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Original Research Article

Laboratory evaluation of pepper fruit (*Dennetia tripetala*) against maize weevil (*Sitophilus zeamais*) on stored maize grains.

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Laboratory studies were conducted at the Pathology laboratory, University of Uyo, Nigeria to evaluate the insecticidal properties of Dennetia tripetala leaf powder against the maize weevil, Sitophilus zeamais Mots. 100g of maize was treated with the leaf powder as a direct admixture at 0, 5 and 10% level to test for mortality, progeny development and damage assessment. Each treatment level was replicated four times and laid out in a complete randomized design. Analysis was done using analysis of variance (ANOVA) and means compared using LSD (P<0.05). Results obtained showed significant weevil mortality after 96 hours of exposure to treatment compared with the untreated control. Significant protection of grains was achieved while progeny emergence was significantly reduced at the 10% treatment level (333.4) compared with the control (602.20). The study revealed that the candidate botanical possessed insecticidal, ovicidal and repellent actions against the pest and such could be used effectively in the management of S. zeamais in post- harvest systems, especially among the poor resource farmers in developing countries.

Keywords *Dennetia*, maize weevil, mortality, repellent, grains, post-harvest system Introduction

INTRODUCTION

Maize is an important staple food in the tropics, where it is consumed by human and used as feed for animals. After harvesting, farmers usually store their maize products for short to long term periods to ensure food security, attain price stabilization and provide raw materials for industries, provision of seeds for planting and enhancement of a nation's strategic stock (Adedire et al., 2011). Post-harvest losses as high as 30 – 100% have been recorded in the tropics as a result of poor storage systems, inclement weather conditions and the incidence of pest infestation constituting major constraints to efficient storage (Demissie et al., 2008; Udo, 2008). Insects attack of stored cereals and legumes has been identified as a major constraint to profitable production and storage of such products. Amongst the storage insect pests of maize, *Sitophilus zeamais* has been observed to be most destructive and can infest grains in the field before storage (Ukeh et al., 2009).

Attempts at control of the maize weevil by farmers have over the years relied on the use of synthetic chemicals with attendant consequences being well reported (Umoetok et al., 2004; Akobi and Ewete, 2007). The negative consequences of the use of synthetic insecticides have over the years, stimulated research interest in botanicals because they are safe, easily degradable and environmentally friendly. Plants produce secondary metabolites such as alkaloids, terpenoids, flavonoids, phenols, etc. which act as a natural defense against phytophagous pests and disease causing organisms (Potenza et. al., 2004, Vendramim and Castiglioni, 2000; Udo, 2013). One of such botanicals is pepper fruit, *Dennetia tripetala* which is an indigenous fruit tree of the tropics and belonging to the family Annonaceae (Etukudo, 2000). *D. tripetala* is a spicy fruit tree with medicinal properties and contains essential oils, phenolic acids, alkaloids, flavonoids, tannins and glycosides (Anyaele and Amusan, 2003; Okwu and Morah, 2004). This study was therefore carried out to evaluate the toxicity and protection effect of *D. tripetala* against *S. zeamais* on stored maize.

MATERIALS AND METHODS

Culturing of Insects

Adult *S. zeamais* were obtained from the infested stock of maize at Uyo main market, Akwa Ibom State, Nigeria and cultured in the laboratory after the methods of Inyang (2004). Adult *S. zeamais* were introduced into pre-equilibrated grains in glass jars and kept for seven days to allow for oviposition. After the seven days, the adult weevils were sieved out using an impact test sieve and kept for 21 days to allow for the

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emergence of same age progeny that were used for the various bioassays.

Plant Material Preparation

D. tripetala leaves were purchased from Ikpe Annang market in Akwa Ibom State, Nigeria. The leaves were air dried in the laboratory for five days and ground into powder using electric blender. The powder was stored in black polythene bags and kept away in laboratory cupboards until use.

Mortality Assessment

One hundred grams of maize were placed in white plastic cups and the leaf powder of pepper fruit was added at 5% and 10% as direct admixtures before twenty adult S. zeamais of mixed sexes were introduced into the cups. The cups were covered with white muslin cloths and held in place with rubber bands. The control treatment had no plant powder added and each treatment was replicated four times. Insect mortality was recorded after 24 hours of treatment and up to 96 hours. Insects were assumed dead on failure to respond to three probing with a blunt dissecting probe (Udo, 2008).

Progeny Production

Grains treated with powder plant materials were assessed for the emergence of the first filial generation. Maize grains which had been kept in the freezer to prevent hidden infestation were used for the experiment. Twenty adult insects were introduced into treated and untreated grains with cups covered with white muslin cloth and left to stand undisturbed for five weeks while the number of insects emerging from each treatment was counted for one week.

Damage Assessment

One hundred grams of grains previously kept in the deep freezer for two weeks to avoid hidden infestation were used for the experiment. Five and ten percent of plant powders were added to the grains and ten pairs of insect pest introduced into treated and untreated grains. The experiment was left to stand for four weeks with each treatment replicated four times. Samples of 100 grains were taken from each cup and number of damaged grains (grains with characteristic holes) and undamaged grains were counted and weighed. Percent damage was computed using the method of FAO (1985).

RESULTS

Insect Mortality

Significant ($P<0.05$) mortality was observed against the insect at both 5% and 10% treatment levels compared with the control (Table 1). There was an increase in mortality after 24 hours of application of plant powder with the 10% treatment level recording a mortality of 65% after 96 hours of treatment. Mortality was observed to increase with an increase in the treatment levels.

Progeny Production

The leaf powder significantly ($p < 0.05$) reduced the progeny of *S. zeamais* (Table 2) compared with the control. However, when the level of plant powders was increased, the progeny was observed to be decreasing.

Damage Assessment

Grains treated with powdered plant materials showed significant difference ($p < 0.05$) in the reduction of damage caused by *S. zeamais* (Table 2). At the 10% treatment level, about 85% protection of maize was attained.

DISCUSSION

Leaf powder of *D. tripetala* was toxic to *S. zeamais* exposed to treatment and this phenomenon suggests the presence of pungent secondary metabolites in the plant. One of the constituent secondary metabolite has been identified as a phenolic acid reputed for insecticidal activity (Anyaele and Amusan, 2003). Some secondary plant metabolites may act both as insecticides and antifeedants thus influencing insect locomotion, oviposition, feeding behavior, developmental and physiological processes as well as behavioural patterns. The plant powder tested at 10% concentration, reduced damage caused by the insect species thus indicating the presence of antifeedant and oviposition deterrent properties in the plant.

This is further evidenced by the reproduction inhibition observed against the insect and confirms the reported reproduction suppression properties of *D. tripetala* against *C. maculatus* on stored cowpea (Ukeh et al., 2011). The effective utilization of *D. tripetala* as a botanical pesticide could minimize the use of hazardous chemicals in stored product pest control. In the traditional post-harvest system in Africa, resource poor farmers could prepare the powders and use them locally at cheaper cost. Therefore, botanical pesticides represent an important component of integrated pest management systems in traditional grain storage as they are broad spectrum in action, based on local materials and potentially less expensive while many are safe to the environment and pose no danger to man and other mammals.

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Table 1: Toxicity of *D. tripetala* against *S. zeamais* on stored grains

Treatment level	Mean percent mortality, hours after treatment			
	24	48	72	96
Control	0.00	0.00	0.00	0.00
10%	25.00	37.50	48.75	61.25
5%	21.25	33.75	47.50	57.50
LSD	ns	0.07	0.10	0.10

Means of four replicates of 20 insects each. LSD test (P<0.05). ns = not significant

Table 2: Effect of *D. tripetala* on progeny development and damage caused by *S. zeamais* to stored grains

Treatment level	Mean number of F_1 progeny	% grain damage
Control	602.20	7.24
10%	333.40	0.88
5%	366.00	1.15
LSD	4.55	1.31

Means of four replicates of 20 insects each. LSD test (P<0.05)