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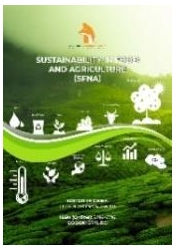

RESEARCH ARTICLE

INSECTICIDAL EFFECT OF SOME SELECTED BOTANICAL EXTRACTS FOR THE MANAGEMENT OF MAIZE WEEVIL (*SITOPHILUS ZEAMAIS*) IN STORED MAIZE GRAINS

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ABSTRACT

The research work was conducted to evaluate the insecticidal effect of some selected botanicals for the management of maize weevil in stored maize grains, in the laboratory of Department of crop production Federal University of Technology Main Campus, Gidan kwano. Extracts of *Azardirachta indica*, *Eucalyptus tereticornis*, *Nicotiana tobaccum* and the mixture of the three botanicals were tested against maize weevils at different level (1 g, 2 g and 3 g respectively) and compared with permethrine dust. Data on mortality rate of weevils were subjected to Analysis of Variance (ANOVA). The means were separated for their significancy using Least Significance Difference (LSD) test. The result indicated that *Eucalyptus tereticornis* leaf extract gave the maximum effect on maize weevil mortality followed by the mixture of the three botanicals and *Azadirachta indica*. *Nicotiana tobaccum* had minimum effect on the weevil mortality when compared with other treatments. The trial indicates that *Eucalyptus tereticornis* had the highest effect on weevil mortality at all level followed by *Azadirachta indica*. Both *Eucalyptus tereticornis* and *Azadirachta indica* are thereby recommended for insect pest control.

KEYWORDS

Botanicals, mortality, weevils, Maize grains, *Sitophilus zeamais*

1. INTRODUCTION

Maize (*Zea mays* L.) is an important cereal crops in the world's agriculture. It is highly yielding adaptable to wider agro-ecologies, cosmopolitan crop for which it is often referred to as "queen of cereal". The grain is rich in carbohydrate, protein, oil and crude fibre (FAO, 2014). It is an important staple cereal crop for most people in sub-Saharan African (Nukenine et al., 2002). Among other essential applications used as food for human major carbohydrate, component of animal feeds, grain in brewing industry, it is also used as starch for textile industries and for the formulation of baby – weaning foods (Adedire and Ajayi, 1996; Gwinner et al., 1996; Adedire, 2001). It ranks first as the most important cereal crop in sub-Saharan African. It provides food for more than 1.2 billion people in addition to other uses, Nigeria is the largest producer of maize in African with annual production of about 8 million metric tons in 2013. Following sorghum and millet, maize is the third most widely grown crop in Nigeria. It is highly productive, cheap and less rigorous to production and adapts to wide range of agro ecological zones

However the availability of maize is often hindered by infestation of insect pest which constitute a major setback in the production and storage of maize. The most important storage pest of maize is *Sitophilus zeamais*, and it is a serious cosmopolitan field-to store pest of maize in tropic and subtropical regions (Obeng and Amiteye, 2005). *Sitophilus zeamias* infestation starts by the female laying eggs into the grain which on hatching the larvae feeds towards the inside of the grain until a pupal stage is reached. The adult emerge by eating their way towards the testa of the grain causing rugged exit holes resulting in an insect damaged grain (Arthur and Throne, 2003). Generally the control of insect largely depends on the use of synthetic insecticides in the field and stored product in particular, however indiscriminate use of many synthetic insecticides is associated with many fold human technical, environmental, non-target organism. Even insect pest management such as resistance of insect pest, food and product contamination with toxic residue, biodiversity erosion and other side effects, impacts incredible magnitude on human's health. In addition non-availability of insecticides to country side farmers and ventilation restrictions in storage grains are the negative effects of synthetic chemicals. Thus the search for economic friendly, health hazard free, cost effective, easily available insect pest management option with the use of plant extracts is earnestly adopted worldwide as an alternative to reduce the menacing effects caused by the use synthetic chemical insecticides in pest management. Broadly speaking plant extracts are effective benign tools in wild range of insect pest management with broad spectrum action. Indiscriminate use of synthetic pesticides for controlling weevils is likely to give rise to weevil resistance and environmental pollution which may result in poisoning of human, especially in developing countries including Nigeria. In view of these, there is need to develop naturally occurring insecticides which may be less toxic to man and animals but as effective against weevil of various cereals as synthetic insecticides. The research therefore aimed at evaluating bio-pesticide properties, concentrations and synergic effect of Tobacco, Eucalyptus and neem plant extracts on stored maize grain pest (*Sitophilus zeamais*).

2. MATERIALS AND METHOD

2.1 Experimental site

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The trial was carried out in the Department of Crop Production Laboratory, Federal University of Technology Gidan kwano main campus, Minna, Niger State, Nigeria.

2.2 Collection of Sample Materials.

Azadirachta indica and *Eucalyptus tereticornis* leaves were collected from fully established trees in Gidan Kwano village opposite Federal University of Technology, Minna Niger State and *Nicotiana tobaccum* was collected from Gidan Mangoro village, Minna Niger state. Weevils used for this trial were obtained from Masohi Farm Nigeria limited maize store.

2.3 Preparations of Sample Materials

The leaves collected from each plant were washed and shade-dried in a controlled environment at an ambient temperature of ±28 ^{0}C and relative humidity of 70 ± 5% for days until they became crisp dry. The dried leaves were crushed into powder and blended with an electric blender. The powdered forms were sieved through a sieve of 0.5 mm size mesh to ensure uniformity. Each sieved powder were poured into a tightly closed plastic container and labelled as follows:

T2: Treatment 1, *Eucalyptus tereticornis,*

T3: Treatment 2, *Nicotiana tobaccum,*

T1: Treatment 3, *Azadirachta indica,*

T4: Treatment 4, mixture *Azadirachta indica, Eucalyptus tereticornis* and *Nicotiana tobaccum* of leaf extracts all at three different level of 1g, 2g and 3g.

T5: A synthetic insecticide (permethrine dust 0.5% a.i) was used as standard

T6: No treatment as control and labelled.

2.4 Procedures

About 2100 g of maize grains was used for the trial, 420 matured maize weevil and 24 g of neem leaf extract, 24 g of *Eucalyptus* leaf extract, 24 g of tobacco leaf extract and 18 g of the admixture of the three botanical extracts were used for the trial. 50 g of uninfested maize was weighed into each plastic container after which 10 pieces of matured maize weevils were introduced and then carefully mixed with the treatments, the plastic containers were then covered with a piece of muslin cloth held firmly with rubber band to prevent weevils from escaping and to ensure adequate ventilation. 50 g of untreated maize grains was used as control and a 50 g of maize grains mixed with 10 g of Permethrine dust as standard. The containers were arranged on the laboratory bench following a Completely Randomized Design (CRD) with each treatment replicated three times at an appropriate relative humidity and temperature.

2mm screen mesh of sieve was used to separate the grains and pests during counting. Weevil mortality in each container was assessed for seven consecutive days at 24 hours interval after introduction of the insect pest. The maize grains were separated from the botanical extract and the numbers of live and dead pest were counted daily from each container to obtain the weevil mortality and determine the efficiency of each botanical extract. Percentage weevil mortality was calculated to evaluate the efficiency of the botanical extracts on the weevils as follows:

$$\text{Percentage weevil mortality} = \frac{\text{number of dead insect pests}}{\text{total number of all insect pests}} \times 100$$

After two weeks of trial, the grains of each container were sieved and cleaned to separate the grains from the botanical powder extracts.

Analysis of variance (ANOVA) for percentage weevil mortality was conducted using a statistical application system (SAS, 2003). Means separation was done using the least significant difference (LSD) to compare the significant differences among the treatments at 5% level of probability.

3. Result

The result of the effect of different botanicals extracts on the mortality of *Sitophilus zeamais* (trial one). At day one the insecticidal effect of *Eucalyptus tereticornis, azadirachta indica* and mixture of the three botanicals on the weevil mortality were significantly different (p≤ 0.05) when compared to the standard. *Nicotiana tobaccum* and control were least effective. At day two and three there were no significant difference among all the treatments on weevil mortality beyond which there was a difference between *Eucalyptus tereticornis* and the control.

The insecticidal effect of *Eucalyptus tereticornis* on weevil mortality at the fourth day resulted in the highest suppression of *S. zeamais* population. There were no significant difference among all the treatments at day 5, 6 and 7. (Table 1).

Table 1: Effect of Different Botanical Extracts on the Mortality of *Sitophilus zeamais* (trail one)

Botanical extracts	day1	day2	day3	day4	day5	day6	day7
Permethrine	7.33^{a}	1.67^{ab}	0.33^{ab}	0.33^{b}	0.00^{b}	0.00^{b}	0.00^{b}
Eucalyptus tereticornis	3.67^{b}	2.09^{a}	1.33^{a}	1.33^{a}	1.00^{b}	1.00^{ab}	1.00^{a}
Nicotiana tobaccum	1.33^{cd}	0.33^{cd}	0.33^{cd}	0.33^{b}	1.33^{a}	1.00^{ab}	0.33^{ab}
Azadirachta indica	3.67^{b}	1.33^{ab}	1.33^{ab}	0.33^{b}	0.67^{ab}	1.33^{a}	0.00^{b}
Mixture	3.66^{b}	1.67^{ab}	0.67^{ab}	0.33^{b}	0.67^{ab}	1.33^{a}	0.33^{ab}
Control	0.00^{e}	0.00^{d}	0.00^{d}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}
LSD	2.03	1.21	1.15	0.93	1.09	1.29	0.85

Means with the same letter in a column are not significantly different p≤0.05 according to least significant difference (LSD).

The effect of different concentrations of the botanical extracts on weevil mortality (Table 2). At day one and two weevils mortality differed significantly (p≤ 0.05) among the botanicals such that the use of *Eucalyptus tereticornis* extract at 1g, 2 g and 3 g, *Azadirachta indica* 2 g and 3 g and the mixture at 3 g producing comparable effect on weevil mortality than *Nicotiana tobaccum* and the control when compared to the standard.

At day three and four the result showed that there was significant different (p≤ 0.05) among all the treatment with *Eucalyptus tereticornis* and *Azadirachta indica* having the highest insect mortality while the standard and control has the least effect on weevils mortality. There was no significant difference among all the treatments day at five, six and seven.

Table 2: Effect of Different Concentration on the Mortality of *Sitophilus zeamais* (trial one)

Botanical extracts	level(g)	day1	day2	day3	day4	day5	day6	day7
Eucalyptus tereticornis	1	3.33	0.33	1.33	0.00	1.00	1.00	1.00
	2	3.67	0.67	1.33	0.00	0.67	0.00	0.33
	3	2.67	2.09	1.33	1.33	0.33	0.67	0.33
Nicotiana tobaccum	1	1.33	0.33	0.33	0.33	1.33	0.33	0.33
	2	2.00	0.33	0.67	0.33	0.00	1.00	0.33
	3	1.00	0.33	0.67	0.33	1.33	0.33	0.00
Azadirachta indica	1	2.67	1.33	1.33	0.00	0.67	0.33	0.00
	2	3.33	1.33	1.00	0.33	0.00	1.33	0.33
	3	3.67	1.00	0.33	0.33	0.67	0.67	0.00

Table 2 (cont): Effect of Different Concentration on the Mortality of *Sitophilus zeamais* (trial one)								
Mixture	1	2.67	1.67	0.33	0.67	0.33	1.00	0.00
	2	2.33	1.67	0.33	0.33	0.33	1.33	0.33
	3	3.33	1.00	0.00	0.67	0.67	1.00	0.33
Control	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LSD		2.03	1.21	1.15	0.93	1.09	1.29	0.85

Means under the same column differs significantly at p≤0.05 level of probability using the least significant difference.

Table 3 showed the effect of different botanical extracts on the Weevil Mortality. At day one and two there was significant difference (p≤0.05) among all the treatments with *Eucalyptus tereticornis* having the highest (p≤0.05) insect mortality when compared to the standard. *Nicotiana tobaccum* and the control had the least effect on weevil mortality. There was no significant difference among all the treatment at day three. At day four and five the botanical extracts show no significant difference but there was significant difference (p≤0.05) between the standard and control. There was no significant different among all the treatment at the sixth and seventh day after the introduction of the treatment and weevils.

Table 3: Effect of Different Botanical Extracts on the Mortality of *Sitophilus zeamais* (trial two)							
Botanical extracts	**day1**	**day2**	**day3**	**day4**	**day5**	**day6**	**day7**
Permethrine	5.67^{a}	4.00^{a}	0.33^{a}	0.00^{c}	0.00^{c}	0.00^{a}	0.00^{b}
Eucalyptus tereticornis	4.00^{ab}	2.00^{bc}	1.00^{a}	0.67^{ab}	0.67^{a}	0.67^{a}	0.33^{ab}
Nicotiana tobaccum	1.67^{cd}	1.00^{cd}	0.67^{a}	0.67^{ab}	0.00^{b}	0.33^{a}	0.00^{bc}
Azadirachta indica	3.00^{ab}	1.00^{cd}	0.67^{a}	1.00^{ab}	1.33^{a}	0.67^{a}	0.33^{ab}
Mixture	2.67^{bc}	0.67^{cd}	1.00^{a}	1.00^{ab}	1.00^{ab}	0.67^{a}	0.33^{ab}
Control	0.00^{e}	0.00^{d}	0.00^{a}	0.00^{c}	0.00^{c}	0.00^{a}	0.00^{a}
LSD	2.02	1.82	1.73	0.96	0.93	0.93	0.57

Means with the same letter in a column are not significantly different at p≤0.05 level of probability using least significant difference.

Effect of Different Concentrations on the Mortality of *Sitophilus zeamais* (Table 4). At day one, the insecticidal effect of *Eucalyptus tereticornis* at 1 g, 2 g and 3 g, *Azadirachta indica* at 2 g and 3 g and the mixture at 1 g, 2 g and 3 g were significantly different (p≤0.05) when compared to the standard. There was no significant difference between *Nicotiana tobaccum* and the control. At day two the effectiveness of the concentrations of the botanicals on weevil mortality was significantly different (p≤0.05) among the treatments such that *Eucalyptus tereticornis* at 2 g and *Azadirachta indica* at 1g result in the highest mortality on the insect pest when compared to the standard. There was no significant difference between *Nicotiana tobaccum* and the control. Similarly there was no significant difference among all the treatments at day three, four, five, six and seven.

Table 4: Effect of Different Concentrations on the Mortality of *Sitophilus zeamais* (trial two)								
Botanical extracts	**level(g)**	**day1**	**day2**	**day3**	**day4**	**day5**	**day6**	**day7**
Permethrine	10	5.67	4.00	0.33	0.00	0.00	0.00	0.00
Eucalyptus tereticornis	1	3.67	1.67	0.33	0.67	0.67	0.33	0.00
	2	4.00	2.00	1.00	0.33	0.67	0.67	0.00
	3	3.33	1.00	0.67	0.67	0.33	0.33	0.33
Nicotiana tobaccum	1	0.33	1.00	0.67	0.67	0.33	0.33	0.00
	2	1.00	1.00	0.33	0.33	0.33	0.00	0.67
	3	1.67	0.33	1.00	1.00	0.67	0.67	0.67
Azadirachta indica	1	1.67	3.00	1.33	1.33	0.67	0.33	0.00
	2	3.33	1.00	0.67	0.33	0.33	0.33	0.33
	3	3.67	1.00	0.33	0.33	0.67	0.67	0.00
Mixture	1	3.33	1.00	0.00	0.67	0.67	1.00	0.33
	2	2.67	0.33	0.67	1.00	0.00	0.00	0.67
	3	2.67	0.67	1.00	0.67	0.33	0.67	0.33
Control	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LSD		2.02	1.82	1.73	0.97	0.93	0.93	0.57

Means in the same column differs significantly at p≤0.05 level of probability using least significant difference.

4. Discussion

The leaf extracts of some botanicals were effective on the mortality of *Sitophlius zeamais*. The effectiveness of the botanicals extract on the management of maize weevil (*Sitophlius zeamais*) varied with different treatment at different concentration. *Eucalyptus tereticornis* has the highest mortality on *S. zeamais,* followed by *Azadirachta indica* and the mixture. *Nicotiana tobaccum* showed least effect on the weevil mortality when compared to the standard (permethrine dust) while the control showed no effect. *Eucalyptus tereticornis* has high effect on weevil mortality; this might be attributed to an insecticidal active compound of the botanical; such as ethanol and methanol and other bioactive compounds such as tannis, alkaloid, flavoids and desteriod. *Azadirachta indica* also showed effectiveness as a result of having some insecticidal effective compound such as azadiractin. The result also indicated the effect of concentration of leaf extracts of the botanicals on weevil mortality. *Eucalyptus tereticornis* showed the highest effect on weevil mortality at 1g, 2g and 3g followed by *Azadirachta indica* at 2g and 3g and the mixture at 1g, 2g and 3g respectively and *Nicotiana tobaccum* indicate less effect on weevil mortality. The effectiveness of these botanicals was as a result of level the insecticidal active compound present in the leaf extracts especially in *Eucaluptus tereticornis* and *Azadirachta indica* which showed maximum effectiveness on weevil mortality.

Lepidoptera show sensitivity to azadirachtin which has antifeedant , growth regulatory effect on larval by disrupting molting and malformation which may contribute to weevil mortality and also disrupt endocrine event showing complete inhibition of moulting. The toxicity of wide range of different plant oil, plant parts of various species have been tried on the mortality of *Sitophilus zeamais*. Combination of eucalyptus and camphor

has been found to be toxic to maize weevil in wheat and maize (Obeng and Reichmuth, 2005).

The trial indicates that *Eucalyptus tereticornis* had the highest effect on weevil mortality at all level followed by *Azadirachta indica*. Both *Eucalyptus tereticornis* and *Azadirachta indica* are there by recommended for insect pest control.

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