Effect of *Dennettia Tripetala* Powder and Reduced Rates of Pirimiphos-Methyl Singly and Combined in Management of *Callosobruchus Maculatus* (F.) [Coleoptera: Bruchidae]

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Received: June 02, 2010 Accepted: June 18, 2010 doi:10.5539/ijb.v3n2p174

Abstract

Dennettia tripetala powder and reduced rates of pirimiphos-methyl dust were tested on cowpea against *C. maculatus* for their effective management. The study was conducted under ambient conditions of 25^0C – 28^0C and 65% - 75% relative humidity in the laboratory for a period of 3 months. Powder of *D. tripetala* and dust of pirimiphos-methyl were tested sole at 0.4g and 0.1g per 20g of cowpea seeds respectively while various combinations at 0.2g DT + 0.05g PM, 0.2g DT+ 0.025g PM, and 0.2g DT + 0.0013g PM were also tested on 20g of cowpea seed. *D. tripetala* powder was more effective at 0.4g when applied singly. Adult mortality of more than 80% occurred in less than 3 days. It also caused a significant reduction in oviposition, adult emergence and weight loss after emergence. Effect of sole application of pirimiphos-methyl dust at 0.1g per 20g of cowpea seed was less when compared with 0.4g of *D. tripetala*. The combined treatments of *D. tripetala* and pirimiphos-methyl slightly reduce adult emergence and weight loss. This study revealed better performance of *D. tripetala* powder when applied singly over reduced rates or even when combined with pirimiphos-methyl against cowpea seed beetle.

Keywords: *Dennettia tripetala*, Pirimiphos-methyl, Oviposition, Powder, Dust, Emergence

1. Introduction

Cowpea, *Vigna unguiculata* (L.) Walp is an important legume crops in tropics and sub-tropics. It assumes a staple position in crop food of Africa and especially in Nigeria where it supplies most of the protein requirement of the diets. A substantial part of the world cowpea production comes from Nigeria with about 4 million hectares and approximately 1.7 million tons of beans annually (Ofuya, 2003). Production of cowpea has however been difficult as a result of attack from cowpea seed beetle, *Callosobruchus maculatus* (F.). *C. maculatus* has drawn attention because it is widely distributed throughout the tropical and sub-tropical regions, tropicopolitans (Lale, 2002). Cowpea seed beetle, *Callosobruchus maculatus* is a cosmopolitan pest of stored grain legumes, especially cowpeas in the tropics and sub-tropics (Jackai & Daoust, 1986; Ofuya, 2001). Several damaged seeds are disfigured with egg covered and riddled with adult exit holes, consequently have reduced weights and poor germinability, often, after six months in storage 100% seed infestation may be recorded (Alabeek, 1996). Caswell (1981) reported an estimated of 4.5% infestation and damage caused by storage bruchids, especially *C. maculatus*. Control of *C. maculatus* has been through the use of conventional dusts, such as pirimiphos – methyl, permethrin and fumigants such as aluminium phosphate. Their effectiveness against *C. maculatus* storage has been reported by Jackai & Daoust (1986). When the chemicals are used improperly they poses risk to man and environment, this is most common among uneducated rural farmers in Africa (Ofuya, 2003). Plant derived insecticides could be a better replacement for the synthetic insecticides in stored products protection (Lale, 2001).

Plant products such as vegetable oils, essential oils, crude extracts and powders have been tested against *C. maculatus*. (Lale, 1995; Dales, 1996; Golob *et al.*, 1991; Boeke *et al.,* 2001). Powder of parts of many indigenous plants when applied at 2% of the weight of stored beans will effectively control the cowpea seed beetle in storage (Lale, 1994; Ogunwolu & Odunlami 1996; Adedire & Lajide, 2001; Ofuya & Salami, 2002). This study investigated efficacy of combined powders of *Dennettia tripetala* and dust of pirimiphos-methyl against their sole treatment in the management of cowpea seed beetle, *Callosobruchus maculatus*.

2. Materials and Methods

This study was conducted in the entomology laboratory of the Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Ondo State, Nigeria in 2009.

2.1 Culturing of Callosobruchus maculatus

The original *Callosobruchus maculatus* used was derived from a colony originating from infested cowpea seeds collected from Oja Oba market in Akure, Ondo State, Nigeria. The emerged adults were sub-cultured in the laboratory and the sub-culture was maintained in Kilner jars containing 500g beetle susceptible cowpea (Ife-brown) in the laboratory at 28 ± 3^0C and 70 ± 5^0 % relative humidity.

The clean beetle susceptible cowpea seeds (Ife-brown) used for the experiment were obtained from the Agricultural Development Program (ADP) office, Akure. Prior to experiments, the seeds were sterilized for 3 hours in a Gallenkamp oven at a temperature of 60ºC to kill any available insects and other microorganisms in them (Allotey & Azalekor, 2000).

2.2 Preparation of plant material

Dennetia tripetala seeds used in this study were obtained from Oja-Oba market, Akure Ondo State. Well dried *Dennetia tripetala* was pulverised using mortar and pestle. It was sieved to obtain fine powder while large fibrous particles were removed and discarded. The fine powder was put in a plastic container with tightly fitted lids and placed in a wooden cupboard in the laboratory for future use.

2.3 Bioassay of the powder Dennetia tripetala and dust of pirimiphos-methyl

Twenty grams (20g) of clean beetle susceptible cowpea seeds (Ife-brown) were weighed into petri-dishes each of which 0.4g and *Dennetia tripetala* powder was added separately. Five pairs of adult *Callosobruchus maculatus* (1-2days old) were introduced into each of the petri-dishes. The contents of the plastic were then shaken vigorously for proper admixture. The experiment was arranged in completely randomized design. Adult mortality was monitored and counted for 3 days after application, after which all the insects were removed. The number of eggs laid on the seeds and adults which emerged from the eggs were counted 21 days post infestation. Treatment and control were replicated three times.

Pirimiphos-methyl dust was tested at a reduced rate of 0.1g per 20g of cowpea seeds using the procedure described for *Dennetia tripetala* powder. Three days after infestation, all insects were removed and the number of eggs laid counted and recorded. Number of adults that emerged was also counted 21 days post infestation.

Combined treatment of *Dennetia tripetala* powder and pirimiphos-methyl dust at different concentrations of 0.2g DT + 0.05g PM, 0.2g DT + 0.025g PM, 0.2g DT + 0.0013g PM were all tested on *C. maculatus* following the same procedure described above. Data on eggs laid, adult emergence, mortality and weight loss after emergence were al monitored and recorded.

2.4 Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) and Genstat software version 5 Release 3.2 (Lawes Agricultural Trust, 1995). Significant differences at ($P>0.05$) were separated using Least Significant Difference (LSD). Data on adult mortality were subjected to arcsine transformation while those on adult emergence and weight loss were transformed using square root transformation to normalize the data for analysis.

3. Results and Discussion

3.1 Mortality

Dennettia tripetala powder and pirimiphos-methyl dust exhibited insecticidal activities on the adult cowpea seed beetles and caused varying degree of mortality. When applied singly *D. tripetala* caused higher mortality (83%) at 3 days (72hrs) post application of treatment while pirimiphos-methyl dust caused (73%) mortality, though their difference is not significantly different at $P>0.05$ (Table 1).

3.2 Number of egg laid, Adult emergence and Seed weight loss

Table 2 shows the number of egg laid, adult emergence and seed weight loss. All the treatments were

significantly different at P>0.05. Fewer numbers of eggs (8) were laid on the cowpea seed treated with 0.4g DT compared with higher number (86) recorded for treatment with 0.1g PM. More number of adult insect (29) emerged treatment with 0.1g PM while less number emerged from seed treated with *D. tripetala* at 0.4g. Higher seed weight loss was also recorded on seed treated with 0.1g PM than those treated with 0.4g DT and were consequently significantly different. However, control treatment recorded highest number in all the parameter determined.

From Table 3, more percentage mortality (60%) was recorded on seeds treated with a combined DT and PM at 0.2g + 0.05g for 72hrs, although does not show any significant difference from (53%) that was obtained from 0.2 DT + 0.025 PM at P>0.05. However treatment combination at 0.2 DT + 0.0013 PM was significantly different from others with percentage mortality of 46 except control treatment.

Table 4 revealed highest number of egg laid on seed treated with 0.2g DT + 0.2g PM compared to treatment with 0.2g DT + 0.05g PM but was not different significantly (P>0.05). Control treatment has the highest number of egg laid on the cowpea seeds and was significantly different from other treatment combinations. Numbers of adult that emerged and seed weight loss recorded from all the treatments were significantly different.

Sole and combined treatments of *D. tripetala* powder and pirimiphos-methyl dust exerted insecticidal activities on the seed beetle and thus caused varying degrees of mortality. All treatments have negative effects on the beetles when applied thus causing reduction in the number of eggs laid, adult emergence and seed weight loss. Various natural plant products have been used with a good degree of success as protectants against a number of stored product insect pests (Ewete & Alamu, 1999; Liu & Ho, 1999; Rajapakse & van Emden, 1997; Okonkwo & Okoye, 1996). Previous work on ash of some bioactive plant species showed that it caused mortality, oviposition deterrence and /or ovicidal action resulting in reduced progeny production of stored product insects (Akob & Ewete, 2007; Abdelgaleil & Nakatani, 2003). The results of this study also confirmed reports of previous works by (Ofuya, 2001; Lale, 2002) that D. tripetala, pirimiphos-methyl and its mixture has a significant contact toxicity action against C. maculatus. The mechanisms of its protective action against the cowpea seed beetle include direct toxicity to adults (which cause mortality) and eggs and inhibition of oviposition by female beetles. Similar effects of plant materials as crop seeds protectants have been observed in the treatment of cowpea and maize weevils (Asawalam *et al.,* 2007; Ewete *et al.,* 2007; Ofuya & Dawodu, 2002)

The powder served as contact insecticides and so was able to enter the body when the insects walk or crawl over the treated surface, the insecticides were absorbed through the body wall (Lale, 2002).

4. Conclusion and Recommendation

It was observed in this study that sole treatment of *Dennettia tripetala* manifested significant contact toxicity against cowpea seed beetle more than sole treatments of pirimiphos-methyl and other treatment combinations. *Dennettia tripetala* reduced number of egg laid, adult that emerged and seed weight loss of treated cowpea seed.

D. tripetala from the viewpoint of this study could be a good candidate to replace synthetic convectional chemicals in the management of insect pests of stored grains as a result of its bioefficacies and availability. When results of sole treatments are compared with combined, this study revealed an antagonistic effects of *D. tripetala* powder and pirimiphos-methyl dust.

Further studies are required to determine various active ingredients available in *D. tripetala*.

Acknowledgments

The authors are grateful to Miss. S.T. Adegunlehin for data collection and the Technologists in the laboratory of the Department of Crop, Soil and Pest Management, Federal University of Technology Akure for their assistance.

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Table 1. Percentage mortality of *C. maculatus* treated separately with *D. Tripetala* powder and pirimiphos-methyl dust

	Percentage mortality (%)		
Treatments (g)	**24hrs**	**48hrs**	**72hrs**
0.4 DT	23.30a	56.67a	83.33a
0.1 PM	26.67a	53.33a	73.33a
Control	10.00b	16.67b	33.33b
LSD	8.00	9.70	10.30

Means followed by the same letter are not significantly different at 5% level of significance

LSD: Least Significant Difference

Table 2. Mean egg laid, adult emergence and seed weight loss of *C. maculatus* treated separately with *D. Tripetala* powder and pirimiphos-methyl dust

Treatments (g)	Number of egg laid	Adult emergence	Seed weight loss (g)
0.4 DT	8.67a	2.33c	0.33a
0.1 PM	86.67b	29.67b	0.58b
Control	100.00c	34.33a	3.43c
LSD	8.00	9.70	10.30

Means followed by the same letter are not significantly different at 5% level of significance

LSD: Least Significant Difference

Table 3. Percentage mortality of *C. maculatus* treated with combined *D. Tripetala* powder and pirimiphos-methyl dust

	Percentage mortality (%)		
Treatments (g)	**24hrs**	**48hrs**	**72hrs**
0.2 DT + 0.05 PM	23.30a	43.33a	60.00a
0.2 DT + 0.025 PM	16.70ac	33.33a	53.30a
0.2 DT + 0.0013 PM	30.00b	36.67b	46.70b
Control	10.00c	16.67c	33.33b
LSD	8.00	9.70	10.30

Means followed by the same letter are not significantly different at 5% level of significance

LSD: Least Significant Difference

Table 4. Mean egg laid, adult emergence and seed weight loss of *C. maculatus* treated with combined *D. Tripetala* powder and pirimiphos-methyl dust

Treatments (g)	Number of egg laid	Adult emergence	Seed weight loss (g)
0.2 DT + 0.05 PM	66.00a	15.33a	0.24a
0.2 DT + 0.025 PM	67.33a	17.33b	0.58b
0.2 DT+0.0013 PM	70.00b	20.00c	0.30c
Control	100.00c	34.33d	0.72d
LSD	2.30	2.00	0.02

Means followed by the same letter are not significantly different at 5% level of significance LSD: Least Significant Difference

 ISSN 1916-9671 E-ISSN 1916-968X