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LABORATORY EVALUATION OF GARLIC POWDER, SUNFLOWER LEAF POWDER AND SUNFLOWER OIL ON THE CONTROL OF MAIZE WEEVIL (*Sitophilos zea mais* L.)

*** [1]Mani U.;[1] Ubale, M. A.; [1]Gabriel, S. I.; [1]Malik, U.;[2] Nuradeen, M.**
[1]Pest Management Technology Program, Samaru College of Agriculture, DAC/ABU Zaria.
[2] School of Agricultural Technology, Nuhu Bamalli Polytechnic, Samaru Kataf Campus.
Correspondence: ubaidumani@yahoo.com 08162173245 or istiqamahkn@gmail.com.

Abstract

A laboratory study was conducted to assess the efficacy of garlic powder, sunflower leaf powder and sunflower oil on the mortality, oviposition and progeny of *Sitophilos zeamais*. Treatments consisted of three doses of each of the plant extracts (15g/mls, 10g/mls and 5g/mls on 500g of maize and control). It was laid in a completely randomized design (CRD) repeated three times. The result revealed that there was 98-100% mortality of *S. zeamais* treated sunflower oil and garlic powder and 75% mortality due from sunflower leaf powder on application of 15g/mls of sunflower oil and garlic powder within eight weeks of trials except in the controls. There was no significant difference between sunflower oil and garlic powder at a dose of 15g/mls but there was significant difference ($P \leq 0.05$) when compared to sunflower leaf powder. However, there was not much weight loss in grains treated with garlic powder and sunflower, but there was about 30% weight loss in grains treated with sunflower leaf powder and 80% weight loss on control, which also recorded 80.7% loss of viability. The 15g/mls of garlic powder and sunflower oil is recommended as biopesticides for effective storage of 500g of maize against attacks by *S. zeamais* while retaining its color and palatability.

Keywords: garlic powder, sunflower leaf powder, sunflower oil, *S. zeamais*, mortality.

1. INTRODUCTION

Maize (*Zea mays* L.) or corn is a major source of dietary carbohydrate as well as the most important cereal in Sub- Saharan Africa (IITA 2009). FAO (2008) reported that the total production of maize in Africa is 55.3million tons with Nigeria producing 7.5million tons. Domestic utilization of maize as a major food crop and an industrial crop is growing rapidly.

About 70-80% of maize produced in Nigeria is stored at farm level for varying duration and purposes (FAO, 1996; Madundi, 2006). The maize weevil *Sitophilus zeamais* (Motsch.) (Coleoptera: Curculionidae), is a major pest of stored maize grain in many regions of the world including Nigeria (Adedire 2001). Although synthetic insecticides have long been widely used in the control of insect pests, the indiscriminate application of synthetic products has led to various problems (Nwachukwu and Esawalam, 2014). Toxic residues in the treated products, environmental pollution, and growing resistance against insecticides by insects and pests emanate from application of synthetic insecticides (Huang *et al*. 1997). There is an urgent need to evolve effective eco-friendly, cheap, sustainable, and safe plant protection agents as grain protectants in storage systems for small holder farmers (Nwachukwu and Esawalam, 2014). Moreover, because they are often viewed as "mild" on the environment, compounds of biogenic origin are generally more positively regarded compared to substances partially or completely chemically synthesized in laboratories (Slusarenko *et al*. 2008). For these reasons, compounds of biogenic origin are more likely to gain wider acceptance among farmers in the long run (Nwachukwu and Esawalam, 2014). They also have the potential to reduce the risk of cross-resistance while offering new leads for the design of target-specific molecules (Zhou *et al*. 2012).There is also the need to effectively preserve the harvested grains in order to ensure adequate supply of safe and uncontaminated food, seeds and raw materials for agro-based industries. This could only be ascertained with naturally occurring substances (botanicals) hence the need to investigate the efficacy of

locally available protectant against (*S. zeamais*) which is safe and eco-friendly.

The experiment was set to determine the efficacy of garlic powder, sunflower leaf powder and sunflower oil on *S. zeamais* on stored maize seeds.

2. MATERIAL AND METHODS

2.1 Study site

The experiment was carried out in the soil Science Laboratory of Samaru College of Agriculture. The study area is located latitude $10^0$20N and $7^0$23E. The area has a tropical climatic condition with strong seasonal rainfall after which a dry season is observed.

2.2 Collection and preparation of experimental samples

Test insects were collected from infested maize seeds obtained from Zaria central market and cultured on disinfested seeds in four kilner jars with each jar containing ten (10) pairs of weevils per 50grams of maize seeds for 45 days. After 24 hours, the insects were removed to prevent over lapping of generations. A culture of *S. zeamais* was established to provide adequate number for the experiment in which 500 grams of uninfested maize was weighed and sterilized for 24hours in deep freezer (4^oC) eliminate potential field infestation.

Garlic cloves were obtained from Zaria central market where the fresh cloves were separated and sliced. The sliced material was dried in diffused light under tree shade for three weeks and thus pounded using mortar and pestle. The powder was sieved using 2 millimeter sieve mesh to obtain a fine powder. The sunflower seed obtained from the seed processing unit of the institute for agricultural research (IAR) ABU; Zaria was taken to the National Research Institute for Chemical Technology (NARICT). The seed was taken to the oil extraction laboratory of the institute. There the seed was cleaned and dried to remove foreign materials.

The sunflower leaves were collected from the Institute for Agricultural Research (IAR) research farm along area C quarters of ABU, Zaria. The fresh leaves were dried under room temperature for 3-4 weeks and thus ground to powder. Each of the prepared botanicals (garlic clove powder and sunflower leaf powder) were weighed in three levels (5g, 10g and 15g for the powdered materials) while sunflower oil was dispensed into 5mls, 10mls and 15mls aliquots and mixed thoroughly with 500g of maize placed in small plastic containers excluding the control. Also introduced into the container were 50 pairs of healthy *S. zeamais* and covered with a muslin cloth to prevent escape of the insect (*S. zeamais*). The experiment was laid out in a completely randomized design. Data was collected on the number of dead insect at weekly intervals.

2.3 Evaluation of the efficacy of garlic and sunflower powder on insects

Evaluation of effect of garlic powder, sunflower leaf powder and sunflower oil on the mortality of *S. zeamais* was carried out. Mortality for each treatment was recorded for eight weeks on weekly basis after the introduction of the insects. Dead insects were counted and recorded while the live insects were returned into the treated grains.

Grain damage assessment was carried out to establish the extent of damage caused by *S. zeamais* on maize grain. This was done by picking 100 seeds at random from each container, the seeds with insect emergence holes on them were counted for each treatment using a simple mathematical formular thus:

% of grain damage =damaged grain/total number of grain taken x 100/1

After the experiment was terminated, test was done on the viability of the treated grains from each treatment to verify if the plant materials had any adverse effect on the viability of the seeds. Grains were taken at random from different repetition. Grains were then sown at a prepared seed bed in the college horticultural garden and watered for seven days. The germination count was taken after the eight day of sowing.

Data collected were subjected to analysis of variance procedure (CRD) using the statistical analysis software (SAS) 2003 and the means were separated using LSD at 5% least significant difference test.

3. RESULTS

From table 1, there was significant difference ($P<0.05$)between the treatments in week one with the highest mortality recorded in those treated with garlic powder and sunflower oil, followed sunflower powder and no mortality was recorded in the untreated controls. There was no grain damage as shown in Tables 1-8 due to high insect mortality recorded.

In the second week (Table 2) there was significant difference ($P<0.05$) between the treatments with the highest mortality recorded in those treated with garlic powder and sunflower oil, followed by sunflower leaf powder and no mortality was observed in the untreated control.

In the third week (table 3) there was significant difference ($P<0.05$)between the treatments with the highest mortality recorded in those treated with garlic powder and sunflower oil followed by sunflower leaf powder and no mortality was observed in the untreated control.

In the third week (Table 4) there was significant difference ($P<0.05$) between the treatments with sunflower oil having the highest mortality followed by garlic powder and next by sunflower leaf powder with no mortality observed in the untreated control.

In the fifth week (table 5) there was significant difference ($P<0.05$) between the treatments with the highest mortality recorded in sunflower oil and garlic powder followed by sunflower leaf powder and no mortality was observed in the untreated control.

In the sixth week (Table 6), there was significant difference ($P<0.05$) between the treatments with the highest mortality recorded in garlic powder and sunflower oil followed by sunflower leaf powder and no mortality least was observed in the untreated control.

In the seventh week (table 7), there was significant difference ($P<0.05$) between the treatments with the highest mortality recorded in garlic powder and sunflower oil followed by sunflower leaf powder while the least was observed in the untreated control. Also damage assessment showed a significant difference with the lowest dose having high number of damaged grain for all the tested materials (Table 9).

In the eight week (table 8), there was significant difference ($P<0.05$) between the treatments with the highest mortality recorded in sunflower oil and garlic powder while sunflower powder showed the least all at 15mls,15g and 15g respectively.

There was no significant difference both among the plant extracts and the doses used regarding grain damage. The highest damage was observed in the untreated control (table 9). Grain damage was assessed separately by taking hundred grains from each treatment at random.

There was no significant difference ($P<0.05$) on the grain weight of maize due to the variation of quantities of the doses of plant extract applied. The lowest reduction was observed in garlic powder followed by sunflower oil then sunflower leaf powder. The highest weight loss was observed in the untreated control. (Table 10).

There was no significant difference ($P<0.05$) between the treatments regarding their percentage germination. The highest was observed in garlic powder and sunflower oil followed by sunflower leaf powder and the least was observed in the untreated control (Table 11).

4. DISCUSSION

It was observed that the three levels of garlic powder, sunflower leaf powder and sunflower oil used are sufficiently effective in controlling *Sitophilus zeamais* with varying levels of mortality recorded within eight weeks. The level of mortality increases with increasing concentration. Previous studies have shown that garlic also possesses some insecticidal, fungicidal, acaricidal, nematicidal, and bactericidal properties (Lalla *et al*. 2013). Also,

Fields *et al*, (2001) reported that *Allium sativum* has an effective range of insecticidal repellent activity against pest of stored products (bean bruchid, *Zabrotes subfaciatus).* Shier, *(*2000) reported garlic as a broad spectrum insecticide that can be used to control a number of storage pests.

Generally there was high mortality of *S. zeamais* in 15g of garlic powder and 15mls of sunflower oil treatments after six weeks post infestation which was slightly higher than 10g, 10mls and 5g, 5mls. This is because *A. sativum* has been very potent due to its strong choky odour which might have exerted toxic effect by disrupting normal respiratory activity of weevils thereby resulting in asphyxiation and subsequently, death (Adedire and Ajayi, 1996). This also corroborate the study of Osipitan and Mohammed (2008) who reported 100% mortality of insects (larger grain borer *Prostephanus truncatus* (Horn))on maize when using garlic powder (2, 4 and 6g/100g). *A. sativum* has been discovered to be active as a repellent, antifeedant, bactericide, fungicide and nematicide (Grainge *et al., 1985*; Mason and Linz, 1987)

5. CONCLUSION

The study has provided some information on the level of efficacy of the botanicals used in the control of *S. zeamais.* The result obtained suggested that sunflower Leaf Powder at 15.0g and 10.0g/100g of cowpea seeds and 15.0 mls of sunflower oil can be utilized in protecting stored maize from *S. zeamais* infestation since they are cheaper than synthetic insecticides and environmentally feasible and safe for human consumption. Further research is recommended for the efficacy of sunflower Leaf Powder and Sunflower oil on the field insect pests of maize like *Clavigralla spp*, Boll worms and aphids.

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Table 1: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week one)

Treatment	**15gor 15mls**	**10g or 10mls**	**5g or 5mls**
Garlic powder	3.67[a]	2.67[a]	2.00[a]
Sunflower powder	1.67[b]	1.67[b]	1.00[b]
Sunflower oil	3.67[a]	2.33[a]	1.67[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.52	0.35	0.31

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD.

Table 2: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week two)

Treatments	**15g or 15mls**	**10g or 10mls**	**5g or 5mls**
Garlic powder	4.33[a]	4.33[a]	2.00[a]
Sunflower leaf powder	2.00[b]	2.67[b]	1.33[b]
Sunflower oil	4.67[a]	4.00[a]	2.00[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.39	0.39	0.3

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD.

Table 3: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week three)

Treatments	**15g or 15mls**	**10g or 10mls**	**5g or 5mls**
Garlic powder	5.00[a]	4.00[a]	2.33[a]
Sunflower leaf powder	3.33[ab]	2.33[b]	1.33[b]
Sunflower oil	4.67[a]	3.00[a]	2.33[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.59	0.47	0.43

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 4: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week four)

Treatments	**15g or 15mls**	**10g or 10mls**	**5g or 5mls**
Garlic powder	4.67[a]	4.33[a]	2.67[a]
Sunflower leaf powder	2.33[b]	3.00[a]	1.33[b]
Sunflower oil	5.67[a]	5.67[a]	3.00[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.62	0.50	0.39

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 5: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week five)

Treatment	15g or 15mls	10g or 10mls	5g or 5mls
Garlic powder	4.33[a]	4.00[a]	3.00[a]
Sunflower leaf powder	3.33[b]	2.33[b]	1.33[b]
Sunflower oil	5.00[a]	3.00[a]	2.33[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.39	0.35	0.33

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 6: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week six)

Treatments	15g or 15mls	10g or 10mls	5g or 5mls
Garlic powder	4.33[a]	3.67[a]	2.00[a]
Sunflower leaf powder	2.33[b]	1.33[a]	1.33[b]
Sunflower oil	3.67[a]	3.00[a]	2.67[a]
Untreated control	0.00[c]	0.00[c]	0.00[c]
LSD	0.39	0.39	0.24

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 7: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week seven)

Treatments	15g or 15mls	10g or 10mls	5g or 5mls
Garlic powder	5.00[a]	3.67[a]	2.33[a]
Sunflower leaf powder	3.00[a]	2.00[b]	1.33a
Sunflower oil	4.00[a]	4.00a	2.00[a]
Untreated control	0.00[b]	0.00[c]	0.00[b]
LSD	0.75	0.47	0.39

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 8: Effect of plant extracts on mortality of *Sitophilus zeamais* on maize grain in the laboratory (week eight)

	Extracts (g or mls /500g grain)		
Treatments	15g or 15mls	10g or 10mls	5g or 5mls
Garlic powder	5.33[a]	4.67[a]	3.67[a]
Sunflower leaf powder	3.00[b]	3.67[a]	2.33a
Sunflower oil	5.00[a]	5.33[a]	2.33[a]
Untreated control	0.00[c]	0.00[b]	0.00[b]
LSD	0.56	0.75	0.43

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 9: Effect of plant extracts on the grain damage of maize caused by *Sitophilus zeamais* in the laboratory (100 seed)

	Extracts (g or mls /500g grain)		
Treatments	**15g/15mls**	**10g /10mls**	**5g/ 5mls**
Garlic powder	15.67[b]	22.33[c]	34.00[b]
Sunflower leaf powder	25.67[a]	35.67[b]	49.33[b]
Sunflower oil	18.67[b]	24.67[bc]	36.00[b]
Untreated control	77.33[a]	82.67[a]	84.33[a]
LSD	3.18	3.97	5.93

Means with the same letter (s) within a column are not significantly different at P≤0.05, LSD

Table 10: Effect of plant extracts on weight loss of maize caused by *Sitophilus zeamais* in the laboratory (initial weight 500g)

	Extracts (g or mls /500g grain)		
Treatments	**15g/15mls**	**10g/10mls**	**5g/ 5mls**
Garlic powder	492.00[a]	483.67[a]	443.33[a]
Sunflower leaf powder	467.33[b]	446.33[b]	335.67[b]
Sunflower oil	488.33[a]	482.67[a]	433.33[a]
Untreated control	411.33[c]	376.67[c]	375.00[b]
LSD	3.93	4.56	6.62

Means with the same letter (s) within a column are not significantly different at p≤0.05, LSD

Table 11: Effect of some plant extracts on percentage germination test after eight weeks

	Extracts (g or mls /500g grain)		
Treatment	**15g or 15mls**	**10g or 10mls**	**5g or 5mls**
Garlic powder	15.67[b]	22.33[c]	34.00[a]
Sunflower leaf powder	25.67b	36.67b	49.33b
Sunflower oil	18.67[b]	24.67[bc]	36.00[b]
Untreated control	77.33[a]	82.67[a]	84.33[a]
LSD	0.59	0.59	0.53

Means with the same letter (s) within a column are not significantly different at P≤0.05

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