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Research Notes

Evaluation of efficacy of *khaya senegalensis* and *cassia occidentalis* leaf powder on *sitophilus zeamais* in stored grain maize (*zea mays*)

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Abstract: The possibility of controlling maize weevil, *S. zeamais* using Mahogany (*Khaya senegalensis*) and cassia (*Cassia occidentalis*) leaf powders were evaluated under laboratory condition in the Department of Crop Production, Federal University of Technology, Minna. The leaf powders were mixed with the maize grains, stored in bowls and covered with muslin cloth for 28days using complete Randomized Design (CRD). Data on anti-oviposition and adult mortality were collected and analysed using Analysis of Variance (ANOVA) and the least significant difference (LSD) to separate the means. The result showed that there was no significant difference ($p<0.05$) in the adult mortality in all the treatments of *Khaya senegalensis* and anti-oviposition at 14, 21, 28days. A significant reduction ($p<0.05$) in the efficacy of *Cassia occidentalis* on adult mortality at 21days and anti-oviposition at 7, 14, 21days was recorded .However, the mixed leaf powder of both treatments (*Khaya senegalensis and Cassia occidentalis*) had no significant difference ($p<0.05$) at 7,21days for adult mortality and anti- oviposition.

Keywords: adult mortality, anti-oviposition. *Cassia occidentalis, Khaya senegalensis Sitophilus zeamais* .

INTRODUCTION

Maize (*Zea mays* L.) belongs to the family Poaceae or Gramineae. It is a cereal grass related. Wheat, rice, oat and barley ranking second after it and followed by third ranking rice in order of world grain production. This regarded as versatile and with many uses since it can thrive in diverse climates;

hence, it is grown in many countries than any other crop. Aside from being one of the major sources of food for both human and animals, it is also processed into various foods and industrial products including starches, sweeteners, oil, beverages, industrial alcohol and fuel ethanol. Moreover, thousand of foods and other everyday items such as toothpaste, cosmetics, adhesive, shoe, polish, ceramics, explosives, construction materials, metals, moulds, paints etc. In addition, maize productions are rapidly replacing petroleum in many ``industrial applications. Polyactide (PLA), a biodegradable polymer made from corn is being used successfully in the manufacture of a wide variety of everyday items such as clothing, packaging, carpentering, recreational equipment and food utensils of renewable resources.

Cereal pest may infest the maize during storage and transportation which is the maize weevils *Sitophilus zeamais* Motschulsky quarter inch long, reddish brown to black snout weevil. In maize or sorghum, attack may start in the mature crops when the moisture content of the grain has increased to 18-20%. Subsequent infestations in store result from the transfer of infested grains into store or from the pest flying into storage facilities, probably attracted by the odour of the stored grain. In store maize, heavy infestation of this pest may cause weight losses of as much as 30-40%, although[1] losses are commonly 4-5%.

The chewing damage caused by the insect bring about increased respiration in the cereals (hot spots), which promotes evaluation of the heat and moisture levels, bacterial growth is favoured which ultimately gives rise to depreciation and finally total loss. Effective pest control is no longer a matter of heavy application of pesticides, partly because of rising cost of petroleum-derived products but largely because excess use of pesticides promotes faster evolution of resistant form of pest, destroys natural enemies, turn formerly innocuous (harmless) species into pests, harms other non-target species and contaminates food. There is thus, an urgent need for control agent, which are less toxic to man and more readily degradable. Among which is the use of botanical pesticide with low mammalian toxicity and can effectively prevent and/or suppress insect pest especially in storage.

The utilisation of plant materials to protect field crops and stored commodities against insect attack has a long history. Opinion now favors a shift away from the reliance on conventional insecticides towards the use of more natural, sustainable method of protecting crops from insect damage[1]. One alternative to synthetic insecticides is insecticidal plants; African farmers are traditionally familiar with them[2]. The tropical flora is a major source of plant-based insecticides[3]. Aromatic species, particularly those in the family Labiatate (or Lamiaceae) are among the most widely used plants in insect pest control[4-6]. *Khaya senegalensis* and *Cassia occidentalis* are commonly found in savannah areas of Africa and utilized for various purposes. The Leaves of these plants are used for various disease treatments as well as in the control of some stored product insects especially in many part of Africa [7].

Two different locally available plants which are *Khaya senegalensis* (mahogany) and *Cassia occidentalis* were evaluated to determine their nature as grain protecting against *Sitophilus zeamais.*

MATERIALS AND METHODS

Collection of plant materials: Fresh and matured leaves of *K. senegalensis and C. occidentalis* were collected at the school forest Gidan-kwano. These were washed and air dried in the shade[8,9].

Preparation of leaf powder: Leaf Powders from *K. senegalensis* and *C. occidentalis* were separately made by grinding the leaves of each of the plants separately using pestle and mortar[10,11] and was sieved through a 0.5mm size mesh to obtain uniform particle size (powdered). The resulting powdered were kept separately in glass jar with screw cap and stored at room temperature 20+30^{o}c prior to use and labelled appropriately for easy identification.

BIO-ASSAY

Anti - oviposition: 50grams of weighed maize grains adjusted to 12% moisture content was placed in a disposable plastic bowl. 5grams each of the three leaf powders was thoroughly mixed with the grains in each jar. Four replicates were provided for each treatment. Treated seeds were placed separately in the disposable plastic bowl. Mixture of 7-day old newly collected male and female maize weevils were introduced into each jar which was covered and sealed with muslin cloth. The female adults were allowed to ovipost on the grains for 48hours, after which they were discarded. After 5days, when the adults have been removed from disposable plastic bowl.

The grains were collected from each disposable bowl for examination and further observation. Direct examination of the grains was done with the aid of a dissecting microscope. Since the eggs cannot be determined, the presence of larval tunnels was used as a basis for counting the number of deposited eggs. A larval tunnel indicates egg deposition. A tunnel was formed inside when the deposited egg hatched and the larva started feeding. Absence of larval tunnel considered no egg deposited. Hence, this is the basis for anti- oviposition effect of the materials.

Anti-oviposition was monitored at 7, 14, 21, and 28 days respectively. Untreated maize grains were served as control, each treatment was applied at four different levels (considerations) (1, 2, 3 and 4 grams). The examined grains were kept separately in properly labelled and covered disposable bowl for adult emergence. Therefore, per cent insect survival was determined by counting the number of insects that emerged into adult stage divided by the total number of eggs oviposited (representing by the total number of grains with larvae tunnel multiplied by 100) as shown below. All the data collected were analysed using Analysis of Variance (ANOVA) followed Completely Randomised Design (CRD). Mean was compared using Least Significant Differences (LSD) at 5% level of significance.

$$\text{\% insect survival} = \frac{\text{Number of adult stage}}{\text{Number of larvae tunnel}} \times 100$$

Adult Mortality Test: 50g of weighed grains was adjusted to 12% MC which was mix with 5g of the leaf powders of each of the three test materials respectively in the disposable bowl. The admixture was shaken manually for 5minutes for easy uniformity. Thereafter, 50 newly collected adult weevils were introduced per treatment. Four replicates were provided for each treatment. The disposable bowls were covered and sealed with muslin cloth to keep the insects. Untreated grains were served as control with each treatment also replicated four times and then left on the laboratory bench for observation[12]. Adult mortality was observed at weekly interval for four weeks (7, 14, 21, 28 days respectively) after the exposure to the treatments at different levels (1, 2, 3 and 4 grams respectively). Percent adult mortality was determined by counting the number of dead insects divided by the total number of insects introduced multiplied by 100 as indicated below.

$$\text{\% Adult mortality} = \frac{\text{Number of dead insect}}{\text{Total number of adult introduce}} \times 100$$

Data were analysed following the Completely Randomised Design (CRD). Least Significant Differences (LSD) was used to compare the means at 5% level of significance.

RESULTS

In **Table 1**, there was no significant difference among all the treatment but there was significant difference ($p<0.05$) between T3, T4 and the control at 7 days. At 14 days, there was no significant difference among T_1, T_2, and T_3 with control having the lowest significant difference. **Table 2** shows no significant difference in the treatments and the control after 7 days and 14days. After 21 days, T_2 has the highest significant difference followed by T_1 among the treatment, there is no significant difference between T_3 and T_4 with the control having the lowest significant difference ($p<0.05$).

Table 1: Effect of *Khaya senegalensis leaf* Powder on Anti-oviposition

Treatment	7days	14days	21days	28days
T_1(1g)	137.50^{ab}	366.75^{ab}	839.50^{a}	1175.30^{a}
T_2(2g)	141.75^{ab}	383.25^{ab}	866.75^{a}	1114.50^{a}
T_3(3g)	175.00^{a}	350.00^{ab}	616.75^{b}	1187.50^{a}
T_4(4g)	150.00^{a}	408.25^{a}	712.50^{ab}	958.30^{a}
C(untreated grains)	50.00^{b}	341.75^{b}	716.75^{ab}	1083.50^{b}
LSD	96.55	62.447	209.62	343,91

Means within the same column denoted by different superscripts are significantly different (P<0.05).

Table 2: Effect of *Khaya senegalensis* Leaf Powder on Adult mortality

Treatments	7days	14days	21days	28days
T_1(1g)	7.50^{a}	9.25^{a}	17.50^{b}	21.50^{a}
T_2(2g)	8.50^{a}	10.50^{a}	23.50^{a}	21.50^{a}
T_3(3g)	7.00^{a}	10.00^{a}	20.00^{ab}	25.50^{a}
T_4(4g)	6.50^{a}	13.00^{a}	20.00^{ab}	21.50^{a}
C(untreated grains)	6.00^{a}	7.50^{a}	6.50^{c}	7.00^{b}
LSD	4.77	5.62	5.07	4.72

Means within the same column denoted by different superscripts are significantly different (P<0.05).

After 28 days, there was no significant difference among the treatments with the control having the lowest significant difference. After 21 days, there is no significant difference between $T_1$and T_2 with the highest significant difference, there was no significant difference between T_4 and control with T_3 having the lowest significant difference. After 28 days, there was no significant difference among the treatments and control. However it was observed that there was a significant difference at 14, 21, 28 days respectively among all the treatments and the control. Similarly at 7 days of observation, there was significantly difference between T_1 and all the treatments, but there was no significant difference between T_2, T_3 and T_4. While there was significant difference ($p<0.05$) between T_2 and control compare to the treatments. After 14, 21, 28 days respectively, there was no significant difference among the treatment and the control **(Table 3).**

Table 4 shows that after 7 days there was no significant difference among the treatments and the control. In **Table 5**, there was no significant difference among the treatments with the control having the lowest significant difference ($p<0.05$). At 14 days, T_3 having the highest significant difference ($p<0.05$) among the treatments followed by the control but there was no significant difference between T_1, T_2 and T_4. At 21 days, there was no significant difference among the treatments and the control. T_1 have the highest significant difference among the treatments at 28 days followed by the control but there was no significant difference between T_2, T_3 and T_4. Lastly at 7 days in **Table 6**, there was no significant difference ($p<0.05$) among the treatments and the control. After 14 days, there was no significant difference between T_1 and T_3 but there was significant difference between all the treatments and control. Similar result was observed after 21 days with significant difference ($p<0.05$) between the treatments and the control.

Table 3: Effect of *Cassia occidentalis* Leaf Powder on Anti-oviposition

Treatments	7days	14days	21days	28days
T_1(1g)	187.50^{a}	425.00^{a}	850.0^{a}	998.8^{a}
T_2(2g)	150.00^{ab}	375.00^{a}	893.8^{a}	1067.3^{a}
T_3(3g)	112.50^{b}	400.00^{a}	798.0^{a}	1220.8^{a}
T_4(4g)	125.00^{b}	425.00^{a}	891.8^{a}	1054.3^{a}
C(untreated grains)	50.00^{c}	341.75^{a}	716.8^{a}	1083.5^{a}
LSD	55.815	118.42	256.83	284.75

Means within the same column denoted by different superscripts are significantly different (P<0.05)

Table 4: Effect of *Cassia occidentalis* Leaf Powder on Adult mortality

Treatments	7days	14days	21days	28days
T_1(1g)	5.50^{a}	13.00^{a}	21.00^{a}	28.00^{a}
T_2(2g)	9.50^{a}	13.50^{a}	22.50^{a}	20.00^{a}
T_3(3g)	8.50^{a}	12.50^{a}	22.00^{a}	26.00^{a}
T_4(4g)	9.00^{a}	13.00^{a}	21.00^{a}	26.00^{a}
C(untreated grains)	6.00^{a}	7.50^{b}	6.50^{b}	7.00^{b}
LSD	4.05	4.88	10.92	9.19

Means within the same column denoted by different superscripts are significantly different (P<0.05).

Table 5: Effect of *Cassia occidentalis and Khaya senegalensis Leaf* powder on Anti-oviposition

Treatment	7days	14days	21days	28days
T_1(1g)	125.00^{a}	358.23^{ab}	941.8^{a}	1173.0^{a}
T_2(2g)	150.00^{a}	433.25^{ab}	875.0^{a}	1558.0^{ab}
T_3(3g)	137.50^{a}	500.00^{a}	910.3^{a}	1341.5^{ab}
T_4(4g)	112.50^{a}	408.50^{ab}	933.3^{a}	1341.5^{ab}
C(untreated grains)	50.00^{a}	341.75^{b}	716.8^{a}	1083.5^{b}
LSD	54.01	153.18	263.09	271.31

Means within the same column denoted by different superscripts are significantly different (P<0.05).

Table 6: Effect of *Cassia occidentalis and Khaya senegalensis* on Adult mortality

Treatment	7days	14days	21days	28days
T_1(1g)	10.50^{a}	16.50^{a}	22.00^{a}	25.50^{ab}
T_2(2g)	6.50^{a}	12.50^{ab}	22.50^{a}	27.00^{a}
T_3(3g)	6.00^{a}	13.50^{a}	24.00^{a}	21.00^{ab}
T_4(4g)	8.00^{a}	12.50^{ab}	22.00^{a}	26.00^{ab}
C(untreated grains)	6.00^{a}	7.50^{b}	6.50^{b}	7.00^{c}
LSD	4.51	5.28	6.30	5.57

Means within the same column denoted by different superscripts are significantly difference (P<0.05)

DISCUSSION

The prepared powders tested were effective in reducing damage caused by *S. zeamais* to some extent .The two prepared powdered leaves were effective in increasing adult mortality and reducing oviposition of *S. zeamais* on the stored maize (except the control) for 28 days. This is in accordance with Prates *et al.*[13], they concluded that the ingestion and the contact with the grain, impregnated with the substance, has proved to be more efficient than the contact test made with the paper filter. It was discovered that *K. senegalensis* and *Cassia occidentalis* have poisonous effect in insect through the cuticle and in ingestion and fumigation causing 100% mortality of *S. zeamais* in dilution ratio of 2:8 at essential oil: acetone. This was also agreed with Bamaiyi *et al.*[9] that the protection of stored cowpea by using different formulations of mahogany against *C. maculatus.* At 28days, it was noted that *Cassia occidentalis* was effective for the control of adult mortality and anti-oviposition on *S. zeamais.* According to Schmutterer[14] he reported that botanical pesticides such as *Cassia occidentalis* and *Khaya senegalensis* have limited persistent in the environment such as temperature, ultraviolent light and other environmental factor can degrade botanical pesticide. Repeated application may be needed to achieve the desired result of effective grain protection for long period. However, the mixture of *Cassia occidentalis* and *Khaya senegalensi* leaf powder though significantly excelled the control but the effectiveness of the mixed leaf powder may be due to the chemical content that may be systemic in nature to the weevil which was observed by Schmutterer[14].

CONCLUSION

Based on the result obtained in this study, it was noted that *Cassia occidentalis* leaf powder has the highest repellency for both the adult mortality and anti-ovipositor of *Sitophilus zeamais* on stored maize, followed by *Khaya senegalensis* leaf powder for both the adult and anti-oviposition but this depends on the period of storage. By and large further study is required to find out the active ingredients in the botanicals that have insecticidal effects.

RECOMMENDATION

Application of *Cassia occidentalis* leaf powdered is recommended at 7 days interval hence, farmers in developing countries should use locally available plant materials possessing insecticidal activities for the management of maize weevils owning their economic status.

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