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EFFICACY OF SESAME (*Sesamum indicum* L.) LEAF POWDER IN PROTECTING STORED MAIZE GRAINS AGAINST MAIZE WEEVIL *(Sitophilus zeamais* MOTSCH.*)*

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ABSTRACT

A study was conducted to investigate the efficacy of sesame (Sesamum indicum L.) leaf powders in protecting maize grains against maize weevil (Sitophilus zeamais Motsch.) infestation. Test insects (S. zeasmais) were introduced into maize seeds treated with sesame powder at four different concentrations (2.0, 4.0, 6.0, 8.0g/20g of maize) and a control. The experiment was laid out in a Complet Randomized Design with three replications. The treated seeds were stored in plastic containers for a period of one month. Data obtained were analyzed using Analysis of Variance, with Duncan's New Multiple Range Test used to separate significant means. The result obtained revealed significant difference (P≤0.05) in the efficacy of the powders in protecting maize seeds against the insect pests. The result showed that 8.0g of the powders is more effective in the control of the insects. The effect is concentration dependent, increase with increase in concentration. The powders offered comparable protection with respect to the control to the maize grains against S. zeamais. Therefore, 8.0g of sesame leaf powder is recommended for use against maize weevils' infestation of stored maize grains.

Key Words: Dose, Mortality, Oviposition, Phytochemicals

INTRODUCTION

Maize (*Zea mays* L.) is a cereal crop used as food, feed, fodder in Nigeria. World-wide production is predicted to increase by nearly 370 MT through the subsequent 10 years, considering a growth of 15% by 2023 (OECD/FAO, 2015). Africa produces around 7% of the total world production (FAOSTAT, 2014).It is of significant for countries where rapid growing population has already out stripped the available food supplies (Khan *et al*., 2014). It belonged to family Poaceae and is one of the third most important cereal crops after wheat and rice (Lyon, 2000) with up to 11% proteins (Larger and Hill, 1991). Maize is an important source of carbohydrate in the tropics and is a major staple in West Africa for a large proportion of the population in addition to being an important poultry feed and also for industrial uses (FAO, 2007).

It is an important source to protein ranking only after meat, fish and legumes in terms of annual protein production (Dasbak *et al*., 2008). The nutritional quality of maize is determined by the amino acid makeup of its protein. Amino acids serve as the building blocks for proteins. Maize contains all the ten essential amino acids in varying amounts. The livestock industry consumes more than half of the total annual maize production (Babatunde and Oyatoye, 2006). Despite this intervention at the production level, there is evidence of seed and food insecurity arising from storage losses. One of the elements contributing to high storage losses is the problem of storage insect pests such as the maize weevil, *Sitophilus zeamais*.

Sitophilus zeamais Motschulsky (Coleoptera: Curculionidae) is a serious pest of stored maize grains in Nigeria. It caused loss in grain weight ranging between 20–30% on average (Rees, 2004) which may increase to a total of up to 80% loss for untreated maize grain in traditional facilities depending on the storage period (Tapondju *et al*., 2005). The need to control maize weevil using synthetic chemicals imparts negative consequences on to the environment and other non-target population including man, besides conferring resistance and other clinical symptoms in man and other animals. These problems led to a search for more effective method of controlling maize weevil that is safer and eco-friendly.

One alternative control method is the use of plant extracts (Trevisan *et al.*, 2006), which favours natural enemies, necessary for the biological balance (Gallo *et al.*, 2002). This study therefore aimed at assessing the efficacy of sesame leaf powders as protectants against maize weevil's infestation on stored maize grains.

MATERIALS AND METHODS

Plant Samples Collection and Plant Materials Preparation

Untreated shelled maize (1000g) was obtained from Institute for Agricultural Research (IAR), Samaru Zaria. The maize sample collected was disinfected at -4°C for two weeks (Kossou *et al.*, 1992). The maize was then air dried under a screen house to prevent possible re-infestation by insects. .

Fresh sesame leaves were collected from the Biological Garden, Ahmadu Be llo University, Zaria. The leaves were carried to the Herbarium section of the Department of Botany, Ahmadu Bello University Zaria for authentication (ABU01583). The collected sesame leaves were air dried at room temperature and grounded by pestle and mortar to fine powder.

Phytochemical Screening

Standard phytochemical tests were carried out on the plant samples to determine the presence of anthraquinones, tannins, saponins, flavonoids, alkaloids, cardiac glycosides, terpenoids, glucosides, and steroids (Sofowora, 1993). Fifty grams of the powdered sample was used for phytochemical screening.

Insect Culture

Adult *Sitophilus zeamais* used for the study were collected from the Institute for Agricultural Research and were maintained at the laboratory of the Department of Biology, Ahmadu Bello University, Zaria. Two hundred unsexed adult *S. zeamais* from the stock were introduced into a plastic container containing 20g of disinfested maize grain and sealed with a clean fine muslin cloth. The insects were allowed to oviposit for ten 10 days before they are seived out and the container was sealed again with the cloth to prevent possible escape and/or re-infestation. The culture was maintained under average temperature of 26°C and relative humidity of 80%.

Mortality, Oviposition and Progeny Development Deterrent Tests

Twenty grams of maize grain was introduced into 750ml plastic containers. Varying volumes of sesame leaves powder (2.0, 4.0, 6.0 and 8.0g) were separately introduced into plastic containers containing 20g of disinfested maize grains and shaken vigorously after every 30 minutes for 2hrs to ensure uniform distribution of each powder over the grain surface. The treated maize grains were allowed to stand for 2hrs before the introduction of the weevils. Fifteen pairs of unsexed adults starved for 24hrs introduced into each plastic container. The plastic containers were covered with muslin cloth sandwiched between two wire mesh. The experiment was arranged in a Completely Randomized Design with three replications. The treatment control was maintained separately for each treatment. The number of dead insects was counted after 7 days to estimate maize weevil mortality. Insects were recorded dead when there is no response to prodding of the abdomen with a sharp pin.

Maize weevil mortality was assessed as:

$$\frac{\text{Number of dead insects}}{\text{Total number of insects}} \times 100$$

After 7 days, number of eggs laid on treated seeds (Ts) and control seeds (Cs) were recorded and the percentage of oviposition deterrence (POD) was calculated by following formula given by Singh and Jakhmola (2011) as follows:

$$POD = \frac{C_S - T_S}{C_S} \times 100$$

Where: Ts = number of eggs laid on treated seeds

Cs = number of eggs laid on control seeds

After the eggs were counted, the experimental set up was kept undisturbed till the emergence of F_1 adults from the treated and untreated seeds. The number of adults emerged from the control seeds (Ac) and treated seeds (At) were recorded. The percentage reduction in adult (PRA) emergence was calculated by following formula given by Singh and Jakhmola (2011):

$$PRA = \frac{A_C - A_t}{A_C} \times 100$$

Where, Ac = number of F_1 adults emerged from the control seeds

At = number of F_1 adults emerged from the treated seeds.

After complete emergence of F_1 adults, the weight losses due to *S. zeamais* infestation on maize seeds recorded. The weight of the treated seeds (Wt) and control seeds (Wc) were observed before and after experiment and the percentage reduction in weight loss (PRW) was calculated using Singh and Jakhmola (2011) formula:

$$PRW = \frac{W_C - W_t}{W_C} \times 100$$

Where: Wc = weight of the control seeds;
Wt = weight of the treated seeds

Data Analysis
The collected data was subjected to one way analysis of variance (ANOVA) with Duncan's New Multiple Range Test used to separate means that were significant at 5% level.

RESULTS
The result for phytochemical screening of the sesame aqueous leaf extracts is shown in Table 1. The result showed the presence of eight (8) active phytochemicals present. The phytochemicals were: Carbohydrates, flavonoids, tannins, alkaloids, cardiac glycosides, phlobatannins and proteins.

Table 1: Phytochemical screening of sesame leaf Powdered Extract

S/N	Phytochemical	Test used	
1	Carbohydrates	Molisch's Test	+
2	Flavonoids	Shinoda's test	+
3	Tannins	Ferric Chloride test	+
4	Alkaloids	Dragendoff's Reagent	+
5	Saponins	Frothing test	+
6	Cardiac glycosides	Salkowski's test	+
7	Phlobatannins	Lead acetate	+
8	Protein	Biurettest	+
9	Anthraquinones	Bontragers test	-

The result for the effects of sesame powder on maize weevil is presented in Table 2. The result showed high mortality rate induced by different doses of the sesame leaf powders on the maize weevil. Similarly, the number of eggs laid (oviposition) was reduced in the treated seeds. The seeds treated with 8g of the powder have the least number of eggs oviposited by the weevils. More so, the number of larvae that metamorphosed from the egg were reduced with increase in the dose of the powder.

Table 2: Effects of sesame leaf powder on *Sitophilous zeamais*

Dose (g/20g)	Mortality (1 week after exposure)	Number of eggs laid	Larvae Development (%)
0.00	0.00%	78.26^{a*}	68.78^{a}
2.0	0.67%	49.36^{b}	18.35^{b}
4.0	2.35%	22.97^{c}	14.66^{c}
6.0	6.98%	13.01^{d}	6.21^{d}
8.0	16.27%	7.24^{e}	0.00^{e}

N.B: *Values down a column with the same superscripts are not significantly different (P=0.05)

DISCUSSION
Botanical pesticides have proved vital in insect pests' management strategies. These botanicals serve as alternatives to commercially used synthetic insecticides and many of them have often been used against a number of species of stored product insect pests including those in the Order Coleoptera and Lepidoptera (Nathan *et al.*, 2007). The powders obtained from sesame proved to possess insecticidal potency for the protection of stored maize grains against *S. zeamais* infestation probably due to the active phytochemicals present in such powder. The present study reported highest percentage mortality induced by higher doses of the plants powders. This is in conformity with the findings of Alvi *et al.* (2018) who reported high mortality induced by the leaf and seed extracts of *Rhazya stricta* on *Rhyzopertha dominica* and *Trogoderma granarium* under laboratory conditions. The powders conferred certain degrees of toxicity to the insect by inhibiting more than 50% of the eggs laid and suppressed progeny development.

This finding agrees with that of Ogendo *et al*. (2004) who reported more than 50% induced mortality by *Tephrosia vogelii* extracts on *Sitophilus zeamais*. Furthermore, botanical extracts have been reported by Amuji *et al.* (2012) to exhibit appreciable magnitude of toxicity to insects inducing mortality. Ousman *et al*. (2007) has reported that *Piper nigrum* leaf oil was toxic to stored insect pests and concluded that the extract be used as a substitute for synthetic insecticides by small scale farmers. Cheruvan and Ragesh (2018) has reported insecticidal effects of cassava leaf extracts against *Sitophilus oryzae* (L.), *Rhyzopertha dominica* (F.), *Tribolium castaneum* (Herbst) and *Callosobruchus chinensis* (L.) under laboratory conditions whilst Ileke and Emmanuel (2018) reported high bioefficacy of *Alstonia boonei* leaf extract against the cowpea beetle (*Callosobruchus maculatus*) infestation of stored cowpea seeds. The toxicity of the plants powders can probably be attributed to the various chemical constituents present in the extracts as reported by Mbailao *et al*. (2006).The effect of the powders reported by the present study in suppressing progeny development and oviposition of *S. zeamais* can be attributed to the toxicity and lethality conferred on the insects thereby interfering with physiological processes of eggs development. This finding is in conformity with the report of Osawe *et al*. (2007) which opined that plant extracts adversely affected the survival and growth of *Sesamia calamistis*. Similarly, Negbenebor *et al*. (2020) reported the insecticidal potency of sesame leaf extracts against *Clavigralla tomentosicollis*.

CONCLUSION

It was concluded that, sesame leaf powders induced mortality to *S. zeamais* between the range of 0.67-16.27% and reduce oviposition from 49.36 to 7.24 and deterred larval development. The effect is dose dependent, increases with increase in dose. This insecticidal activity of the leaves powder is attributed to the presence of Eight (8) active constituents:Carbohydrates, flavonoids, tannins, alkaloids, saponins, cardiac glycocides, Phlobatannins and proteins present in the leaves. 8.0g/20g of sesame leaves powder recommended for protecting maize grains against *S. zeamais* infestation.

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