Available Online at ESci Journals
International Journal of Entomological Research
ISSN: 2310-3906 (Online), 2310-5119 (Print)
http://www.escijournals.net/IJER

MANAGEMENT OF COWPEA WEEVIL (*CALLOSOBRUCHUS MACULATUS* FABR.) (COLEOPTERA; CHRYSOMELIDAE: BRUCHINAE) USING GMELINA (*GMELINA ARBOREA* ROXB) TREE PARTS POWDER IN STORAGE OF COWPEA (*VIGNA UNGUICULATA* L. WALP) AND THEIR EFFECTS ON NUTRITIONAL QUALITY OF THE COWPEA

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A B S T R A C T

The experiment aimed at evaluating the effects of *Gmelina arborea* tree parts powder on the management of stored insect pest of cowpea and their effects on nutritional quality of the cowpea, carried out at Niger State College of Agriculture, Mokwa, Pest Management Technology Laboratory, Niger state, Nigeria, during 2012 season. The trial of four treatments with three replicates was directly applied on cowpea seeds. The treatment included bark of *G. arborea* tree part powder 20g on 200g of cowpea seed; root of *G. arborea* tree part powder 20g on 200g of cowpea seed; leaf of *G. arborea* tree part powder 20g on 200g of cowpea seed; stem of *G. arborea* tree part powder 20g on 200g of cowpea). The result showed insects mortality were significantly different at 15, 30, 45, 60, 75 and 90 days after storage, and no significant difference in live insects at 15, 30 and, 60 days after storage but significantly different in the live insects after 45, 75,and 90 days of Storage. However, no significant difference in weight lost of cowpea after 15, 30, 45, 60, 75 and 90 days of storage all at 5% probability. The bark of *G. arborea* tree part powder was the most effective throughout the three months of the cowpea storage, followed by the root then the leaf, and lastly the stem. They generally reduce the number of emerging adults significantly,-and also increase the mortality rate of *Callosobruchus maculatus* at different level depending on the part of *Gmelina* used. For crude protein preservation of cowpea grains, Gmelina root powder and Gmelina bark powder give promising result.

Keywords: *Callosobruchus maculatus*, cowpea. *Gmelina arborea*.

INTRODUCTION

In Nigeria control of stored product insect population is primarily dependent on continued application of synthetic insecticides although effective, their repeated use for several decades has led to outbreaks of insect pests, wide spread of development of resistance, undesirable effects on non-targets organism, environmental and human health concerns. The highlighted shortcomings of synthetic insecticides needed to explore and develop new sources of chemical compounds from plant origin that constitute a rich source of bioactive chemicals (Wink, 1993; and Champ and Dyte,1977) which are non-toxic, safe, biodegradable and of broad activity spectrum (Singh et al, 1983 and Caswell, 1999). Fortunately, Nigeria has a wide range of herbal land races spread across the various ecological zones which are largely unexplored. Some of these tree species have been reported to have insecticidal properties (Gangadharen, 2012), against some stored and field pest of crops. Neem products have shown efficiency against maruca pod borer (*Clavigralla tomemosicollis*) (Jackai and Oyediran, 1991).Cowpea production is affected world-wide by a complex of insect pest and other pests both in the field and in the storage (Jackai and Oyediran, 1991) Drastic reduction in the utilization of cowpea had been attributed to destruction by the cowpea weevil (*Callosobruchus maculatus)* which is a field to storage pest. In Nigeria losses of 50 – 100% of stored seeds have been attributed to *Callosobruchus maculatus* (Aswell, 1960; Singh, 1978). This severely reduced the quality and germination potential of the

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seeds (Rahaja, 1984). In spite of heavy reliance on insecticides more and more insect species developed immunity to pesticides apart from the danger of delay toxicity to human and with adverse effect on the natural environment (White and Leesch, 1995). This therefore requires serious search for alternative to the use of conventional chemical control safe to the farmers and their ecoagrosystem. Hence this paper highlights a laboratory study on the effect of *Gmelina's* tree parts in the management of storage insect pest of cowpea and their effects on nutritional qualities of the legume seeds.

MATERIALS AND METHODS

The trial was carried out at the Pest Management Technology department, Niger State College of Agriculture, Mokwa. Geographically, Mokwa is located on Latitude 09^{o} 18^{l}N and Longitude 05^{o} 04^{l}E of the Equator. It is situated on the Southern Guinea Savannah of agro-ecological zone of Nigeria. Fresh *Gmelina* tree parts was collected using cutlass and hoe in Niger State College of Agriculture, Mokwa premises, cowpea was purchased from Mokwa central market and screened. *Gmelina* tree parts (leaves, root, bark and stem) was collected fresh and air dried in room temperature so as to maintain its color and chemical contents for nine days. The dried specimen was pounded into powder by using pestle and mortal and was stored separately in polythene bags at room temperature. The seeds were kept in the refrigerator at a temperature of 4^{o}C in order to prevent weevil infestation until they were needed for the experiment. A laboratory culture of *Callosobruchus maculatus* was established from already infested cowpea seeds obtained from Mokwa market. The culture was manifested in a Kliner jar in the pest management technology laboratory under ambient temperature of 29^{o}C – 30^{o}C and humidity of 82.87% to obtain young weevils that were later sexed. In order to have adequate result, 200g of cowpea seed was placed into kliner jar and teneral adults (males and females) of *Callosobruchus maculatus* were introduced irrespective of sex to oviposit on the seeds. The insects were sifted out after five days and the jar was set aside in the laboratory until the adults emerged. The experiment was set up in Complete Randomized Design (CRD) consisting of five treatments (powder of *Gmelina* leave, bark, stem and root), replicated three (3) times with 20g of each of the *Gmelina* tree part applied to 200g of cowpea and 200g into each plastic container, 10 of the newly hatched *Callosobruchus maculatus* were introduced into mixed up and sealed with muslin cloth and rubber band so as to maintain proper ventilation. Number of dead insects at two weeks interval for three months, number of live insects at two weeks interval for three months, weight of cowpea seed at two weeks for three months were all noted and taken. The data collected were subjected to Analysis of Variance (ANOVA) and the mean separated was partition using Least Significant Different (LSD) at 5% probability. The seed proximate composition determination passed through the method adopted by A.O.A.C (1990) to determine moisture content, protein content, ash content, fat content and crude fiber content.

RESULTS AND DISCUSSIONS

Number of insect's mortality were significantly different at 15, 30, 45, 60, 75 and 90 days after storage (Table 1), just like there was no significant difference in live insects at 15, 30, 45, 60 and 75 days after storage (Table 2), except significant difference in the live insects after the 90 days storage. There was also no significant difference in weight lost of cowpea after 15, 30, 45, 60, 75 and 90 days (Table 3), but there was significant difference after 30 days of storage. However the effect in terms of the tree parts follow this order; bark of *Gmelina* > root of *Gmelina* > leaf of *Gmelina* and lastly stem of *Gmelina* tree part. The cowpea seeds treated with Gmelina root powder supported significantly higher moisture content compared with other treated cowpea seeds, while value for Gmelina stem powder showed least moisture content, (Table 4).

Table 1. Mortality of Insects at;

Treatment	15days	30days	45days	60days	75days	90days
Root power (GRP)	6.67a	6 a	4.66b	5.6b	7.3a	4.3a
Control (CONT)	2.67b	3.6 b	4 c	5 b	3b	2.22b
Stem powder (GSP)	1.3b	2 b	3 c	6 .6a	4.3b	3a
Leaf powder (GLP)	4.6a	5.33a	5 b	5.3 a	6.3a	3.6a
Bark powder (GBP)	7a	6.6a	8.3a	8.6a	8a	6.3a
LSD value at 5%	7.17	2.29	2.48	2.20	2.92	3.50

Means followed by same letter (s) within a column are not significantly different at 5% probability.

Table 2. Mortality of Insects at;

Treatment	15days	30days	45days	60days	75days	90days
Root power (GRP)	5	7.33	4.67b	7.33	3.33b	4.67b
Control (CONT)	8	11.67	9a	8	6.67a	7.67a
Stem powder (GSP)	8.67	13.67	10a	8.67	4.67a	6.67a
Leaf powder (GLP)	5.33	14.33	5.67b	10.33	5.67a	5.33b
Bark powder (GBP)	3.67	3.33	2.5b	4.33	1.33b	1.78a
LSD value at 5%	NS	NS	4.29	NS	2.99	1.53

Means followed by same letter (s) within a column are not significantly different at 5% probability.

Table 3. Weight lost of Cowpea at;

Treatment	15days	30days	45days	60days	75days	90days
Root power (GRP)	199	197.33	196	194	190.67	188.67
Control (CONT)	198.67	197	195	114.33	189	187.33
Stem powder (GSP)	198.33	197.33	196.67	195.67	190	189
Leaf powder (GLP)	198.67	196.67	195.33	194.67	190.67	189.33
Bark powder (GBP)	198.67	198.67	197	196	192.67	191.33
LSD value at 5%	NS	NS	NS	NS	NS	NS

Table 4. Proximate composition of Cowpea seeds as effected by the treatments.

Treatment	Moisture content %	Ash content %	Protein content %	Fat content %	Crud fiber content %
Fresh seeds	13.71b	5.11a	27.99a	3.35a	4.73a
Bark Powder	12.60e	4.66b	25.11d	2.88c	4.55b
Root Powder	13.61c	3.46d	26.66b	3.10b	3.69e
Leaf powder	12.66d	4.62b	26.80c	2.80d	4.33c
Stem Powder	11.81f	3.80c	24.40e	2.30e	3.77d
Control	15.55a	3.80c	24.40e	2.30e	3.77d
LSD value at 5%	1.81*	0.15*	1.61*	0.35*	0.37*

Means followed by same letter (s) within a column are not significantly different at 5% probability.

The loss of moisture content in the treated samples was significant ($p<0.05$) with a minimum value for Gmelina Stem Powder (GSP). This is likely to be the removal of excess water from the treated seeds. But the control value was higher in moisture percentage (15.55%) than the fresh seeds before application of treatment (13.71%) because since there was no application, insect population would have seemed to increase untempered. Absorption of the moisture from the atmosphere would have also been increased by the increased insect population and increased insect metabolism. This claim is supported by Isah et al, (2007) that keeping wet and dry produce together in the store can cause moisture migration hence increased seed moisture composition. In term of ash and crude fiber in the treated samples, there was significant difference ($p<0.05$). The Gmelina Bark Powder (GBP) treated samples noted significantly higher values of ash content (4.66%) and fiber content (4.55%) but less than that of fresh seeds respectively before treatment application samples. This is likely to be as a result of less *C. maculatus* larval attack. This is in line with Siddiqui (2002) and Adejumo (2007) assertion that the use of natural herbs is less harmful and does not affect nutrient composition of grains during storage. Ash and fiber contents of the control noted a significant different ($p<0.05$) with a minimum of 3.80% and 3.77% respectively. This is probably because ash and fiber are rich in husk content of the seeds and might have decreased due to formation of emergence holes in the husk by *C. maculatu*s larval attack. Crude protein values in the treated samples were slightly low compared to fresh seeds before application of treatments (4.73%). This could be blamed to proteolytic enzymes in the treated grains. GBP and GLP (4.55% and 4.33%) noted higher protein contents significantly than other treated samples, because of likely less infestation by *C. maculatus* larvae. The fat percentage noted from treated cowpea grains with GRP was significantly higher

(3.10%) than the rest but less than fresh seeds before treatment (3.35%) with minimum values for control (2.30%). This is probably because fat component is rich in endosperm and germ part of the seeds, therefore the loss may be due to consumption of this nutrient by *C. maculatus*.

CONCLUSION

The ability of *Gmelina* tree parts to inhibit the growth and development of cowpea weevil (*Callosobruchus maculatus*) was evident, which reduces the storage losses. The Gmelina tree parts generally reduce the number of emerging adults significantly, and also increase the mortality rate of *C. maculatus* at different level depending on the part of *Gmelina* used. In terms of proximate composition of the cowpea grains, it is concluded that storing cowpea for protein preservation, Gmelina Root Powder (GRP) or Gmelina Bark Powder (GBP) gives good result compared to other treatments in the study. Further work is on-going on the active compound extracted from Gmelina for use on commercial quantity against *C. maculatus*.

ACKNOWLDGEMENT

The authors are grateful to the management of Niger State College Of Agriculture, Mokwa, Nigeria, for providing us the opportunity of using College facilities. The technical assistance of auxiliary staff of Pest Management Technology Department is highly appreciated.

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