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Insecticidal Effects of *Eucalyptus globules* and *Azadirachta indica* Leaves against *Callosobruchus muculatus* in *Vigna unguiculata* Storage.

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Abstract

The insecticidal potentials of *Eucalyptus globules* and *Azadirachita* were determined against *Callosobruchus muculatus* cowpea (*Vigna unguiculata*) storage as well as the complementary effect of both botanicals in controlling these weevils. Cowpea grains from two different varieties ("Kananado" and "Drum") were used. *Azadirachita indica*, *Eucalyptus globules* and their combination were the treatments used. The treatment were mixed with the cowpea grain and stored in jute bags. They were stored for ten weeks using complete Randomized Design (CRD). Data were collected every two weeks of storage (until the 10th week) on grain weight, weight of undamaged and damaged grain, number of weevils and average grain hole per seed. The findings ($P<0.05$) in the grain weight, weight of damaged and undamaged grain and the number of weevils at week two, four and six. A significant reduction in the potency of these botanicals was found at week eight and ten. However, complementary effect (combination of Eucalyptus globules and Azadirachita indica) was found in controlling the cowpea weevil at week eight and ten than individual botanicals.

Keywords: Insecticidal, *Azadirachita indica, Callosobruchus muculatus, Eucalyptus globules, Vigna unguiculata.*

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Introduction

Cowpea (*Vigna unguiculata* (L.) walp) is an important food and crop in semi-arid tropics. Being drought tolerant crop, cowpea is well adapted to drier region of the tropics where other food legumes do not perform well. It also has the unique ability to fix atmospheric nitrogen through its nodules and grows well even in soil with less than 85% sand and 0.2% organic matter as well as low phosphorus (Scott, 2008). Its quick and rapid ground cover check erosion and insitu decay of its roots and Nitrogen rich residues improves soil fertility and structure which have made cowpea an important component of the subsistence agriculture, particularly in the dry Savannah of the sub-Saharan Africa. Cowpea is also important as nutritious fodder for livestock (Scott, 2008).The crop is of major importance to the livelihood of millions of people in less developing countries of the tropics particularly Asia and Africa. It is consumed in many forms, including young leaves, green pods and green seeds. These forms in various food preparations with over 25% protein (on dry matter basis) in its seeds, while the tender leaves of cowpea is a major source of protein, minerals and vitamins in the daily diets and thus, has it positive impacts on health of women and children (Ufeigbo,1978). The protein-rich grains are prepared in different forms in various parts of the globe as relatively cheap and locally available sources of protein, energy minerals vitamins and roughages for man and livestock (Singh et.a.,1997).Thus, cowpea is described as "the poor man's meat" (Ufaya,2001) .

Trading of fresh produce and proceeds of cowpea foods and snacks provide rural and urban opportunity for earning cash income. However, with these benefits to humans and livestock's, the nutritive values of the crop are threatened both on the field and in storage by insect pests, most especially *Callosobruchus maculatus*.

C. maculatus commonly known as cowpea weevil is a major pest of wild range of stored leguminous seeds. In many countries of western and central Africa, cowpea is a major dietary staple. But the stocks are rapidly broken down by Cowpea Weevil three to four months after harvesting (Singh et al, 1978). During storage, Cowpea weevil causes qualitative and quantitative losses. Caswell (1981) reported a loss of approximately 50% of Cowpea in three to four months in northern Nigeria, while Tanzubil (1991) found out that the loss can reach 60% in Northern Ghana. The larva stage of the weevil tunnel and developed within the cowpea. They may consume nearly the beans contents. Pupation occurs in the seed coat. Damage is a combination of the feeding and contamination. The damaged seeds are unsuitable for human consumption and cannot be used for planting or as seed. Preservation of quality seeds for the next planting season is one of the worrying problems for the farmers. However, modern control methods are too costly and technically difficult for African farmers. Application of synthetic insecticides may be difficult and they could persist in farm produce (Dendant, 1994).

Furthermore, their application may require a degree of skills that rural farmers who are producers of the bulk of the nation's food supply do not have. Each generation of insect becomes more immune to chemical pesticides leading to resistance (Georghiou, 1991).However, there have been lots of search for locally available plant materials that may be of grain protectant ability(Ajayi and Adedire,2003 Adedire and Akinneye,2005 Akinkurolere et al.,2006).

In recent years, attention has been focused on organic farming, in which synthetic chemicals are avoided in crop production and storage. Also, there is need to provide control measures that are affordable, non-toxic, environmental friendly and sustainable. The current study reports on the insecticidal potential of the powder of two plant leaves; *Eucalyptus globules* and *Azadirachita indica* against *Callosobruchus maculatus*.

Materials and Methods

'Kanannado' and 'Drum' varieties were used in this study. 'Kanannado' is a white variety and 'Drum' a red variety. The two varities were sourced from Bosso market, Minna, Niger State. The clean and undamaged grains selected based on physical appearance. *Azadirachita indica* and *Eucalyptus globules* leaves were collected from mature trees with hand into clean polythene bags, in Federal University of Technology Minna, Gidan Kwano Campus, Niger State, Nigeria. Six kilogram was weighed for each and sundried. Each sample crushed into coarse form using mortar and pestle, milled into powder in an electric Phillips Kitchen blender run at 10,000 rpm for about one minute. The leaf powder was weighed, 5g, 10g, 15g, 20g and 40g into polythene bag (each in triplicate, with the help of electronic weighing balance and labeled properly.

Four treatments were used for this experiment.

Treatment 1:- *Azadirachita indica* leaf powder

Treatment 2:- *Eucalyptus globules* leaf powder

Treatment 3:- Mixture of Treatment 1 and treatment 2

Treatment 4:- Control.

Each treatment has four replicates of varied weight. Two controls were used, one for each variety of cowpea. Treatment 1 and 2 was made into replicates of 10g, 20g, 30g and 40g dosage each. While treatment 3 was equal combination of 5g+5g, 10g+10g, 15g+15g and 20g+20g of treatment 1 and treatment 2. 0.25kg of cowpea was mixed with each dosage of each treatment; they were stored in jute bags made into small sizes of 20cm x10cm and treatment 4 is the control. The dosage of each treatment and the controls were randomized and stored in the Crop Production laboratory, using complete Randomized Design (CRD) for ten weeks in accordance with the method described by Sharia et *al*. (2006).

Data were collected every two weeks on number of weevils after treatment, Average number of hole per damaged grain, weight of damage grain, weight of undamaged grain. Results were subjected to statistical analysis using one-way Analysis of variance (ANOVA) AND Duncan's multiple Range Test (DMRT) was used for mean separation.

Results and Discussion

For variety one, the grain weight of treatment four (control) was the smallest (247.75), the control has the largest damaged grain (4.90) and the smallest undamaged grain (242.86). It has more weevils (6.50) than others (Table 1).Significant difference was found among treatment four and others (T_1, T_2 and T_3). However, there was no significant difference in the average grain hole per seed at ($P<0.05$). In variety two, there was also a significant difference in the grain weight, damaged grain weight, undamaged grain weight and number of weevils. With treatment four having the highest damaged grain (5.35), highest number of weevils and the smallest grain weight. But no significant difference was found in the average grain hole per seed. Treatment four (control) has more grain holes compared with other treatments. At four weeks of storage, there were significant differences in grain weight, damaged grain and undamaged grain and weevils $P<0.05$) in the two varieties as shown in table two, the control has the smallest grain weight (237.5, 236.94) largest damaged grain (33.94, 43.34) and the largest number of weevils (91.00, 107.5) in varieties one and two respectively. However, there was no significant difference in the grain hole for both varieties. Equal number of grain holes were recorded in variety one and two after the fourth week, compared with variety one and two at the second week, with more grain holes in treatment four followed by treatment one.

There was a significant difference in the grain weight, damaged grain and number of weevils for the two varieties after six weeks of storage as shown in table three. The control has the smallest grain weight (182.30, 182.07), largest damaged grain (108.33,110.07) and the largest number of weevils (119.00.122.00)for a variety one and two respectively. while in variety one, treatment three has the largest grain weight (236.31), the least damaged grain (33.95) and the smallest weevil number (28.58). But in variety two, treatment three has the largest grain weight (231.30), the least damaged grain (31.32), the highest undamaged grain weight (199.96) and the smallest weevil number (38.00). However, there was no significant difference in the number of grain hole for the two varieties. After eight weeks of storage, there was no significant difference in the grain weigh, damaged grain and the grain hole for variety one. But there was a significant difference in the number of weevils ($P<0.05$). Treatment four has the largest number of weevils (149.50) and treatment three has the smallest number of weevil (57.50) on the highest grain weight (203.24), undamaged grain (135.42), the least number of weevils (57.50 and the least average grain hole (1.00). In variety two, there was a significant difference in the weight, undamaged grain weight, number of weevils and the grain holes. Treatment three (mixture of *Azadirachta* and *Eucalyptus*) has the highest grain weight (219.05), undamaged grain ((128.68), the least number of weevils and the least average grain hole (1.00) while treatment four has the largest number of weevils (152.50) and grain holes (3.00) as indicated in table IV.

Only the grain hole has a significant difference for variety one while treatment four has the largest number of grain hole (3.00) at $P<0.05$) as shown in table IV. Treatment three has the highest grain weight (191.68), smallest number of weevil (146.75) and the least grain hole (1.75). The control has the smallest grain weight (146.88), the smallest undamaged weight (0.85), the largest number of weevils (261.50) and grain holes (3.00). In variety two, there was no significant difference in the undamaged grain weight, however , grain weight weevils and grain holes were significantly difference $P<0.05$) as indicated in table V. Treatment three has the highest grain weight (221.87), smallest number of weevil (116.25) and the least grain hole (2.50). The control has the smallest grain weight (146.47), the smallest undamaged weight (0.76), the largest number of weevils (268.50) and grain holes (4.00). The two prepared powders tested were effective to some degree in reducing damage caused by *C muculatus* as the cowpea grains were protected by all the treatments (except the control) up to the sixth week. This is in accordance with Ivbijaro (1983) who documented toxicity of neem (*A. indica*) against weevils. He reported that more than 60 insect pests may be affected by azadirachtin, including weevils, aphids, beetles, bugs, leafhoppers, leaf miners, mealy bugs, psyllids, thrips, caterpillars, lace and whiteflies. That due to its insect growth regulating properties, it is most effective against the immature stages of insects. This is also agreeing with Locke (1994) findings, that *A. indica* were toxic to *C muculatus*. Similarly, Sharaby (1989) reported that leaf powder of Eucalyptus showed repellant activity against S granaries after exposure period of 70 days. At week eight and ten, the cowpea grain were less protected from damage in variety one, but treatment three served as the best protectant for variety two. The reduction in the potency of these botanicals to protect against damage by *C .muculatus* may be due to limited persistence in the environment, characteristics of botanical pesticides such as *A. indica* and *E. globules* as previously documented by Schmutter (1990). In view of this, repeated application may be needed to achieve the desired result of effective grain protection for a long period. However, the combination of *A. indica*, *E. globules* leaf powder significantly excelled the control in their effectiveness at week eight and ten, due to its lowest undamaged grain weight as result of its lowest weevil number.

Conclusion and Recommendations

Based on the results obtained in this study, *A .indica*, *E. globules* leaf powder and the combination of the two leaf powders showed promising insecticidal potential on *C. muculatus* in storage. However, it is suggestive that the powder be renewed every six weeks for the desired effective protection.

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Table 1: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils at the second week of storage

Variety	Parameters	T_1	T_2	T_3	T_4	SE$^{\pm}$	LS
1	Grain weight	249.78^b	249.90^b	249.8^b	247.75^b	0.21	S
	Damaged grain	0.90^b	0.42^b	0.28^b	4.90^a	0.44	S
	Undamaged grain	248.84^b	249.48^b	249.53^b	242.86^a	0.65	S
	Weevils	1.00^b	0.25^b	0.00^b	6.50^a	0.62	S
	Grain hole	0.50	0.25	0.00	1.00	0.13	NS
2	Grain weight	249.62^b	249.52^b	249.94^b	247.43^b	0.24	S
	Damaged grain	1.23^b	1.70^b	0.74^b	5.35^a	0.42	S
	Undamaged grain	248.39^b	247.57^b	249.20^b	242.08^a	0.66	S
	Weevils	1.25^b	1.00^b	0.75^b	9.50^a	0.87	S
	Grain hole	0.75	0.50	0.50	1.00	0.13	NS

Means within the same row denoted by different superscripts are significantly different (P. <0.05)

Table 2: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils fourth week of storage.

Variety	Parameters	T_1	T_2	T_3	T_4	SE$^{\pm}$	LS
1	Grain weight	244.88^b	245.73^b	245.73^b	237.57^a	0.90	S
	Damaged grain	6.83^b	9.22^b	6.05^b	33.94^a	2.94	S
	Undamaged grain	238.05^b	236.12^b	239.68^b	203.63^a	3.79	S
	Weevils	32.75^b	17.00^b	13.25^b	91.00^a	7.69	S
	Grain hole	1.00	1.00	1.00	1.00	0.00	NS
2	Grain weight	243.56^b	243.94^b	244.07^b	236.94^a	0.77	S
	Damaged grain	228.20^b	225.00^b	235.13^b	193.60^a	3.43	S
	Undamaged grain	15.36^b	18.94^b	8.94^b	43.34^a	4.16	S
	Weevils	34.00^b	38.75^b	16.75^b	107.50^b	8.35	S
	Grain hole	1.00	1.00	1.00	1.00	0.00	NS

Means within the same row denoted by different superscripts are significantly different (P. <0.05)

Table 3: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils at the six week of storage

Variety	Parameters	T_1	T_2	T_3	T_4	SE$^{\pm}$	LS
1	Grain weight	217.42^b	226.31^b	224.44^b	182.30^a	4.79	S
	Damaged grain	50.95^b	33.95^b	29.17^b	108.33^a	7.94	S
	Undamaged grain	166.47^b	192.35^b	195.26^c	73.98^a	12.60	S
	Weevils	62.50^b	28.50^c	29.50^b	119.00^a	9.26	S
	Grain hole	1.00	1.00	1.00	1.00	0.00	NS
2	Grain weight	207.50^b	202.03^b	231.30^c	182.07^a	4.87	S
	Damaged grain	51.91^b	58.15^b	31.32^b	110.81^a	7.98	S
	Undamaged grain	155.59^{ab}	118.87^{ab}	199.96^{ab}	71.15^a	15.69	S
	Weevils	56.00^{ab}	71.50^b	38.00^c	122.00^a	8.37	S
	Grain hole	1.00	1.00	1.00	2.00	0.97	NS

Means within the same row denoted by different superscripts are significantly different (P. <0.05)

Table 4: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils at the eight week of storage

Variety	Parameters	T_1	T_2	T_3	T_4	SE$^{\pm}$	LS
1	Grain weight	192.10	201.53	203.24	159.84	6.24	S
	Damaged grain	106.54	77.90	67.82	124.69	8.75	S
	Undamaged grain	85.56^a	128.64^a	135.42^a	35.15^a	14.53	S
	Weevils	92.50^b	60.25^b	57.50^b	149.50^a	10.38	S
	Grain hole	1.00	1.00	1.00	2.00	0.00	NS
2	Grain weight	189.48^b	185.38^b	219.05^a	155.72^c	6.50	S
	Damaged grain	102.28	107.10	90.19	137.13	6.51	S
	Undamaged grain	87.18^{bc}	78.28^b	128.86^a	18.59^c	11.54	S
	Weevils	78.50^{ab}	98.25^b	57.25^c	152.50^a	9.24	S
	Grain hole	1.00	1.75	1.00	3.00	0.20	NS

Means within the same row denoted by different superscripts are significantly different (P. <0.05)

Table 5: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils at the tenth week of storage

Variety	Parameters	T_1	T_2	T_3	T_4	$SE^{\pm}$	LS
	Grain weight	179.52	186.25	191.68	146.881	7.45	NS
	Damaged grain	157.23	156.90	101.97	146.03	11.3	NS
1	Undamaged grain	22.29	29.34	89.72	0.85	0.27	NS
	Weevils	225.00^{a}	168.759	146.75^{a}	261.50^{a}	17.95	S
	Grain hole	2.00^{b}	2.00^{b}	1.75^{b}	3.00^{a}	0.13	S
	Grain weight	185.68^{b}	163.22^{ab}	221.87^{c}	146.47^{a}	8.22	S
	Damaged grain	161.89	134.31	166.76	145.71	5.40	NS
2	Undamaged grain	$23.79b^{b}$	28.91^{b}	55.13^{c}	0.76^{a}	5.55	S
	Weevils	192.50^{b}	223.75^{bc}	116.25^{a}	268.50^{c}	15.92	S
	Grain hole	3.00^{b}	3.00^{b}	2.50^{b}	4.00^{a}	0.15	S

Means within the same row denoted by different superscripts are significantly different (P. <0.05)

Table 5: Insecticidal effect of *Azadirachta indica* and *Eucalyptus globules* against cowpea weevils at the tenth week of storage

Variety	Parameters	T_1	T_2	T_3	T_4	$SE^{\pm}$	LS
	Grain weight	179.52	186.25	191.68	146.881	7.45	NS
	Damaged grain	157.23	156.90	101.97	146.03	11.3	NS
1	Undamaged grain	22.29	29.34	89.72	0.85	0.27	NS
	Weevils	225.00^a	168.759	146.75^a	261.50^a	17.95	S
	Grain hole	2.00^b	2.00^b	1.75^b	3.00^a	0.13	S
	Grain weight	185.68^b	163.22^{ab}	221.87^c	146.47^a	8.22	S
	Damaged grain	161.89	134.31	166.76	145.71	5.40	NS
2	Undamaged grain	$23.79b^b$	28.91^b	55.13^c	0.76^a	5.55	S
	Weevils	192.50^b	223.75^{bc}	116.25^a	268.50^c	15.92	S
	Grain hole	3.00^b	3.00^b	2.50^b	4.00^a	0.15	S

Means within the same row denoted by different superscripts are significantly different (P. <0.05)