BOTANICALS: A SUBSTITUTE FOR SYNTHETIC CHEMICALS IN CONTROLLING MAIZE WEEVILS (*Sitophilus zeamais*)

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ABSTRACT

A research was conducted to test the efficacy of the powder of *Aframomum melegueta***,** *Cymbopogon citrates*, *Moringa oleifera*and Actellic Dust Insecticide against adult *Sitophilus zeamais* in stored maize grain. The various treatments were admixed with 10maize grain each and infested with adultweevil**.** 5, 10, 15, 20, 25 and 30g of the plant powder and 0.2g of synthetic powder/10grain was the ratio of mix. The treatments were kept in petri-dishes in an incubator for a period of 96hrs. The experiment was laid out in a completely randomized design of 8 treatments and 3 replicates. The mortality of weevils to the plant powders and the synthetic powder were recorded. Highest percentage mortality of 80% was recorded in the plant powder at 25 and 30g dose respectively. The highest weevil mortality percentage recorded at 25 and 30g in all the plant treatments coincide with that recorded in the synthetic powder. Maize was not affected by weevil at dose 20 and 30g likewise at 0.2g of the synthetic powder. The results of the study show that all the botanicals were effective in the treatment and prevention of maize weevil from invading stored-grain and their use should be advocated in prolonging the longevity of stored-product.

Keywords: *Aframomum melegueta***,** *Cymbopogon citrates*, *Moringa oleifera***,** Actellic Dust Insecticide, *Sitophilus zeamais,* weevil,

INTRODUCTION

Maize is a staple cereal crop that is widely cultivated throughout the world in a range of agro-ecological environments. The quantity produced annually surpassed any other grain. It is the third mostly cultivated grain crops after rice and wheat (Lyon, 2000). Its kernels, like other seeds are storage organs that contain essential components for plant growth and reproduction. Many of these kernel constituents, including starch, protein, and some micronutrients, are also required for human health. It's richness in energy makes it compete favorably with tubers especially in livestock feeds (Dasbak *et al.*, 2008). For this reason, and others, maize has become highly integrated into global agriculture, human diet, and cultural traditions.

Despite the prospect of maize grain being an essential food source in the food industry with the ability to withstand long storage, the preservation of quality is a key problem in most part of the world especially in sub-Sahara Africa (Gras *et al*., 2000). Thousands of tones of this food were being lost annually to weevils both in the field and in confinement due to poor storage and storage facilities (Rajendran and Sriranjini, 2008). Integrated pest management is one of the widely used pests control methods that involves various contact and residual insecticides/pesticides in addition to the fumigants which have proved effective to prevent or suppress the menace of weevils in stored grain (Singh, 2017). But today's major concern of health organizations is the residual effects of these chemicals which a times triggered by human error due to overdosing the grains or consuming treated grains before the due time.
Long-term application and continuous use of synthetic insecticides have resulted in accumulating their residues in foods, water,and soil and cause adverse health effects to human and ecosystems (Mossa *et al.,* 2018).The incidence of insecticide resistance by storage pest is also a growing problem in stored-product protection (Donahaye, 2000). Resistance to insecticides has been reported in severalspecies of insects and mites. Botanicals were seen by several health organizations and researchers as a useful alternative to replace the use of synthetic insecticides as a control agent for weevils in stored grains. Botanicals have been reported in several works to be eco-friendly and cheap with little or no deleterious effects on both man and livestock animals (Owusu, 2001; Sim et al., 2006; Singh, 2017)

This study intends to beam a searchlight on the efficacy of three botanicalsAlligator pepper (*Aframomum melegueta),* Lemon grass *(Cymbopogon citrates)* and Moringa (*Moringa oleifera*) as a replacement for synthetic pesticides and protective agent for stored-maize grain.

MATERIALS AND METHODS

Experimental site
This study was carried out in the Environmental Biology Laboratory of the Federal Polytechnic Ilaro, Ogun State.

Methodology

Sourcing of Plant materials
All the plant materials used for this study were locally sourced in Ilaro, Ogun State.

Preparation of Maize Grain and Rearing of *S. zeamais*
Healthy maize grains were purchased from a Sayedero market Ilaro, Ogun State. The maize was kept in a clean airtight transparent plastic for 2months to effect the infestation of grain weevil (*Sitophilus zeamais*). At two months, the grains were already attacked by grain weevil(*Sitophilus zeamais*). The newly emerged adult weevils were selected and used for the experiment.

Preparation of Plant Materials
Plant materials namely; Alligator pepper (*Aframomum melegueta), Lemon grass (Cymbopogon citrates)* and Moringa (*Moringa oleifera)* were air-dried in a well ventilated room within the laboratory for about 2weeks before grinding into fine powder. The plant materials were ground using laboratory blender and prepared into fine powder. Each plant powder was separately kept in clean polythene nylon under room temperature for further use.

Adult Mortality Assessment
The adult survival of *S. zeamais* was observed using the method of Dawit and Bekelle (2010).Twenty clean disinfected healthy maize grains were selected into sterilized petri-dishes. 5g, 10g, 15g, 20g, 25g and 30g of each of the plant powder were thoroughly mixed with the maize grain using a clean spoon to ensure admixture.A separate petri-dish containing maize grains was treated with Actellic® Dust Insecticide at 0.2g/10grains of maize to serve as positive control while another containing no treatment was used as negative control. Treated grains were left undisturbed for 30minutes after which 10 adult *S.zeamais* was introduced into each of the petri-dishes containing the treated maize.Treated and untreated grain in petri-dish were covered with clean muslin cloth to avoid germs interference and placed in an incubator. Observations were made at 96 hours to record weevil mortality and the number of damaged grain. Each treatment was replicated three times in petri-dishes. The petri-dishes were arranged in a Completely Randomized Design

Damaged Assessment
Observable damage caused by the weevils to the grains was assessed using the method described by Asawalam *et al*, (2007). Grainswith holes were separated from healthy ones and counted then percentage grain damage was calculated using the formula of Fatope *et al.,* (1995).

$$\%\text{Damage} = \frac{\text{Number of grain perforated}}{\text{Number of grain sampled}} \times 100$$

Statistical analysis
Statistical analysis (Standard Deviation, Standard Error of Mean, % Mean Mortality and P-value) of the experimental data was performed using the computer software SPSS for windows version 16.0. MS EXCEL 2007 and Finney (1971) Probit table were used to find the Probit values, LC_{50} and $LC_{90.}$ Regression equations (Y= BX + Intercept)
Where Y = mortality; X = concentrations.
Percentage mosquito larvae mortality was calculated by using the formula of

$$\%\text{ Mortality} = \frac{\text{Number of dead weevil}}{\text{Number of weevil tested}} \times 100$$

RESULTS

Table 1 shows the empirical probit and insecticidal activity of the leaf powder of *Moringa oleifera* on *S. zeamais* at 96hrs exposure. The botanical powder varying quantity applied showed significant effect P<0.05 on the weevil. The result showed that weevil mortality is dose dependent.At higher dose of 25 and 30g, percentage mortality recorded were similar to that recorded in ADI. No significant effect P<0.05 was observed at the control (0g). Lesser mortalities of 70% were recorded at dose 5, 10, 15 and 20g respectively.
The effects of the leaf powder of Moringa were similar to that observed in table 1. The results obtained at 25 and 30g dose were similar and also coincide with the mortality value recorded when the weevil were subjected to maize treated with ADI. Although lower percentage mortalities were observed when at dose 5 and 10g compared to that in table 1. There is upward increment in the mortality percentage as the dose increase from 0 to 30g. No mortality was observed in the control.

Table 3 shows the efficacy of Lemon grass on maize weevil. The result obtained shows that lemon grass powder is also a promising botanical in the control of maize weevil. Dose 15, 25 and 30g shows significant effect P<0.05 similar to that obtained in ADI. No mortality was recorded at the control. 60% mortality was recorded at 5g dose which is similar to that obtained in table 2 when weevil were exposed to maize grain treated with 5g of Moringa leaf powder.

All the results obtained in the botanicals used in this study shows significant effects P<0.05 especially at higher dose of 25 and 30g.

Table 4, 5 and 6 shows the efficacy of the three botanicals in preventing maize grain damage. All the botanicals shows significant effects P<0.05 in preventing grain damage by adult *S. zeamais*. The results obtained were almost similar. No damage was observed on all the grain at dose 25 and 30 among all the 3 treatments. Lemon grass shows better result at dose 15 and 20g (0% grain damage) compare to Alligator pepper powder (10% grain damage), although it shows similar results (0% grain damage) with Moringa leaf powder at 20g dose. At dose 25 and 30g the three botanicals had similar results with ADI. This shows their potential to replace the synthetic ADI.

Table 1: Effects of Alligator pepper powder on mortality of adult *S. zeamais* at 96hrs

Quantity applied(g)	No of weevil	No of	% Mortality	Log_{10}	Empirical	% Mean Mortality±SD	SEM	LD_{50}	LD_{90}
0 (Control)	10	0	-	-	-	65.00±2.812	1.063	2.55	32.15
5	10	7	70	0.70	5.52				
10	10	7	70	1	5.52				
15	10	7	70	1.18	5.52				
20	10	7	70	1.30	5.52				
25	10	8	80	1.40	5.84				
30	10	8	80	1.48	5.84				
ADI(0.2g)	10	8	80	-0.70	5.84				

*Significance level at P<0.05
SD = Standard Error; SEM = Standard Error Mean; ADI = Actellic Dust Insecticide

Table 2: Effects of Moringa leaf powder on mortality of adult *S. zeamais* at 96hrs

Amount applied (g)	No of weevil	No of	%	Log_{10}	Empirical	% Mean Mortality±SD	SEM	LD_{50}	LD_{90}
0	10	0	-	-	-	62.50±2.77	1.047	3.50	33.50
5	10	6	60	0.70	5.25				
10	10	6	60	1	5.25				
15	10	7	70	1.18	5.52				
20	10	7	70	1.30	5.52				

25	10	8	80	1.40	5.84
30	10	8	80	1.48	5.84
ADI(0.2g)	10	8	80	-0.70	5.84

*Significance level at P<0.05
SD = Standard Error; SEM = Standard Error Mean; ADI = Actellic Dust Insecticide

Table 3: Effects of Lemon grass powder on mortality of adult *S. zeamais* at 96hrs

Amount applied (g)	Total No of weevil introduced	No of Affected weevil	% Mortality	Log_{10} Conc.	Empirical Probit	% Mean Mortality±SD	SEM	LD_{50}	LD_{90}
0	10	0	-	-	-	63.75±2.80	1.056	3.45	34.5
5	10	6	60	0.70	5.25				
10	10	7	70	1	5.52				
15	10	8	80	1.18	5.84				
20	10	7	70	1.30	5.52				
25	10	8	80	1.40	5.84				
30	10	8	80	1.48	5.84				
ADI(0.2g)	10	8	80	-0.70	5.84				

*Significance level at P<0.05
SD = Standard Error; SEM = Standard Error Mean; ADI = Actellic Dust Insecticide

Table 4: Effects of Alligator pepper applied at varying amounts on maize grain perforation caused by *S.zeamais* (96hrs)

Amount applied (g)	No of grain sampled	No of perforated grain	Grain damage (%)
0	10	3	30.00
5	10	1	10.00
10	10	0	0.00
15	10	1	10.00
20	10	1	10.00
25	10	0	0.00
30	10	0	0.00
ADI(0.2g)	10	0	0.00

ADI = Actellic Dust Insecticide

Table 5: Effect of Moringa leaf powder applied at varying amounts on maize grain perforation caused by *S.Zeamais* (96hrs)

Amount applied (g)	No of grain sampled	No of perforated grain	Grain damage (%)
0	10	4	40.00
5	10	1	10.00
10	10	1	10.00
15	10	1	10.00
20	10	0	0.00
25	10	0	0.00

30	10	0	0.00
ADI(0.2g)	10	0	0.00

ADI = Actellic Dust Insecticide

Table 6: Effect of Lemon grass powder applied at varying amounts on maize grain perforation caused by *S.Zeamais.(96hrs)*

Amount applied	No of grain sampled	No of perforated grain	Grain damage (%)
0	10	3	30.00
5	10	1	10.00
10	10	1	10.00
15	10	0	10.00
20	10	0	0.00
25	10	0	0.00
30	10	0	0.00
ADI(0.2g)	10	0	0.00

ADI = Actellic Dust Insecticide

DISCUSSION

Botanicals are now recognized as potent alternative having strong insecticidal effects in various pest control programmes due to their excellent larvacidal, pupicidal and adulticidal properties. This present study shows that all the botanicals used are effective in controlling *S. zeamais* present in maize grain. In most parts of the world, the residual synthetic insecticides are currently the choice desired by many for the control of stored product insect pest. The prolonged uses of these chemicals have path way for many species of stored-product pest to develop resistance (Rahman et al., 2009). The residual effects in terms of environmental contamination and health hazards are also issue of interest. All thesegave researchers the insight to source for alternative which are eco-friendly, cheap and easy to prepare.

From the result tables, it can be deduced that all the plants powder used during this study have significant effects on the mortality of adult *S. zeamais* and the longevity of the maize grain. The present study agrees with the result of Danjuma *et at*., (2009) who reported similar results ranging from 76-100% mortality using the powder of *A.sativum, N. tabacum,* and*Z. officinale* at a dose of 0.5, 1.0, 1.5 and 2g respectively, although at a period of 72hrs. The results obtained also corroborate that of Arannilewa *et al*., (2006) who also reported about 85% mortality when adult *S. zeamais* were exposed to maize grain containing extract of *A. sativum*for 4days. Plant powders often reduce adult weevil growth (Rajapakse, 2006). They have lethal effects on adult emergence of insect pest such as *S. zeamais* attacking stored grains such as maize and cowpea(Suleiman and Yusuf, 2011). The lethal ability of theseplants could be attributed to their contact toxicity on the weevil (Muhammad and Babatunde, 2015). The botanicals at higher dose of 25 and 30g appear to have similar effects with ADI which shows their ability to replace ADI and other synthetic chemicals.

CONCLUSION

The three botanicals used in this study all show promising effects and their use can be adopted in treating stored-products to prevent insect pest invasion. In addition all the plants used are edible since they are used as either food ingredients or medicinal herbs for the treatment of various ailments in both human and animals.

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