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EFFICACY OF SEED POWDER AND EXTRACTS OF *AZADIRACHTA INDICA* LINN (MELIACEAE) AT GRADED LEVELS ON ADULT *CALLOSOBRUCHUS MACULATUS* (COLEOPTERA: BRUCHIDAE) IN MUBI, NORTH-EASTERN NIGERIA

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ABSTRACT
The efficacy of *Azadirachta indica* seed powder and extracts (oil and aqueous) was evaluated for the control of bean weevils (*Callosobruchus maculatus*) on stored cowpea grains in Mubi. Neem seed products and Darksh (synthetic chemical) were compared with the control (untreated). Daily mortality count was noted for three days, while the F1 generation emergence and weight loss by the grains were subsequently noted. Data collected was subjected to ANOVA, and the treatment means were compared using LSD at 5% probability level (P=0.05). The results showed that all the treatment levels showed some toxic activity and deterrence in the further infestation. Neem seed oil and aqueous extracts showed encouraging toxic activities, deterrent activities and promptness that were just as good as Darksh, the control inorganic insecticide. Neem seed products showed high level of toxicity, low F1 emergence and weight loss by the grains. The advantages proffered by the window of utilizing neem as pesticide, namely: availability, safety, low cost, ease of application, was highlighted.

KEY WORDS: Antifeedant, Biopesticides, Cowpea, F1 adult emergence.

INTRODUCTION

Cowpea weevils *Callosobruchus maculatus* damage cowpea after harvest, attack dried cowpeas and other related stored seeds, (Agboola, 1982). The weevils prefer dried cowpeas but will attack other beans and peas in storage (Ohiagu, 1987). In Nigeria, it has been estimated that as much as 10% of the cowpea crop may be damaged before it goes into storage and the infestation builds up rapidly (Ogunwolu and Odunlami, 1996). Cowpea is a major source of dietary protein in tropical and subtropical regions of the world especially where availability and consumption of animal protein is low (Oparaeke *et al*., 1998). Enhancing cowpea productivity on the field and storage therefore requires the control of the bruchids activities. The high cost of synthetic pesticides, the danger of pesticide misuses and toxic residues in food concerns have resulted in the search for plant botanicals which can serve as good alternatives for the control of stored product pests (Bamaiyi *et al*., 2007). Techniques have been developed for the management of these stored beans which involves the protection of shelled cowpea seeds with both synthetic and biopesticides obtainable from locally available species of plants (Ethang, 2000; Ivbijaro and Agbage, 1986; Don Pedro, 1990; Lale, 1995; Rahman and Talukder, 2006).

The neem tree (A*zadirachta indica* A. Juss), from the Maliaceae family, known as margosa has long been recognized for its properties both against insect and in improving human health, (Raguraman and Singh, 2000). The neem tree is very useful as its back, roots, sap-water, leaves, flowers and seed, all are valued as medicinal importance, National Research Council (1996). The tree is now grown in most tropical and sub-topical areas of the world for shade, for reforestation programs and in plantations for the production of compound which have toxic, antifeedant and repellent properties against insects (Mordue *et al*., 1996). Azadirachtin extracted from the seed kernel has a high antifeedant and growth regulating properties for which it has been successfully used for the management of several insects pests (Mordue and Blackwell, 1993). Neem is therefore one of the few sources of botanicals pesticides currently attracting research interest world-wide. Therefore, this research was carried out to evaluate the toxicological activities of neem seed powder and extracts on bean weevils in Mubi, North Eastern Nigeria.

MATERIALS AND METHODS

Matured fallen neem seeds were collected from a neem plantation in Mubi, Adamawa State, Nigeria in May, 2011. The seeds were sun-dried, decorticated and ground into fine powder using electric blender and was stored in bottles with screw cap tops. A portion of the powder was mixed thoroughly with boiled water in a little quantity at a time, the mixture continued until a dough-like substance was formed. The oil was pressed out manually into a collecting container; this was stored also in a bottle with screw cap top.

75g portion of the powder sample was subsequently constituted by soaking it in a litter of distilled water. It was allowed to stand for about 24 hours and thereafter, filtered through double folds of Muslin cloth to obtain the filtrate.

This filtrate formed the aqueous neem seed extract (NSAE). Darksh (Dichloruos 0.1 100.00% W/V) a synthetic chemical was procured from Agrochemical Store in Mubi market, Adamawa State. Clean cowpeas were procured from Mubi market. The seeds were dried to a constant weight in an oven at 30 – 35°C for 14days, they were subsequently air dried for about an hour and were wrapped tightly in a polythene bag and stored in a deep freezer for fourteen (14 days). Initial stock was obtained from the infested cowpea and was maintained on beans in a transparent 500cm^3 jar. Thereafter, the top end of the jar was covered with a white muslin cloth with aid of rubber bands. This was allowed to stand for about twenty four (24) hours before the insects were removed. The stock was then monitored under laboratory conditions for newly adult emergence of uniform size and age. Four replicates of each of the powder treatments were constituted as follows: 0.5g, 1.0g and 1.5g of the powder treatment samples were added to 10g of beans in a 300cm^3 rearing plastic jars. They were stirred vigorously to ensure a uniform coating of the seeds with the powder treatment sample. Therefore, 10 newly emerged adult insects were introduced into the plastic jars; these were covered with muslin cloth with the help of rubber-ring to allow ventilation.

In the oil treatment cups, four replicates were constituted for 0.5ml, 1.0ml and 1.5ml respectively as follows; treatment, samples were put inside the plastic jars, then filter paper on top of the treatment samples, 10g of cowpea was introduced in each jar and 10 newly emerged adult insects were introduced into the plastic jars and were covered with Muslim cloth using rubber-ring. Four replicates were constituted for each aqueous extract concentration.1ml of each treatment concentration was introduced into the plastic jars and filter papers were used to cover the treatment, 10grams of cowpea was added to each of the plastic jars before 10 newly emerged adult insects were introduced. Plastic jars were covered with muslin cloth using rubber ring. The synthetic chemical (Darksh), was constituted for each of 0.5ml, 1.0ml and 1.5ml into four replicates as was done for the oil treatment sample. The control jar (four replicates) contained 10 newly emerged adult insects and 10grams of cowpea without treatment was added. The plastic jars were covered with Muslin cloth with the aid of rubber-ring. Mortality counts were carried out for each treatment cup, and number of adult emergence and weight loss in each cup was also noted. Measurement of adult mortality started after 24hrs of treatment and continued for about 72hrs.

Adult mortality was determined daily by counting the number of dead insects. Adult emergence was determined by counting the number of adult *C. maculatus* that emerged at 56 days after treatment. Weight loss by the grains was measured as the difference between the initial weight of the grains and their final weight.

Data collected were subjected to Analysis of Variance (ANOVA). Treatments with significant differences were compared and separated at P=0.05 level of probability using Least Significant Difference (LSD).

RESULT

The result as indicated in Table 1 shows that there were significant differences among different neem treatments as well as the synthetic chemical (Darksh) on the mortality of adult *Callosobruchus maculatus*.

TABLE 1: Effect of NSP, NSO, NSAE and Darksh on the mortality of adult *C. maculatus*

Treatment	Concentration	Hours of treatment (Mean±SD)		
		24 Hrs	48Hrs	72Hrs
Control	0.0	0.00±0.00^{a}	0.25±0.50^{a}	0.50±0.58^{a}
NSP	0.5g	1.00±0.82^{ab}	1.50±0.58^{b}	1.00±0.82^{ab}
NSP	1.0g	2.00±0.82^{bc}	2.75±0.96^{c}	2.75±1.50^{b}
NSP	1.5g	2.50±1.29^{c}	4.50±1.00^{d}	2.25±1.50^{ab}
NSO	0.5ml	1.50±0.58^{b}	4.75±0.96^{bc}	0.75±0.50^{ab}
NSO	1.0ml	1.75±0.96^{b}	6.00±1.41^{b}	1.50±0.58^{bc}
NSO	1.5ml	3.25±0.50^{c}	4.00±1.41^{c}	2.00±0.82^{c}
NSAE	0.5ml	1.00±0.82^{a}	2.25±0.82^{ab}	2.25±0.96^{b}
NSAE	1.0ml	2.25±0.50^{b}	2.00±0.50^{b}	2.50±0.58^{b}
NSAE	1.5ml	4.50±1.29^{c}	3.00±1.29^{ab}	2.00±0.82^{b}
Darksh	0.5ml	8.50±0.58^{b}	1.50±0.58^{b}	0.00±0.00^{b}
Darksh	1.0ml	9.25±0.96^{bc}	0.75±0.96^{ab}	0.00±0.00^{b}
Darksh	1.5ml	10.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{b}

Values are means of four replicates. Means carrying the same superscript are not significantly different from each other at P=0.05. where NSP= Neem Seed Powder, NSO= Neem Seed Oil, and NSAE= Neem Seed Aqueous Extract

Among the neem treatments, neem seed oil (NSO) performed significantly better than powder (NSP) and aqueous extract (NSAE) on the mortality of *C. maculatus*. Highest mortality was recorded in 48Hrs in NSO treatment (6.00±1.41) at 1.00 level of treatment. NSP was least in evoking adult mortality, but was significantly better than the untreated control.

Table 2 shows that there was a significant difference between the neem treatments as well as the synthetic chemical (Darksh) on adult emergence of *C. maculatus* as well as the weight loss by the maize grains.

TABLE 2: Effect of NSP, NSO, NSAE and Darksh on the adult F1 emergence and weight loss by cowpea grains.

Treatment	Concentration	Adult Emergence Mean±SD	Weight Loss Mean±SD
Control	0.0	11.00±2.58[a]	0.93±0.10[a]
NSP	0.5g	2.00±1.83[b]	0.20±0.22[b]
NSP	1.0g	2.50±2.08[b]	0.10±0.14[b]
NSP	1.5g	0.75±1.50[b]	0.05±0.10[b]
NSO	0.5ml	1.75±1.26[b]	0.10±0.08[b]
NSO	1.0ml	1.25±1.50[b]	0.08±0.15[b]
NSO	1.5ml	0.75±1.50[b]	0.03±0.05[b]
NSAE	0.5ml	3.50±1.00[b]	0.28±0.17[b]
NSAE	1.0ml	2.50±2.52[b]	0.25±0.13[b]
NSAE	1.5ml	3.00±2.16[b]	0.33±0.33[b]
Darksh	0.5ml	0.00±0.00[b]	0.00±0.00[b]
Darksh	1.0ml	0.00±0.00[b]	0.00±0.00[b]
Darksh	1.5ml	0.00±0.00[b]	0.00±0.00[b]

Values are means of four replicates. Means carrying the same superscript are not significantly different from each other at P=0.05. where NSP= Neem Seed Powder, NSO= Neem Seed Oil, and NSAE= Neem Seed Aqueous Extract.

NSO and NSP significantly suppressed adult *C. maculatus* emergence least by 0.75±1.50 each at 1.5ml and 1.5g respectively. Though there was no emergence in the control treated (0.00±0.00), it was not significantly different from the neem treatments when compared with the control untreated (11.00±2.58). Similarly, there was no weight loss recorded in the control treated (0.00±0.00), but it was not significantly different from the neem treatments when compared with the control untreated (0.93±0.10).

DISCUSSION

All the treatments caused significant mortality of adult *Callosobruchus maculatus* than the control. Darksh (synthetic chemical) caused 100% mortality in 1.5ml concentration within 24hours of treatment (Table 1). Generally, mortality of *C. maculatus* was highest after 24hours, and only the control recorded 0% mortality, confirming the effectiveness of neem as biopesticide. This goes with Oparaeke *et al*., (1998) where neem (*Azadirachta indica*) caused high mortality in adult *C. maculatus* within 48hours. NSP, NSAE and NSO did not differ from Darksh in the mortality effects compared to the control, suggesting that seed powder and extract of neem possess properties similar to the chemical pesticide and therefore can be exploited for commercial and local levels.
In Table 2, no adult *C. maculatus* emergence was recorded in the synthetic chemical (Darksh) at all levels, while the control recorded the highest (11.00 ± 2.58). The neem seed treatments significantly suppressed adult emergence of *C. maculatus* when compared to the control, confirming their effectiveness against *C. maculatus*. This supports the finding of Ogunwolu and Odunlami (1996), where neem products significantly prevented emergence of F1 adults of *C. maculatus*.
The control untreated recorded the highest weight loss of the grains (0.93±0.10). This could be as a result of *C. maculatus* feeding of the adult *C. maculatus* on the cowpea grains, which subsequently caused the weight loss. More so, neem seed products significantly performed equal activities with the Darksh (synthetic pesticide) in reducing adult *C. maculatus* emergence and feeding on the cowpea grains. This also confirms their effectiveness against *C. maculatus*.

Conclusively, this study has also revealed that treating cowpea with Neem Seed Powder, Neem Seed Aqueous Extract and Neem Seed Oil prevented emergence of *C. maculatus* as well as prevented *C. maculatus* from feeding on cowpea grains. Therefore, sustainable use of neem seed products whose availability in Mubi, North-Eastern Nigeria is enormous, its biodegradability, low cost, and ease of application will enhance cowpea production in this part of the country.

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REFERENCES

Agboola, S. D. (1982) Research for effective food storage in Nigeria. *Nigeria Stored Prod. Res. Inst*. Occasional paper No. 4.

Bamaiyi, L. J., Ndams, I.S., Toro, W.A., and Odokina, S. (2007) Laboratory Evaluation of Mahogany (*Khaya senegalensis* Desv.) Seed Oil and Seed Powder for the control of *Callosobruchus maculatus* (Fab.) (Coleoptera: Bruchidae) on stored cowpea. *Journal of Entomology* **4**(3): 237-242.

Don Pedro, K.N. (1990) Insecticidal activity of fatty acid constituents of fixed vegetable oils against *Callosobruchus maculatus* (F.) on cowpea. *Pesticide Science* **30** (**3**):295-305.

Ethang, E.A. (2000) Deterrent effect of some botanical products on oviposition of the cowpea bruchid *Callosobruchus maculatus* (F), (Coleoptera Bruchidae). I*nternational Journal of Pest Management* **46**(2): 143-145.

Ivbijaro, M.F. and Agbaje, M. (1986) Insecticidal activity of *Piper guineense* Schum and Thonn, and *Capsicum* species on the cowpea bruchid, *Callosobruchus maculatus* (F). *Insect science and its Application*. **7 (4)**: 521-524.

Lale, N. E. S. (1995) An overview of the use of plant products in the management of stored products Coleoptera in the tropics. *Postharvest News and Information* **6**: 69-75.

Mordue, A. J. and Blackwell, A. (1993) Azadirachtin: An update, *J. Insect Physiol*. **39**: 903-924.

Mordue, A. J., Nisbet, A.J., Nasiruddin, M., and Walker, E. (1996) Differential thresholds of azadirachtin for feeding deterrence and toxicity in locusts and an aphid. *Entomol. Exp. Appl*. **80**: 69-72.

National Research Council (1996) Underexploited tropical plants. *National Academy of Sciences Press.* Washington DC, pp 388.

Ohiagu, C.C. (1987) Storage of food grains n the savannah zones of northern Nigeria. Pages 361-368. In menyonga, J. M. Benzumar, T. and Youdeowie A. (Eds) food grain production in semi arid Africa. SAFGRAD. Ouagadougou, Burkina Faso.

Ogunwolu, F. O. and Odunlami, A.T. (1996) Suppression of seed bruchid *Callosobruchus maculatus* (F). Development and damage on cowpea (*Vigna unguiculata*) (L) with *Zanthoxylum zanthoxiloides* (Lam) western (Ruteceae) root back powder when compared to neem seed powder and pirimiphos-methyl crop protection. **15**: 603 – 607.

Oparaeke, A. M.; Dike, M.C. and Onu, I. (1998) Evaluation of seed and leaf powders of neem (*Azadirachta indica* A. Juss) and pirimiphos-methyl for control of *Callosobruchus maculatus* (F.) in stored cowpea. *Entomological Society of Nigeria* (ESN) occasional publication **31**:237-242.

Raguraman, S. and Singh, R.P. (2000) Biological effects of neem (*Azadirachta indica*) seed oil on an egg parasitoid, *Trichologramma chilonia. J. Econ. Entomol.* **92**: 1274-1280.

Rahman, A. and Talukder, F. A. (2006) Bio-efficacy of some plant derivatives that protect grain against the pulses beetles *Callosobruchus maculatus*. *Journal of Insect Science.* **6**: 1-8.