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POST-HARVEST PROTECTANT EFFICACY ASSESSMENT OF *MORINGA OLEIFERA* POWDER AND OIL EXTRACTS AGAINST *SITOPHILUS ZEAMAIS* NIGERIA

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ABSTRACT
The research assessed the effect of *Moringa olifera* seed powder/Oil on the mortality of adults of *Sitophilus zeamais*, protection of treated maize seeds from pest infestation/damage and ability of germination of treated seed. This research was carried out at Parasitology and Entomology Laboratory and the crop garden of the Department in Nnamdi Azikiwe University, Awka, South East Nigeria. The seed extract was diluted with acetone at the ratios of 1:10, 1:20, 1:30 and 1:40(20%,10%,5%,2.5%) while 0.5g,1.0g,1.5g,2.0g of Moringa powder were prepared. 20 grains were treated with different concentrations of the oil and powder in four replicates. The experiment was arranged in a complete randomized design (CRD) with four replications. Treated maize grain samples were infected with 42 weevils each and the experiment was run for 8weeks. A high rate of mortality of weevils was recorded at 20% concentration of the *Moringa oleifera* seed oil extract (MSE) while the seed powder recorded less mortality. The oil was more effective than the powder. The controls had the least mortality rate. The percentage of germination of grains treated with the powder after 8 weeks in storage was higher(85%) compared to the oil extract (10%). There was no significant difference between weight loss and various concentration of the Moringa seed powder or oil on maize grain. The *Moringa oleifera* seed oil is most efficacious to serve as biopesticide but its low performance in promoting germination of treated stored grains when compared with the seed powder calls for more research.

KEYWORDS: *Sitophilus zeamais*, *Moringa oleifera*, Biopesticide, Viability, Ethanolic extract.

1.0 INTRODUCTION
Maize is the most important cereal after wheat in the world.[1,2] and is a staple food in Nigeria, widely grown by rural farmers. In Nigeria as well as in other third world countries, the major constraints facing effective and efficient storage of cereal grains are the insect and vertebrate pests. Profitable productions of cereal grains are seriously being hampered by the inability to store these grains for a long period of time without losing sizeable proportion to weevil attack. This problem is further aggravated by the simple fact that production and storage of cereals like maize is left in the hands of small scale peasant farmers. Very little research has been done on the development of affordable organic pesticides which offer same control levels as synthetics to maize weevils. After harvesting, the grain needs to be dried to right moisture content of 12.5%[2] to avoid rotting in storage. High moisture predisposes grain to attack by bacteria, fungi, insects and other microbes.[3] *Sitophilus zeamais* is one of the pests of economic importance in stored maize. It is so devastating and is capable of multiplying to large populations causing tremendous damage to the grain. The use of synthetic insecticides has lots of attendant problems notably high mammalian toxicity, health hazard[4] and mostly out of reach of most smallholder farmers.[5] There is therefore urgent need for cheaper alternatives. Current research efforts on product development are being focused more on ecologically tolerable control measures including the use of inert material plant powder, oils and extract. There is also increasing awareness that plant possess chemicals which naturally protect them from pests and pathogens. The tropical region is well endowed with a wide variety of these floristic species with defensive chemicals and quite

a number of them have been used traditionally in protecting maize against weevil attack. Though botanicals are being used, questions remain on their appropriate rates and forms which are effective. Most Farmers view use of traditional remedies with mixed feelings but inference can be drawn from work done elsewhere on their effectiveness.[5]

Moringa plant is an abundant invasive plant found throughout the country and has generated a lot of interest among farmers in some African countries for its use as a medicinal plant. Use of *Moringa Oleifera*, will provide a cheap and safe option for use in granaries. Its potential as biopesticides needs to be evaluated and determined. The research is aimed at assessing the effectiveness of *Moringa Oleifera* seed oil and powder in controlling *Sitophilus zeamais.* The hypothesis of this research was "application of *Moringa* extract to stored maize (Zeamays) can protect it from *Sitophilus zeamais* and also effectively support seed germination after weeks of storage".

2.0 MATERIALS AND METHOD

This study was carried out at parasitology and Entomology Laboratory in Nnamdi Azikiwe University, Awka, south East Nigeria.

2.1 Experimental Design

The experiment was laid out in a complete randomized design (CRD) with four treatments replicated in fours using *Moringa oleifera* seed oil, *Moringa oleifera* seed powder, Control TEC(grain treated with Petroleum ethanol and Control TUC-(grain with no *Moringa* extract/Ethanol added). The treatment involved the use of different concentrations of *Moringa oleifera* seed oil and powder. The alcohol control was added to establish if its use in the extraction had any effect on the growth of the plants or pest mortality rate.

Table 1: Description of treatments.

TREATMENT	DESCRIPTION	TREATMENT	DESCRIPTION
T_{1O}	*Moringa oleifera* seed oil	T_{1P}	*Moringa oleifera* seed powder
T_{2O}	*Moringa oleifera* seed oil	T_{2P}	*Moringa oleifera* seed powder
TEC	Petroleum ethanol(control)	TEC	Petroleum ethanol(control)
TUC	Untreated grain(control)	TUC	Untreated grain(control)

Key: **CRD:** **C**omplete randomized design (CRD),
TEC: Grain treated with Petroleum ethanol
TUC: Grain with no *Moringa* extract/Ethanol added).

2.2 Selection of Maize Seeds for Study

The maize seeds used for the study were common maize purchased from the market. They were kept in air tight containers and aerated for 5 days in containers covered with muslin cloth, secured tightly with bands. Twenty grain seeds were weighed into labeled 60ml glass vials and covered with ventilated screw cap, sealed with nylon netting to prevent infestation by insects.

2.3 Preparation of *Moringa* Seed Powder and Oil

Dry *Moringa* seed were pulverized with electric blender to obtain the powder. The powders were packed in plastic containers with tight lids and stored in a refrigerator prior to use. Also *Moringa* seed oil extraction was done using soxhlet extractor for 3 hours according to the AOAC method (Anon 1984) and the resulting extract was air dried in order to remove traces of the solvent. Serial dilutions of the ethanolic extract were prepared in acetone achieving different concentrations of the Moringa Seed Extract (MSE) at the following ratios: 1:10, 1:20, 1:30 and 1:40. (20%, 10%, 5%, 2.5%). Petroleum ethanol alone served as control .Also different concentrations of the powder 0.5g, 1.0g, 1.5g, 2.0g were used respectively.

2.4 Insect Culture

Sitophilus zeamais was reared in the laboratory under fluctuating ambient temperature of 30^{oc} and 65-67% relative humidity on white maize variety procured from the market. Vials containing the seed and *Sitophilus zeamais* were covered with fine mesh mosquito net to prevent escape of the insects. This was left for 3 months before being used for the study prior to the study; old adults were removed and destroyed. The seeds were left for 24 hours to obtain day old adult weevils for the study.

2.5 Toxicity of Moringa Seed Oil and Powder to Adult S.Zeamais

1 ml aliquots of various concentrations of acetone oil extract were added to 20 grains of same species of maize seeds placed in Petri dishes. There were four replicates for each treatment. The *Moringa* oil treated maize seeds were allowed to air dry alongside the controls. Another set of maize seeds were treated in four replicates with 0.5g, 1.0g, 1.5g, and 2.0g of *Moringa* powder. No sexing of weevils was done as female and male presence were inevitable, as it was the case with other experiments done by Chinwada and Giga[6] on bean bruchid and the larger grain borer .20 unsexed adult of *Sitophilus zeamais* were introduced to each Petri dish.

2.6 Mortality Rate

2(two) days after setting the experiment, physical weevil count was done to check if there were weevils that had escaped. Mortality count of the weevils were carried out 1(one) week after the introduction and was counted daily

for four (4) days. Subsequent counts were at two week intervals. Insects were certified dead when probed with a pin at the abdomen and there was no response or life.[7]

2.7 Percentage (%) Germibility of the Treated Maize Seeds

Disinfested maize seeds (20) were treated with various concentrations of the oil and powder as described above. All treatments were replicated four (4) times and stored in ambient condition in the laboratory for 8 weeks. They were subsequently moistened and planted on cotton wool in Petri dishes. Viability of the treated seeds was assessed after 5-7 days of planting according to the normal planting method.

Percentage Germination was calculated as

$$\frac{\text{Number of seeds germinated}}{\text{Total number of seed planted}} \times 100$$

2.8 Data Collection and Statistical Analysis

The weevil counts data was given as percentages to compound averages on the mortalities. Probit values of corrected mortality were plotted against the corresponding log dose to determine LD_{50}. Analysis of variance (ANOVA) was conducted on the percentage loss and damage and means were separated using least significant difference (LSD) at P=0.05.

3.0 RESULT

The result of the mean mortality effect of different concentrations of *Moringa* seed oil on *S. zeamais* on treated maize after 1 week of introduction showed that Percentage mortality increased as concentration of extract used increase. The highest number of death after treatment with seed oil was recorded in the 20%(0.2ml) concentrations while 2.5%(0.025 ml) recorded the least number of death. The highest % observed mortality of 62.5% was observed in grains treated with *Moringa* seed powder. Mortality in the control was 5%. None of the treatments achieved 100% mortality as shown in table 2 while the highest number of death was recorded in the 2.0g concentration while 0.5g was the least in table 3.

Table 2: The mean mortality effect of different concentrations of *Moringa* seed oil on *S. zeamais* on treated maize.

CONC(ml)	Daily intervals				Total observed mortality	Mean mortality	% Observed mortality	Corrected % mortality(PM)	Probit
	Day 1	Day 2	Day 3	Day 4					
0.2ml	4.25	0.75	0.5	1	6.5	1.63± 1.14	65	63.15	5.3345
0.1 ml	1	0.5	1.25	0.5	3.25	0.81± 0.56	32.5	28.95	4.4437
0.05ml	1	0.25	0.25	0.25	1.75	0.44±0.53	17.5	13.15	3.8783
0.025 ml	0.25	0	0.75	0.25	1.25	0.31±0.46	12.5	7.89	3.5813

$LSD = t_{0.05}\, Erdf_{12} \sqrt{2Ems/r}$

Ems = 15.62, r=4, $t_{0.05}$, $Erdf_{12}$ =2.179

LSD =2.179 X $\sqrt{2X\ 15.62/4}$

2.179 X 2.795 = 6.090

LSD = 6.090

Table 4: Themeanmortality effectof different concentrations of Moringaseed powder on *S. zeamais* on treated maize.

CONC Control (g)	Daily intervals				Total Observed mortality	Mean mortality	% Observed mortality	Corrected % mortality (PM)	Probit
	Day 1	Day 2	Day 3	Day 4					
0.5g	0.25	0.5	0.25	0.25	1.25	0.31± 0.5	12.5	12.5	3.9636
1g	0.75	0.5	1	0.25	2.5	0.63± 0.3	25	25	4.2446
1.5g	1.5	0.25	1	1	3.75	0.94±0.59	37.5	37.5	4.6814
2g	1.75	1.25	1.5	1.75	6.25	1.56±0.43	62.5	62.5	5.3853

$LSD = t_{0.05}\, Erdf_{12} \sqrt{2Ems/r}$

Ems = 1,18, r=4, $t_{0.05}$, $Erdf_{12}$ =2.179

LSD =2.179 X $\sqrt{2X\ 1.18/4}$

2.179 X 0.768 = 1.67

LSD=1.67

Table 5: The effect of different concentrations of *Moringa* seed oil on Viability of treated maize after 8weeks.

%CONC(ml)	Replicates				Total	% germination	No of seeds planted
	R1	R 2	R 3	R 4			
20% (0.2ml)	-	-	-	-	-	0.00	20
10% (0.1ml)	-	-	2	-	2.00	10.0	20
5% (0.05ml)	-	2	-	-	2.00	10.0	20
2.5% (0.025ml)	-	-	-	2	2.00	10.0	20

- The rate of Viability was low across the concentrations and replicates except in conc. 20% which recorded no germination.
- The rate of germination of grains treated with *Moringa* seed powder increased from the lowest to the highest concentrations (Table 6).

Table 6: The effect of different concentrations of *Moringa* seed powder on the Viability of treated maize after 8weeks.

CONC(µg)	Replicates				Total	% germination	No of seeds planted
	R1	R 2	R 3	R 4			
0.5g	2	3	3	2	10	50	20
1.0g	2	4	4	4	14	70	20
1.5g	3	3	5	4	15	75	20
2g	4	5	3	5	17	85	20

DISSCUSSION

Maize farmers in the rural areas are constantly challenged by storage pests particularly the Sitophilus zeamais. Affordable and readily available protectants are needed most especially as Nigerian Government makes Agriculture an alternative source of her economy in other to survive the ongoing economic meltdown. This provides a sustainable and degradable pesticide to the poor farmers. The results obtained in this study showed that powder and oil of *M.oleifera* seeds tested were toxic to the maize weevil *Sitophilus zeamais*. The plant extracts being moringa seed oil and powder are directly toxic to *Sitophilus zeamais.* the parameters used to access the effectiveness of the oil and powders are the mortality of the insects and germination ability of the treated maize with various concentrations of the extracts. The result of the toxicity indicates that as the concentration of oil extracts increases the mortality rate of the adult weevils also increases. Hence *Sitophilus zeamais*could be effectively controlled with Moringa seed extracts. A high rate of mortality of weevils was recorded at 20% concentration of the seed oil extract while the seed powder recorded littlemortality. Also from the experiment the LD_{50} of the oil was 161.0 and that of the powder was 1764.

Mbailo*et al.*[8] and Ileke and Oni[9] reported that high concentration of *M. oleifera* powder significantly reduced the longevity of adult *Callosobruchus maculates* on cowpea seeds and *S. zeamais. M. oleifera* like other botanicals is environmentally friendly and less expensive than the synthetic compounds yet botanicals cannot replace completely chemical pesticides.

In the Viability assessment, the effect of plant extract on the viability of treated grains showed that the powder the plant powder extractssupported germination while the oil adversely affected the viability of the maize grains when compared with the untreated control after 8 weeks of storage.

4.1 CONCLUSION AND RECOMMENDATION

Not much is known about *M. oleifera* as a crop protectant so this finding could open new grounds in using *M. oleifera* oil and powder extracts as an insecticide. The finding of this study presents *M. oleifera* as a potential crop protectant that needs to be exploited. Nevertheless Higher concentrations and the undiluted form of the *Moringa oleifera* seed extract(both oil and powder) can also be tried in further experiments to ascertain the level at which appreciable toxicity to the insect pest can be achieved and at the same time not adversely affecting treated seed viability. Efforts to isolate the active ingredients in the seed extract are important to know if *Moringa oleifera* seed extract have growth support hormones aside its insecticidal qualities.

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