COMPARATIVE EFFICACY OF NEEM (*Azadirachta indica*), FALSE SESAME (*Ceratotheca sesamoides*) ENDL. AND THE PHYSIC NUT (*Jatropha curcas*) IN THE PROTECTION OF STORED COWPEA (*Vigna unguiculata*) L. WALP AGAINST THE SEED BEETLE *Callosobruchus maculatus* (F.).

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Abstract

A study to evaluate the insecticidal properties of some plants was undertaken. Powder and aqueous extracts of Neem, Azadirachta indica, False sesame, Ceratotheca sesamoides and the Physic nut, Jatropha curcas were evaluated as grain protectants against the cowpea seed beetle, Callosobruchus maculatus (F.) in the laboratory at 1.5, 2.0 and 2.5 (% v/w) concentrations per 20g of cowpea seeds. Seeds of Ife-brown cowpea variety were used for the experiment. Aqueous extracts and seed powder of the plant materials were applied to the cowpea seeds using the contact method of application in the laboratory. Results revealed 2.0 % v/w and 2.5 % v/w had significant increase (P< 0.05) in adult mortality of C. maculatus in both the powder and aqueous treatments of J. curcas. Oviposition, adult emergence and percentage grain weight damage decreased significantly (P < 0.05) in a proportionate, dose dependent manner. Although C. sesamoides was the least effective when compared with the other treatments, it was significantly better than the control in the protection of stored cowpea. There was no significant difference between treatments in the germination percentage of the seeds and there was no observed discolouration of the treated seeds. All the test plant materials (Aqueous and powder) of all the test plants effectively reduced the weight loss of cowpea treated seeds with J. curcas followed by A. indica at 2.5% being the most effective. Farmers in developing countries can use J. curcas and A. indica as an alternative to chemical pesticide in rural grain storage.

Keywords: *Cowpea, extracts, Callosobruchus maculatus, botanicals, Natural Pesticides, Pest Management*

Introduction

Cowpea *Vigna unguiculata* L. (Walp) is one of the most important crops grown in the tropical and sub-tropical regions of the world (Ntoukam *et al*., 2000). It is also a multipurpose crop grown as food and fodder (Patterson *et al.*, 2000). Worldwide, cowpea is grown on about 10.1 million hectares, with annual grain production at approximately 4.99 million tons (FAO 2008), with West and Central Africa being the leading producing regions in the world. These regions produce about 64% of the total estimated 3.3 million tons of cowpea produced annually (FAO, 2004). In Africa, more than 70% of the total production has been traced to three countries; Nigeria, Niger and Mali (Adedire *et al*., 2003). Cowpea production is widely distributed throughout the tropical regions, with the area of production lying mainly between latitudes 10^{o}N and 15^{o}N, covering the dry savannah (Northern Guinea and Sudan savannah) as well as the Sahel (Ntoukam *et al.*, 2000).

In Nigeria various constraints which range from lack of adequate storage facilities to general government negligence in supplying essential inputs for the support of agricultural activities limit cowpea production (Adams, 2007). However, a major constraint which both reduces yield and/quality of harvested products is the problem of pests both on the field and in storage (Singh, 2003). The nutritional advantage associated with cowpea over other arable crops render all parts of the plants susceptible to insect pests (Profit, 1997), being attacked by pests from

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the seedling stage up to maturity (Emosairue *et al*., 2004).

Cowpea in store has been observed in the tropics to be heavily infested by various pests, especially the cowpea weevil, *Callosobruchus maculatus* (Profit, 1997). There are many species of storage pests of cowpea but the most destructive is *Callosobruchus maculatus* which is a cosmopolitan pest of stored legume seeds. It causes considerable economic damage to cowpea seeds (Profit, 1997) and is ranked as the most severe pest of cowpea in West Africa (Cope and Fox, 2003). In Nigeria, the dry weight loss due to infestation by *C. maculatus* can cause grain yield loss of up to 75% particularly in those parts of Nigeria where effective techniques of production are limiting (IITA, 2007). Losses resulting from cowpea infestation in Nigeria by *C. maculatus* were estimated at 2.45 billion tons in 2001 and 3.62 billion tons in 2005 (FAO, 2007).

Efforts are consistently being made to curtail the problems of damage done to cowpea in storage by insect pest especially *C. maculatus*. In Nigeria, farmers make use of conventional pesticides which are expensive, thus most of the rural farmers are barely able to afford the products (Adedire, 2009). In addition, Addor (1995) reported that pesticides are highly persistent, broad spectrum and carcinogenic. There have also been reported cases of resistance, pest resurgence and secondary pest outbreaks when these pesticides are used. The problems associated with the use of synthetic pesticides have necessitated the search for natural methods of control which are environmentally friendly, affordable and provide adequate supply to meet the insecticide shortage (Jackai and Oyediran, 1991). The use of naturally available plant materials such as *Azadirachta indica*, *Jatropha curcas* and *Ceratotheca sesamoides* could offer a good substitute with little deleterious effect to human and environmental health if proven to be effective.

The aim and objective of this study is to determine the effectiveness of *Ceratotheca sesamoides, Azadirachta indica* and *Jatropha curcas* seed powder and aqueous extract in controlling the seed beetle *Callosobruchus maculatus* against cowpea in storage. The concentration that is most effective in controlling *C. maculatus* is also to be determined.

Materials and Methods

The cowpea seed used for the study is Ife-brown, a susceptible variety. It was procured from the National Seed Service, Ilorin, Kwara State. The plant materials used were *Azadirachta indica* (Neem), *Jatropha curcas* (Physic nut) and *Ceratotheca sesamoides* Endl. (False sesame). These materials were collected from Tanke area in Ilorin. Pirimiphos-methyl was used as a standard check. A culture of *C. maculatus* maintained in the laboratory at room temperature was used for the study.

Processing of the Plant Materials

Dry seeds of *J. curcas* and *C. sesamoides* were dehulled and the seed kernels ground into powder with a macro hammer mill while the dried leaves of *A. indica* were ground into powder. The powders were then sieved through a 0.02 mm sieve and prepared into extracts using distilled water. The extracts were prepared into three (3) concentrations of 1.5g, 2.0g and 2.5g. A control using only distilled water was also included. Aqueous extracts of the plant materials were obtained by homogenizing pulverized products in water. Each suspension was vigorously stirred and left for 24 hours before filtering with muslin cloth. The filtrates of the different plant materials were prepared into 1.5%, 2.0% and 2.5% weight/volume as follows: 1.5g/100ml, 2.0g/100ml and 2.5g/ml. Contact method of application was used in the study for both aqueous and powder treatments.

Aqueous seed treatment

Clean whole cowpea seeds (20g) were steeped in the filtrate of the different concentrations (i.e. 1.5, 2.0, and 2.5) for thirty seconds and quickly removed and air dried for five hours. They were then placed in transparent 250ml plastic containers. Cowpea steeped in water served as the control, while Pirimiphos-methyl (0.5% w/w) protected cowpea was included as the standard check.

Powdered seed treatment

A 20g sample of clean whole cowpea seeds was placed in transparent plastic containers (250 ml). Powders of the plant materials were introduced into the containers in different concentrations (i.e. 1.5g, 2.0g, and 2.5g) and then agitated vigorously to spread the powder over the seeds uniformly. 20g of untreated cowpea seeds served as the control, while Pirimiphos-methyl protected cowpea was included as the standard check.

In both the aqueous and powder treatments, six (6) newly emerged adults of *C. maculatus* (3 males and 3 females) were introduced into each plastic container. There were four replicates for each treatment in a completely randomised design. Adult mortality, oviposition and F_1 progeny emergence were assessed. The number of damaged seeds, weight loss and germination test were also evaluated.

Data Analysis

The data collected were transformed using square root transformation and then subjected to analysis of variance. The means were separated using the Least Significant Difference (LSD).

Results and Discussion

There were significant differences in adult mortality ($P < 0.05$) between the powder and aqueous treatments at 24, 48, 72 and 168 hours after infestation (HAI) for all the treatments. At 24 HAI, Pirimiphos methyl had the highest number of adult mortality (6.00) (Table 1). *Azadirachta indica* at 2.5% had a higher mortality (1.75) when compared with *Jatropha curcas* and *Ceratotheca sesamoides*. Although *C. sesamoides* recorded the least adult mortality (0.75), it was significantly different from the control (Table1).

At 48 HAI, *J. curcas* at 2.0% was the most effective against *C. maculatus* when compared with the other test plant materials, although it was not significantly different from *A. indica* at $P < 0.05$. This observed mortality may be due to the sterols and tritepene alcohols contained in the *J. curcas* seed oil. Adebowale *et al.* (2003) reported that tritepene oil extracts of *J. curcas* seed oil are highly insecticidal. A similar trend was observed in the aqueous extract treatments at 24, 48, 72 and 168 HAI, with *A. indica* being the most effective test plant material against *C. maculatus* at 2.0% concentration. As from the 72 HAI, the powder treatment was more effective than the aqueous extract treatment of the same concentration. The reason for this observation is not known (Table 1). The results show that the aqueous extracts evaluated were more efficient for the first two days in causing mortality than the powder. This supports the findings of Addor (1995), who observed that aqueous solution of plant materials readily forms a complete coating around the seeds which immobilizes the insects consequently causing their deaths.

At Ten (10) days after infestation (DAI), Pirimiphos methyl reduced the mean oviposition from 7.25 to 0.00 for both powder and aqueous treatments (Table 2). However, *J. curcas* (aqueous) at 2.0% had the least oviposition (1.25) followed by *A. indica* at 2.5% (2.25). *C. sesamoides* caused a significant reduction in oviposition when compared with the control (Table 2). A similar trend was also observed in the powder treatment though the aqueous extracts had a higher mortality than the powder treatments. Results from this study contradicts the findings of Coats (1994) who observed that progeny emergence was the protection that most plant materials give cowpea seeds with little or no oviposition reduction.

Pirimiphos methyl treated seeds at 30 DAI had no F_1 progeny emergence. However there were significant differences ($P<0.05$) among the other test plant materials. *A. indica* at 2.0% and 2.5% (powder and aqueous) significantly ($P<0.05$) reduced F_1 progeny emergence when compared with the control (Table 3). Progeny emergence also reduced with increased concentration in all the powder treated cowpea seeds, while this was not the case in the aqueous treated seeds. Although *C. sesamoides* had the highest number of F_1 progeny emergence in all the test plant materials, it was significantly different ($P<0.05$) from the control (Table 3)

There was no grain damage or weight loss in Pirimiphos methyl treated cowpea seeds (Table

4). *J. curcas* at 2.5% was the most effective plant material followed by *A. indica* at 2.5% preventing weight loss in the powder treatment (Table 4). In the aqueous treatment, *J. curcas* at 2.5% followed by *A. indica* at 2.5% were the most effective in preventing weight loss in cowpea seeds. This supports the work of Boeke *et al*. (2004), who reported that powder and aqueous extracts of *A. indica, J. curcas* and *Vernonia amygdalina* significantly reduced the number of progeny emergence. Emosairue and Ubana (1998) found *A. indica* to be very effective in reducing progeny emergence.

Conclusion

All the test plant materials (aqueous and powder) were effective in reducing the weight loss of cowpea treated seeds without any discolouration to the treated seeds, with *J. curcas* being the most effective. Farmers in developing countries can use *J. curcas and A. indica* as an alternative to chemical pesticide in rural grain storage.

Table 1 Effect of Plant Materials (Powder and Aqueous) on Mortality of *C. maculatus*

Botanical	Conc. (%)	Mortality							
		Powder Treatment (HAI)				Aqueous Treatment (HAI)			
		24	48	72	168	24	48	72	168
C. sesamoides	0.0	0.00	0.00	0.25	0.50	0.00	0.00	0.25	0.50*
	1.5	0.25	1.00*	3.00*	1.75*	0.50	1.50*	3.00*	1.50*
	2.0	0.75*	1.00*	2.25*	2.00*	1.00*	1.50*	2.50*	1.50*
	2.5	0.75*	1.25*	0.75*	1.50*	0.75*	1.75*	0.75	0.75
J. curcas	0.0	0.00	0.00	0.50*	1.25*	0.00	0.00	0.50	1.00*
	1.5	1.00*	1.25*	2.75*	1.25*	1.25*	1.75*	2.75*	0.75*
	2.0	1.25*	1.75*	2.25*	0.75*	1.75*	1.50*	2.25*	0.00
	2.5	0.75*	1.50*	2.00*	0.75*	2.00*	2.25*	2.00*	0.75*
A. indica	0.0	0.00	0.00	0.75*	1.00*	0.25	0.00	0.75	0.75*
	1.5	0.75*	1.00*	3.00*	1.25*	1.25*	2.25*	3.00*	0.50
	2.0	1.50*	1.50*	2.25*	0.75*	2.25*	2.75*	2.25*	0.00
	2.5	1.75*	1.50*	1.75*	1.00*	1.75*	1.35*	1.75*	0.00
Pirimiphos-methyl	0.0	0.00	0.00	0.25	5.50*	0.00	0.00	0.75	5.50*
	1.5	6.00*	0.00	0.25	0.00	6.00*	0.00	0.00	0.00
	2.0	6.00*	0.00	0.75*	0.00	6.00*	0.00	0.00	0.00
	2.5	6.00*	0.00	1.00*	0.00	6.00*	0.00	0.00	0.00
Water	0.0	0.00	0.00	0.75*	1.50*	0.00	0.00	0.25	1.50*
	0.0	0.00	0.00	0.00	1.00*	0.00	0.00	0.25	1.00*
	0.0	0.00	0.00	0.00	1.00*	0.00	0.00	0.75	1.00*
	0.0	0.00	0.00	0.00	1.25*	0.00	0.00	1.00*	1.25*
	SED	0.31	0.33	0.53	0.50	0.35	0.36	0.51	0.44
	LSD	0.62	0.66	1.06	1.00	0.70	0.72	1.06	0.88

*-Denotes Significant difference at P<0.05 HAI: Hours after infestation

Table 2 Efficacy of the Botanicals in the Prevention of Oviposition Ten (10) Days after Infestation

Botanical	Conc. (%)	Mean No. of Eggs Laid	
		Powder	Aqueous
C. sesamoides	0.0	7.75	7.75
	1.5	4.75*	4.25*
	2.0	4.25*	4.00*
	2.5	4.00*	4.25*
J. curcas	0.0	7.50	7.75
	1.5	4.75*	3.75*
	2.0	4.25*	1.25*
	2.5	2.50*	2.25*
A. indica	0.0	7.50	7.75
	1.5	4.50*	4.75*
	2.0	2.25*	2.50*
	2.5	2.25*	2.25*
Pirimiphos methyl	0.0	7.25	7.25
	1.5	0.00*	0.00*
	2.0	0.00*	0.00*
	2.5	1.75*	1.75*
Water	0.0	7.50	7.50
	0.0	6.25	6.25
	0.0	5.50	5.50
	0.0	6.0	6.00
	SED	0.94	0.90
	LSD	1.90	1.81

*-Denotes Significant difference at P<0.05

Table 3 Effect of the Botanical (Powder and Aqueous) Treatment on F_1 Progeny Emergence, Thirty (30) Days after Infestation.

BOTANICAL	CONC. (%)	MEAN NO. EMERGED F_1 ADULTS	
		POWDER	AQUEOUS
C. sesamoides	0.0	8.00	7.50
	1.5	4.50	4.00
	2.0	4.00	3.50*
	2.5	3.50*	4.25
J. curcas	0.0	7.25	8.00
	1.5	3.50*	2.50*
	2.0	2.50*	0.75
	2.5	1.25*	0.75*
A. indica	0.0	7.50	6.75
	1.5	3.50*	3.75*
	2.0	1.50*	2.00*
	2.5	0.75*	0.75*
Pirimiphos methyl	0.0	5.50	5.50
	1.5	0.00	0.00
	2.0	0.00	0.00
	2.5	0.00	0.00
Water	0.0	4.75	4.75
	0.0	5.25	5.25
	0.0	5.50	5.50
	0.0	4.50	4.50
	SED	0.64	0.59
	LSD	1.28	1.99

* -Denotes Significant difference at P<0.05

Table 4 Percentage Grain Weight Loss of Treated Cowpea Seeds

Botanical	Conc. (%)	Initial Weight (G) (Powder And Aqueous)	Final Weight (G) Powder	Final Weight (G) Aqueous (Powder)	%Weight Loss (Aqueous)	%Weight Loss
C. sesamoides	0.0	20	17.42	17.54	12.88	12.13
	1.5	20	17.95	17.95	10.25	10.25
	2.0	20	18.07	18.17 *	9.63	9.12
	2.5	20	18.20*	18.20 *	9.00	9.00
J. curcas	0.0	20	17.45	17.42*	12.75	12.87
	1.5	20	18.07	18.25*	9.63	8.75
	2.0	20	18.55	19.17	7.25	4.12
	2.5	20	19.55	19.67	2.25	1.62
A. indica	0.0	20	17.37	17.40	13.13	13.00
	1.5	20	18.10	18.25	9.50	9.12
	2.0	20	19.15	19.17	4.25	5.50
	2.5	20	19.50*	19.67*	2.50	2.25
Pirimiphos methyl	0.0	20	17.45	17.45	12.75	12.75
	1.5	20	20.00*	20.00*	0.00	0.00
	2.0	20	20.00*	20.00*	0.00	0.00
	2.5	20	20.00*	20.00*	0.00	0.00
Water	0.0	20	17.87	17.87	10.63	10.63
	0.0	20	17.12	17.12	14.37	14.37
	0.0	20	17.75	17.75	11.25	11.25
	0.0	20	17.87	17.87	10.53	10.63
	SED		0.22	0.21		
	LSD		0.44	0.42		

*- Denotes Significant difference at P<0.05

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