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EVALUATION OF POWER AND ASH FROM NEEM TREE *(AZADIRACHTA INDICA* A. JUSS) AS SEED PROTECTANTS AGAINST INFESTATION OF COWPEA SEEDS BY *CALLOSOBRUCHUS MACULATUS* (F.) (COLEOPTERA: BRUCHIDAE).

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ABSTRACT

Under laboratory conditions (28 ± 3°C and 65 ± 5% r.h.) in Akure, Nigeria, powder and ash made from parts of the neem tree (*Azadirachta indica* A. Juss): seed, seed shell, leaf, and bark, were compared at two rates of application (0.25 and 0.50 g per 10 g of seed), as seed protectants against infestation of cowpea seeds (*Vigna unguiculata* (L.) Walp.) by *Callosobruchus maculatus* (F.), a very serious storage pest. Oviposition by the beetle was lowest on seeds treated with powders from the seed shell and seed applied at 0.5 g. Adult emgergence from eggs laid on treated seeds was lowest with powders from the neem seed followed by that from the seed shell at 0.5 g. Oviposition and adult emergence of *C. maculatus* was lowest in treatment with neem seed ash at 0.5 g. Oviposition and adult emergence from eggs laid was significantly lower for powder than for ash with neem seed and seed shell. Powder from neem seed was most lethal to adult beetles, followed by that obtained from seed shell.

Key Words: Powder, ash, *Azadirachta indica*, *Callosobruchus maculatus*, control.

INTRODUCTION

The bruchid, *Callosobruchus maculatus* (F.) is a major pest of stored cowpea seeds in the tropics and subtropics (Jackai and Daoust, 1986; Murdock *et al.*, 1997). The edible seeds of cowpea constitute a cheap proteineous dietary staple and therefore need protection from depredation by the bruchid in storage. The use of synthetic insecticides has been investigated for the control *C. maculatus* and several have been found effective and recommended for use either as dusts, sprays or fumigants (Jackai and Daoust, 1986). However, the adoption and use of the insecticide technology for storage protection by many African farmers have been generally slow due to several factors including prohibitive costs and inconsistent supplies of the chemicals, problems with insecticide adulteration and safety of workers and consumers (Ogunwolu *et al.*, 1998). Traditionally, African farmers use plant materials (as dried whole plant part, crushed or powdered part, ash, or oil) for protection of pulses from bruchid damage (Compton *et al.*, 1993; Lale, 1995). Their use may be more sustainable and needs further exploitation and documentation (Murdock *et al.*, 1997). Use of parts of the neem tree, *Azadirachta indica* A. Juss has been investigated by many workers for *C. maculatus* control (Lale, 1995), but not as ash, and the possibility of using products from the seed shell has not been considered. Fayape and Ofuya (2000) observed differences in the ability of ash and powders obtained from various medicinal plants to protect cowpea seeds from damage by *C. maculatus*. In this study we compared the potential of using different parts of the neem tree, including the seed shell, as ash and powder, in reducing damage to cowpea seeds by the storage bruchid.

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MATERIALS AND METHODS

Beetle Culture

The *C. maculatus* used was derived from a colony originating from infested cowpea seeds collected from a local market in Akure, Nigeria. The colony has been maintained in Kilner jars in a cooled incubator at 30 ± 5° C and 50 ± 10% relative humidity for more than 40 generations, using Ife Brown cowpea as substrate.

Preparation of powder and ash from neem tree parts

The neem tree parts from which powder and ash were obtained are seed shell, leaf, stem bark, and seed. These parts were obtained from trees growing in Akure metropolis in southern Nigeria. To obtain each plant powder, the collected plant part was oven dried for 24 h at a temperature of 80° C and ground using a hand driven grinder, to pass through a 0.4 mm screen. To obtain ash, each oven dried plant material was broken into smaller bits and placed inside a crucible. The plant materials were then subjected to a temperature of 400° C in a laboratory furnace set until a complete ash material was obtained. The ash material was similarly pulverized to pass through a 0.4 mm screen.

Effect of powder and ash from neem tree parts on oviposition and adult emergence

Powder and ash from each neem tree part were tested at 0.25, 0.50 g, per 10 g of seed in separate test tubes. Two freshly emerged couples of *C. maculatus* were introduced into each tube. Any living female that did not initiate egg laying after 24 h was replaced. There were five replications per treatment. An untreated replicated control was similarly set up. After 14 days when all introduced insects were dead, the number of eggs laid on the seeds in each replicate were visually counted and recorded. Numbers of adults emerged were recorded per replicate 38 days after infestation.

Ability of powder and ash from neem tree parts in causing adult beetle mortality

Powder and ash from each neem tree part were tested at 0.5 g of material per 10 g of seed in separate Petri plates. Ten couples of freshly emerged *C. maculatus* were introduced into each plate which was shaken. Adult mortality was monitored in 24, 48 and 72 hours. The procedure was repeated five times for each treatment and a control.

Experimental design and analysis

All tests utilized a completely randomized design with five replicates per treatment. Data collected and calculated were subjected to analysis of variance (ANOVA). Treatment means which differed significantly at P = 0.05 were separated using least significant difference (LSD) statistic.

RESULTS

Effect of powder and ash from neem tree parts on oviposition and adult emergence

Mean number of eggs laid by *C. maculatus* on seeds protected by powder made from seed, seed shell, leaf or bark was significantly lower than that in the control (Table 1). Amongst the powders made from the different neem tree parts, oviposition by the beetle was lowest in treatments involving powders

Table 1. Oviposition and adult emergence of *C. maculatus* in cowpea seeds protected using powder made from different parts of the neem tree.

Part of neem tree	Amount of material/10.0g of seed	Number of eggs laid on seeds ± S.E.	Percentage adult emergence from eggs laid ± S.E.
Seed shell	0.25	42.0 ± 3.03	75.5 ± 2.56
	0.50	22.0 ± 2.00	60.5 ± 3.33
Leaf	0.25	75.2 ± 4.12	84.6 ± 2.62
	0.50	47.4 ± 2.22	69.8 ± 2.76
Stem bark	0.25	58.0 ± 5.39	83.6 ± 3.74
	0.50	50.2 ± 4.81	60.8 ± 3.75
Seed	0.25	40.4 ± 5.73	59.3 ± 7.66
	0.50	24.8 ± 2.72	29.3 ± 5.39
Control		115.8 ± 4.14	78.4 ± 5.10
LSD (0.05)		7.11	7.80

Table 2. Oviposition and adult emergence of *C. maculatus* in cowpea seeds protected using ash made from different parts of the neem tree.

Part of neem tree	Amount of material/10.0g of seed	Number of eggs laid on seeds ± S.E.	Percentage adult emergence from eggs laid ± S.E.
Seed shell	0.25	62.4 ± 2.65	75.3 ± 2.28
	0.50	62.4 ± 3.61	70.7 ± 3.20
Leaf	0.25	65.8 ± 3.02	73.3 ± 2.30
	0.50	57.6 ± 3.72	57.2 ± 1.53
Stem bark	0.25	71.4 ± 2.90	74.2 ± 3.19
	0.50	74.8 ± 3.88	65.5 ± 3.09
Seed	0.25	73.2 ± 2.63	67.1 ± 2.71
	0.50	22.8 ± 2.45	47.9 ± 2.60
Control		118.0 ± 3.20	77.4 ± 2.12
LSD (0.05)		5.60	4.64

Table 3. Comparison of *C. maculatus* oviposition and adult emergence from cowpea seeds protected with powder and ash made from different parts of the neem tree (at the rate of 0.5 g of neem material/ 10 g of seed)

Neem product	Number of eggs laid on seeds ± S.E.	Percentage adult emergence from eggs laid ± S.E.
Seed shell powder	22.0 ± 2.00	60.5 ± 3.33
Seed shell ash	62.4 ± 3.61	70.7 ± 3.20
Leaf powder	47.4 ± 2.22	69.8 ± 2.75
Leaf ash	57.6 ± 3.72	57.2 ± 1.53
Stem bark powder	50.2 ± 4.81	60.5 ± 3.82
Stem bark ash	74.8 ± 3.88	65.5 ± 3.09
Seed powder	24.8 ± 2.72	29.3 ± 5.39
Seed ash	22.8 ± 2.45	47.9 ± 2.50
LSD (0.05)	6.29	6.43

from the seed shell and seed applied at 0.5 g. There were significant differences in percentage adult emergence from eggs laid on seeds protected using powders made from the different neem tree parts. It was lowest in the treatment involving use of neem seed powder applied at 0.5 g. It was also significantly lower in treatments involving use of seed applied at 0.25 g, seed shell applied at 0.5 g and bark applied at 0.5 g than others.

Mean number of eggs laid by *C. maculatus* on seeds protected by ash made from seed, seed shell, leaf or bark of the neem tree was significantly lower than that in the control (Table 2). Amongst the ashes made from the different neem tree parts, oviposition by the beetle was lowest in treatment involving ash from the seed applied at 0.5 g. There were significant differences in percentage adult emergence from eggs laid on seeds protected using ashes made from the different neem tree parts. It was lowest in the treatment involving use of neem seed ash applied at 0.5 g.

Table 3 summarizes statistical comparison of *C. maculatus* oviposition and adult emergence from cowpea seeds protected with powder and ash made from different parts of the neem tree and applied at the rate of 0.5 g of neem material per 10 g of seed. Each neem tree part applied as powder significantly reduced oviposition than when applied as ash, except for seed powder and seed ash. Percentage adult emergence from eggs laid was significantly lower for powder than for ash with neem seed and seed shell. It was significantly lower for ash than for powder with neem leaf, but similar for both ash and powder for neem bark.

Ability of powder and ash from neem tree parts in causing adult beetle mortality

There were significant differences in mortality of freshly emerged adult *C. maculatus* introduced onto cowpea seeds protected with powders and ashes made from the different neem tree parts. At all times of observation the number of beetles killed was highest in treatments involving use of neem seed powder. Neem seed shell powder also exercised significant kill of adult beetles at all times of observation than ash or powder made from the remaining parts of neem tree and the control.

Table 4. Mortality of freshly emerged *C. maculatus* adults introduced onto cowpea seeds (10.0 g) protected with ash and powder from different parts of the neem tree (0.5 g).

Material	24 hours	48 hours	72 hours
Seed shell powder	0.8 ± 0.37	4.0 ± 0.71	10.0± 0.71
Seed shell ash	0.0 ± 0.00	0.0 ± 0.00	0.6 ± 0.40
Leaf powder	0.0 ± 0.00	0.8 ± 0.37	1.8 ± 0.58
Leaf ash	0.0 ± 0.00	0.0 ± 0.00	0.8 ± 0.58
Stem bark powder	0.0 ± 0.00	0.6 ± 0.40	2.0 ± 0.71
Stem bark ash	0.0 ± 0.00	0.0 ± 0.00	0.4 ± 0.40
Seed powder	4.4 ± 0.51	10.2± 0.86	15.4± 1.21
Seed ash	0.4 ± 0.24	1.2 ± 0.58	2.8 ± 0.73
Control	0.0 ± 0.00	0.0 ± 0.00	0.0 ± 0.00
LSD (0.05)	0.40	0.81	1.18

Values are mean number of dead insects out of 20 introduced.

DISCUSSION

This study has corroborated the reports of many other workers reviewed by Lale (1995), that products from the neem tree, including neem seed powder, can be used to control *C. maculatus* infestation and damage to stored cowpea seeds. It has perhaps for the first time shown that powder made from the neem seed shell can be effective in reducing infestation and subsequently damage by the beetle. The protection given by powder from the seed shell was better than that from powders from the leaves or bark.

Our study further extended the potential of using neem tree products for *C. maculatus* control by considering use of ash made from the different parts. Ash obtained from the different neem tree parts significantly reduced oviposition by the beetle in comparison with the control. Reduction of oviposition by *C. maculatus* by using ash from plants has been reported (Ofuya, 1986; Fayape and Ofuya, 2000). Our results however showed that the use of neem tree part powder was generally superior to its ash counterpart in the control of *C. maculatus*. Therefore, use of powder is preferred, and in terms of method of preparation, may be easier and cheaper.

The bioactivity of products from the neem tree has been attributed to various compounds which include nimbin, nimbidin and salannin, but the most important of the compounds appears to be the triterpenoid, azadirachtin (Lale and Abdulrahman, 1999). These compounds have been demonstrated to possess insecticidal, ovicidal, larvicidal, antifeedant, and growth-inhibiting effects against many species of insect pests including *C. maculatus* (Schmutterer, 1990; Lale, 1995). The relative effectiveness of the different neem tree parts in the control of *C. maculatus* observed may be due to differences in the concentrations of the active components.

In Nigeria and probably in many other areas neem seed shell is discarded and thrown away.Thus, the observation that it can be pulverized and used for stored products protection is significant. Its efficacy against other stored product insect pests requires empirical verification. The protected produce, for example cowpea seeeds, will not be totally free from infestation and damage. However, because of the high tolerance of poor quality produce in the tropics (Taylor, 1981) and the fact that pulses in tropical markets are often sold by volume which is not reduced by bruchid damage, products like neem seed shell powder can be recommended for use.

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