). Response of okra seeds crop to sowing time and plant spacing in South Eastern hilly region of Bangladesh. *Bangladeshj. Agril. Res*. 32 (3): 393 – 402.

Patel, D.B., Patel, T.U., Patel, H.H., Patel, D.D., Patel, H.M and Zinzala, M.J. (2020). Irrigation scheduling and weed management in rabi green gram (*Vigna radiata*). *International Journal of Chemical Studies* 8(3); 204 – 210.

Patel, T.U., Zinzala, M.j., Petal, H.M., Patel, P.S and Patel, D.D. (2022).Impact of weed management practices on weeds and okra crop. *Indian Journal of Agronomy* 67 (1): 82 – 88.

Sah, D., Heisnam, P and Pandey, A.K. (2018). Weed management in okra under foothill conditions of North Eastern Himalaya. *Journal of Crop and Weed* 14 (1); 201 – 201.

Schippers, R.R. (2000). *African Indigenous Vegetable*: An overview of the cultivated species. Natural Resources Institute / ACP-EU Technical centre for Agricultural and rural cooperation. Chaltham, UK. 214p.

Shamla, K., Sindhu, P.V and Meera, V. (2017). Effect of weed management practices on growth and yield of okra (Abaelmoschus esculentus (L.) Moench). Journal of Tropical Agriculture 55 (1): 57 – 62.

Snedecor, G. W and Cochran, W.G. (1967). *Statistical Method* 6[th] (ed). The IOWA, State University press, Anes IOWA USA, 607 pp.

Thompson, H.C. (1949). Vegetable crops, me gram hill book company, inc. New York, Toronto, London, 1919 – 1949. 611 pp.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

EFFICACY OF GENERIC HERBICIDE OF AMINOPYRALID 248 g l^{-1} FOR WEED CONTROL IN JUVENILE OIL PALM

C.O. Okeke, O.A. Ogundipe, M.U. Garko, F. Ekhator and C.E. Ikuenobe

Agronomy Division Nigerian Institute for Oil Palm Research Benin – City, Edo State.
Corresponding Author: celestinaogochukwu2013@gmail.com

ABSTRACT

Weed control is component of oil palm production in Nigeria because of plating distance in cultivation of oil palm which encourages luxuriant growth of weeds. Then, the use of herbicides for weed control in oil palm cultivation cannot be overemphasized with the increased labour and cost involved in manual weed control. Since there is increase in labour cost of maintaining oil palm plantation then, the need to seek for other herbicides that will adequately replace previous herbicides for control of broad leaves in oil palm which becomes pertinent. A field study was carried out in Nigeria Institute for Oil Palm Research Benin – city Edo State , Nigeria in year 2020 Field measuring (406m x 45m) of 16,200m^2 , was used to test the efficacy of aminopyralid (248gl^{-1}) herbicide at different rates ; 200 g a.i ha^{-1} , 300g a.i ha$^{-1,}$ 400 g a.i ha^{-1} 500 g a.i ha^{-1} triclopyr at 1.44 kg a.i ha^{-1} as reference herbicide , plantation manual weed control practice and weedy plot. The herbicides were applied at four weeks after slashing, herbicides were applied as post emergence to actively regrown weeds. Herbicides was applied manually using mounted 15 litter knapsack sprayer fitted with a hand-held operated nozzle and was calibrated to deliver a spray volume of 240 liter per hectare. Data were collected on monthly basis on weed flora, visual weed control rating and biomass of weed growth, weed control efficiency, weed coverage and herbicides toxicity. Result concluded that aminopyralid could be used at a rate of 0.4gka.i ha-^{1} and could serve as an alternative to triclopyr used at rate of 1.44 kg a.i ha^{-1}.

INTRODUCTION

Oil palm is grown in Nigeria for its palm oil and palm kernel oil for both local and for export. Weed control limits its cultivation because the climate of the area where it is cultivated in Nigeria encourages luxuriant growth of weeds (Ekhator *et al.*, 2018). Following this, most farmers have abandoned their plantation due to the frequent growth of weeds even after manual slashing for three to six times annualy. In addition, oil palm production involves huge amount of labour and weed control constitutes between 20% and 30% of labour used in the production cost. The reasons for this high labour cost in oil palm are the intention to reduce weed interference with oil palm productivity and to allow for plantation traffic. Generally, it is impossible to isolate weed control from oil palm production system. In commercial estate management practices weed control is typically done to enable the determination of fruit ripening and adequate collection of oil palm loose fruit in addition to other essentials. Uncollected loose fruits can constitute direct reduction on yield and results to volunteer oil palm seedlings problem. The type of weed control adopted is contingent on the type of weed problem and cost of control. The costs of weed control in the long run is dependent on how frequent and effective the initial weed control was carried out immediately after field planting. The composition of weed in any oil palm plantation is also very important because it enable the plantation owner to plan in advance on the choice of herbicide for weed control. Broad spectrum of weeds has been found previously to abound in oil palm cultivation and the predominant weed species were perennial dicots which were the most difficult to control (Ekhator *et al*, 2018; Sit *et al*, 2007; Traoré *et al* , 2010). Clearly, weed control in oil palm plantation becomes pertinent to avoid losses in yield and high labour cost. Weed control using herbicides is essential because of its long duration of weed control and is currently the prefered choice by oil palm farmers. High frequency of 4 - 6 times per annum of manual weed control in oil palm has led to attendants' production cost and for this reason many oil palm growers had abandoned their plantations. It is obvious that weed control in oil palm involves much labour and capital, but minimal cost of weed control could be achieved by using persistent and broad spectrum herbicides (Ekhator *et al*., 2018). Herbicides that have been previously found suitable for broad leaves control in oil palm were Folar (glyphosate + terbuthylazine), 2,4-D, triclopyr, and triclopyr + asulam (Ekhator *et al*, 2020; NIFOR, 2003; Boum and Hornus 1987; Queneez and Dufor, 1982a). Some broadleaf weeds such as *Alchornea cordifolia, Alchornea laxiflora, Cnestis ferruginea, Combretum racemosum, Euphorbia Heterophylla, Peperomia pellucid, Rauwolfia vomitora, Synelisia scabrida, Icacina trichantha*, *Ficus sp.*,and *Triclisia gillettii* had been found previously in oil palm plantation to be resistant to applied herbicide thereby leading to increasing cost of farm upkeep (Ekhator *et al*., 2018). In this regard, it becomes pertinent to look for a choice herbicide that will adequately control broadleaves in oil palm so that it can be incorporated into oil palm weed control strategies.

METHODOLOGY

The experiment was conducted at field 2 of the Nigerian Institute for Oil Palm Research (NIFOR), Benin City Nigeria. The total field area was 16,200m^2 (406 m x 45 m) and experimental plot size was 144m^2 (36m x 4m) respectively. The field was planted in August, 2020 and the planted palms were two months old at the commencement of the trial in October, 2020. The spacing adopted for planting was a standard oil palm spacing of 9 m x 9 m in triangular (NIFOR, 2003). Herbicides treatments were along and thirty-six meters long. The experiment consisted of seven treatments laid out in complete randomized block design. The treatments applied were aminopyralid aminopyralid 248 g l^{-1} at 200 g a.i.ha^{-1}, 300 g a.i. ha^{-1} 400 g a. i. ha^{-1}, 500 g a.i. ha^{-1}, triclopyr at 1.44 kg a.i. ha^{-1} as reference herbicide, plantation manual weed control practice and weedy plot. The herbicides were applied at four weeks after slashing as post emergence to actively re-growing weeds. The herbicides were applied manually using mounted 15 liters knapsack sprayer fitted with a handheld operated nozzle. This was calibrated to deliver a spray volume of 240 liters per hectare. The herbicides were applied in the morning during warm temperature and high humidity. Data collected on monthly basis were on predominant weed flora, visual weed control rating, and biomass of weed growth, weed control efficiency, and weed coverage and herbicide toxicity. Data collected was subjected to analysis of variance and interpreted according to scale of the European Weeds Research Council (EWRC) (Frans *et al*., 1986; Marnotte and Tehia, 1992; Mathieu and Marnotte, 2000; Auskalnis, 2003; Ekhator *et al*., 2018a). European Weed Research Society Scale (EWRS) was used to interpret herbicide toxicity. Results interpreted were reference to the two scales.

Data Collection on Weeds

Weed dry (biomass) weight: The weed shoot falling within the frames of the quadrat of size 1m × 1m were harvested from the ground level after throwing the quadrat randomly within each treatment plots four times. The mean weed dry weight quadrat^{-1} treatment^{-1} was recorded after oven dried to a constant weight at 80 °C for 72 hours.

Visual weed control rating: Visual weed control rating was taken by using the weedy plot as reference. Then visual assessment of the percentage reduction of weeds in the treatment plots was compared to the weedy plot. *Weed control efficiency:* Weed control efficiency was calculated as per the procedur: e

$$WCE\ \% = \frac{WD_C - WD_T}{WD_C} X\ 100$$

Where WCE Represents weed control efficiency (percent)
WD_C Represents weed biomass (kg m^{-2}) in control (weedy) plot
WD_T Represents weed biomass (kg m^{-2}) in treated plot (Budu*et al*., 2014, Ekhator *et al*., 2018a).

Weed coverage: Weed coverage was assessed by visual estimation of the percentage coverage of the emerged weeds in the treatment plot within the 1m × 1m quadrat against the weedy plot as explained by EWRC for herbicide evaluation (Ekhator *et al*., 2018a).

Herbicide toxicity: Plant toxicity due to herbicide was assessed by comparison of the state of palm tree fronds in the treatment plots with area without herbicide treatment slashed as plantation manual weeding practice and toxicity rating was assessed using EWRS –scale for visual rating of herbicide toxicity.

Statistical Analysis

The data on weeds were statistically analyzed using the analysis of variance in Gen Stat Version 8.1 (2005). Where significant differences existed, critical difference was constructed at five percent probability level for guidance. However, interpretation of results was largely based on EWRC scale for herbicide evaluation and EWRS – scale for toxicity.

RESULTS AND DISCUSSION

Weed Flora

A total of forty-three initial weed species were observed at the beginning of the study. From this total, twentytwo weed species were perennial and twenty-one weed species annual. Morphologically, thirty-six species were dicot and seven were monocot. While dicots were prevalent in the field, the four families of the monocots observed were Euphorbiaceae, poaceae, commelinaceae and cyperaceae (Table 1).

Table 1: Initial weed composition before herbicide treatments

Acanthus montanus (Nees) T. Anders	Acanthaceae	Perennial	-	√
Aspilia africana(Pers.) C.D. Adams	Compositae	Perennial	-	√
Amarathus montanus L.	Amaranthaceae	Annual	-	√
Amarathus viridis L.	Amaranthaceae	Annual	-	√
Blepharis maderspatensis (L.) B.Heyne ex Roth	Acanthaceae	Perennial	-	√
Brachiaria deflexa (Schumach) C.E.Hubb. ex Robyns	Poacae	Perennial	√	-
Bryophyllum pinnatum Kurz	Crassulaceae	Perennial	-	√
Celosia leptostachya Benth	Amaranthaceae	Annual	-	√
Chromoleana odorata (L.) R.M. King & Robinson	Asteraceae	Perennial	-	√
Cleome rutidosperma DC.	Cleomeceae	Annual	-	√
Cnestisferruginea DC	Connaraceae	Perennial	-	√
Commelina difusa Burn f. Subsp.diffusa J.K Morton	Commelinaceae	Perennial	√	-
Conyza sumatrenis (Retz) E.H. Walker	Compositae	Annual	-	√
Corhorusolitorius L.	Malvaceae	Perennial	-	√
Eleutherranthera ruderalis (Swartz) Sch. Bip	Compositae	Perennial	-	√
Emilia praeteromissa Melne-Redh	Asteraceae	Perennial	-	√
Emilia sonchifolia (L.)	Asteraceae	Perennial		√
Ergrestis tenella (Linn.) P Beauv ex Roem. & Schult.	Poaceae	Annual	√	-
Ficus exasperata Vahl	Moraceae	Perennial	-	√
Heterotis rotundifolia (Sm) H.Jacques-Félix.	Melastomaceae	Perennial	-	√
Hyptis suaveolens (L.) Poit.	Lamiaceae	Annual	-	√
Icacina trichantha Oliv.	Icacinaceae	Perennial	-	√
Ipomoea cordatotriloba Dennst.	Convolvucaceae	Perennial	-	√
Laportea aestuans (Linn.) Chew.	Utricaceae	Annual	-	√
Laportea ovalifolia (Schumach) Chew.	Utricaceae	Annual	-	√

Weed species				
Mallatus oppositifolius (Geisel) Müll.-Arg.	Euphorbiaceae	Perennial	-	√
Manniophyton fulvum Müll.-Arg	Euphorbiaceae	Perennial	-	√
Mariscus longibracteatus Cherm.	Cyperaceae	Perennial	√	-
Panicum brevifolium Linn.	Poaceae	Annual	√	-
Panicum maximum Jacq.	Poaceae	Annual	√	-
Physalis micrantha Link.	Solanaceae	Annual	-	√
Platostoma africanum P.Beauv	Labiatae	Annual	-	√
Sida acuta Burm. f	Malvaceae	Perennial	-	√
Spermacoce ocymoides Burm.f	Rubiaceae	Annual	-	√
Spilanthes filicaulis (Schum & Thonn) C.D. Adams	Compositae	Perennial	-	√
Solenostermon monostachyus	Lamiaceae	Annual	-	√
Synedralla nodiflora Gaertn	Asteraceae	Annual	-	√
Terbernaemantana Africana Hook	Apocynaceae	Perennial	-	√
Tridax procumbens Linn.	Compositae	Annual	-	√
Triumfetta rhomboidea Jacq.	Tiliaceae	Annual	-	√
Venonia perrrottii	Compositae	Annual	-	√
Vicoa leptoclada (Webb.) Dandy	Compositae	Annual	-	√
Acalpha fimbriata Schumach. & Thonn.	Euphorbiaceae	Annual		-

Weed Control Rating on Individual Weed Species

Aminopyralid applied at 0.2 kg a.i. ha^{-1} had poorly and no weed control of 30.2%; deficient and moderate weed control of 45.5% and 23.3 % respectively. Plot treated with 0.3 kg a.i. ha^{-1} aminopyralid had no weed control to poorly weed control of 25.6 %, 44.2 % deficient weed control, 23.3 % moderate weed control and 4.7 % satisfactory weed control. Consequently, applying aminopyralid at 0.4 kg a.i. ha^{-1} had no control of weed to poorly weed control, deficient weed control, and moderate and satisfactory weed control rating of individual species of 18.6 %, 2.3 %, 46.5 % and 30.2 % respectively. Furthermore, plots treated with aminopyralid at 0.5 kg a.i. ha^{-1} improved individual weed species control and had 18.6 % of no weed control to poorly control of individual weed species, 9.3 % moderate control of individual weed species, 55.8 % satisfactory control of individual weed species and 16.3 % excellent control of individual weed species. Triclopyr at 1.44 had 18% no control to poorly control of individual weed species, 2.3 % deficient in control of individual weed species, 4.7 % moderate control of individual weed species, 72.1 % satisfactory control of individual weed species and 2.5 % excellent control of individual weed species. Plantation manual weed control practices had deficient control of individual weed species of 40 % to 50 %, while weedy plot had 100 % no weed control (Table 2).

Difficult to Control Weeds

Nine weed (20.9%) out of the forty-three weeds species identified to be poorly or not controled by the treatments with varying rates of aminopyralid were *Acalpha fimbriata*, *Brachiara deflexa, Bryophllium pinnatum, Commelina difusa, Ergrestis tenella, Ficus exasperata, Mariscus longgibracteatus, Panicum maximum* and *Panicum breifolium* respectively (Table 2).

Emerged Weed Species

Following herbicide treatments at the experimental plots, aminopyralid at 0.2 kg a.i. ha^{-1} and at at 0.3 kg a.i. ha^{-1} had 14 emerged weed species each m^{-2} with corresponding density of 80 m^{-2} and 73 respectively. Furthermore, aminopyralid applied at 0.4 kg a.i. ha^{-1} had 10 emerged weed species m^{-2} and a density of 76 m^{-2}. The plot treated with aminopyralid at 0.5 kg a.i. ha^{-1} had number of emerged weed species and density of 15 and 53 m^{-2} respectively. Consequently, triclopyr used at 1.44 kg a.i. $ha^{-}1$ as reference herbicide had weed species emergence rate and density of 17 and 69 respectively. In effect, plantation weed control practices had 22 emerged weed species and a density of 106 m^{-2} respectively. Weedy plot recorded 26 different emerged weed species with a weed density of 120 m^{-2} respectively (Table 3).

Visual Weed Control Rating

Herbicide treatments of aminopyralid at 0.2 kg a.i. ha^{-1}, 0.3 kg a.i. ha^{-1}, 0.4 kg a.i. ha^{-1} and 0.5 kg a.i. ha^{-1} were significantly different in visual weed control rating and sustained weed control up to 12 weeks after treatment with values of 60.0 %, 59.9 %, 65.0 % and 65.0 % respectively. Aminopyralid applied at 0.2 kg a.i. ha^{-1}, 0.3 kg a.i. ha^{-1}, 0.4 kg a.i. ha^{-1} and 0.5 kg a.i. ha^{-1} had visual weed control rating of 69.3%, 70.0 %, 80.0 % and 80.0 % respectively at 4 weeks after treatment and 28.0 %, 34.0 %, 48.0 % and 48.0 % respectively at 16 weeks after treatment. Plot treated with triclopyr had visual weed control rating of 70.0 % and 75 .0 % respectively at 4 and 12 weeks. While plantation weed control practice had higher visual weed control rating of 70.0 % at 4 weeks and was reduced to 30.0 % at 8 weeks. After slashing back of the vegetation at 8 weeks, plantation weed control increase in visual weed control rating up to 72 at 12 weeks and decrease further to 48.3 % at 16 weeks. The weedy plot which serves as a reference plot had 0 % visual weed control rating. Treatment of aminopyralid at 0.2 kg a.i. ha^{-1}, 0.3 kg a.i. ha^{-1} and triclopyr at 1.44 kg a.i. ha^{-1} was significantly the same in up to 12 weeks. Also treatment of aminopyralid at 0.4 kg a.i. ha^{-1} and at 0.5 kg a.i. ha^{-1} was significantly the same up to 12 weeks. Aminopyralid applied at 0.4 kg a.i. ha^{-1} , 0.5 kg a.i. ha^{-1} , triclopyr applied at 1.44 kg a.i. ha^{-1} , and plantation weed control practice were significantly similar at 16 weeks after treatment (Table 4).

Biomass Weed Reduction

Biomass of weed reduction was significantly different up to 16 weeks in all herbicide treatments. However, triclopyr at 1.44 kg a.i. ha^{-1} + 0.04 kg a.i. ha^{-1} had the lowest weed biomass reduction of 280 g m^{-2}, 253 m^{-2}, 394 m^{-2} and 915 g m^{-2} respectively at 4 8 and 12 weeks after treatment. Higher weed biomass was sustained in plot treated with aminopyralid at 0.2 kg a.i. ha^{-1} with corresponding values of 560 g m^{-2}, 533.7 g m^{-2} 652.3 g m^{-2} and 1203.2 g m^{-2} respectively at 4, 8 , and 12 weeks (Table 4).

Weed Control Efficiency

Weed control efficiency differs significantly in all the treatments up to 16 weeks after herbicide treatments. However, aminopyralid applied at 0.2 kg a.i. ha^{-1}, 0.3 kg a.i. ha^{-1}, 0.4 kg a.i. ha^{-1},0.5 kg a.i. ha^{-1}, and triclopyr at 1.44 kg a.i. ha^{-1} had moderate to satisfactory weed control efficacy up to 12 weeks after treatment. At 12 weeks after treatment, only triclopyr had satisfactory weed control of 75 %. While aminopyralid applied at 0.2 kg a.i. ha^{-1}, 0.3 kg a.i. ha^{-1}, 0.4 kg a.i. ha^{-1}, and 0.5 kg a.i. ha^{-1} had moderate weed control efficacy of 60.0 %, 59.9%, 65.0 %, and 65.0 % respectively at 12 weeks after treatment. However, weed control efficacy was significantly same up to 16 weeks with aminopyralid applied at 0.4 kg a.i. ha^{-1} and 0.5 kg a.i. ha^{-1} respectively. Due to manual weed control at 8 weeks, plantation weed control practice had satisfactory weed control efficacy of 74.2 % at 12 weeks. Plantation manual weed control was satisfactory only up to 4 weeks (76.3 %) after slashing. Moreover, at 8 weeks plantation manual weed control was poor and ineffective and was later slashed back (Table 5).

Weed Coverage

Weed coverage was moderate up to 12 weeks after treatment with aminopyralid at 0.4 kg a. i. ha^{-1}, 0.5 kg a. i. ha^{-1} and triclopyr at 1.44 kg a. i. ha^{-1} respectively. Aminopyralid at 0.4 kg a. i. ha^{-1} and 0.5 kg a. i. ha^{-1} were similar in percentage weed coverage of 34.1 and 33.4 respectively at 12 weeks. While triclopyr applied at 1.44 kg a. i. ha^{-1} and plantation weed control was significantly similar in weed coverage of 24.7 % and 25.8 % respectively at 12 weeks. Conversely at 16 weeks, weed coverage was poor and weedy in all the treatments and aminopyralid at 0.2 kg a. i. ha^{1} and at 0.3 kg a. i. ha^{-1} had the highest weed coverage of 73.3 % and 76.1 % respectively (Table 5).

Herbicide Toxicity

Toxicity of the herbicides to the palms was not observed because the herbicides were not directed on the palms and besides, spraying was done by trained personnel. The spraying was done during low wind, warm temperature and under high humidity to minimize herbicides drift to the palms.

Weed Flora

The prevalence of perennial weeds over annual weeds at the experimental site was probably because in oil palm cropping systems the soil is hardly turn or disturb a practice which could advance the growth of perennial weeds. The cultural practices / cropping systems, cropping history, prevalent high annual rainfall, fertile soil and fluctuations in temperatures within the seasons (wet and dry season) in the area could have also contributed to the emergence and dominant of dicots over monocot. Sit *et al* (2007) and Traoré *et al* (2010) had previously reported dominance of dicots in oil palm field in India and Côte d' Ivoire respectively. Because oil palm is cultivated mainly as monoculture there is likelihood of perennial dominance (Ekhator *et al.*, 2013).

Weed Control Rating on Individual Weed Species

The satisfactory and excellent control of individual weed species by aminopyralid at 0.3 kg a.i. ha^{-1} to 0.5 kg a.i. ha^{-1} shows the efficacy potential of the herbicides even at low dose compared to 2, 4-D or triclopy used at high dosage of 1.44 kg a.i. ha^{-1} . Therefore aminopyralid could serve as alternate choice post emergence herbicide to 2,4D or triclopyr currently used for weed control in oil palm plantation. The no control of most grassy weed species indicated that this herbicide needs to be tank mixed with other post emergence like glyphosate or glufosinate for broadspectrum of weed control in oil palm. Ekhator *et al* (2018) had previously report tank mixture herbicides for broadspectrum of weed control in oil palm.

Difficult to Control Weeds

Thus, the weeds that were difficult or poorly controlled by aminopyralid could be attributed to the morphological and physiological state of the weeds particularly the monocotyledon. Consequently, the physiological state of some weed could help modify herbicide molecule from active form to inactive form. Therefore, tank mixing of this herbicide with other post emergence herbicides currently used for grassy weed control in oil palm become imperative if the goal of keeping broad spectrum- of weed control in oil palm is to be achieved.

Emerged Weed Species

The similarity in low density of emerged weeds from the treatment of aminopyralid compared to treatment of triclopyr is because aminopyralid like triclopyr belonging to the same herbicide group of picolinic acid which control a spectrum of broadleaf weeds and could serve as an alternate herbicide for broadleaf weeds control oil palm. Herbicides in the group of picolinic aicd are known to effectively control spectrum of broadleaf weeds due to their apoplastic and symplastic translocation (Akobundu, 1987).

Visual Weed Control Rating

The dissimilarity in effectiveness between triclopyr and aminopyralid up to 12 weeks shows that triclopyr is slightly superior in activity to aminopyralid. Although, triclopyr and aminopyralid belong to the same herbicide group but differential in translocation and absorption of the herbicide could have been responsible for differences in effectiveness. The similarity between aminopyralid applied at 0.4 kg a.i. ha^{-1} and 0.5 kg a.i. ha^{-1} up to 12 weeks shows the efficacy limits of the herbicide for weed control in oil palm and for the purpose of cost and environment consideration the herbicide should not be used above this limit. The high rate of application of triclopyr could lead to serious environmental concern and therefore aminopyralid could be an alternative choice herbicide for broadleaf weed control in oil palm. The frequent alternation in slashing for manual plantation weed control indicated that herbicide use in oil palm is a dependable choice. Herbicide use in weed control in oil palm had been reported previously as a suitable weed control choice in oil palm plantation due to ineffectiveness of manual weed control and acute shortage of labour for manual weeding (Ekhator *et al* 2018a; Hamel, 1986).

Weed Biomass

The lowest weed weight recorded with triclopyr compare to other treatment of aminopyralid is an indication that competition of weeds with oil palm was less with triclopyr treatment and suggests that aminopyralid could only serve as alternative choice herbicide post emergence herbicide for weed control in oil palm because of its high significance in reduction in weight over plantation manual weed control practices. The short duration observed in reduction in weed weight due to plantation manual weed control practices is an indication that oil palm farmers will incurr huge expenses in controlling weeds frequently.

This high weed weight recorded with plantation manual weed control practices could have indicated intense competition of weeds with the palms. Weed weight has been indicated as an important parameter in assessing the competitiveness of weed with crop growth and productivity because considerable reduction in weed weight indicated very minimal competition from weed (Akobundu, 1987; Ramalingram *et al*, 2013).

Weed Control Efficiency

The moderate effectiveness of aminopyralid and triclopyr for a longer period could be attributed to their similarity in activity of the picolinic herbicide which both herbicides belong. The similarity in efficacy of both herbicides over a longer period showed that aminopyralid could serve as an alternative choice herbicide for long period of broadleaf weed control in oil palm.

Weed Coverage

The moderate weed coverage observed with triclopy and aminopyralid could have resulted from the high activities of the picolinic herbicides against most broad leaf weeds. These effects could be partly due to the high absorption and translocation of the picolinic herbicides. Akobundu (1987) had previously reported higher rate of absorption and translocation of the picolinic herbicides.

Herbicide Toxicity

Herbicides application to weed was carefully carried out with skill personnels and spray drift was minimized. Toxicity of herbicide to the palms was not observed and healthy palms were sustained. This does not indicate that when the herbicide is abused it cannot kill the plant.

Conclusion and Recommendation

This result concluded that aminopyralid could be used at a rate of 0.4 kg a.i ha^{-1} and could serve as an alternative to triclopyr used the rate of 1.44 kg a.i ha^{-1} . This study recommends aminopyralid for use in broadleaf weeds control in oil palm due to the low rate of application instead of triclopyr use at higher rate which could result to serious environmental concern.

Table 2: Effect of herbicide treatment on control of individual weed species

Weed species	Aminopyralid at 0. 2 kg a.i. ha^{-1}		Aminopyralid at 0.3 kg a.i. ha^{-1}		Aminopyralid at 0.4 kg a.i. ha^{-1}		Aminopyralid at 0.5 kg a.i. ha^{-1}		Triclopyr at 1.44 kg ha$_{-1}$		Platation weed manual control practice		Weedy plot(no-weeded plot)	
	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis
Acalpha fimbriata	0	No control	0	No control	0	No control	0	No control	0	No control	40	Deficient	0	No control
Acanthus montanus	60	Moderate	60	Moderate	70	Less satisfactory	90	Excellent	60	Deficient	50	Deficient	0	No control
Aspilia Africana	60	Moderate	60	Moderate	70	Moderate	90	Excellent	80	Less satisfactory	50	Deficient	0	No control
Amarathus montanus	70	Moderate	75	Satisfactory	80	Satisfactory	90	Excellent	90	Excellent	50	Deficient	0	No control
Amarathus viridis .	60	Moderate	70	Less satisfactory	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Blepharis maderspatensis	50	Deficient	55	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Brachiaria deflexa	0	No control	0	No control	0	No control	0	No control	0	No control	40	Deficient	0	No control
Bryophllum pinnatum	10	Poor	10	Poor	30	Poor	30	Poor	0	Poor	50	Deficient	0	No control
Celosia leptostachya	60	Moderate	60	Moderate	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Chromoleana odorata	50	Deficient	60	Moderate	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Cleome rutidosperma	40	Deficient	40	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Cnestis ferruginea	30	Poor	40	Deficient	60	Moderate	70	Less satisfactory	80	Satisfactory	50	Deficient	0	No control
Commelin adifusa	10	Poor	10	Poor	20	Poor	20	Poor	20	Poor	50	Deficient	0	No control
Conyza sumatrenis	30	Poor	45	Deficient	65	Moderate	65	Moderate	80	Satisfactory	50	Deficient	0	No control
Corhorus olitorius	60	Moderate	60	Moderate	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Eleutherranthera ruderalis	60	Moderate	60	Moderate	65	Moderate	85	Satisfactory	80	Satisfactory	45	Deficient	0	No control
Emilia praeteromissa	60	Moderate	60	Moderate	70	Less satisfactory	85	Satisfactory	80	Satisfactory	45	Deficient	0	No control
Emilia sonchifolia (L.)	60	Moderate	60	Moderate	70	Less satisfactory	80	Satisfactory	80	Satisfactory	50	Deficient	0	
Ergrestis tenella	10	Poor	10	Poor	10	Poor	10	Poor	10	Poor	50	Deficient	0	No control

Weed species	Aminopyralid at 0. 2 kg a.i. ha^{-1}		Aminopyralid at 0.3 kg a.i. ha^{-1}		Aminopyralid at 0.4 kg a.i. ha^{-1}		Aminopyralid at 0.5 kg a.i. ha^{-1}		Triclopyr at 1.44 kg ha^{-1}		Platation weed practice manual control		Weedy plot(no-weeded plot)	
	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis
Ficus exasperata	30	Poor	30	Poor	30	Poor	70	Less satisfactory	60	Moderate	50	Deficient	0	No control
Heterotis rotundifolia .	40	Deficient	60	Moderate	60	Moderate	70	Less satisfactory	80	Satisfactory	50	Deficient	0	No control
Hyptis suaveolens	70	Deficient	75	Deficient	80	Satisfactory	80	Satisfactory	90	Satisfactory	50	Deficient	0	No control
Icacina trichantha	30	Poor	30	Poor	40	Deficient	60	Moderate	60	Moderate	50	Deficient	0	No control
Ipomoea cordatotriloba	40	Deficient	40	Deficient	60	Moderate	60	Moderate	70	Less satisfactory	50	Deficient	0	No control
Laportea aestuans	50	Deficient	50	Deficient	60	Moderate	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Laportea ovalifolia .	45	Deficient	50	Deficient	60	Moderate	65	Moderate	80	Satisfactory	50	Deficient	0	No control
Mallatus oppositifolius	50	Deficient	50	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Manniophyton fulvum	50	Deficient	55	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Mariscus longibracteatus	0	No control	10	No control	0	No control	10	Poor	10	Poor	50	Deficient	0	No control
Acalpha fimbriata	0	No control	0	No control	0	No control	0	No control	0	No control	40	Deficient	0	No control
Acanthus montanus	60	Moderate	60	Moderate	70	Less satisfactory	90	Excellent	60	Deficient	50	Deficient	0	No control
Aspilia Africana	60	Moderate	60	Moderate	70	Moderate	90	Excellent	80	Less satisfactory	50	Deficient	0	No control
Amarathus montanus	70	Moderate	75	Satisfactory	80	Satisfactory	90	Excellent	90	Excellent	50	Deficient	0	No control
Amarathus viridis .	60	Moderate	70	Less satisfactory	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Blepharis maderspatensis	50	Deficient	55	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Brachiaria deflexa	0	No control	0	No control	0	No control	0	No control	0	No control	40	Deficient	0	No control
Bryophllum pinnatum	10	Poor	10	Poor	30	Poor	30	Poor	0	Poor	50	Deficient	0	No control

Celosia leptostachya	60	Moderate	60	Moderate	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Chromoleana odorata	50	Deficient	60	Moderate	70	Less satisfactory	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Cleome rutidosperma	40	Deficient	40	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Cnestis ferruginea	30	Poor	40	Deficient	60	Moderate	70	Less satisfactory	80	Satisfactory	50	Deficient	0	No control
Commelin adifusa	10	Poor	10	Poor	20	Poor	20	Poor	20	Poor	50	Deficient	0	No control
Conyza sumatrenis	30	Poor	45	Deficient	65	Moderate	65	Moderate	80	Satisfactory	50	Deficient	0	No control
Corhorus olitorius	60	Moderate	60	Moderate	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Eleutherranthera ruderalis	60	Moderate	60	Moderate	65	Moderate	85	Satisfactory	80	Satisfactory	45	Deficient	0	No control
Emilia praeteromissa	60	Moderate	60	Moderate	70	Less satisfactory	85	Satisfactory	80	Satisfactory	45	Deficient	0	No control
Emilia sonchifolia (L.)	60	Moderate	60	Moderate	70	Less satisfactory	80	Satisfactory	80	Satisfactory	50	Deficient	0	
Ergrestis tenella	10	Poor	10	Poor	10	Poor	10	Poor	10	Poor	50	Deficient	0	No control
Ficus exasperata	30	Poor	30	Poor	30	Poor	70	Less satisfactory	60	Moderate	50	Deficient	0	No control
Heterotis rotundifolia .	40	Deficient	60	Moderate	60	Moderate	70	Less satisfactory	80	Satisfactory	50	Deficient	0	No control
Hyptis suaveolens	70	Deficient	75	Deficient	80	Satisfactory	80	Satisfactory	90	Satisfactory	50	Deficient	0	No control
Icacina trichantha	30	Poor	30	Poor	40	Deficient	60	Moderate	60	Moderate	50	Deficient	0	No control
Ipomoea cordatotriloba	40	Deficient	40	Deficient	60	Moderate	60	Moderate	70	Less satisfactory	50	Deficient	0	No control
Laportea aestuans	50	Deficient	50	Deficient	60	Moderate	90	Excellent	80	Satisfactory	50	Deficient	0	No control
Laportea ovalifolia .	45	Deficient	50	Deficient	60	Moderate	65	Moderate	80	Satisfactory	50	Deficient	0	No control
Mallatus oppositifolius	50	Deficient	50	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Manniophyton fulvum	50	Deficient	55	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Mariscus longibracteatus	0	No control	10	No control	0	No control	10	Poor	10	Poor	50	Deficient	0	No control
Weed species	Aminopyralid at 0.2 kg		Aminopyralid at 0.3 kg		Aminopyralid at 0.4 kg		Aminopyralid at 0.5 kg		Triclopyr at 1.44 kg ha^{-1}		Platation manual weedWeedy		plot(no-	

	a.i. ha^{-1}		a.i. ha^{-1}		a.i. ha^{-1}		a.i. ha^{-1}				control practice		weeded plot)	
	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis	% control	Exegesis
Panicum brevifolium Linn.	0	No control	0	No control	0	No control	0	No control	10	Poor	50	Deficient	0	No control
Panicum maximum Jacq.	0	No control	0	No control	0	No control	0	No control	10	Poor				
Physalis micrantha	50	Deficient	50	Deficient	60	Moderate	80	Satisfactory	70	Less satisfactory	50	Deficient	0	No control
Platostoma africanum	50	Deficient	50	Deficient	70	Less satisfactory	80	Satisfactory	70	Less satisfactory	50	Deficient	0	No control
Sida acuta	30	Poor	30	Poor	60	Moderate	70	Less satisfactory	70	Less satisfactory	50	Deficient	0	No control
Spermacoce ocymoides	60	Moderate	60	Moderate	70	Less satisfactory	80	Satisfactory	70	Less satisfactory	50	Deficient	0	No control
Spilanthes filicaulis	50	Deficient	50	Deficient	70	Less satisfactory	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Solenostermon monostachyus	55	Deficient	65	Deficient	70	Less satisfactory	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Synedralla nodiflora	45	Deficient	50	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Terbernaemantana Africana	45	Deficient	50	Deficient	60	Moderate	70	Less satisfactory	70	Less satisfactory	50	Deficient	0	No control

Tridax procumbens	55	Deficient	55	Deficient	60	Moderate	80	Satisfactory	80	Satisfactory	50	Deficient	0	No control
Triumfetta rhomboidea	50	Deficient	50	Deficient	60	Moderate	70	Less satisfactory	70	Less satisfactory	50	Deficient	0	No control
Venonia perrrottii	50	Deficient	50	Deficient	60	Moderate	70	Less satisfactory	70	Less satisfactory	50	Deficient	0	No control
Vicoa leptoclada	50	Deficient	50	Deficient	70	Less satisfactory	80	Satisfactory	70	Less satisfactory	50	Deficient	0	No control

Table 3: Emerged weed species and density from herbicide treated plots upto12 weeks after treatment.

Treatment	Rate (kg a.i. ha^{-1})	Emerged weed species (m^{-2})	Density m^{-2}
Aminopyralid	0.2	*Bryophyllum pinnatum* (2), *Commelina adifusa* (13), *Commelina benghalensis* L (8), *Cyperus esculentus* L (11), *Digitaria longiflora* (Retz.) Pers (7), *Emilia praeteromissa* (4), *Ficus exasperata* (2), *Icacina trichantha* (3), *Ipomea convolvulifilia* Hallier f (2), *Mariscus longibracteatus*(8), *Oplismenus burmannii* (Retz.) P.Beauv (4) *Panicum maximum*(11), Sida acuta (4), *Terbernaemantana Africana* (4),	(2), (13), (8),(11), (7), (4), (2),(3),(2),(8), (4),(11),(4), (4) Total = (80)
Aminopyralid	0.3	*Bryophyllum pinnatum* (3), *Commelina adifusa* (10), *Commelina benghalensis* L (6), *Cyperus esculentus* L (10), *Digitaria longiflora* (Retz.) Pers (7), *Emilia praeteromissa* (3), *Ficus exasperata* (2), *Icacina trichantha* (2), *Ipomea convolvulifilia* Hallier f (2), *Mariscus longibracteatus*(6), *Oplismenus burmannii* (Retz.) P.Beauv (12) *Panicum maximum*(8), Sida acuta (2), *Terbernaemantana Africana* (2),	(3), (10), (6),(10), (7), (1), (2), (2), (2),(6),(12),(8), (2),(2) Total = (73)
Aminopyralid	0.4	*Cana indica* L (3) *combretum racemosun* P. Beauv (4) *Commelina adifusa* (13), *Commelina benghalensis* L (7), *Cyperus esculentus* L (9), *Emilia praeteromissa* (3), *Ficus exasperata* (2), *Icacina trichantha* (3), *Mariscus longibracteatus*(10), *Panicum maximum*(18),	(3), (4) (13),(7), (9) (3), (2), (3), (10), (18) Total = 76
Aminopyralid	0.5	*Aspilia Africana* (2), *Chromoleana odorata* (2) *Commelina adifusa* (10), *Commelina benghalensis* L (3),*Cnestis ferruginea* (1), *Cyperus esculentus* (8), *Digitaria longiflora* (Retz.) Pers (3), *Emilia praeteromissa* (5), ,*Ficus exasperata* (1) *Icacina trichantha* (1),, *Panicum maximum*(8), *Sida acuta* (2),*Terbernaemantana Africana* (1), *Talinum triangulare* (4) *Tridax procumbens* Linn (3)	(2), (2),(10) (3),(1),(8),,(3) , (5), (1), (1), (8), (2) (1),(4),(1) Total = 53
Triclopyr	1.44	*Acapha segetallis* (2), *Aspilia Africana* (2), Canna indica(3) *Chromoleana odorata* (2), *Cnestis ferruginea* (1), *Combretum racemosum* (3), *Commelina difusa* (6), *Cyperus esculentus* (8), *Emilia praeteromissa* (3), *Ficus exasperata* (2) *Icacina trichantha* (2), *Mariscus longibracteatus* (9), *Panicum maximum*(11), *Rauwolfia vomitoria* (1), *Sida acuta* (2), *Terbernaemantana Africana* (1), *Talinum triangulare* (7)	(2), (2),(3),(2),(1), (3),(6),(10), (3),(2),,(2), (2), (9), (14), (1), (2), (1), (7) Total= 69
Platation manual weed control practice	2 month s interval	*Acapha segetallis* (2), *Aspilia Africana* (6), *Canna indica* (7) *Celosia isertii.*(1), *Celosia laxa* (1). *Chromoleana odorata* (8), *Cnestis ferruginea* (1), *Combretum racemosum* (3), *Commelina adifusa* (4), *Conyza sumatrenis* (2), *Emilia praeteromissa* (2), *Heterotis rotundifolia* (10), *Hyptis suaveolens* (11), *Icacina trichantha* (4), *Mariscus longibracteatus* (9), *Panicum maximum*(10) , *Rauwolfia vomitoria* (2), *Sida acuta* (3), *Terbernaemantana Africana* (1), *Talinum triangulare* (8), *Tridax procumbens* (6) *Venonia perrrottii* (5)	(2), (6),(7), (8), (1), (3), (4), (2), (2),(10) (11), (4), (9), (10), (2), (3), (1), (8), (5) Total = 106

Weedy plot(noweeded plot	0	*Acapha segetallis* (4), *Amaranthus spinosus* (6), *Aspilia Africana* (8), *Celosia isertii.*(1), *Celosia laxa* (1). *Chromoleana odorata* (7), *Cnestis ferruginea* (2), *Combretum racemosum* (7), *Commelina difusa* (4), *Conyza sumatrenis* (1), *Emilia praeteromissa* (1), *Heterotis rotundifolia* (9), *Hyptis suaveolens* (11), *Icacina trichantha* (4), *Ipomoea cordatotriloba* (6) , *Mariscus alternifollus* Vahl (6), *Melastomastrum capitatum* (3), *Panicum maximum* (11) ,*Pueraria phaseolides* (3), *Rauwolfia vomitoria* (2), *Sida acuta* (6), *Solenostermon monostachyus*(1), *Terbernaemantana Africana* (2), *Talinum triangulare* (6), *Tridax procumbens* (4) , *Venonia perrrottii* (6)	(4), (6), (8), (1), (7), (2), (3), (7), (1), (1), (9), (11), (4), (6), (6),(1), (11), (3), (2), (6), (1), (2), (6), (4), (6) Total = 120

Table 4: Effect of herbicide treatment on visual weed control rating and weed biomass

Treatment	kg a.i. ha $^{-1}$	Weeks after treatment: Visual weed control rating % 4	8	12	16	Weed biomass (g m^{-2}) 4	8	12	16
Aminopyralid (248 g l^{-1})	0.2	69.3 b	65.3 c	60.0 b	28.0 b	560c	533.7c	652.3e	1203.2d
Aminopyralid (248 g l^{-1})	0.3	70.0 b	65.3 c	59.9 b	34.0 c	395b	528c	616.7d	1122 c
Aminopyralid (248 g l^{-1})	0.4	80.0 c	75.0 d	65.0 c	48.0 d	280a	393b	552.3c	1003 b
Aminopyralid (248 g l^{-1})	0.5	80.0 c	74.7 d	65.0 c	48.3 d	286a	401.7b	555.0c	993.7 b
Triclopyr	0.04 +0.5	70.0 c	80.0 e	75.0 e	46.0 d	280a	253.7a	394.3a	915.7 a
Plantation manual weed control practice	Manual Slashing once in every months	70.0 b	30.0 b	72.0 d	48.3 d	256.7b	1223.7 d	427.3b	908a
Weedy plot (un weeded plot)	No manual or herbicide weed control	0.0a	0.0a	0.0a	0.0a	1503.3 d	1603.3 e	1661.0 f	1703 e
S:E		2.5	1.6	0.9	1.9	25.8	23.3	11.01	4.5

Table 5. Effect of herbicide treatment on visual weed control rating and weed biomass

Treatment	kg a.i. ha $^{-1}$	Weeks after treatment: weed control efficiency(%) 4	8	12	16	Weed coverage (%) 4	8	12	16
Aminopyralid (248 g l^{-1})	0.2	62.5b	66.7c	60.7 b	29.5 b	30.0 b	40.0 c	39.2d	73.3 b
Aminopyralid (248 g l^{-1})	0.3	73.7c	67.0c	62.9c	34.3 c	30.0 b	30.0 b	37.4c	76.1 b

Aminopyralid (248 g l^{-1})	0.4	81.3d	75.8d	66.8 d	41.2 d	20.0 a	30.0 b	34. 1b	58.7 a
Aminopyralid (248 g l^{-1})	0.5	81.3d	74.9d	66.6 d	41.8 d	20.0 a	26.0 a	33. 4b	57.7 a
Triclopyr	0.04 +0.5	81.0d	84.2e	76.2f	46.4 e	20.0 a	30.0 b	24. 7a	56.7 a
Plantation manual weed control practice	Manual Slashing once in every months	76.3 c	23.7b	74.2e	46.8 e	29.3 b	72.0 d	25. 8a	55.8 a
Weedy plot (un weeded plot)	No manual or herbicide weed control	0.0 a	0.0a	0.0a	0.0a	100c	100e	100 e	100. 0c
S:E		1.8	1.6	0.9	0.29	1.3	1.7		5.9

REFERENCES

Anonymous, (2007). *Ignite Product Label*. Research Triangle Park, NC: Bayer CropScience LP. 5.

Auskalnis, A.(2003). Experience with Plant Protection on line for weed control in Lithuania.*In the Proceedings of the 2003 Crop Protection Conference for the Baltic Sea Region*.166-175.

Buchanan, G. A. (1992). Trends in weed control methods. Pages 47–72. In McWhorter, C. G. and Abernathy, J. R. *Weeds of Cotton: Characterization and Control*. Memphis, TN: The Cotton Foundation. 631.

Corbett, J. L., Askew, S. D., Thomas, W. E., and Wilcut, J. W. (2004). Weed efficacy evaluations for bromoxynil, glufosinate, glyphosate, pyrithiobac, and sulfosate. *Weed Technol* 18:443–453

Frans et al., (1986). In Camper, N.D. (ed). Research Methods in Weed Science. Southern Weed Science Society, Champaign, Il., USA, PP 37-38.

Ekhator, F. Ola, O.T. & IkuenobeC.E.(2018a). Effectiveness of tank mixture of glyphosate plus Metsulfuron for weed control in a juvenile oil palm in Nigeria.*International Journal of Agronomy and Agricultural Research* (IJAAR).13(1), 29-38. ISSN: 2223-7054(Print) 2225-3610(Online).

Ekhator F, Ikuenobe CE, Okeke CO, Eruaga H. (2013). Prevalence of Chromolaena odorata and other weed species in oil palm cropping systems. In: Zachariades C, Strathie L.W., Day M.D and Muniappan R (Eds). Proceeding of the 8th International Workshop on Biological Control and Management of Chromolaena odorata and other eupatoriaeae. 1-2 nd Nov. 2010, Nairobi, Kenya.Pp 35-42.

Marnotte P,&Tehia, K.E. (1992).Bilan de triosannéesd'essaisd'efficacited'herbicides de pré-levée pour la culture de mais en zone centre de Côte d'Ivoire. *In. Actes de la 15ème conférence.Sur la biologie des mauvaisesherbes.* Versailles (France), *COLUMA*. 1231-1238.

Mathieu, B &Marnotte,P.(2000). L'enherbement des sols à Muskuwari au Nord-Cameroun.*In: Actes du 11ème Collaboration Internationale. sur la biologie des mauvaisesherbes*. Dijon (France), COLUMA.151-158.

Ramalingram SP, Chinnagounder C, Perumal M, Palanisamy MA. (2013). Evaluation of new formulation of Oxyfluorten (23.5% EC) for weed control efficacy and bulb yield of onion. American Journal of plant science 4, 890-895. http://dx.doi.org/10.4236/ajps2013.44109.

Sit AK, Bhattacharya M, Sarker B, Arunachalam V. (2007). Weed floristic composition in agroeco systems of cupuacu (Theobrma grandiflorum) and peach palm (Bactricgasipaes). *Planta*-Daninha21, 249-255.

Traoré K, Soro D, Camara B, Sorho F. (2010). Effectiveness of glyphosate herbicide in a juvenile oil palm plantation in Côte d' Ivoire. *Journal of Animal and Plant Science* 6(1), 559-566.
Wesley J. Everman, Scott B. Clewis, Alan C. York and John W. Wilcut (2009). Weed Control and Yield with Flumioxazin, Fomesafen, and *S*-Metolachlor Systems for Glufosinate-Resistant Cotton Residual Weed Management. *Weed Technology*, Vol. 23, No. 3 (JULY-SEPTEMBER 2009), pp. 391-397 (7 p

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

GROWTH AND YIELD OF BEETROOT (*Beta vulgaris* L.) AS INFLUENCED BY NPK FERTILIZER RATES AND WEED CONTROL PRACTICES IN NORTHERN GUINEA SAVANNA OF NIGERIA

M. Haruna[1], D.M. Jibrin[*1], H.A. Hamidu[2] and Y.A. Nasidi[3]

[1]Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, PMB 1058, Zaria, Kaduna State, Nigeria.
[2]College of Agriculture and Animal Science, Mando Kaduna, Division of Agricultural Colleges Ahmadu Bello University, Zaria.
[3]Department of Crop Production Technology, Audu Bako College of Agriculture Kano State.
*dahiru62@yahoo.com +2347038785335

ABSTRACT

A field trial was conducted in 2017 dry season at teaching and research farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria to study the effect NPK fertilizer rates and of weed control practices on Beetroot in
Samaru. The experiment consisted of two factors NPK fertilizer rates (NPK 80 40 40 kg ha^{-1}, NPK 100 80 80 kg ha^{-1}, NPK 150 75 75 kg ha^{-1}) and weed control practices (Weedy check, hoe weeding at 3 WAS(Week After Sowing), hoe weeding at 6 WAS and hoe weeding at 3 and 6 WAS). The trial was laid out in a randomized complete block design with three replications. The results indicated that application of NPK fertilizer at 100 50 50 kg ha^{-1} recorded the higher values for Number of root per plot of beetroot than other rates of NPK fertilizer used. Also hoe weeding at 3 and 6 WAS recorded the least value for weed dry weight while the weedy check recorded the highest value for weed dry weight of beetroot. The values for number of leaves, plant height, root length and number of roots per plot of beetroot was at maximum on plots subjected to hoe weeding at 3 and 6 WAS while the control recorded the least value for the aforementioned growth and yield characters of beetroots. From the results of the study, It could be concluded that the use of NPK fertilizer at the rate of 100 50 50 kg ha^{-1} and hoe weeding twice at 3 and 6 WAS recorded higher growth and yield characters of beetroots measured.

Keywords: Growth, Yield, Weed control, NPK fertilizer Rates and Beetroot

INTRODUCTION

Beetroot (*Beta vulgaris* L.) is commonly known as red beet, garden beet or table beet is one of the most popular vegetable crops grown in many parts of the world (Rana, 2018; Stintzing and Carle, 2004). It belongs to the *Chenopodiaceae* Family and is a close relative of sugar beet, fodder beet and Swiss chard (Prohens and Nuez, 2008).

Beetroot originates from Asia (Ibid) and was originally mainly grown for its greens. More recently swollen root types were developed. Though beetroot is portrayed as a red rooted vegetable, there are several root and leaf colours which exist, hence it has been considered as a colourful vegetable (Goldman *et al.*,2008).

Beetroots are biennials although they are usually grown as annuals producing green tops and swollen roots during the 1st growing season. The different ways that beetroot are used is in salads, as a hot vegetable to accompany meat and fish and in pies, In addition to methods for their preservation such as pickling and canning. Beetroot is a good source of minerals, carbohydrates, protein and it has high levels of vitamin B1 and micro nutrients (Cerne and Vrhovnik, 1999). Considered as a vegetable, beetroot may have many positive influences on human health (Cerne and Vrhovnik, 1999). Beetroot juice is today advocated as a stimulant for the immune system, as well as a cancer preventative and it has long been considered beneficial to the blood, heart and the digestive system (Nottingham, 2004).

According to Jursik *et al.* (2008) weed control is a decisive and one of the most difficult agricultural arrangements in beet growing. Main reason includes slow early growth of sugar beet, its very low competitive ability at the beginning of vegetation, high sensitivity to herbicides (mainly in early growth stages) and also high cost of special herbicides. Moreover, using herbicides in sugar beet usually induced a decrease of root yield, even in the cases when visual symptoms of injury are not evident (Abdollahi and Ghadiri, 2004). Weeds can also lower the quality of sugar beet by reducing sucrose content (Mesbah, 1993). On the other hand, the use of hoe weeding regime which is more ecofriendly could manage weed problems in beet root especially at the tender stage of the plants which eventually translate to better quality of roots at harvest.

Today, the challenge is no longer the production of agricultural products that are high yielding only, but also those that have high quality, especially nutritional (Petek *et al.*, 2012). Efficient vegetable production is based on large investments, including in fertilizers, and optimizing plant nutrition is essential in achieving high yields and product quality. Imbalances of all nutrients can increase the risk of environmental damage (Zhang *et al.,* 2009) as well as reduce plant growth. Only a well-nourished plant can provide enough minerals for human nutrition, which can be achieved by optimal fertilization following the rules of good agricultural practices.

Nitrogen (N) is directly involved in phosphorus (P) uptake and metabolism as such the amount of N required by the plant depends to some extends on the level of phosphorus (Ahmad and Tulloick, 1968). Although most of the vegetable farmers apply inorganic fertilizer indiscriminately thereby overdosing or under dosing the crop which in turn affects the yield at harvest and at the same time polluting the environment.

Therefore, this research was conducted with the following objective: To determine the most appropriate rate of NPK fertilizer on growth and yield of beetroot in Samaru; To determine the effect of weed control practices on growth and yield of beetroot in Samaru.

MATERIALS AND METHODS

The experiment was conducted in 2017 dry season at teaching and research farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria (11° 11' N, 07° 38' E, and 686m above sea level) located in the northern
Guinea Savanna agro ecological zone of Nigeria. The experiment consisted of two factors NPK fertilizer rates (NPK 80 40 40 kg ha^{-1}, NPK 100 80 80 kg ha^{-1}, NPK 150 75 75 kg ha^{-1}) and weed control practices (Weedy check, weeding at 3 WAS, weeding at 6 WAS and weeding at 3 and 6 WAS). The trial was laid out in a randomized complete block design with three replications. The land was harrowed twice to a fine tilt and then converted to sunken beds with 1m spacing between blocks and 0.5 m between plots. The gross and net plot size was 4.0m^2 (2 m x 2 m) and 2.0m^2 (2.0 m x 1m) respectively. The beetroot seeds were sown at intra row and inter row spacing of 30cm x 50cm with 2 seed per hole. Both the NPK Fertilizer and weed control treatments was applied according to treatments. Data on weed dry weight, plant height, number of leaves, root length and Number of roots per plot were collected. The data were subjected to Analysis of Variance (ANOVA) using general linear model (GLM) of Statistical Analysis System package (SAS, 2003) and the means were separated using the Duncan Multiple Range Test (5% probability level) Duncan (1955).

RESULTS

The effect of NPK fertilizer rate and weed control practices on weed dry weight, number of leaves, plant height, number of roots per plot and root length of beetroot at Samaru during 2017 dry season is presented in Table 1.

Table 1: Effect of NPK fertilizer rate and weed control practices on weed dry weight, number of leaves, plant height, Number of root per plot and root length of beetroot at Samaru during 2017 dry season

Treatments	Weed dry weight (cm)	Number of leaves	Plant height (cm)	Number of root per plot	Root length (cm)
NPK Fertilizer rates (F)					
80 40 40 kg ha^{-1}	241.13	8.083	10.070	9.750b	4.785
100 50 50 kg ha^{-1}	235.78	6.945	8.180	18.833a	4.883
150 75 75 kg ha^{-1}	232.51	9.139	12.772	9.166b	5.583
SE±	38.206	1.1974	2.1391	1.6428	1.0392
Weed control practice (W)					
Weedy check	488.06a	1.222c	3.454c	9.667b	1.611b
Hoe weeding at 3 WAS	215.76b	10.148b	12.445b	11.444ab	7.329a
Hoe weeding at 6 WAS	143.10b	3.907c	5.102c	13.444ab	3.074b
Hoe weeding at 3 and 6 WAS	98.98b	16.944a	20.362a	15.778a	8.322a
SE±	44.117	1.3826	2.4700	1.8969	1.1999

Means followed by the same letter (s) within treatment group are not significantly different using D.M.R.T at 5% level of probability

Application of NPK 100 50 50 kg ha^{-1} recorded higher values for Number of root per plot of beetroot alone than the other NPK fertilizer rates used. However, hoe weeding at 3 and 6 WAS (weeks After Sowing) recorded lower value for weed dry weight of beetroot though statistically at *par* with the rest of the weed control methods used except for the weedy check that recorded higher values for weed dry weight of beetroot. Also hoe weeding at 3 and 6 WAS produced more number of leaves, taller plant, more Number of root per plot and longer root of beetroots though statistically similar to hoe weeding at 3 WAS for root length. While the control recorded the least value for the aforementioned growth and yield parameters measured.

DISCUSSION

One major constraint identified in crop production is weed infestation. It is also evident that the extent of damage caused by weeds in any crop production is related to the type and density of weeds growing in the crop community (Sumanth, 2005). According to Akobundu (1987) weed may account for 30 to 40% of potential yield losses.

At the termination of the trial, the values for plant height, number of leaves, root length and Number of root per plot was at maximum to plots that received hoe weeding at 3 and 6 WAS than the rest of the weed control methods used control including the weedy check. The reason for the variation in the growth and yield characters is that beetroot takes 7-10 days to emerge to the soil surface. However, at that time the weed population has already been built up. Thereby, plots grown to Weedy check and Weeding at 6WAS cannot stand the chance of competing with the weeds. According to Sumanth (2005) who reported that weed are capable of undergoing rapid dissemination, faster growth and multiplication, enabling them to compete at every crop growth stage for growth factors such as Nutrients, moisture, light and space and thereby reducing the produce quantity and quality. The author also indicated the extent of yield reduction largely depended on the time, duration and intensity of weed infestation.

When plots applied with NPK 100 50 50 kg ha^{-1} produced more number of roots per plot of beet root than other NPK fertilizers rate. This could be due to the fact that, at the beginning of the trials most of the fertilizer has not yet leached or volatilized. Thus, the fertilizer was channeled to the essential part of the plant for better growth and development including root formation.

Hussein and Hanan (2014) reported that application of NPK pronouncedly increased root and top as well as whole plant fresh weight to reached about 2 – 3 fold of that of control treatment.

CONCLUSION

It can be concluded that the use of NPK fertilizer at the rate of 100 50 50 kg ha^{-1} and hoe weeding twice at and 6 WAS recorded higher growth and yield characters beetroots measured.

REFERENCES

Abdollahi F., Ghadiri H. (2004): Effect of separate and combined applications of herbicides on weed control and yield of sugar beet. *Weed Technol.*, *18*: 968–976.

Ahmad, N. and Tulloick, R. L. 1968. Effects of N, P and K on vegetable growth and yield of okra. *Punjab Horticultural Journal 10 :130 -136.*

Akobundu, I.O. (1987). *Weed Science in the Tropics.* Principle and practice. John Wiley and Sons, new york 55 – 522pp.

Cerne, M. and Vrhovnik, I. (1999). Effect of nitrogen fertilization on quality and yield of red beet. *Agricultural Institute of Slovenia, Slovenia*.

Duncan, D.B. (1955). Multiple Range and multiple F-test. *Biometrics* II: 1-42.

Goldman, I. L., Navazio, J. P., Prohens, J., and Nuez, F. (2008). Table beet (Vol. Vol. 1): *Vegetables* I. Springer.

Hussein, M.M and Hanan. S.S (2014). Growth, yield and water use efficiency of fodder beets responses to the NPK fertilizer and withholding irrigation. *International Journal of Science and Research* (IJSR) Volume 3, Issue II, November, 2014.

Jurski,M., Holec, J., Soukup, J and Venclovd, V. (2008). Competitive relationships between sugar beet and weeds independence of time of weed control. *Plant Soil Environ., 54, 2008 (3): 108 – 116.*

Mesbah, A. (1993): Interference of broadleaf and grassy weeds in sugar beet. [Ph.D. Thesis.] University of Wyoming, USA.

Nottingham, S. (2004). Beetroot (2004) http://www.stephennottingham.co.uk/beetroot.htm 2012.

Petek, M., Custic, M. H., Nina, T., Slunjski, S., Lepomir, C., Pavlovic, I., CVETKOVI, S. (2012). Nitrogen and crude proteins in beetroot (Beta vulgaris var. conditiva) under different fertilization treatments. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 40(2), 215-219.*

Prohens, J., and Nuez, F. (2008). *Vegetables*: Springer.

Rana, M.K. (2018). *Vegetable Crops Science*: CRC Press.

SAS. (2003). Statistical Analysis Software Data watch.com.

Sumanth Kumar, (2005) Physiological Studies on weed control efficiency in cluster bean (Cyamopsis tetragonolaba L.). MSC. (Ag) *Thesis.Unw.Agric.Sci,* Dharwad, Karataka, India.

Stintzing, F. C., and Carle, R. (2004). Functional properties of anthocyanins and betalains in plants, food, and in human nutrition. *Trends in Food Science & Technology*, 15(1), 19-38.

Zhang, Q. T., Ahmed, O. A. B., Inoue, M., Saxena, M. C., Inosako, K., and Kondo, K. (2009). Effects of mulching on evapotranspiration, yield and water use efficiency of Swiss chard (*Beta vulgaris* L. var. flavescens) irrigated with diluted seawater. *J. Food Agric. Environ, 7 (3 – 4), 650 – 654.*

Parasitic Weed Management

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

THE EFFICACY OF BOTANICALS ON THE CONTROL OF *Alectra vogelii* ON GROUNDNUT (*Arachis hypogaea* L.) VARIETIES IN SUDAN SAVANNA OF NIGERIA

I. Murtala[1], A. Lado[2], I. Saidu[3] and E.A. Shittu[2]

[1]Department of Horticulture, Audu Bako College of Agriculture, Dambatta, Kano state.
[2]Department of Agronomy, Bayero University Kano.
[3]Department of Agricultural Technology, Hussaini Adamu Federal Polytechnic Kazaure, Jigawa state
Corresponding mail: isahmurtala1@yahoo.com

ABSTRACT

A field experiment was conducted during 2018 rainy season at Bayero University Research Farm (11^0 57'N, 8^{0}24'E) and Garko, in Garko local Government area, Kano state (22^{0}11'N, 68^{0}008'E) to evaluate the efficacy of botanicals on the control of Alectra vogelii on groundnut (Arachis hypogaea L.) varieties in Sudan Savannah of Nigeria. The experiment consisted of four (4) groundnut varieties (Kwankwaso, Maibargo, Sabaiya and Samnut 24) and four (4) plant botanicals (Azadirachta leaf powder, Tamarind leaf powder, Ficus spp leaf powder, Parkia fruit powder) and control. These were factorially combined and laid out in a Randomized Complete Block Design (RCBD) replicated three (3) times. The gross plot was 9m^2 while net plot size was 2.4m^2. Data were colected on Alectra parameters (Number of Alectra per stand and Alectra dry weight per plot) and crop parameters: penology (establishment count, CGR, chlorophyll content, leaf area index, defoliation percentage and stand count at harvest) and yield (haulm and pod yield hectare^{-1}). The results showed that varieties significantly influenced number of Alectra per stand where Kwankwaso recorded the high number of Alectra (1.97) while Samnut 24 recorded the lowest (1.10). Sabaiya and Kwankwaso had the highest chlorophyll content, while Samnut 24 recorded the lowest. Samnut 24 had the highest stand count at harvest while Kwankwaso recorded the highest defoliation percentage at maturity. Maibargo recorded the highest haulm yield (4481kg) which was statistically similar to Sabaiya (4185kg) but different from other varieties. Sabaiya recorded the highest pod yield than the other varieties. Tamarind leaf powder recorded the highest pod yield in both locations. The use of Ficus spp leaf powder increase haulm yields while Tamarind leaf powder and Parkia fruit powder where found to increase pod yield of Sabaiya and can therefore be recommended in the study area.

Keywords: Botanicals, Groundnut, *Alectra control haulm, pod*

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop cultivated in the semi-arid and subtropical regions of the world. It is grown in nearly 100 countries on six continents between 40^o N and S of the equator on nearly 24.6m ha, with a production of 41.3 m.t. and average yield of 1676 kg ha^{-1} in 2012 (FAOSTAT, 2014).China, India, Nigeria, USA and Myanmar are the leading groundnut producing countries in the world (Ajeigbe *et al.,* 2014). Developing countries in Asia, Africa and South America account for over 97% of world groundnut area and 95% of total production. However, the yield ha^{-1} of Asia (2217 kg ha^{-1}) and Africa (929 kg ha^{-1}) are very poor as compared to Americans (3632 kg ha^{-1}) (Ajeigbe *et al.,* 2014).

Groundnut is a good source of protein (25%-34%) (Ajeigbe *et al.*, 2014) and can be used to treat protein related malnutrition, (Nigerian finder, 2010). Cooking oil (48%-50%) and vitamins. The haulms are a good source of feed for livestock, especially during the dry season when fresh green grasses are not available. This serves as an additional source of income for farmers in the dry season when the fodder is in high demand. Groundnut improves soil fertility through nitrogen fixation, thereby increasing the productivity of other crops when used in rotation or in a cereal cropping system (Ajeigbe *et al.*, 2014). .A botanical is a plant or plant part valued for its medicinal or therapeutic properties and used for a long time for pest control (U.S, 2011).

Alectra vogelii is a parasitic plant belonging to the family *Orobanche*, is a hemi-parasite that derives its water and nutrients from roots of its host plant (Magani and Lagoke, 2008). It is an Annual herb, 20–50 cm high; stems erect, simple or with several branches arising from the base or above (Ghazanfar *et al.*, 2008) The parasite is most commonly found in areas of mono-modal rainfall with a long dry season (CABI, 2019). *A. vogelii* is the most important species parasitizing mainly grain legumes in sub -Saharan Africa, which include cowpea, bambara groundnut (*Vigna subterranea* (L.) Verdc.), soybean (*Glycine max* (L.) Merr.), mung bean (*Vigna radiata* (L.) Wilczek), groundnut (*Arachis hypogea* L.) and common bean (*Phaseolus vulgaris* L.) (Parker and Riches 1993). Its presence on the field can result into total crop failure (Emechebe *et al.,* 1983, Lagoke, 1989).

Despite potential benefit of groundnut, its productivity has been declining in African countries due to use of low yielding varieties, weed competition, poor adoption of agronomic practices and limited extension services (Ajeigbe*et al.*, 2014). The use of botanicals may become environmental friendly, more affordable and cost-effective, since the plant materials used are widely available and at no or minimum cost (Shinggu, 2015).

MATERIAL AND METHODS

The experiment was conducted during the wet season of 2018 at t the Research and Teaching farm of Faculty of Agriculture, Bayero University Kano (latitude 11º57'N and longitude 8º24'E) and Garko, (Latitude 22^0 11'N, longitude $68^0$008'E) in Garko local government area of Kano state. The experiment consisted of two (2) factors i.e. groundnut varieties and plant botanicals. The varieties used were Kwankwaso, Maibargo, Sabaiya (obtained at local market) and Samnut 24 (obtained from ICRISAT) .The plant botanicals used included *Azadiractha indica* leaf powder, *Tamarindus indica* leaf powder, *Ficus* spp. leaf powder, *Pakia biglobosa* fruit powder and control (plot inoculated with Alectra vogelii seed not treated with Botanicals) These were Factorially combined and laid out in Randomized Complete Block Design (RCBD), replicated three times.

The plot size consisted of six rows of 0.75m apart and 3m long was measured 4.5m broad x 2m long ($9m^2$); while the net plot size was 1.5m x 1.6m ($2.4m^2$). The *Alectra* inoculums stock was prepared by thoroughly mixing 30 g of Alectra seeds with 500 g of sieved sand as reported by Karanja.*et al. (*2013). 0.3g of the above mixture was measured and placed in to the planting hole during planting.

The leafs of the botanicals were collected and dried under shade and grinded into powder and applied into sowing hole at the rate of 3g per hole during sowing. The groundnut seed were manually placed in a planting hole on the top of the plant botanicals at spacing of 75 x 25 cm using 2 seed per hole. Fertilizer was applied at the rate of 20 kg N, 54 kg $P_2 O_5$ and 20 K_2O using NPK (15 – 15 – 15) and single superphosphate (18% P_2O_5) at two weeks after sowing (WAS) using side dressing. Weed were controlled manually by using hoe at 3 and 6 WAS. Harvesting was done manually after the crop have reached physiological maturity by digging and lifting the crop and allow to dry. The pod where manually handpicked and shelled.

The phytochemical analysis of the pant botanicals was determined in chemistry analytical laboratory, Department of chemistry, Yobe State University Damaturu. The analysis was done with Gas Chromatography- Mass Spectroscopy (GCMS), using high performance thin layer chromatography method as reported by Sahira and Catherine (2015).

Data collected were number of Alectra per stand, Alectra dry weight per plot, establishment count, crop growth rate, chlorophyll content, leaf area index, stand count at harvest, haulm yield per hectare and pod yield per hectare. Data generated were subjected to analysis of variance (ANOVA) using GenStat discovery Edition version 7. Significantly treatments means were separated using SNK (student-neuman-keuls'test)

RESULTS

Approximately ten (10) phytochemical compounds (Flavonoids, Alkaloids, Glycossides, Coumarins, Terpenoids, Phenols, Tannins, Anthraquinones and Saponins) were detected in the plant botanicals sample (Table 1).Varieties and plant botanicals had no significant effect on days to *Alectra* emergence in both locations (Table 2). Ground nut varieties significantly influenced number of Alectra per stand at Garko. Kwankwaso recorded high number of *Alectra* per stand which was statistically similar to Maibargo and Sabaiya but different from Samnut – 24 which had the lowest. Plant botanicals significantly affected number of *Alectra* per stands at BUK while non- significant effect was observed at Garko (Table 2). The *Azadirachta* leaf powder treated plots recorded the lowest number of *Alectra* per stand than all other plant botanicals, while the control had the highest. Plant botanicals significantly affected *Alectra* dry weight in both locations. The control treated plot recorded higher *Alectra* dry weight which was significantly different from all other plant botanicals. Kwankwaso had the highest defoliation percentage which was statistically similar to Sabaiya and Samnut 24 but different from Maibargo.

Variety and plant botanicals had no effect on leaf area index and defoliation at BUK. However, at Garko, variety significantly affected leaf index but plant botanical had no effect on this character. Kwankwaso had the highest defilation percentage while Maibago had the lowest. Plant botanical had no effect on all these characters in both location (Table 4). Maibargo recorded the highest haulm yield per hectare at Garko which was statistically similar with Sabaiya (Table 5). Sabaiya consistently recorded the highest pod yield ha^{-1} in both locations. Kwankwaso and Samnut – 24 recorded the lowest pod kg ha^{-1} yield at BUK. At Garko, Kwankwaso and Sabaiya had the highest pod yield than Maibargo and Samnut 24. Ficus leaf powder supported higher haulm yield than other botanicals at BUK. At Garko Tamarind leaf powder supported higher pod yield than the other botanicals. The interaction between plant botanicals and variety on pod yield was significant on pod weight (Table 6). All varieties supported significantly similar pod yield across the plant botanicals in the region. Treating Salbiya with Azadrichta leaf powder supported higher pod yield than treating Samnut-24 with the same leaf powder.

DISCUSSION

The variety Kwankwaso recorded the highest number of *Alectra* per stand at Garko. This indicates that this variety is highly susceptible to *Alectra* while Samnut-24 recorded the lowest. This implies that Samnut – 24 may have some resistant to the parasite and can be used in managing the parasite. Similar result is reported by Yohanna *et al,.*(2010)on the related strain Samnut-18 which has low *Alectra* shoot number in both field and screen house experiment. Groundnut varieties Sabaiya, Kwankwaso and Maibargo recorded the highest leaf chlorophyll content than Samnut-24 at BUK. This reflects genetic variation between these varieties. Higher chlorophyll content result in higher assimilate which result in higher yield. Variety Samnut 24 where observed to be taller than the other varieties in both locations. This could be attributed to the upright growth habit as reported by Ajeigbe et al., (2014). Samnut24 had lowest stand count at harvest. Probably because of its poor emergence and establishment.

Samnut-24 had lowest stand count at harvest. Probably because of its poor emergence and establishment. Maibargo recorded the highest haulm yield probably because of its lowest defoliation percentage. Muktar *et al* (2014) had earlier reported that level and intensity of defoliation could have diverse effect on the crop biological and economic yield. Higher pod yield recorded by Sabaiya may be attributed to its high pod number and pod yield per plant. This is as a result of good adaptation to environment Higher pod yield recorded by Sabaiya may be attributed to its high pod number and pod yield per plant. This is as a result of good adaptation to environment. The higher number of pod recorded by Kwankwaso at Garko may be attributed to the varieties having the highest chlorophyll content which contributes to the higher assimilate which are contributing factor to higher yield. This variety is also a runner cultivar whose leaves had equal opportunity of trapping sunlight without mutual shading. Sing and Joshi (1993) had reported that the runner cultivars of groundnut showed higher chlorophyll production with more leaf and this contribute to the high assimilate production, biomass and yield.

Ficus spp leaf powder recorded the highest haulm yield than other plant botanicals, this could be as a result of the compound present in *Ficus* spp. such asphenolic, alkaloids, terpenoids, and tannins which stimulate growth as reported by Maria *et al*. in (2015). This indicates that use of *Ficus* spp enhance groundnut growth and increase haulm yield which is used as livestock feed. This result was in line with findings of Bamisida *et al.,* (2016) who reported that the use of *Cassia fistula, Azadirachtaindica* and *Cassia siamoa* leaf powder significantly control population of *Meloidogyne incognita*, which resulted better growth of groundnut and yield compared to control.

Tamarind leaf powder recorded the highest number of pod yield ha^{-1} among all plant botanicals used. This is as a result higher phenols compound in *Tamarinds* leaf which is essential for reproduction and Flavonoids which stimulate root nodules formation as reported by Maria*et. al*. (2015). Increase in nodule implies increase supply of Nitrogen which increased growth and yield. Thus, may results in more N for subsequent crops in rotation. Zubaida (2014) reported increase in maize grain yield when *Tamarind* leaf extract was spray on maize under reduced nitrogen rate by 50%. This result was in line with what Shinggu (2015) reported that *Tamarind* seed and leaf powder increase cowpea seed yield. Similarly, Fatima (2017) reported that application of *Parkia* fruit powder basally increase pod yield, pod length and number of grain pod^{-1} of cowpea. Therefore, the content of *Tamarind* is effective on control of *Alectra* might have explained the reason of higher number of pods per plants and per hectare. Similar result was reported by Hassan *et al.,* (2016) Who highlighted the efficacy of *Azadirchta indica* neam leaf extract spray and *Polyacthia longifolia* leaf extract spray shows better performance in controlling leaf spot and increasing pod yield and pod weight of groundnut. The response of Kwankwaso, Maibargo and Sabaiya to plant botanicals on pod yield ha^{-1} was statistically similar (Table 6). However Samnut 24 responded differently to plant botanicals on pod yield ha^{-1} . Treating Samnut 24 with *Tamarind* leaf powder had higher pod yield than treating the same variety with *Azadirachta* and control.

CONCLUSION

Based on the result obtained from this study it can be concluded that treating planting hole with plant botanicals significantly reduced the number of *Alectra* per stand and reduced the infestation level. This implies that there will be depletion of *Alectra* seed bank since the germination is reduced which in turn ensured control of *Alectra* control and reduced future infestation. While *Ficus* Spp. leaf powder had higher haulm yield than all other botanicals used. *Tamarind* leaf powder was found to be effective on pod yield. Kwankwaso had higher defoliation percentage at maturity while maibargo and sabaiya had higher haulm yield Sabaiya performed better than other varieties used on all yield parameters tested. Therefore, the use of plant botanicals increased groundnut production.

REFERENCES

Ajeigbe, H.A., Waliyar F., Echekwu C.A., Ayuba K., Motagi B.N., EniayejuD.,andInuwa A., (2014). A Farmer's Guide to Groundnut Production in Nigeria.Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 36 pp

Bamsida, Z., Channya, F.K., Chimbekuywo, L.B. & Tame, V.T., (2016). Effect of organic soil amendments on the Groundnut (*Arachis hypogeal* L.) infected by nematode (*Meloidogyne incognita*) in Girei Local Government Area, Adamawa state. *International Journal of Research in Agriculture and Forestry*. .3 (9): 8 – 13.

CABI, (2012). *Alectra vogelii* (yellow witch weed). *Invasive species compendium*. 4(2). 34.

Emechebe A.M, Leleji O.I, and Salako E.A. (1983) control of root parasitic weed in cowpea and groundnut, A paper presented at institute for Agricultural Reseach symposium on Striga and its control. Institute for agricultural research, Ahmadu Bello University Samaru, Zaria. Nigeria.

Fatima, U. S. (2017). Effect of *Parkiabiglobosa* fruit powder and cowpea variety (*Vignaunguiculata* (L) walp) on the control of *Striga* (*Striga gesnerioides*). M sc. Thesis submitted to Dept. of Agronomy, Faculty of Agriculture, Bayero university, Kano.

FAOSTAT. 2014. Available at http://www.faostat.fao.org 35 pp

Ghazanfar, S.A., Hepper, F.N., and Philcox, D. (2008). Flora of Tropical East Africa. Vol 4, pp1

Hussain, M.A., (2011). Lecture note on Arable crop production. Department of Agronomy, Faculty of Agriculture, Bayero University Kano.

Karanja, J, Nguluu S. N, Wambua, J, and Gatheru, M, (2013). Response of cowpea genotype to *Alectra vogelii* parasitism in Kenya. *African Journal of Biotechnology.* 12 (47): 6591 – 6598.

Lagoke S.T.O. (1989). Striga in Nigeria, In: robson, T.O. and Broad, H.R., (eds) Striga improvement management in Africa, proceedings of the FAO/OAU. All African Govt. consultation on striga control. Moroua Cameroun pp 6.

Magani, I.F & Lagoke, S.T.O. (2008). Pre-emergence and post-emergence herbicide control of the parasitic plant *Alectra vogelii* in cowpea. *Journal of Animal and Plant Science,* 1 (1): 26-32.

Maria, J., Matos L., Santara, E, U, Orlndo, A. A., Enrique, M. and Estela, G. Y. (2015). An important class of phytochemicals, phytochemical isolation, clinical roles in human health. *Intech Open Dol.*10 : 5772 – 5992.

Muktar, A.A., Falaki, A.M., Ahmad, A., Jaliya, M.N. & Abdulkarim, B. (2014). Response of groundnut (*Arachis hypogeae* L.) varieties to varying defoliation intensities. Proceedings of 4th ISOFAR scientific conference. Istanbul, Turkey. 13 – 15.

Nigerian finder (2012). Groundnut farming: Step by step guide. Nig. Fiderpubcompany, pg 1-2

Parker, C. and Riches. (1993). Parasitic weeds of the world: Biology and Control. CAB international Wallingford, UK. pp332.

Sahira, B. K. and Cathrine, L.(2015). General techniques involved in phytochemical analysis. *International Journal of Advance Research in Chemical Science* (IJARCS). 2 (4): 25 -32

Shinggu, C.P. (2015). Reaction of cowpea *(vignaunguiculata L.)* varieties to*alectravogelii(*Benth) as influenced by botanicals (plant materials) in the northern guinea Savanna of *Nigeria*. *International Journal of Agronomy and Agricultural Research (IJAAR)*..7: 20-24

Sing, A.L., & Joshi, Y.C. (1993). Comparative studies on chlorophyll content, growth, N uptake and yield of groundnut varieties of different habit group. *Article in oleagineux*48 (1): 27-34.
United State (U.S.) (2011).Botanical dietary supplements.Department of Health and Human Services. The office of the dietary supplements (ODS).
Yohanna, M.K., Olussoji. O., Balarabe. T., Joseph. S. & Lagoke. S.T.O. (2010). Geneotype effect to *Alectra vogelii* (benth) infestation in sub – humid environment. *Journal of American Science*. 6 (10):644-651
Zubaida, G.D. (2014). Allelophatic effect of *Tamarind* leaf extract on growth and yield of maize. Research project Submitted to Department of agronomy, Faculty of Agriculture, Bayero University, Kano.

Table 1. Phytochemical composition of Plant Botanicals

S/No	Phytochemical Constituents	*Ficus*	*Tamarind*	*Parkia*	*Azadirachta*
1	Flavonoids	+	+	+	+
2	Alkaloids	+	+	+	+
3	Glycossides	+	-	+	+
4	Coumarins	+	+	+	+
5	Terpenoids	+	+	+	+
6	Phenols	+	+	+	+
7	Tannins	+	-	+	+
8	Anthraquinones	-	+	+	+
9	Steroids	-	-	-	-
10	Saponins	+	+	+	+

+ = present of phytochemical constituent, - = absent of the phytochemical constituent

Table 2: Effect of groundnut varieties and plant botanicals on Number of *Alectra* per stand and *Alectra* dry weight per plot at BUK and Garko.

Treatments	Locations: BUK No of Alectra per stand	BUK Alectra dry weight per plot	Garko No of Alectra per stand	Garko Alectra dry weight per plot
Varieties (V)				
Kwankwaso	1.70	6.59	1.97 a	9.4
Maibargo	1.3	6.46	1.72 ab	10.4
Sabaiya	1.22	5.90	1.68 ab	11.0
Samnut 24	1.44	7.85	1.10 b	7.0
Level of probability	0.081	0.837	0.041	0.588
S E	0.18	2.19	0.21	2.21
Plant botanicals (P)				
Azadirachta Leaf powder	1.00 b	2.02 b	1.76	0.41 b
Tamarind Leaf powder	1.41 ab	5.24 b	1.21	8.03 b
Ficus spp. Leaf powder	1.36 ab	3.83 b	1.37	5.26 b
Parkia fruit powder	1.71 a	6.07 b	1.86	7.51 b
Control	1.68 a	16.33 a	1.89	20.06 a
Level of probability	0.007	<.001	0.170	2.47
S E	0.20	2.44	0.24	2.47
Interaction				
V x P	0.356	0.542	0.312	0.882

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test.

Table 3: Effect of groundnut varieties and plant botanicals on stand count, crop growth rate and chlorophyll content at BUK and Garko.

Treatment	Locations					
	BUK			Garko		
	Stand count.	Crop growth rate (g/wk)	Chlorophyll content	Stand count.	Crop growth rate (g/wk)	Chlorophyll content
Variety (V)						
Kwankwaso	9.73	50.3	20.41 a	10.87	48.8	27.50
Maibargo	10.13	54.9	24.95 ab	11.13	30.0	26.80
Sabaiya	10.20	57.3	28.87 a	11.47	39.7	28.04
Samnut 24	9.13	49.8	23.51 b	10.40	30.9	28.57
Level of probability	0.236	0.700	0.002	0.086	0.031	0.746
S E	0.570	7.46	2.022	0.292	5.30	1.184
Plant botanicals (P)						
Azadirachta leaf powder	9.67	62.23	23.78	11.42	37.45	26.44
Tamarind leaf powder	9.50	46.82	22.33	10.75	35.29	27.36
Ficus spp. Leaf powder	10.25	60.04	27.27	10.42	32.31	27.32
Parkia fruit powder	9.58	49.16	24.49	11.42	35.89	28.53
Control	10.00	47.12	24.28	10.83	45.62	28.99
Level of probability	0,744	0.195	0.302	0.148	0.587	0.665
S E	0.637	8.34	2.260	0.327	5.92	1.324
Interaction						
V x P	0.884	0.411	0.931	0.908	0.881	0.292

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test. g/wk =gram per week.

Table 4: Effect of Groundnut Varieties and Plant Botanicals on Leaf Area Index, Defoliation Percentage (%) and Number of Plant at Harvest at BUK and Garko.

Treatments	BUK Leaf Area index (LAI)	BUK Defoliation percentage (%)	BUK Number of plant at harvest.	Garko Leaf Area index (LAI)	Garko Defoliation percentage (%)	Garko Number of plant at harvest.
Variety (V)						
Kwankwaso	0.96	23.86	14.40	0.96	22.90 a	15.93 a
Maibargo	1.12	21.00	15.53	1.08	17.48 b	17.27 a
Sabaiya	1,16	21.06	14.93	0.95	20.63 ab	16.67 a
Sammut 24	0.93	23.87	12.93	1.12	19.95 ab	12.93 b
Level of probability	0.333	0.188	0.139	0.439	0.032	0. 001
S E	0.1489	1.788	1.128	0.0870	1.238	0.750
Plant botanicals (P)						
Azadirachta Leaf powder	1.00	23.44	14.58	1.05	19.29	15.67
Tamarind Leaf powder	0.88	24.32	13.83	1.09	20.58	16.25
Ficus spp. Leaf powder	1.06	22.05	14.58	1.06	19.90	15.00
Parkia fruit powder	1.16	20.47	14.58	1.07	18.94	14.83
Control	1.12	21.97	14.67	0.867	22.48	16.75
Level of probability	0.499	0.370	0.961	0.473	0.409	0.450
S E	0.1665	1.999	1.216	0.0973	1.384	0.838
Interaction						
V x P	0.513	0.507	0.904	0.502	0.293	0.841

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test. %= percentage.

Table 5: Effect of Groundnut varieties and plant botanicals on Haulm yield (kg hectare^{-1}) and pod yield (kg hectare^{-1}) at BUK and Garko.

Treatment	BUK Haulm yield (kg hectare^{-1})	BUK Pod yield (kg hectare^{-1})	Garko Haulm yield (kg hectare^{-1})	Garko Pod yield (kg hectare^{-1})
Varieties (V)				
kwankwaso	3519	1466 c	3815 b	1753 a
Maibargo	3889	1661 b	4481 a	1562 b
Sabaiya	4037	1864 a	4185 ab	1892 a
Samnut 24	4259	1367 c	2407 c	1403 b
Level of probability	0.201	< .001	< .001	< .001
SE	345.8	95.9	183.8	61.0
Plant botanicals (P)				
Azadiractha leaf powder	3700 ab	1509	3847	1703 ab
Tamarind leaf powder	3519 b	2064	3704	1772 a
Ficus spp. Leaf powder	4676 a	1506	3565	1635 ab
Parkia fruit powder	3704 ab	1469	3796	1678 ab
Control	3981 ab	1400	3704	1473 b
Level of probability	0.044	< .001	0.896	0.045
SE	386.6	107.2	205.5	68.2
Interaction				
V x P	0.177	0.302	0.329	0.041

Means followed by the same letter (s) in the column are not significantly different at 5% level of probability using student – Newman keuls Test. kg = kilogram.

Table 6: Interaction between groundnut varieties and plant botanicals on Pod yield hectare-1 (kg) at Garko.

Plant botanicals	Groundnut Varieties			
	Kwankwaso	Maibargo	Sabaiya	Samnut 24
Azadirachta leaf powder	1935ab	1510abc	2051a	1316bc
Tamarind leaf powder	1570abc	1761ab	1901ab	1853ab
Ficus spp. Leaf powder	1809ab	1573abc	1793ab	1364abc
Parkia fruit powder	1786ab	1378abc	2066a	1483abc
Control	1663ab	1586abc	1650ab	993c
S E = 136.4				

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

STRIGA (*Striga hermonthica* Del. Benth) MANAGEMENT IN SORGHUM (Sorghum Bicolor L. Moench) USING CROP VARIETY AND GREEN MANURE AT SAMARU, IN THE NORTHERN GUINEA SAVANNA OF NIGERIA

ABDULLAHI, Rabi'u[1] and Musa Usman[2]

[1]Department of Crop Science, Faculty of Agriculture Umaru Musa Yar'adua University, Katsina State.
[2]Department of Agricultural Education, Isah Kaita College of Education, Katsina State.
Corresponding author: abulsudys70gmail.com

ABSTRACT

A field experiment was conducted during the wet seasons of 2013 and 2014 at the experimental farm of institute of Agricultural Research Samaru "Lat 11⁰ 11⁰ N, 7⁰ 38 E; 686 above sea level) in the northern Guinea Savanna of Nigeria to evaluate the effects of variety and organic manure for Striga control in Sorghum. The treatments consisted of two varieties of sorghum (SAMSORG – 40 and SAMSORG – 41, three levels of organic manure (Cassia obtusifolia green manure at 0, 7.5 and 15t ha^{-1} and Cowdung at 10t ha^{-1}). The experiment was laid in a split-plot design and replicated three times. The experimental site was inoculated to boost Striga level. SAMSORG – 40 had longer period to Striga emergence while SAMSORG – 41 supported less Striga count than SAMSORG – 40 in 2013. No significant influence was recorded by variety and manure rates on the Striga infestation and sorghum crop – reaction score. More number of days to Striga emergence was observed by green manure at 0 – 7.5t ha^{-1} in 2013 which was contrary to the result obtained by the same treatments in 2014. SAMSORG – 40 had greater values of yield compared to SAMSORG – 41. Significant interactions between variety and green manure was recorded. SAMSORG-40 out yielded SAMSORG-41 when treated with green manure from 0 – 15t ha$^{-.1}$ Application of 15t ha^{-1} green manure resulted in significant number of yield under Striga pressure and infestations compared to all other treatment combinations.

Key words: - *Green manure, Sorghum and Striga*

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is commonly referred to as guinea corn in West Africa, is the fifth most important cereal crop in the world after rice (*Oryza sativa* L.), wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.) and maize (*Zea mays* L.) (Abunyewa, 2008). Nigeria is the fourth largest producer of sorghum after USA, India and Mexico (CGIAR, 2013). It is unique to environmental conditions, including biotic and abiotic stresses and fits well in the diets of poor people of the semi-arid tropics where drought causes frequent crop failure (Godharle *et al*., 2010). Sorghum is a principal source of nutrition for millions of people and provides a major source of energy to human diets in Africa and much of Asia (Anon., 2015). The grain and vegetative parts of the crops are used as animal feed. Sorghum serves as a major raw material in the brewing industry. Some varieties of sorghum can be malted to produce nutritious food stuff for infants and used in bakery.

Striga has adverse effect on sorghum, and infestation can result in crop failure. The extent of yield losses is related to the incidence and severity of attack, crop susceptibility to *Striga,* environmental factors (edaphic & climatic) and the management level under which the crop is produced (Esilaba, 2006). Its effect ranges from extraction of nutrients, water, assimilates and mineral salt from the host plant resulting in stunted growth, chlorosis, wilting and consequently death of the plant. It was reported that annual sorghum losses attributed to *Striga* in USA were 22-27% and 25% in Ethiopia and 235% in Nigeria (Anon,2011). In terms of monetary value, the annual cereal losses due to *Striga* are estimated at US$ 7 billion in USA. In Ethiopia, Mali and Nigeria, the annual losses are estimated at US$

75 million, US$ 87 million and US$ 12 billion respectively (Anon., 2011). Parasitic weed species of the genus
Striga establishes preferentially on poor soils and fields which have been exhausted by continuous cropping (Vogt *et al.,*1991), and *Striga* infested areas are characterized by agricultural production systems that witness low crop productivity. The work reported in this paper aimed at assessing the influence of Crop variety and green manure on the performance of sorghum in a *Striga* infested field at Samaru.

MATERIAL AND METHODS

Two field trials were conducted during each of the wet seasons of 2013 and 2014 to investigate the effects of organic manure, (using of *Cassia obtusifolia* L. & Cowdung) on two varieties of sorghum grown on a *Striga*-infested field at the Experimental farm of the Institute for Agricultural Research, Samaru (Lat. 11^0 11 56 "N, 7^0 38" E; 686m above sea level) in Northern Guinea Savanna zone of Nigeria. The Experiment consisted of two sorghum varieties (SAMSORG-40 and SAMSORG-41), four levels of organic manure (*Cassia* green manure at 0, 7.5 and 15t ha^{-1} and cow dung at 10t ha^{-1}). Soils of the experimental Site and the green manure were analyzed for their physical and chemical properties and are presented in Table 1. And Cassia green manure was analyzed for its nitrogen, phosphorus and potassium contents, and is presented in Table 2. The experiment was laid out in a split plot design and the treatments were replicated thrice. The gross plot size consisted of six ridges,75cm apart, each 3m long giving an area of 13.5 m^2, while the net plot consisted of the two inner ridges, giving an area of 4.5 m^2.

In each trial and season, the land was harrowed to a fine tilth and ridged, 75cm apart. The site was marked into plots and replications. Alley path ways of one meter across and one ridge along the ridges were allowed as borders between the plots, while replications were separated by two ridges along and 1m across the ridges. *Cassia obtusifolia* plants were harvested at five weeks after emergence from nearby fields in both locations. The green manure and crushed cow dung were uniformly applied and incorporated into ridges two weeks before sorghum seed sowing according to treatments. The incorporation was done by opening the center of each ridge to about 15cm depth, and applying cow dung or burying *cassia* plants according to treatments, after which, each was covered with soil.

Each experimental site was inoculated with *Striga* seeds, a day to sowing. This was done by using 25g of *Striga* seeds per 1kg of fine sand to inoculate each field. The inoculants were uniformly applied by broadcasting immediately after manure application. The inoculation was done to boost the *Striga* level of the infested fields. Dressed seeds of Sorghum was done on June 20th and 15th in 2013 and 2014, respectively at Samaru using 4 - 5 seeds per hill at a spacing of 30cm on 75cm ridges. Sorghum seedlings were thinned to two plants per stand at 3 weeks after sowing (WAS). Paraquat as a Gramazon 270 E.C. was applied on the experimental field prior to land preparation and repeated at two weeks after manure incorporation to control emerged weeds. Hoe weeding was done at 3 and 6 WAS. Subsequent weed control was done by hand pulling as the need arose, avoiding *Striga* plants destruction. Sorghum was harvested when the panicles had attained physiological maturity (Easteen *et al.,* 1973). Data collected included Number of day*s to Striga emergence, Striga* shoot count, crop reaction score and sorghum grain yield. The data collected were subjected to analysis of variance to test the significance of differences between treatment means using the F-test as described by Snedecor and Cochran (1967). The treatment means were compared using the Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The Soil in both years was loam, and was slightly acidic with low organic Carbon, total N and available P (Table 1). The exchangeable bases and C.E.C. were lower in 2014 than 2013. The nutrients (N, P& K) content of the green manure was lower in 2013 than 2014 (Table 2). Crop variety and organic manure application significantly influenced the number of days to *Striga* shoot emergence. SAMSORG – 40 had longer periods to *Striga s*hoot emergence in both years than SAMSORG -41(Table 3). Cassia green manure at 15t ha^{-1} and Cowdung at 10t ha^{-1} emerged earlier compared to untreated control and lower rate (7.5t ha^{-1}) of green manure in 2014.

SAMSORG – 41 supported less *Striga* shoots at harvest than SAMSORG – 40 in 2013. In 2014, green manure at 0 t ha^{-1} and 7.5 t ha^{-1} resulted in less *Striga* shoots than the 15 t ha^{-1} level green manure. Cowdung treatment was at par with the other treatments. The lower shoot count of *Striga* with SAMSORG – 41 might be as a result of the reduction of *Striga* weeds shoot density induced by native soil treated with Cowdung which is riched in N.

Crop variety at 6 WAS did not influence crop reaction to *Striga* in 2014 contrary to the result obtained by same treatment in 2013 where significant crop reaction score was observed by SAMSORG-40. Crop reaction with green manure at 7.5t ha^{-1} was reduced compared to untreated control at 6 and 9 WAS. Green manure at 15t ha^{-1} and Cowdung at 10t ha^{-1} resulted in crop reaction values that were similar to both the control and the lowest by 7.5t ha^{-1} green manure at this period. In 2014, organic manure treatments shows no any influence on sorghum reaction score. In both periods under study, SAMSORG – 40 out yielded SAMSORG – 41. The higher values of sorghum grain yield exhibited by SAMSORG-40 over SAMSORG-41 despite the fact that they are all tolerant to *Striga* may be the earlier variety responded favorably to fertilizer than the later. Also in each case, grain yield increased with green manure from 0 – 15t ha^{-1}. The use of 15t ha^{-1} green manure resulted in higher grain yield than Cowdung at 10t ha^{-1}. The greater values of yield by SAMSORG – 40 under higher dose of green manure shows that *Cassia obtusifolia* green manure releases more nitrogen to sorghum which in turn contributes significantly to yield. Yield of fresh vegetable maize on weed green manure was highest 12702 kg ha^{-1} by *Cassia obtusifolia.* Abdullahi, (2011) reported that SAMSORG – 40 had significant number of yield and yield attributes over the Kano fara-fara, a local variety.

There were significant interactions of crop varieties and organic manure in both 2013 & 2014. Grain yield increased with green manure from 0 - 15 t ha^{-1} under SAMSORG - 40 in both years under study. With each variety, green manure at 15 t ha^{-1} had higher yield over Cowdung at 10 t ha^{-1}. At each level of green manure, SAMSORG - 40 out yielded the other variety (SAMSORG - 41).

Soil properties	2013	2014
Physical properties		
Sand (%)	19.8	25.0
Silt (%)	13.2	16.6
Clay (%)	67.0	58.4
Textural class	Loam	Loam
Chemical properties		
pH in water (1:2.5).	6.30	6.05
pH in 0.01m $CaCl_2$ (1:2.5.).	5.61	5.08
Organic carbon (g/kg).	0.80	0.41
Total Nitrogen (g/kg).	0.58	0.50
Available P mg/kg	2.10	4.30
Exchangeable cation (Cmol/kg)		
K	1.40	1.20
Mg	1.80	1.50

Ca	4.30	3.03
Na	0.41	0.58
CEC (meq/100g)	2.40	5.27

Table 1: Physical and chemical characteristic of soil (0-30cm) taken from the experimental site during 2013 and 2014 wet seasons at Samaru

Soil Chemical Laboratory, Department of Agronomy, A.B.U., Zaria

Table 2: Nutrients content of *Cassia* green manure used in the experiment at Samaru in 2013 and 2014 wet seasons

Nutrients (%)	2013	2014
Total N	1.75	22.78
Available P	1.60	1.96
Available K	0.56	0.63

Soil Chemical Laboratory, Department of Agronomy, A.B.U., Zaria

Table 3: *Striga* management in Sorghum using Crop variety and organic manure on *Striga* parameters and Sorghum grain yield during 2013 wet season at Samaru.

Treatment	Number of days to Striga emergence	*Striga* shoot count @ harvest	Crop *striga* reaction score @ 6 WAS	Grain yield ($kgha^{-1}$).
Variety (V)				
SAMSORG – 40	107.0a	1.44a	6.9	2000a
SAMSORG – 41	96.0b	0.42b	6.8	1809b
SE±	0.17	0.36	0.14	9.70
Green manure (M) ($t\ ha^{-1}$)				
0	106.0a	0.67	6.9	1516d
7.5	103.0ab	1.33	7.0	1815c
15	91.7b	1.17	6.6	2166a
Cowdung 10t ha-1	92.2b	0.55	6.8	2120b
SE±	0.19	0.53	0.20	13.7
Interactions.				
V x M	NS	NS	NS	*

Means followed by the same letter (s) within a column of each treatment group are not significantly different at 5% level of probability using the DMRT.

In conclusion, although SAMSORG - 40 delayed *Striga* seed emergence, and supported more *Striga* shoots, it was more tolerant to the parasitic weeds and gave higher yield than its counterpart, SAMSORG - 41. The use of 7.5 - 15.0 t ha^{-1} of green manure and 10t ha-1 of Cowdung ameliorated the effect of *Striga* on Sorghum growth, and gave a linear yield response to green manure rates from 0 - 15t $ha^{-1.}$ The use of green manure at 15t ha-1 out yielded Cowdung at 10 t ha-1.With variety, SAMSORG – 40 had an edge over SAMSORG – 41 with respect to *striga* shoot count even though both varieties were tolerant to *Striga*, yet *Striga* density was significantly higher in SAMSORG – 41. The study also revealed that, the highest grain yield of sorghum was by the application of 15t ha^{-1} green manure with SAMSORG – 40 grown on *Striga* infested field. Improving soil fertility, especially N will reduce the effect of *Striga* on sorghum.

Table 4: *Striga* management in Sorghum using Crop variety and Organic manure on *Striga* parameters and Sorghum grain yield during 2014 wet season at Samaru.

Treatment	Number of days to *Striga* emergence	*Striga* shoot count @ harvest	Crop *Striga* reaction score @ 6 WAS	Grain yield ($kgha^{-1}$).
Variety (V)				
SAMSORG – 40	105.0a	0.64b	3.91	2149a
SAMSORG – 41	95.2b	0.86a	3.85	1980b
SE±	0.15	0.16	0.12	18.7
Green manure ($t\ ha^{-1}$)				
0	93.7b	0.67b	3.93	1698d
7.5	109.0a	0.61b	3.90	2039c
15	92.2b	1.33a	3.90	2289a
10	102.2a	0.34bc	3.79	2233b
SE±	0.17	0.22	0.17	26.5
Interactions				
. V x M	NS	NS	NS	*

Means followed by the same letter (s) within a column of each treatment group are not significantly different at 5% level of probability using the DMRT.
WAS = Weeks After Sowing.

Table 5: Interaction of variety and organic manure on Sorghum grain yield during 2013 & 2014 wet seasons at Samaru

Manure rate ($t\ ha^{-1}$)	Variety		
	SAMSORG-40	2013	SAMSORG-41
0	1605f		1427g
7.5	1882d		1749e
15	2302a		2031c
10	2211b		2029c
SE±	5.0		
	Variety	2014	
0	1769c	1627 f	
7.5	2137c	1940 d	
15	2365a	2140 c	
10	2325b	1940 d	
SE±	5.2		

Means followed by same letter are not significantly different at 5% level of probability using DMRT.

REFERENCES

Abdullahi, R. (2011), Use of Cotton, Cowpea and Soyabean Varieties as Trap Crops for the Control of Striga in Sorghum in Northern Guinea Savannah. Unpublished M. Sc. Thesis Submitted to the Department of
Agronomy Ahmadu Bello University, Zaria, Nigeria. 69pp

Anonymous, (2011). Feasibility study on Striga control in Sorghum. *African Agriculture Technology Foundation*, Nairobi: ISBN 9968-775-12-9.

Anonymous, (2015). IAR Released Variety Descriptors. Institute For Agricultural Research, Samaru, Federal Ministry of Agriculture and Rural Development, Ahmadu Bello University, P M B 1044, Zaria. 85pp.

Arunah, U. L., U. F., Chiezey and L. Aliyu, 2006. Response of two Sorghum varieties to inorganic fertilizer and poultry manure on yield and yield components. Programme and Book of Abstract of the31stAnnual conf. Soil sci. society of Nigeria. 13th-17thNov., 2006 Ahmadu Bello University, Zaria, Nigeria. Pp: 42.

Duncan, D. B. (1955). Multiple Range and Multiple F - test. *Biometrics II*, (1955): 1 -42. Godbharle, A. R, More, A.W. and Ambekar, S. S. (2010). Genetic variability and correlation studies in elite 'B' and 'R' lines in kharif sorghum. *Electronic Journal of Plant Breeding*, 1(4) : 14-23.

Esilaba, A.O.F. (2006). Options for *Striga* management in Kenya, *Kenya Agricultural Research Institute,* Nairobi, Kenya.

Gworgwor, N. A. (1993), Studies on the Biology and Control of Striga spp Unpublished Ph D Thesis, Phillips University, Margurg, FRG 184pp

Vogt, W., Sauborn, J. and Honissch, M. (1991). Striga hermonthica, distribution and Infestation in Ghana and Togo on Grain Crops. In Proceedings of the Fifth International Symposium on parasitic Weeds. Ransom, J.K., Musselman, L. J., Worsham, A. D. and Parker, C. (Eds.), Pp. 272 - 277. CIMMYT, Mexico. Pp34.

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

ROOT AND SHOOT DRY WEIGHT RESPONSE OF COWPEA (*VIGNA UNGUICULATA* L. WALP) VARIETIES GROWN ON *ALECTRA VOGELII* INOCULATED SOIL TO *GLOMUS DESERTICOLA*

D.O. Makanjuola[1], S. O. Alonge[2], A.B. Zarafi[3], J.O. Adeosun[4] and Y. Tanimu[2]

[1]Department of Environmental Sciences, College of Environmental Studies, Kaduna Polytechnic, Kaduna.
[2]Department of Botany, Faculty of Life Sciences, Ahmadu Bello University, Zaria.
[3] Department of Crop Protection, Faculty of Agriculture, Ahmadu Bello University, Zaria.
[4] National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria.
Corresponding Author Email: deboraholaofe@gmail.com

ABSTRACT

This research was conducted to evaluate the effect of Glomus deserticola on the root and shoot dry weight of four cowpea varieties on Alectra vogelii inoculated soil. The four cowpea varieties used were: SAMPEA 7, IFE 82-12, IT97K-499-35 and TVX 3236. The sterilized sandy-loamy soil used for this experiment consisted of mixture of top soil and sand in ratio 1:1 (v/v). Glomus deserticola was applied in five rates: the control without Alectra, control with Alectra, 10, 20 and 30 g/pot. A constant quantity of Alectra was maintained (3.3 g). The treatments were arranged in complete randomized design. The cowpea plants were sampled for root and shoot dry weight at 5, 7 and 9 weeks after planting (WAP). The Glomus deserticola treatments at different rates significantly increased cowpea root and shoot dry weights compared with the two control treatments. Glomus deserticola treatment at 30 g/pot resulted in the highest root and shoot dry weight of the cowpea varieties. Among the cowpea varieties, SAMPEA 7 had higher values than the other cowpea varieties at 9 WAP. In conclusion, Glomus deserticola treatments significantly increased root and shoot dry weight of the four cowpea varieties on Alectra inoculated soil and can be recommended as a biological control agent in Alectra vogelii infested fields.

Keywords: *Glomus deserticola*, *Alectra vogelii*, Cowpea, Soil, Root and Shoot dry weights

INTRODUCTION

Cowpea is an important legume crop which is widely grown under low input production systems and in arid and semi-arid agro-ecologies of the world. It is predominantly a self-fertilizing crop. Cowpea grain contains a high proportion of protein (19 to 35 %) which is rich in two essential amino acids, lysine and tryptophan (Abadassi, 2015; Ibro *et al.*, 2014). The crop has the ability to grow under harsh environmental conditions where other major crops fail to grow. Its foliage is regarded as an important source of high-quality livestock feed. In addition, cowpea has the ability to restore soil fertility through nitrogen fixation, making it a good crop to use in crop rotation with major cereal crops (Daryanto *et al.*, 2015). *Alectra vogelii* which affects cowpea adversely belongs to the Orobanchaceae family (Broomrape family) or sub-family Orobanchoideae of Scrophulariaceae. It is also a serious weed of late planted groundnut and soybean in the same ecological zone (Nikcrent and Musselman, 2004). A Mycorrhiza is a symbiotic (generally mutualistic, but occasionally weakly pathogenic) association between a fungus and the roots of a vascular plants (Kirk *et al.*, 2001). *Glomus* is a genus of arbuscular mycorrhizal fungi with all species forming symbiotic relationships (mycorrhizas) with plant roots. *Glomus* is the largest genus of AM fungi, with 85 species described but currently defined as non-monophyletic (Kirk *et al.*, 2008). *Glomus deserticola* are arbuscular mycorrhizal fungi that form symbioses with plant roots, where they obtain carbon (photosynthate) from the host plant in exchange for nutrients and other benefits. The mycorrhizae consist of arbuscules, vesicles, as well as intra and extra radical hyphae (Kirk *et al.*, 2008).

The current control measures being used by some farmers (such as cultural, mechanical, physical, chemical e.t.c) have many shortcomings. Considering the limitations of each control method there is still need to search for an effective control measure that can be suitable for the host plant, safe for the environment, control the parasite and can be easily adopted by poor resource farmers. Therefore, this study was conducted to evaluate the tripartite interactions between cowpea varieties, Arbuscular Mycorrhizal Fungi and *Alectra vogelii* with emphasis on the role of the fungi on root and shoot dry weight of cowpea varieties.

MATERIALS AND METHODS

This pot experiment was conducted on a fenced farmland at Agwa New Extension, Trikania, Kaduna in 2016, 2017 and 2019 wet seasons. Four cowpea varieties comprising of two susceptible varieties (SAMPEA 7 and TVX 3236) and two moderately resistant varieties to *Alectra* (IFE 82-12 and IT97K-499-35) were obtained from the Seed Production Unit, Institute for Agricultural Research (IAR), Ahmadu Bello University, Zaria. Also, the *Alectra* seeds and AM inoculum were gotten from IAR farms, Zaria and University of Ibadan, Ibadan respectively. The method of Heckman and Angle (1987) was used to prepare *Glomus deserticola* inoculum. Soil composed of a mixture of topsoil and sharp sand in ratio 1:1 was sieved, sterilized and placed in polythene bags (used as pots) and used for planting. Four seeds each of the different cowpea varieties were planted in each polythene bag. These pots were arranged at an intra-row spacing of 0.30 m. The cowpea plants were inoculated with propagules of *Glomus deserticola* depending on the treatments (control without *Alectra*, control with *Alectra*, 10, 20 and 30 g per pot) with a constant quantity of *Alectra* (3.3 g). The AM fungal inoculum was mixed with the top 3 cm of the pot soil for the relevant treatments. Each of the treatment was assigned eight pots in three replicates. The treatments were arranged in Complete Randomized Design (CRD). The plants were thinned to two plants per pot at two weeks after planting. The cowpea seedlings were sprayed with Benlate (Benomyl) and Dithane M45 (Carbendazim) at the product rate of 0.6 kg/ha and 2.5 kg/ha respectively (to control fungal diseases) and Rogor (dimethoate) at 0.75 L/ha at 4 WAP, to prevent viral diseases. Sherpa with (cypermethrin + perfekthion) was applied fortnightly at the rate of 1.0 L/ha, beginning from 7 WAP until harvest, to control insect pests during flowering and pod development. Weeds with the exception of *Alectra* were controlled by hand pulling as at when necessary from 2 WAP. At each sampling, cowpea plants were carefully uprooted from three pots. The sampled plants were brought to the laboratory in labeled polythene bags, washed carefully with tap water and the surface water was allowed to drain. The selected cowpea plants were separated into root and shoot using a knife and each part was then put in labeled envelopes, oven dried at 70 ^{0}C and dried weight taken. Root and shoot dry weights were taken fortnightly beginning from 5 to 9 WAP.

Data Analysis

The data obtained on the root and shoot dry weights were subjected to analysis of variance (ANOVA) as described by Lawes Agricultural Trust (1980), to compare the varietal reaction of cowpea varieties to the presence of Arbuscular mycorrhizal fungi. Significant differences between treatments means were compared using Duncan Multiple range test (DMRT). The three years data on each parameter were pooled and subjected to ANOVA.

RESULTS

Root Dry Weight: *Glomus deserticola* at 30 g/pot treatment mostly resulted in a higher root dry weight in SAMPEA 7, IFE 82-12 and TVX 3236 at 5 and 9 WAP in 2016 compared with that due to all the other treatments (Table 1). The control without *Alectra* treatment mostly resulted in a lower root dry weight in IFE 82-12 and TVX 3236 at 5 – 9 WAP in 2017 compared with all the other treatments (Table 1). Most treatments mostly resulted in comparable root dry weight in IFE 82 – 12, IT97K-499-35 and TVX 3236 at 5 – 9 WAP in 2019 (Table 1). Root dry weight due to the control without *Alectra* treatment was higher than that due to the control plus *Alectra* treatment in IFE 82 – 12 and IT97K-499-35 (Table 1). The ANOVA of the three years data based on *Glomus deserticola* treatments showed that, 30 g/pot *Glomus deserticola* treatments recorded the highest root dry weight which was significantly higher than that due to all the other treatments. This was followed by that due to the control without *Alectra* treatment. The lowest root dry weight due to 20 g/pot *Glomus deserticola* treatment was only comparable with the control plus *Alectra* treatment (Table 3). Also, *Glomus deserticola* treatments resulted in the highest root dry weight in SAMPEA 7 which was significantly higher than that observed in all the other varieties. This was followed by that produced in IT97K – 499 – 35. The lowest root dry weight in TVX 3236 was only comparable with that observed in IFE 82 – 12. (Table 3). The root dry weight recorded at various cowpea plant ages varied significantly from each other with the highest root dry weight recorded at 9 WAP significantly higher than that at 5 and 7 WAP. The lowest root dry weight at 5 WAP was significantly lower than that at 7 and 9 WAP (Table 3).

Shoot Dry Weight: At 7 and 9 WAP, the control treatments mostly resulted in a lower shoot dry weights in SAMPEA 7 in 2016 than that due to 20 and the 30 g/pot *Glomus deserticola* treatments (Table 2). In 2017, most treatments produced comparable shoot dry weight at 5 and 7 WAP in most of the varieties (except SAMPEA 7). Similar observation was made in TVX 3236 in 2016 at 5 and 7 WAP. At 5 and 9 WAP, the control without *Alectra* treatment resulted in a lower shoot dry weight in IFE 82-12 in 2017 than that due to 20 and 30 g/pot *Glomus deserticola* treatments (Table 2). The control without *Alectra* treatment mostly resulted in the highest shoot dry weight in SAMPEA 7 and IFE 82-12 at 5 – 9 WAP in 2019 (Table 2). *Glomus deserticola* treatment at 20 and 30 g/pot resulted in lower shoot dry weight at 5 and 7 WAP in SAMPEA 7 and IFE 82-12, compared with the two control treatments (Table 2). The ANOVA of the three years data based on *Glomus deserticola* treatments showed that, control without *Alectra* treatment resulted in the highest shoot dry weight in cowpea varieties which was comparable with that due to 10 and 30 g/pot *Glomus deserticola* treatments. This was followed by that due to 20 g/pot *Glomus deserticola* treatment. The control plus *Alectra* treatment resulted in significantly lower shoot dry weight than that due to all the other treatments (Table 3). Also, the highest shoot dry weight in SAMPEA 7 was significantly higher than that observed in all the other varieties. This was followed by that observed in IFE 82-12. The lowest shoot dry weight in TVX 3236 was only comparable with that observed in IT97K – 499-35 (Table 3). The shoot dry weight recorded at various cowpea plant ages varied significantly from each other with the highest shoot dry weight recorded at 9 WAP significantly higher than that at 5 and 7 WAP. The lowest shoot dry weight at 5 WAP was significantly lower than that at 7 and 9 WAP (Table 3).

Table 1: Effect of *G. deserticola* on Root Dry Weight of Cowpea Varieties in 2016 and 2017

Year	Cowpea variety	VAM CONC (g)	*Plant' age (WAP)* Root Dry weight		
			5	7	9
2016	SAMPEA 7	0 – parasite	0.47c	1.07a	4.50c
		0+ parasite	0.53c	0.87b	4.13c
		10	0.80b	1.07a	3.30d
		20	0.70b	1.07a	6.17b
		30	1.53a	1.20a	7.23a
		Mean	0.81	1.06	5.07
		SE ±	0.05	0.06	0.13
	IFE 82 -12	0-Parasite	0.33cd	0.40b	2.57ab
		0+ parasite	0.30d	0.50b	2.40ab
		10	0.67b	0.67a	2.07b
		20	0.43c	0.50b	2.07b
		30	1.87a	0.67a	3.13a
		Mean	0.72	0.55	2.47
		SE ±	0.03	0.04	0.23

	IT97K – 499 – 35	0- parasite	0.50b	0.57b	6.53a
		0+ parasite	0.17c	0.40c	3.53c
		10	0.20c	0.77a	3.50c
		20	0.30c	0.27d	2.03d
		30	1.90a	0.27d	4.57b
		Mean	0.61	0.45	4.03
		SE ±	0.05	0.03	0.12
	TVX – 3236	0-parasite	0.53b	0.37d	2.97b
		0+ parasite	0.20b	1.00a	2.20c
		10	0.37b	0.83b	3.67ab
		20	0.40b	0.57c	1.57c
		30	1.70a	0.73b	3.97a
		Mean	0.64	0.70	2.87
		SE ±	0.10	0.03	0.22
2017	SAMPEA 7	0 – parasite	0.67a	0.83a	0.77ab
		0+ parasite	0.33c	0.50b	0.63abc
		10	0.67a	0.63b	0.50bc
		20	0.50b	0.53b	0.80a
		30	0.43bc	0.60b	0.47c
		Mean	0.52	0.62	0.63
		SE ±	0.05	0.06	0.08
	IFE 82 -12	0-Parasite	0.37c	0.50b	0.37c
		0+ parasite	0.60a	0.60ab	1.00a
		10	0.43bc	0.60ab	0.73b
		20	0.50abc	0.60ab	1.03a
		30	0.57ab	0.77a	0.50c
		Mean	0.49	0.61	0.73
		SE ±	0.05	0.05	0.06
	IT97K – 499 – 35	0- parasite	0.43a	0.43b	0.73ab
		0+ parasite	0.40a	0.70a	0.70ab
		10	0.37a	0.77a	0.67ab

		20	0.03c	0.27a 0.23a
		30	0.02c	0.23a 0.23a
		Mean	0.20b	0.30a
		SE ±	0.16	0.25
	TVX – 3236	0-parasite	0.03	0.03
		0+	0.23a 0.20a	0.27c
		parasite	0.23a 0.23a	0.33bc
		10	0.23a	0.23c
		20	0.23	0.47ab
		30	0.03	0.50a
		Mean	0.07a	0.36
		SE ±	0.04ab	0.53b
2019	SAMPEA 7	0-	0.03ab	0.87a
		0+	0.03ab	0.70
		10	0.02b	0.07
		20	0.04	0.53c
		30	0.01	0.80ab
		Mean	0.20ab	0.90a
		SE ±	0.13bc	0.57c
	IFE 82-12	0-	0.30a	0.73b
		0+	0.09c	0.71
		10	0.20ab	
		20		0.04 0.06
		30	0.19	0.05
		Mean	0.03	0.63a
		SE ±	0.53b	0.27b 0.70a
	IT97K-499-35	0-	0.37b	0.67a
		0+	0.56	0.70a
		10	0.05	0.59
		20	0.47c	0.04
		30	0.67a	0.73a
		Mean	0.53bc	0.47b
		SE ±	0.53bc	0.67ab
	TVX 3236	0-	0.63ab	0.90a
		0+	0.57	0.70ab
		10	0.03	0.69
		20	0.63a	0.07
		30	0.30b	0.40a
		Mean	0.37b	0.37a
		SE ±	0.63a	0.13b
0.37a			0.17c	0.40a
0.37a			0.42	0.43a
0.39			0.02	0.35
0.06			0.50a	0.06
0.33a 0.33a			0.43ab	0.20b 0.63a
0.43a 0.23a			0.43ab	0.47a
0.37a			0.33bc	0.27b
0.34			0.23c	0.50a
0.06			0.39	0.41
0.20b 0.33a			0.03	

Note: Means followed by the same letter(s) in each column, under each variety, in each year are not significantly different ($P \leq 0.05$), using DMRT.

WAP- Weeks after Planting

Table 2: Effect of *G.deserticola* on Shoot Dry Weight of Cowpea Varieties in 2016 and 2017

Year	Cowpea variety	VAM CONC (g)	PLANT'S AGE (WAP) Shoot Dry Weight		
			5	*7*	*9*
2016	SAMPEA 7	0 – parasite	1.47b	3.80c	4.50c
		0+ parasite	1.47b	2.80d	4.13c
		10	2.20a	4.47b	3.30d
		20	2.37a	5.10a	6.17b
		30	1.53b	4.30b	7.20a
		Mean	1.53	4.09	5.06
		SE ±	0.10	0.12	0.15
	IFE 82 -12	0-Parasite	2.27ab	1.40c	2.57b
		0+ parasite	1.33d	2.53b	2.40b
		10	2.43a	3.40a	2.07c
		20	1.60cd	3.70a	2.07c
		30	1.87bc	3.73a	3.13a
		Mean	1.90	2.95	2.45
		SE ±	0.12	0.11	0.08
	IT97K – 499 – 35	0- parasite	1.53b	2.00a	6.20a
		0+ parasite	1.27b	2.97a	3.53c
		10	1.43b	1.50cd	3.40c
		20	1.37b	1.20d	2.03d
		30	1.90a	1.80bc	4.57b
		Mean	1.50	1.89	3.95
		SE ±	0.11	0.13	0.22
	TVX – 3236	0-parasite	1.70a	1.80c	2.97b
		0+ parasite	0.70b	3.93a	2.30c
		10	1.67a	3.93a	3.67a
		20	1.53a	3.10b	1.57d
		30	1.77a	3.80a	3.30a
		Mean	1.47	3.13	b
		SE ±	0.14	0.11	2.76
					0.20
2017	SAMPEA 7	0 – parasite	1.60a	1.90a	3.17a
					b
		0+ parasite	0.77c	1.33b	2.03c
		10	1.43ab	2.00a	2.77b
		20	1.00bc	1.17c	3.57a
		30	1.00bc	1.97a	1.70c
		Mean	1.16	1.67	2.65
		SE ±	0.16	0.05	0.14
	IFE 82 -12	0-Parasite	1.10b	2.00a	1.27c

		0+ parasite	1.50ab	2.03a	3.07a
		10	1.70a	1.63b	2.00bc
		20	1.50ab	2.20a	2.67ab
		30	1.47ab	2.23a	1.67c
		Mean	1.45	2.02	2.14
		SE ±	0.12	0.11	0.22
	IT97K – 499 – 35	0- parasite	1.27a	1.40b	2.13b
		0+ parasite	1.20a	2.03a	2.00bc
		10	1.10a	2.33a	1.93c
		20	1.17a	2.07a	1.73d
		30	1.07a	1.50b	2.93a
		Mean	1.16	1.87	2.93
		SE ±	0.07	0.13	0.05
	TVX – 3236	0-parasite	0.97b	1.57ab	1.67c
		0+ parasite	0.97b	1.93a	2.73a
		10	1.23a	1.50ab	2.73a
		20	0.53d	1.50ab	1.70c
		30	0.77c	1.43b	2.13b
		Mean	0.89	1.59	2.19
		SE ±	0.05	0.14	0.07
2019	SAMPEA 7	0-	0.93a	2.23a	3.33a
		0+	0.73b	1.10b	1.77bc
		10	0.57c	1.10b	2.27b
		20	0.47c	0.87bc	1.77bc
		30	0.50c	0.67c	1.40c
		Mean	0.64	1.19	2.11
		SE ±	0.05	0.08	0.22
	IFE 82-12	0-	1.03a	1.67a	3.00a
		0+	0.90b	1.70a	1.77b
		10	0.70c	1.50a	2.63a
		20	0.70c	1.10a	3.07a
		30	0.33d	1.00b	1.83b
		Mean	0.73	1.39	2.46
		SE ±	0.04	0.10	0.21
	IT97K-499-35	0-	0.30b	0.90b	3.10a
		0+	0.33b	0.90b	2.00b
		10	0.20c	0.90b	0.90c
		20	0.53a	0.97b	3.03a
		30	0.27bc	1.50a	1.83b
		Mean	0.33	1.03	2.17
		SE ±	0.03	0.07	0.09

TVX 3236	0-	0.53ab	0.97a	1.60b
	0+	0.50ab	1.10a	2.13a
	10	0.63a	1.27a	2.27a
	20	0.37b	1.23a	1.63b
	30	0.47ab	1.23a	1.10c
	Mean	0.50	1.16	1.75
	SE ±	0.05	0.10	0.12

Note: Means followed by the same letter(s) in each column, under each variety, in each year are not significantly different (P ≤ 0.05), using DMRT. WAP- Weeks after Planting

Table 3: Effect of *Glomus deserticola* on Root and Shoot dry weight of cowpea varieties in 2016-2019 (combined data)

Treatment	Root dry weight (g)	Shoot dry weight (g)
VAM (Conc.) g/pot		
0-	0.88b	2.00a
0+	0.76d	1.83c
10	0.80c	1.97a
20	0.75d	1.90b
30	1.10a	1.97a
Mean	0.86	1.93
SE±	0.01	0.02
Variety		
SAMPEA 7	1.10a	2.26a
IFE 82-12	0.76c	1.94b
IT97K-499-35	0.82b	1.78c
TVX 3236	0.75c	1.74c
Mean	0.86	1.93
SE±	0.01	0.02
Age		
Week 5	0.43c	1.13c
Week 7	0.54b	2.02b
Week 9	1.60a	2.65a
Mean	0.86	1.93
SE±	0.01	0.02
Year		
2016	1.66a	2.76a
2017	0.57b	1.74b
2019	0.31c	1.29c
Mean	0.86	1.93
SE±	0.001	0.001
Interactions		
Var*Conc.	*	*
Var*Age	*	*
Var*Year	*	*
Conc.*Age	*	*
Conc.*Year	*	*
Age*Year	*	*
Var*Conc.*Age*Year	*	*

Note: Means followed by the same letter(s) on each column, under each parameter are not significantly different (P≤
0.05), using DMRT. NS = Not Significant, *= Significant

DISCUSSION

Generally, the root and shoot dry weight increased with the *Glomus deserticola* treatments compared with the two control treatments. The highest root and shoot dry weight was at 30 g/pot *Glomus deserticola* treatment. The increase observed in the root and shoot dry weights suggests an efficient compensatory effect of AM fungi in the presence of the parasite thereby minimizing the *Alectra* effect on the host plant hence its being reflected in the dry weights of the root and shoot. Haro *et al.* (2016) also reported that the inoculation of cowpea varieties with AMF resulted in significant increase in shoot and root biomass compared with the control plants.

The highest root and shoot dry weight observed in cowpea variety SAMPEA 7 followed by IFE 82-12 may be attributed to the genetic make-up of the host plants. The cowpea varieties genetic make-up enables variation in AMF responses causing differences in the degree of the fine root development (Lebr on *et al.*, 2012). Also, it may be due to the preference of association between these cowpea varieties and the AM fungi species. Rolden-Fajardo (1994) posited that, each plant has a specific reaction to certain associated mycorrhizal fungal strain. Root dry weight and shoot dry weight having their highest values at 9 WAP may probably be due to the crop level of maturity. This is in agreement with Das *et al*. (2008) that dry matter production in plant gradually increases with crop age and attain maximum at maturity.

CONCLUSION

The result of this work shows that *Glomus deserticola* at different concentrations resulted in significant increase in root and shoot dry weight compared with the control with *Alectra* treatment in the four cowpea varieties considered.

Therefore, the following are being recommended: Farmers can cultivate cowpea varieties SAMPEA 7 on soils infected with *Alectra*, if *Glomus deserticola* treatments are applied in order to obtain higher values for root and shoot dry weight. The use of each *Glomus* species at 30 g/pot treatment in soils, with *Alectra* is recommended for farmers to obtain higher values for root and shoot dry weight. For higher values of root and shoot dry weight of cowpea, 9 WAP should be considered for its collection time.

REFERENCES

Abadassi, J. (2015). Cowpea (*Vigna unguiculata* (L.) Walp.) agronomic traits needed in tropical zone. *International journal of pure and applied bioscience*, 3: 158-165.

Daryanto, S., Wang, L. and Jacinthe, P. A. (2015). Global synthesis of drought effects on food legume production. *PLoS One*, 10 (6)1-15. Article e0127401.

Das, A. K., Khaliq, Q. A. and Islam, D. (2008). Effect of phosphorus fertilizer on the dry matter accumulation, nodulation and yield in chickpea. In: *Bangladesh Research Publications Journal*, I (1): 47-60.

Haro, H., Sanon, K. B., Blagna, F. and Fofana, B. (2016). Effect of native arbuscular mycorrhiza fungi inocula on the growth of cowpea (*Vigna unguiculata* (L.) Walp.) in three different agro ecological zones in Burkina Faso. *Journal of Applied Biosciences*, 108:10553-10560.

Heckman, J. R. and Angle, J. S. (1987). Variation between soyabean cultures in Vesicular-arbuscular mycorrhiza fungi colonization. *Agronomy of Environmental Quality*, 16(2):113-117.

Ibro, G., Sorgho, M.C., Idris, A.A., Moussa, B., Baributsa, D. and Lowenberg-DeBoer, J. (2014). Adoption of cowpea hermetic storage by women in Nigeria, Niger and Burkina Faso. *Journal of Stored Product Research*, 58: 8796.

Kirk, P. M., Cannon, P. F., David, J. C., Stalpers, J. A. (2001). *Ainsworth & Bibsy's Dictionary of the Fungi*, ninth Edn. CABI publishing, Washington. 655 pp.

Kirk, P. M., Cannon, P. F., Minter, D. W. and Staplers, I. A. (2008). *Ainsworth and Bisby's Dictionary of the Fungi*. 10th Edn. Wallingford CAB International. 784 pp.

Lawes Agricultural Trust (1980). Genstat Manual Release 4.03, Ms_DOS version by C.E.M.S (J.C. and Y.M) Rotihamsted Experimental Station.

Lebron, L., Lodge, D. J. and Bayman, P. (2012). Differences in arbuscular mycorrhizal fungi among three coffee cultivars in Puerto Rico. *ISRN* Agronomy, 7 pp. DO1:10.5402/2012/148042.

Nickrent, D. L. and Musselman, L. J. (2004). *Parasitic Flowering Plants*. The Plant Health Instructor web publication. Doi: 10.1094/PHI-I-2004-0330-01.

Rolden-Fajardo, B. E. (1994). Effect of indigeneous arbuscular mycorrhizal endophytes on the development of six wild plants colonizing a semi-arid area in South-East Spain. https//doii.org/10.1111/j.14698137.19994,tbo4265.X.

Herbicide Use and Environmental Safety

Proceedings of the 49th Annual Conference of the Weed Science Society of Nigeria 2023

ASSESSMENT OF PESTICIDE RESIDUE IN SELECTED ARABLE FARMLANDS IN OGBOMOSO SOUTH LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

G.O. Adesina, K.A. Adelasoye and B.I. Akinjide

Department of Crop and Environmental Protection, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso
*Correspondent Author: goadesina@lautech.edu.ng

ABSTRACT

Pesticide residues in soils and farmlands have always been an important concern in Agricultural safety. The ignorance and illiteracy of untutored farmers in developing countries have greatly contributed to this. Pesticides (herbicides, Insecticides, etc.) are capable of leaving residues in the soil. The study was carried out in selected arable farms in Ogbomoso South Local Government Area of Oyo state to evaluate and determine the possibility of pesticide residues in the soils of farmers who are fond of using pesticides in crop production. A questionnaire was administered to farmers in the study area and soil samples were collected from some of the farms owned by farmers interviewed and found to have relevant pesticide usage history. Soil samples were also collected from farms with no records of pesticide usage which served as control. The soil samples were then taken to the laboratory for pesticide residue analysis. The results showed that pesticide usage leaves residues in the soil. Paraforce and Force Up recorded the highest percentage usage by farmers, while the majority of farmers use NPK 15:15:15 as a soil amendment in the area. From soil sample analysis eight pesticide residues were observed and dBHC (32.41mg/kg) in the cultivated plots and 39.27 mg/kg of the uncultivated (control) recorded the highest concentration in the soil as residues. Based on our study, we discovered that rural farmers employ mostly synthetic chemicals for the control of weeds in their respective niches. Alternatives to the use of synthetic chemicals is needed, and public education is required to enlighten farmers on the dangers associated with the use of synthetic chemicals.

Keywords: Pesticides, Residues, Crop production, Farmers, Public health

INTRODUCTION

Food is of utmost importance to man, and the demand for it has been progressively increasing. The production of food however, has been stalled and affected by other living competitors referred to as pests. They can also reduce production and decimate the crops, thereby, affecting the supply of food to meet the increasing population of man. (Garcia *et al*., 2016). The contamination of the environment and food by chlorinated organic pesticides has become a topical issue of considerable concern in many parts of the world, and has led to a lot of fatal and non-fatal cases. In 2020, a systematic review of the scientific literature published between 2006 and 2008, supplemented by mortality data from WHO was carried out. The result shows that approximately 740,000 annual cases of Unintentional Acute Pesticide Poisoning (UAPP) were reported, resulting from 7446 fatalities and 733,921 non-fatal cases. On this basis, it is estimated that about 385 million cases of unintentional acute pesticide poisoning occur annually worldwide without including around 11,000 fatalities. Based on worldwide farming population of approximately 860 million, this means that about 44% of farmers are poisoned by pesticides every year (WHO, 2020).

In 2011, studies carried out in Borno state revealed the presence of Lindane, Diazinon, and Aldrin in the prestorage bean samples, while DDT, Dichlorvos, and Endrin were present in both pre-storage and post-storage samples (Ogah, 2011). Similarly, National dailies reported that 120 students of Government Girls Secondary School, Doma in Gombe, Nigeria were rushed to the Gombe Specialist Hospital after consuming a meal of beans that was suspected to contain residues from pesticides. The result of the analysis showed that samples of the cooked beans and the uncooked beans contained outrageously high levels of an Organochlorinated pesticide. For this reason, it is therefore expedient that the pesticide used by farmers and pesticide residues in the soil on which farmers grow that which they eat and sell to secondary consumers be assessed.

Despite the good results of using pesticides in agriculture, public health consultant described their use as usually accompanied by deleterious environmental and public health effects. Pesticides hold a unique position among environmental contaminants due to their high biological activity and toxicity (acute and chronic). Although some pesticides are described to be selective in their modes of action, their selectivity is only limited to test organisms. Thus, pesticides can be best described as biocides (capable of harming all forms other than the target pest). The contamination of water bodies with pesticides can pose a significant threat to aquatic ecosystems and drinking water resources. Pesticides can enter water bodies via diffuse or via point sources. Diffuse-source pesticide inputs into water bodies are the inputs resulting from agricultural applications in the field. These are tile drain out-low, base-flow seepage, surface and subsurface runoff, and soil erosion from treated fields, Spray drift at application, and deposition after volatilization. In contrast, point-source inputs derive from a localized situation and enter a water body at a specific or restricted number of locations. These are mainly farmyard runoff, sewage plants, sewer overflows, and accidental spills. There are also point sources of pesticides from non-agricultural use, e.g. from application on roads, railways, or urban sealed surfaces such as parking lots (Reichenberger *et al*., 2007). The specific objectives are to evaluate the extent to which farmers use pesticides in the selected farm settlement, identify types of pesticides being used on the farms in the study areas, and evaluate the level of pesticide residue in the soil of selected farms within the study area.

MATERIALS AND METHODS

Study Area

The samples were collected from the Ogbomoso south local government area of Oyo state, Nigeria, with its administrative headquarters located at Arowomole. As shown in Figure 1 below, it is bounded by Surulere, Oriire, and Ogo Oluwa town. Samples were taken from farms in Agric, Atoba, Abede, Ibapon, and Abe-Emin areas of Ogbomoso South local government.

Questionnaire Administration

Questionnaires were administered to farmers to obtain information on farm use history, type of pest being controlled (weed, insect pest), type of pesticides used and their sources, type of soil amendments/fertilizer, and other relevant information.

Soil Sampling

Soil samples were collected using bucket auger and stored inside paper sampling bags from all the selected sample sites and were appropriately labelled for laboratory analyses. Soil samples were taken systematically by diagonal method from different locations on each plot and were replicated four times. A soil auger was used to take about 2 kg of soil sample from the soil, up to 0 – 30 cm depth in four spots per plot.

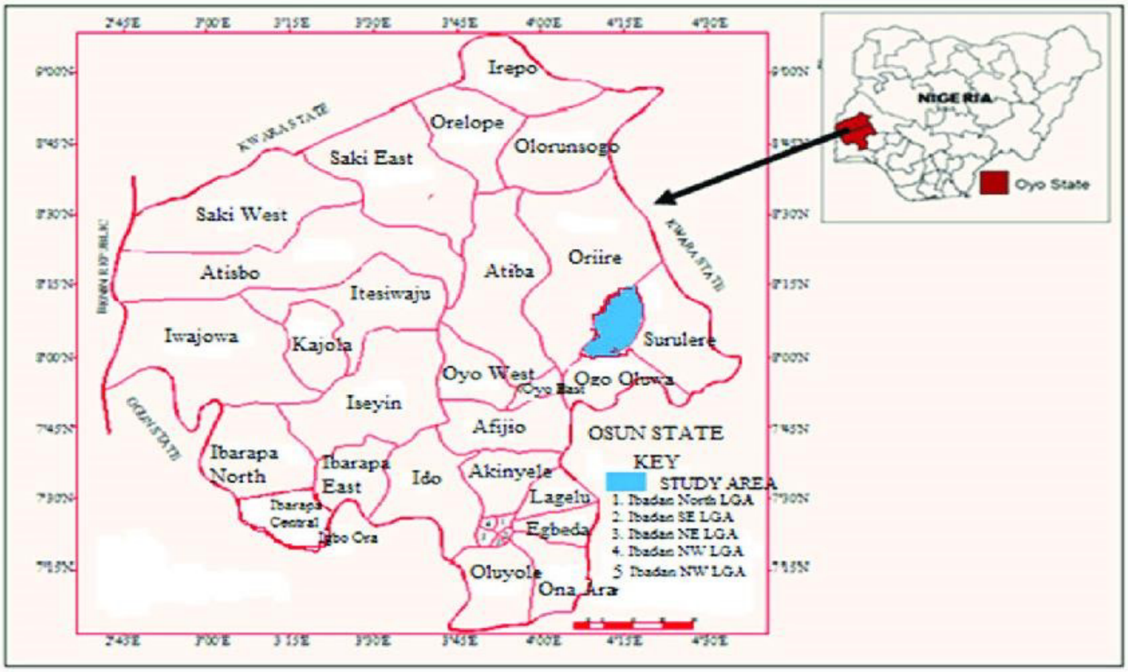


Figure 1: Map of Oyo state showing the study area (Ogbomoso South Local Government)

The soil samples were kept in labeled polythene bags, the samples collected were taken to the laboratory for pesticide residue analysis. Control samples were taken outside the cultivated farm which serves as control for the soil samples that were taken from the cultivated farm which serves as Treatment and were put in a labeled polythene bag and were taken to the laboratory for pesticide residue analysis. Extraction of pesticide residues from soil was done according to the method developed by Khan *et al.* (2007) and Riazuuddin *et al.* (2011) with slight modifications.

RESULTS

Name and Type of Pesticides Used by the Respondents

Table 1 shows the distribution of respondents by the name of pesticides used by the arable crop farmers in the study area. The result reveals that the majority (92.4%) of the respondents use Paraforce and Force-up on their farmland respectively, 79.2% of the respondents use Atrazine on their farmland, 52.8% use Karate on their farmland, 39.6% use Weed crusher on their farmland, 19.8% use Nwura Wura on their farmland, while 6.7% use Laraforce on their farmland. The table also shows that Herbicides and Insecticides are the only types of pesticides used by the farmers in the study area.

Types of Soil Amendment/Fertilizer Used by the Respondents

Table 2 shows the distribution of respondents by various type of soil amendment/fertilizer applied to their arable crops in the study area. The result revealed that most (79.2%) of the respondents make use of NPK 15:15:15 on their farmlands, 59.4% of the respondents make use of Urea on their farmlands, 23.4% of the respondents make use of pig dung on their farmlands, 19.8% make use of poultry dung and cow dung as fertilizers on their farmlands, while 16.7% of them make use of ammonia as a type of soil amendment/fertilizer applied on their farmland. This shows that all farmers in the study area make use of fertilizers in order to make up for nutrient deficiencies in the soil and consequently increase yield. Most of the farmers make use of NPK 15:15:15 which is an inorganic fertilizer.

Table 1: Names and types of pesticides used by the respondents

Name of Pesticide (Trade Name)	Type of Pesticide	Frequency*	Percentage
Paraforce	Herbicide	28	92.4
Force Up	Herbicide	28	92.4
Atrazine	Herbicide	24	79.2
Karate	Insecticide	16	52.8
Round up	Herbicide	3	10
Laraforce	Insecticide	2	6.7
Weed crusher	Herbicide	12	39.6
Nwura Wura	Herbicide	6	19.8
Total No. of Respondents		30	100

Field survey, 2022 Multiple responses*

Table 2: Type of soil amendments/fertilizers used by the respondents

Soil Amendments	Frequency*	Percentage
Cow dung	6	19.8
Urea	18	59.4
NPK 15:15:15	24	79.2
Poultry dung	6	19.8
Pig dung	7	23.4

Ammonia	5	16.7
Total No. of Respondents	30	100

Field survey, 2022 Multiple responses*

The Concentration of Pesticide Residue in the Selected Farmlands

Table 3 shows the residues of pesticides in the soil samples collected. A total of eight (8) compounds were analyzed. They include d-benzene hexachloride, Chlorothalonil, Alachlor, Aldrin, Dacthal, Heptachlor epoxide, gChlordane, and Trans-Nonachlor respectively. On average, d-BHC has the highest concentration in both the cultivated lands (32.41mg/kg) and the uncultivated lands (39.27mg/kg) compared to other pesticide residues analyzed in the soil. Chlorothalonil has the lowest concentration in uncultivated lands (1.05 mg/kg) compared to other pesticide residues (0.62 mg/kg) . On the other hand, Aldrin was not detected in any of the cultivated lands, as well as three out of the five uncultivated lands. d -BHC has a higher concentration in three of the cultivated lands compared to their respective controls. In the remaining cultivated lands (two), there is a lower concentration of d-BHC when compared to their controls. This indicates a buildup of residues in the cultivated lands due to the regular use of the pesticide by the Farmers. Chlorothalonil, Alachlor, Aldrin, Dacthal, Heptachlor epoxide, g-Chlordane, and Transnonachlor, on an average basis, all have a higher concentration in the uncultivated lands than the cultivated lands.

DISCUSSION

The use of pesticides in the Agricultural sector has increasingly become an important aspect of Agricultural technology and innovation, critical for Agricultural development, Economic growth, and poverty reduction. Globally, the use of pesticides in food production is common with many farmers using commercial pesticides for pest control to increase yield and improve quality (Lamichhane, 2017). The World Health Organization (WHO, 2009) reports that 20% of pesticide use in the world is concentrated in developing countries (Anonymous, 2012). The increase in the world's population in the 20th century could not have been possible without a parallel increase in food production and about one-third of agricultural products are produced using pesticides. Most of the farmers have been using their land for a very long time, which implies that there will be accumulation of pesticide residue which may in turn find their way into crops thereby having negative impacts on the health of consumers.

From our study, Paraforce and Force Up are the two most commonly used herbicides utilized by farmers. Paraquat and Glyphosate are the active ingredients in Paraforce and Force Up respectively. This agrees with Udensi
(2020) who reported that Paraquat is among five pesticides most frequently used in Plateau State and the entire Northern Nigeria. McConnell and Hruska (1993) and Erhunmwunse *et al.*, (2012) reported that it is the most deadly chemicals used in Nigeria because they are cheaper than newer safer pesticides. Udensi *et al.*, (2020) reported the need to prohibit the use of paraquat in Nigeria, due to serious negative impacts on human health via contamination of food and water (Ogeleka *et al.*, 2017).

In our study, d-BHC has the highest concentration in both the cultivated lands (32.41mg/kg). Contrarily, Mishra *et al.*, (2009) reported that BHC levels are at an undetectable limit in their study where they evaluate the levels of two pesticides (DDT and BHC) in farmland soils irrigated with secondary treated sewage wastewater as well as their accumulation in crop plants.

Chlorothalonil has the lowest concentration in uncultivated lands (1.05 mg/kg) compared to other pesticide residues. This agrees with Baćmaga *et al.*, (2018) who stated that chlorothalonil used in the optimal dose causes no changes in the biological homeostasis of soil.

NPK 15:15:15 is the most used fertilizer in our selected sites. This agrees with Liverpool-Tasie *et al.*, (2010) who reported that the types of fertilizer commonly produced and used in Nigeria include urea, Nitrogen-PhosphorousPotassium (NPK), and Superphosphate (SSP).

It was discovered that all the compounds tested and detected left residues in the soil since they are active ingredients in synthetic pesticides which can find their way into water and food and can adversely affect human health (Hvězdová *et al.*, 2018).

CONCLUSION

Based on this study, It was discovered that rural farmers employ mostly synthetic chemicals for the control of weeds in their respective niches. However, these chemicals have direct and indirect effects on the health of humans and the environment. One major observation in this study is that the majority of the farmers lack basic education and knowledge on how to properly apply these chemicals. In addition, most of the farmers obtain their pesticides from the marketplace, which in Ogbomoso south, has no regulation and allows for all sorts of pesticides (registered and unregistered, banned and unbanned). Therefore, public education is needed to train these farmers on the dangers associated with the use of synthetic herbicides, and the alternatives to the use of these synthetic chemicals.

Table 3: Pesticide residues in soil (mg/kg)

Compound	Abede	Control	Abe-Emin	Control	Ibapon	Control	Atoba	Control	Agric	Control	Farm mean	Control mean	T	Tcal	
d-BHC	70.76	17.81	31.49	74.11	23.93	4.25	19.09	87.59	16.79	12.58	32.412	39.27	0.25	1.86	3.36
Chlorothalonil	0.43	0.58	ND	0.64	0.33	1.92	1.11	ND	ND	ND	0.62	1.05	0.63	2.13	4.6
Alachlor	ND	ND	1.64	ND	1.02	ND	1.54	2.25	1.39	2.03	1.39	2.14	3.05	2.13	4.6
Aldrin	ND	ND	ND	1.8	ND	ND	ND	ND	ND	1.19	-	1.495	4.91	-	-
Dacthal	2.53	0.91	7.27	2.72	6.04	2.65	2.17	28.29	1.54	18.68	3.91	10.65	1.02	1.86	1.86
Heptachlor epoxide	6.2	9.76	5.89	3.24	2.18	3.73	6.82	15.55	6.06	5.83	5.43	7.62	0.7	1.86	1.86
g-Chlordane	6.59	11.61	2.83	8.97	4.91	7.6	5.31	5.07	13.77	4.14	6.68	7.47	0.25	1.86	1.86
Trans-Nonachlor	ND	ND	ND	3.07	5.26	ND	4.3	10.82	ND	5.31	4.78	6.4	4.02	2.35	5.84

REFERENCES

Anonymous (2012). PAN Germany. Pesticides and Health Hazards, facts and figures. Bochum:Pesticides and Gesundheitsgefahren: Daten and Fakten.

García-Barrios, L., Perfecto, I., &Vandermeer, J. (2016). Azteca chess: Gamifying a complex ecological process of autonomous pest control in shade coffee. *Agriculture, Ecosystems & Environment*, *232*, 190-198.

Hvězdová, M., Kosubová, P., Košíková, M., Scherr, K. E., Šimek, Z., Brodský, L., Šudoma, M., Škulcová, L., Sáňka, M., Svobodová, M., Krkošková, L., Vašíčková, J., Neuwirthová, N., Bielská, L., &Hofman, J. (2018).
Currently and recently used pesticides in Central European arable soils. *Science of The Total Environment*, *613–614*, 361–370. https://doi.org/10.1016/j.scitotenv.2017.09.049

Khan, I. A. T., Riazuddin, Parveen, Z., & Ahmed, M. (2007). Multi-residue determination of synthetic pyrethroids and organophosphorus pesticides in whole wheat flour using gas chromatography. *Bulletin of Environmental Contamination and Toxicology*, *79*(4), 454–458. https://doi.org/10.1007/s00128-007-9266-8

Lamichhane, J. R. (2017). Pesticide use and risk reduction in European farming systems with IPM: An introduction to the special issue. *Crop Protection*, *97*, 1–6. https://doi.org/10.1016/j.cropro.2017.01.017

Ogah, C. O. (2012). Quantification of organophosphate and carbamate pesticide residues in maize. *Journal of Applied Pharmaceutical Science*. https://doi.org/10.7324/JAPS.2012.2919

Reichenberger S, Bach M, Skitschak A and Frede HG (2007). Mitigation strategies to reduce pesticide inputs into ground and surface water and their effectiveness; A review. Science of the Total Environment 384: 1–35.

Udensi, U.E., Ekpere, J., Irtwange, S., Kolo, M.G.M., Yahaya, M.K., Ladele, A., ... & Dixon, A. (2020). A case to deregister and prohibit the use of Paraquat in Nigeria. Ibadan: IITA. (32 p.).

Riazuddin, Khan, M. F., Iqbal, S., & Abbas, M. (2011). Determination of multi-residue insecticides of organochlorine, organophosphorus, and pyrethroids in wheat. *Bulletin of Environmental Contamination and Toxicology*, *87*(3), 303–306. https://doi.org/10.1007/s00128-011-0325-9.

Udensi, U.E. 2020. Rural appraisal on the use of Paraquat in Nigeria. IITA, Ibadan, Nigeria.

Virendra K. Mishra · Alka R. Upadhyay · B. D. Tripathi. Bioaccumulation of heavy metals and two organochlorine pesticides (DDT and BHC) in crops irrigated with secondary treated waste water. Environ Monit Assess (2009) 156:99–107

Baćmaga, M., Wyszkowska, J. & Kucharski, J. The influence of chlorothalonil on the activity of soil microorganisms and enzymes. *Ecotoxicology* **27**, 1188–1202 (2018). https://doi.org/10.1007/s10646-018-1968-7

Saweda L.O. Liverpool-Tasie, Abba A. Auchan and Afua B. Banful (2010) An Assessment of Fertilizer Quality Regulation in Nigeria. Nigeria Strategy Support Program (NSSP) Report 09.