Journal of Agricultural Technology 2012 Vol. 8(1): 117-124
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Insecticidal activity of *Secamone afzelii* (Schult) *K. schum* powder in the control of *Stiphilous zeamais* (Mots) (Coleoptera: Curculionidae)

Adesina, J.M.*, Ofuya, T.I. and Afolabi, L.A.

[1]Agricultural Technology Department, Rufus Giwa Polytechnic, P.M.B 1019, Owo, Ondo state, Nigeria
[2]Crops, Soil and Pest Management Department, Federal University of Technology, P.M.B. 704, Akure, Ondo State, Nigeria

Adesina, J.M., Ofuya, T.I. and Afolabi, L.A. (2012) Insecticidal activity of *Secamone afzelii* (Schult) K. schum powder in the control of *Stiphilous zeamais* (Mots) (Coleoptera: Curculionidae). Journal of Agricultural Technology 8(1): 117-124.

Maize seeds are highly susceptible to beetles attack and every year this insect causes great loss in storage.The present study investigated the efficacy of the insecticidal properties of *Secamoneafzelii* plants powder against *Sitophilus zeamais.* Four application rates *S.afzelii* leaf and vine powder i.e. 0g/20g, 0.5g/20g, 1.0g/20g, 1.5g/20g and 2.0g/20g of maize seeds were test under ambient laboratory condition. Mortality of adult insects at 48 hours and 15 days post treatment, adult emergence, adult exit holes and percentage weight loss in each treatment were compared with those of control.Amongst the various treatments tested application rate of 2.0g/20g seeds was observed to significantly ($P< 0.05$) suppress adult emergence. While adult exit holes and percentage weight loss were significantly reduced at all levels of application.

Key words: adult emergence, application rates,efficacy, *Secamoneafzelii, Sitophilus zeamais.*

Introduction

Maize seeds damaged in storage by *Sitophilus zeamais* are particularly important in Nigeria because they significantly reduce the availability of the produce as a good source of carbohydrate. (Stanton *et al.,* 1996). Maize damage by *Sitophilus zeamais* eventually result in viability loss, caking and mould growth thereby making the maize to be unfit for consumption and reduce economic value (Agboola, 1982).

The most effective method of controlling *Sitophilus zeamais* attack and damage in developing countries is currently the use of conventional synthetic insecticides (Mbah and Okoronkwo, 2008). Despite the effectiveness of these insecticides, their adoption and use at the peasant farmers and semi-commercial

* Corresponding author: Adesina, J.M.; e-mail: moboladesina@yahoo.com

farmers' level under which cowpea and maize are produced in Nigeria, have been characterized by several problems, such as, appearance of resistant strain of pest (Boeke *et al.,* 2004), high cost of procurement (Mabbet, 2004), pest resurgence and secondary pest outbreaks (Epidi *et al.,* 2009). In addition, non-selective insecticides kill beneficial insects and non-targeting organism thereby causing an imbalance in the ecosystem (Gupta *et al.,* 2001). Public concerns over the toxicity of pesticides and their impact on the environmental damage and public health have necessitated research on alternative eco-friendly and sustainable methods to control (Chaudhary and Kaul, 2011). This may proffer solution to problems emanating from the use of conventional insecticides. Therefore the objective of this study is to evaluate the insecticidal activity of *Secamone afzelii* powder in the control of *S. zeamais.*

Materials and methods

S. zeamais Culture and Experimental Condition

The *S. zeamais*used for the experiment were derived from a colony originating from infested cowpea seeds collected from Ulede (Oja Oba) market in Owo, Ondo State, Nigeria(latitude 5^0 12' N and longitude 5^0 36' E). The emerge adults were sub-cultured in the Crop Protection Laboratory of Agricultural Technology Department of Rufus Giwa Polytechnic, Owo, Ondo State, and the sub-cultures were maintained in kilner jars in the laboratory under ambient conditions (28 ± 3^0C and 70 ± 5 % relative humidity) and emerging adult insect were recycled from generation to generation. *S. zeamais*was maintained on T-Swam yellow maize variety used as substrate.

The clean maize seeds used for the experiment were obtained from the seed store of Ondo State Agricultural Development Project, Akure. The clean seeds showed no visible presence of adults or their exit hole, but were nevertheless disinfested by storing them in a deep freezer for two weeks and then acclimatized in the open laboratory for 24 hours to avoid mouldiness before use (Olotuah *et al.,* 2007).

Preparation of Secamone afzelii powder

Fresh *Secamoneafzelii* plants were collected from Laosuo Camp in Ondo West Local Government, Area of Ondo state, Nigeria (07^0 05' N, 04^0 55'N). The identity was confirmed at The Herbarium, Department of Forestry and Wood Technology, The Federal University of Technology, Akure, Nigeria. The plants were shade dried and the leaves and vines were detached separately. Thereafter, the dried leaves and vines were grounded into powder using electric

laboratory hammer mill (Ogendo *et al.,* 2004). The powders from leaves and vine were stored separately in air tight plastic containers and placed in a wooden cupboard in the laboratory for future use.

Contact Toxicity of Secamone afzelii powder to S. zeamais

The powders of *Secamone afzelii* leaves and vines were tested at 0.5g, 1.0g, 1.5g, and 2.0g per 20g of uninfested maize seeds in separate Petri-dish glass (9.0 cm) plates. Each of the Petri plate was tumbled several times to ensure homogenous mixing of powder with grains. Five males and females (ten insect) of *S. zeamais* were introduced into each Petri-dish glass. *S. zeamais* sex was determined using snout characteristics (Halstead, 1962; Tolpo and Morrison, 1965). Adult mortality was monitored and counted 48 hours after infestation; percentage mortality was calculated using the method adopted by Omotoso and Oso (2004).

$$\% \text{ Mortality} = \frac{\text{No of dead insect}}{\text{Total no of insect}} \times 100$$

Adult weevils were removed 21 days after infestation and number of adult weevil emergence and exit hole was counted 45 days after infestation.
There was also a control treatment involving no addition of plant powder on to the seeds. At the end of the experiment the final weight of each of the treatment were taken and this was used to calculate the percentage weight loss (Omotoso and Oso, 2004).

$$\% \text{ Weight loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Experimental Design and Data Analysis

The experimental design adopted for the experiment was Complete Randomised Design (CRD) and each treatment was replicated three (3) times. Data collected were subjected to analysis of variance (ANOVA). Whilst egg counts, exit hole were subjected to square root transformation, percentages were arcsine transformed, before analysis.Percentage efficacy was determined using Abott's formula (Abbott, 1925). Treatment means were separated using Least Significant Difference (LSD) statistics at $P < 0.05$.

Results

Mortality of adults of *S. zeamais* 48 hours post treatment with different concentration of *S. afzelii* powder is presented in Table 1. The leaf powder of *S. afzelii* applied at 2.0g inflicted significantly greater mortality to *S. zeamais* adults than when applied at other dosages except at 1.5g. The mortality in *S. zeamais* adults caused by the vine powder applied at 2.0g was also highest, but was not significantly different ($P > 0.05$) from mortality caused when applied at 1.5g and 1.0g.

Table 1. Percentage mean mortality of *S. zeamais* 48 hours after treatment of infested product with *Secmone afzelii* at different dosages

g powder / 20g of grain	*S. zeamais* mortality in	
	Leaf powder	**Vine powder**
0.0g	0.00	0.00
0.5g	24.20	26.07
1.0g	26.07	28.08
1.5g	30.99	33.00
2.0g	37.14	41.07
LSD (0.05%)	8.25	14.36

NB Value were arcsine transformed

The mean mortality of *S. zeamais* 15 days post treatment with different concentration of *Secamone afzelii* was as shown in Table 2. Both leaf and vine powder exercise significantly kills of adult *S. zeamais* ($P < 0.05$) at all levels of application. The number of adult killed 15 days post treatment was highest at 2.0g concentration for both leaf (61.92) and vine powder (68.85) than other dosages.

Table 2. Percentage means mortality of *S. zeamais* 15 days after treatment of infested product with *Secmone afzelii* at different dosage

g powder/20g of grain	*S. zeamais* mortality in	
	Leaf powder	**Vine powder**
0.0g	17.37	26.07
0.5g	45.00	59.71
1.0g	54.99	61.92
1.5g	59.01	63.93
2.0g	61.92	68.85
LSD (0.05%)	13.45	12.13

NB Value were arcsine transformed

Adult emergence of *S. zeamais* 45 days post treatment with different concentration of *S. afzelii* powder is summarized in table 3. The vine powder recorded significant different ($P < 0.05$) compared to control and 0.5g. The leaf powder recorded lowest *S. zeamais* adult emergence in 2.0g than other dosages and was significantly different ($P < 0.05$) compared to control and 0.5g.

Table 3. Mean adult emergence of *S. zeamais* when treated with different dosages of *Secamone afzelii*

g powder/20g of grain	***S. zeamais* mortality in**	
	Leaf powder	**Vine powder**
0.0g	35.71	36.26
0.5g	24.58	20.79
1.0g	14.51	15.60
1.5g	11.24	15.09
2.0g	7.15	14.53
LSD (0.05%)	7.40	4.45

NB Value were arcsine transformed

The transformed mean number of adult exit hole on the grains treated with different concentration of *S. afzelii* powder was shown in Table 4. .Adult exit hole in leaf and vine powder treatment exhibit significantly difference ($P < 0.05$) when *S. afzelii* when applied at 2.0g compared to 0.5g and control.

Table 4. Mean number of adult exit hole on maize seed treated with different concentration of *Secamone afzelii*

g powder/20g of grain	***S. zeamais* mortality in**	
	Leaf powder	**Vine powder**
0.0g	6.07	6.41
0.5g	4.74	4.05
1.0g	3.17	3.19
1.5g	2.64	3.10
2.0g	2.49	3.01
LSD (0.05%)	3.04	0.74

NB Value were square root transformed

Transformed percentage mean weight loss of grains treated with different concentration of *S. afzelii* powder is summarized in table 5. The leaf powder treated on the grains is significantly different at 2.0g compared with 0.5g and control. Vine powder on maize recorded the highest percentage of weight loss in control, and its significantly different ($P <0.05$) compared to 2.0g and 0.5g.

Table 5. Percentage weight loss of maize seeds treated with different dosage of *Secamone afzelii*

g powder/20g of grain	*S. zeamais* mortality in	
	Leaf powder	Vine powder
0.0g	21.88	21.26
0.5g	21.27	15.43
1.0g	9.84	10.25
1.5g	8.57	10.17
2.0g	7.66	10.08
LSD (0.05%)	6.19	4.89

NB Value were arcsine transformed

The percentage efficacy of grains treated with different concentration of *S. afzelii*. Was shown in Fig.1. Maize treated with 2.0g of leaf powder of *S. afzelii* recorded highest efficacy and vine powder recorded the highest efficacy when treated at 0.5g compared to other dosages.

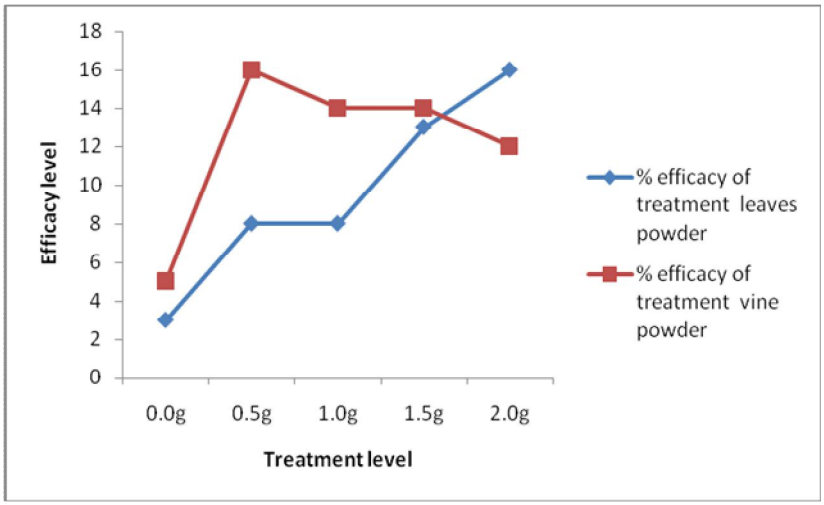

Fig.1. Percentage efficacy of maize seeds treated with different doses of *Secamone afzelii.*

Discussion

The significant mortality of *S. zeamais* when leaf and vine powders of *S. afzelii* were applied indicates the presence of insecticidal properties in this plant, which negatively impacted on survival of the adult beetles. This is consistent with the findings of other workers who have reported the effectiveness of various plant powders used as grain protectants against various insect pests of stored products (Sule and Ahmed, 2009).

The effectiveness of each of the treatment types against in suppressing the adultemergence revealed that the plants were effective against *S. zeamais*. For instance mean adult emergence at 2.0g for leaf powder and vine powder was 7.15 and 14. 53 compared to control 35.71 and 36.26 respectively.The result is in line with Ofuya (1986) and Chinwada and Giga (1977) that mixing grains seeds with inert materials like wood-ash and sand can cause physical impediment to beetle movement thereby preventing mating and oviposition and in turn reduce adult emergence.

The reduction in seed damage as reflected by the mean number of adult exit hole and percentage weight loss in both grains is in tandem with the mean number of adult emergence from the treated grains The lower the percentage adult emergence from the treated grains, the lower the adult exit hole and damage weight loss or vice versa. This result confirmed earlier findings of Akob and Ewete (2007) that ash of some bioactive plant species cause oviposition deterrence and or ovicidal action resulting in reduced progeny production of stored product insects, thus reduce seed damage.

Conclusion

The observations of this study concluded that the application of *S. afzelii* powderhad cumulative effect on reduction in the weevil adult emergence of treated seed and thus could be used as storage protectant to complement conventional synthetic insecticide.

References

Abbott, W.S. (1925). A method of computing effectiveness of an insecticide. Journal of Economic Entomology18 :265-267.

Agboola, S. D. (1982). Research for effective food storage in Nigeria. NSPRI Occasional Paper Series No. 4, p21.

Akob, C.A. and Ewete, F.K. (2007). The efficacy of ashes of four locally used plant materials against *Sitophilus zeamais* (Coleoptera: Curculionadae) in Cameroon. International Journal of Tropical Insect Science 27 (1): 21-26.

Boeke, S.J., Barnaud, C., van Loon, J.A., Kossous, D.K., van Huis A., Dicke, M. (2004). Efficacy of plant extracts against the cowpea beetle Callosobruchus maculatus. International Journal of Pest Management 50 (4): 251–258.

Chaudhary, K.K. and Kaul, R.K. (2011) South Asian Journal of Experimental Biology, 1 (1): 36-42; 2011

Chinwanda, P. and Giga, D.P. (1997). Traditional seed protectants for the control of bean bruchids. Tropical Science 37: 80 – 84.

Epidi T.T., Udo, I.O. and Osakwe, J.A. (2009) . Susceptibility of *sitophilus zeamais* Mots. and *callosobruchus maculatus* Fab. To plant Parts of ricinodendron heudelotii. Journal of Plant Protection Researc. Vol. 49, No. 4

Gupta, A., Upadhyay, R.K. and Saxena, P.N. (2001). Toxicity evaluation of certain blood biochemical parameters in *Passer domesticus* (Linn.).- Journal of Scientific and Industrial Research, 60: 668-674.

Halstead, D.G.H. (1962). External sex difference in stored-product Coleoptera. Bulletin of Entomological Research 65, 1-3.

Mabbet, T. (2004). IPM the African way. In: Africa Farming and Food Processing. Hy-line int'l. West Des Moines, Iowa, USA pp. 17-20.

Mbah, O.I. and Okoronkwo (2008). An assessment of two plant product efficacy for the control of the maize weevil (*Sitophilus zeamais* Motschulsky) in stored maize. African Journal of Agricultural Research Vol. 3 (7), pp. 494-498.

Ofuya, T.I. (1986). Use of wood ash, dry *chilli* pepper and onion scale leaves for reducing *Callosobruchus maculatus* damage in cowpea seeds during storage. Journal of Agricultural Science, Cambridge, 107: 467-468.

Ogendo, J.O., A.L. Deng., S.R. Belamin., D.J. Walker and Musandu, A.A.O. (2004). Effect of insecticidal plant materials, *Lanatana camara L .and Tephrosia vogelii* Hook, on the quality parameter of stored maize grains. The Journal of Food Technology in Africa Vol. 9 (1): 29 – 35.

Olotuah, O.F., Ofuya, T.I. and Aladesanwa, R.D. (2007). Comparison of four botanical powders in the control of *Callosobruchus maculatus* (Fab.) (Coleoptera: Bruchidae) and *Sitophilus zeamais (*Mots) (Coleoptera: Crculionidae). Proceeding Akure Humbolt Kellong 3rd SAAT Annual Conference, Fed. University of Tech., Akure, Nigeria 16th – 19th April, 2007, pp. 56-59.

Omotoso, O.T. and A. A. Oso (2004). Insecticidal and Insect Productivity Reduction Capacities of *Aloe vera and Bryophyllum pinnatum* on *Tribolium casteneum* (Herbst). African Journal Of Applied Zoology and Environ. Biology, vol. 7:95-100.

Santon, E., Kostjukovski, M. and Eilberg J. Sukprakarnc (1996). Plant oils as fumigant and contact insecticides for the control of stored products insects. Journal of Stored Products Research 33 (1): 7-15.

Sule, H. and Ahmed, B.I. (2009). Effect of Plant Product, Application Rates and Grain Type on the Control of Red Flour Beetle *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae) on Stored Millet (*Pennisetum glaucum* (L.) R.Br.). Academic Journal of Entomology 2 (1): 22-30.

Tolpo, N.C. and Morrison, E.O. (1965). Sex determination by snout characteristics of Sitophilus zeamais Motschulsky. Texas Journal of Science 17, 122–124.

(Published in January 2012)