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INSECTICIDAL ACTIONS OF SOME BOTANICALS ON STORAGE BRUCHID, *Callosobruchus maculatus* (F.) OF STORED COWPEA *(Vigna unguiculata* L. WALP.)

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ABSTRACT

The effect of some botanicals on the control of cowpea (Vigna unguiculata (L.) Walp) against the bruchid, Callosobruchus maculatus during storage was investigated. Three plant materials used were powdered ginger, garlic and bitter leaf, while five varieties of cowpea used included Aloka, IAR48 (Big Brown), IT3629 (Big White), Iron Beans and IT84E-124 (Ife Brown). The experimental design used was a factorial laid out in a completely randomized design (CRD) with three replications. Results showed that there was a significant (P<0.05) difference among the cowpea varieties and plant materials used. An improved line, IT84E-124 (Ife Brown) resisted C. maculatus attack most during storage and subsequently gave the least weight reduction of 13.51 g during the entire storage period when compared to other varieties. Next was Aloka which gave 48.20 g, followed by IAR 48 (Big Brown), big white and lastly by iron beans (an unimproved line) with kthe highest weight reduction of 126.99 g. Among the treatments, bitter leaf gave the best protection against cowpea bruchid compared to the other plant materials giving least weight reduction of 1.09 g. Next to bitter leaf in efficacy was garlic. The interaction between cowpea varieties and plant materials used was also significant. The relative efficacy of these botanicals showed that they can also be used to preserve cowpea against C. maculatus during storage more so that they are environment friendly and have no negative side effect on human health.

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp) otherwise called the southern pea belongs to the family *Leguminosae* and is a crop of high value which contributes significantly to farm income and dietary protein of Africans (Ogbaji, 2002).

Cowpea constitutes the cheapest source of protein for most people in the Tropical world where per capital income and consumption of animal protein are both very low (Rachie, 1985). It contains about 24% protein and 62% soluble carbohydrates. It also has high lysine content. Cowpea also serve as a quick cover crop for erosion control and smothering of weed seeds in addition to its capability in fixing up to 240 kgN/ha to the soil after a crop cycle (Rachie, 1985). In Africa, cowpeas are commonly consumed as fried bean cake, beans soup, boiled fresh green beans for salad, boiled bean balls (Danwake), boiled can paste (moin-moin). The haulms and husk of cowpea serve as roughage for livestock (IITA, 2002).

Insect infestation is a major contributor to quality deterioration of cowpea stored in warm and humid climates. Considerable physical and nutritional loss sustained on cowpea are due to infestation by weevils, and results in reduction of quality. Currently, insect control in stored cowpea relies primarily on the use of gaseous synthetic fumigants and residual insecticides both of which may pose serious hazards to warm blooded animals and the environment. In Nigeria, multi-tactic control methods have been developed to reduce the menace of storage pests. Cultural methods entail manipulation of the environment to make it unfavourable for growth rate of population build up but it has limited or no remedial value in emergency situations. The use of plant materials for the protection of crops and stored commodities against insect attack has a long history (Golob and Webley, 1980). It is quite safe and promising (Jilani *et al.,* 1988). The use of botanical insecticides to control *Callosobruchus maculatus* in stored cowpea has the advantage of lowering adverse impacts of chemicals on non-targeted beneficial organisms.

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Over the years, significant results have been reported with the use of botanical insecticides in treating grains meant for storage. These included the use of plant oils (Odunlami, 1992), Fagara, *(Zanthoxylum* spp) (Ogunwolu, 1996), neem (*Azadirachta indica)* (Ivbijaro, 1983), tobacco (*Nicotiana tobacum)* (Tooley, 1971), pepper, (*Capsicum* spp) (Ivbijaro, 1983), Ginger *(Zinger officinale)* (Olitodun, 2001), ash (Murdock and Babalola, 1990) and Bitterleaf (*Vernonia amygdalina).*

Hence, the objective of this study was to evaluate the efficacy of some other plant materials such as bitterleaf (*Vernonia amygdalina*), ginger (*Zinger officinale*) and garlic *(Allium sativum)* in the control of some varieties of cowpea against "weevils" *(Callosobruchus maculatus)* during storage in Makurdi, a location in the Southern Guinea Agro-Ecological Zone of Nigeria.

MATERIALS AND METHODS

The experiments were conducted in the Botany Laboratory of the Benue State University, Makurdi, Nigeria between September and December of 2009 and 2010.

The five cowpea varieties used were: Aloka, IAR48 (Big Brown), IT3629 (Big White), Iron Beans and IT84E-124 (Ife Brown). These were all obtained from the National Cereals Research Institute (NCRI), Yandev Substation and Benue State Agricultural and Rural Development Programme (BNARDA), Makurdi. These varieties have earlier been confirmed to do very well in the Makurdi environment (Ogbaji and Ndam, 2002). The cowpea varieties were sorted out to remove undersized and perforated seeds and were then sun-dried for 7 days to allow *Callosobruchus maculatus* escape. Sun drying continued until there was ceasation of reproduction to ensure that all the immature stages had been hatched. After the sun-drying, the cowpea seeds were then stored in airtight plastic containers. Each variety had three replicates and a control.

The plant products used were ginger, bitterleaf and garlic. Bitterleaf was obtained from the bank of River Benue while Ginger and garlic were obtained from the Makurdi Modern Market in Benue State. They were all sun-dried for a month and powdered into powdery form.

Green 1-liter plastic containers with transparent plastic cover were used for the storage of the materials. The central portion of each cover or lid was perforated using a stainless pin of 0.5mm diameter with five holes. This was to allow aeration and breeding of the insect.

Equal quantity of the plant materials (50g) of each test plant (*Allium sativum, Zingiber officinale* and *Vernonia amygdalina)* as recommended by Olitodun (2001) were measured with a digital sensitive weighing balance and 500g of seeds of each of the cowpea varieties were also measured and both were mixed into a 1 litre size flat bottom green plastic container. In each of the two years, the experimental design used was a factorial laid out in a Completely Randomized Design (CRD) with three replications. They were then stored at the Botany Laboratory of Benue State University, Nigeria at room temperature.

The data collected were the progressive weight loss of the cowpea varieties at two weekly intervals. The weight loss was measured using a digital sensitive weighing balance (name = Adam and make = AFP – and LC series). Percentage weight loss was calculated as follows:

Initial weight of cowpea and container = a
Final weight = b
Weight loss = a-b
Percentage weight loss = weight loss/Initial weight x 100/1 = a-b/a x 100/1

Collected data were analyzed using Analysis of Variance (ANOVA), Treatment means were separated using Fishers Least Significant Difference at 5% level of significance. Orthogonal comparisons between the two years were also carried out using the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Orthogonal comparison of the results for the two years (2009 and 2010) did not indicate any significant difference hence the results were pooled together. Significant varietal differences existed among the cowpea varieties used for the study in their levels of resistance to *C. maculatus* attack during storage (Table 1). An improved line, IT84E-124 (Ife Brown) resisted *C. maculatus* attack most during storage and subsequently gave the least actual weight reduction of 13.51g during the entire storage period. Next was *Aloka* which gave 48.20g then IAR 48 (Big Brown), big white then lastly iron beans (an unimproved line) with highest weight reduction of 126.99g. The variability in the levels of resistance in the cowpea varieties to *C. maculatus* attack during storage is most probably as a result of genetic differences among these lines as they were developed from different pedigrees. This result corroborates a study by Jackai *et al.* (1990) who also reported genetic variability among some cowpea lines. In the

Table 1: Main Effects of Varieties and Botanicals on Weight Loss (grams) of Cowpea Seeds During Storage.

Varieties	Weeks of Storage					
	2	**4**	**6**	**8**	**10**	**12**
Aloka	537.18	537.27	536.19	524.01	504.50	501.80
IAR48 (Big Brown)	538.35	525.20	502.95	427.56	441.40	435.88
TVu3629 (Big White)	538.02	522.99	508.46	484.24	432.60	431.84
Iron beans	537.84	516.98	503.01	471.85	425.30	423.01
IT84E-124 (Ife Brown)	539.65	538.99	538.31	537.93	536.90	536.49
S.E (±)	0.07	2.43	2.89	1.44	3.82	2.91
LSD (0.05)	0.15	4.91	5.84	2.90	7.72	5.88
CV(%)	0.00	1.10	1.40	0.70	2.00	1.50
Botanicals						
Ginger	550.97	545.06	529.28	511.59	474.80	471.90
Garlic	550.83	539.97	529.77	507.86	477.80	474.23
Bitterleaf	550.91	552.83	532.87	517.96	493.00	489.18
Control	500.93	490.08	481.62	456.65	426.90	427.90
LSD (0.05)	0.06	4.39	5.23	2.59	6.91	5.26

Table 2: Main Effects Varieties and Botanicals on Percentage Weight Loss (grams) of Cowpea Seeds During Storage.

Varieties	Weeks of storage					
	2	**4**	**6**	**8**	**10**	**12**
Aloka	0.13	0.12	1.03	1.16	3.74	0.56
IAR48 (Big Brown)	0.16	2.45	4.26	4.31	6.64	1.57
TVu3629 (Big White)	0.10	2.81	2.79	2.78	9.03	1.12
Iron beans	0.07	3.82	2.72	2.69	9.18	1.28
IT84E-124 (Ife Brown)	0.40	0.25	0.06	0.08	0.56	0.08
S.E (±)	0.01	0.13	0.16	0.13	0.48	0.23
LSD (0.05)	0.03	0.24	0.32	0.27	0.97	0.48
CV(%)	18.90	15.40	18.10	14.90	20.20	63.70
Botanicals						
Ginger	0.18	1.64	2.39	2.58	6.83	1.21
Garlic	0.15	2.08	1.94	1.90	5.44	1.05
Bitterleaf	0.16	1.57	1.87	1.84	4.97	0.84
Control	0.19	2.27	2.49	2.48	6.08	22.20
LSD (0.05)	0.02	0.22	0.29	0.24	0.87	0.43

case of the botanicals, there were also significant ($P<0.05$) differences among them. Biter leaf gave the best protection against the cowpea weevils giving the overall cowpea varietal weight reduction of 60.82 g followed by garlic (75.77 g) and then ginger (78.10 g). Some of the principal chemical constituents found in the bitter leaf herb are a class of compounds called steroid glycosides – type vernonioside BI (Ebiamodon *et al*., 2011). These chemical substances posses potent insecticidal substances that repel insects. Cowpea varieties not treated with any plant materials (control) were very heavily damaged giving significantly higher weight reduction of 122.10 g. These results indicated that even though all the botanicals had some insectidal effects, some were more efficacious than others. Results of the main effects of varieties and botanicals on percentage weight loss of cowpea during storage (Table 2) also followed the above trend. IT84E-124 (Ife brown) gave the least percentage weight loss of 0.08%, while iron beans gave the highest percentage weight reduction of 1.28%. The botanicals performed in the order of Bitter leaf >Garlic>Ginger and >Control. Cowpea varieties not treated with any plant materials gave significantly higher percentage weight loss of up to 22.20%. The significant seed weight reduction in all the cowpea varieties stored with the botanicals may be as a result of reduced oviposition and adult
emergence of *C. maculatus.* This result agrees with previous work done by Ivbijaro (1983) who found neem effective at 5-15% of seed weight. The significant reduction in the damage of the cowpea varieties is a good indication of the insecticidal activity of the botanicals used in this study against the cowpea seed bruchid.

Table 3: Interaction Effects of Varieties and Botanicals on Weight Loss (grams) of Cowpea seeds during storage.

Varieties	Botanicals	Weeks of Storage					
		2	4	6	8	10	12
Aloka	Ginger	550.76	564.80	537.21	518.84	476.50	469.63
	Garlic	550.66	550.23	544.00	537.04	516.30	513.50
	Bitterleaf	550.63	549.87	548.51	545.02	538.30	537.66
	Control	500.67	500.18	515.04	495.15	487.00	486.42
IAR48 (Big Brown)	Ginger	551.44	538.80	517.34	491.92	452.50	443.60
	Garlic	550.75	550.23	514.60	475.13	453.50	448.28
	Bitterleaf	550.89	549.43	519.47	498.37	465.90	460.98
	Control	500.32	485.85	460.41	242.84	393.60	390.91
TVu 3629Big White	Ginger	550.14	536.03	521.01	502.84	461.00	455.80
	Garlic	550.45	535.61	521.73	498.50	466.70	441.55
	Bitterleaf	550.56	536.94	523.29	499.53	454.20	449.10
	Control	500.94	483.37	467.82	436.06	368.40	380.91
Iron beans	Ginger	550.75	532.60	517.55	492.09	434.90	441.60
	Garlic	550.18	525.77	514.60	475.80	423.60	419.11
	Bitterleaf	550.43	532.56	519.47	494.78	457.70	449.25
	Control	499.98	476.98	460.41	424.74	385.00	382.07
IT84E-124 (Ife Brown)	Ginger	551.73	553.00	553.27	552.27	549.00	548.87
	Garlic	552.14	553.57	553.90	552.86	549.00	548.71
	Bitterleaf	502.72	553.37	553.62	552.10	549.10	548.91
	Control	552.01	504.02	504.44	502.47	500.50	499.47
LSD (0.05)		0.14	9.83	11.68	5.81	15.44	11.77

Table 4: Interaction Effects of Varieties and Plant Botanicals on Percentage (%) Weight Loss (grams) of Cowpea Seeds During Storage

Varieties	Botanicals	Weeks of Storage					
		2	4	6	8	10	12
Aloka	Ginger	0.14	0.18	2.29	2.73	8.17	1.44
	Garlic	0.12	0.07	1.13	1.16	3.89	0.55
	Bitterleaf	0.11	0.14	0.25	0.31	1.24	0.11
	Control	0.13	0.09	0.43	0.43	1.64	0.13
IAR48 (Big Brown)	Ginger	0.26	2.28	3.99	4.29	8.17	1.98
	Garlic	0.14	2.92	3.75	3.62	4.56	2.48
	Bitterleaf	0.16	1.72	4.05	4.09	6.51	1.06
	Control	0.06	2.89	5.24	5.24	7.33	0.75
TVu 3629Big White	Ginger	0.03	2.56	2.80	2.79	8.31	1.14
	Garlic	0.08	2.69	2.59	2.71	7.05	1.15
	Bitterleaf	0.10	2.47	2.54	2.38	9.08	1.13
	Control	0.19	3.51	3.22	3.22	11.69	1.08
Iron beans	Ginger	0.14	2.99	2.83	3.02	8.92	0.02
	Garlic	0.03	4.43	2.13	1.90	10.78	0.10
	Bitterleaf	0.07	3.25	2.45	2.37	7.59	0.04
	Control	0.04	4.60	3.47	3.47	9.35	0.21
IT84E-124 (Ife Brown)	Ginger	0.31	0.23	0.05	0.07	0.60	0.02
	Garlic	0.39	0.26	0.08	0.09	0.70	0.05
	Bitterleaf	0.36	0.25	0.04	0.07	0.54	0.04
	Control	0.54	0.26	0.08	0.08	0.39	0.21
LSD (0.05)		0.05	0.48	0.64	0.54	1.94	0.96

The interaction effect of the cowpea varieties and botanicals on actual weight loss of cowpea seeds (Table 3) and the interaction effects of varieties and plant botanicals on percentage weight loss of cowpea seeds during storage (Table 4) were all significant. These results indicated that all the plant materials used for the storage were effective in the control of cowpea weevils *(C. maculatus)* during storage but some botanicals are more effective on some cowpea varieties than others. Therefore, with proper combination between the cowpea varieties and the botanicals, more efficiency in the control of *C. maculatus* damage will be achieved.

The relative efficacy of these botanicals showed that they can also be used to preserve cowpea against *C. maculatus* during storage more so that they are environment friendly and have no negative side effect on human health. The pungent and offensive odour of these plant materials may have caused an unconducive environment for the insects to reproduce.

The results of this study are in total conformity with results obtained by Ebiamadon *et al*, 2011. Ebiamodon *et al*, 2011 why controlling bruchid pests of stored cowpea seeds using dried leaves of bitter leaf reported that the insecticidal activity of bitter leaf (*vernonia amygdalina*) was because it contained fairly high levels of bioactive constituents with fumigant activity which made it to have potent insecticidal properties. Also, Schmuhener and Ascher (1984), while working on another botanical, reported that the insecticidal activities of neem (*Azadirachta indica*) was a result of the presence of highly oxidized tetrapenoids, azadirachtin, salanin and other active products that posses repellant, antifeedant and growth disruptive properties against various insect species particularly *C. maculatus.* It is therefore recommended that cowpea farmers and consumers in Nigeria and the world at large should promote and support the development and efficient use of botanicals in the storage of cowpea seeds against *C. maculatus* particularly bitter leaf because they are readily available, cheap, leave no harmful residues, environment friendly and require less skill for their use.

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REFERENCES

Ebiamadon, A.B., Sophia, E.A., Uduak, E., Fradideh, B. and Glyn, M. F. (2011). Controlling Bruchid Pests of Stored Cowpea Seeds with Dried Leaves of *Artemisia annua* and other common Botanicals. African Journal of Biotechnology Vol. 10 (47), PP. 9586-9592.

Golob, J. and Webley, T. (1980). Objective and Achievements in the Improvement of Grain Legumes. *Proceedings of the Nutrition Society* 41, 27-39.

Gomez, K.A. and Gomez A.A. (1984). Statistical Procedures for Agricultural Research (Second Edition). A Wiley-Interscience Publication, John Wiley and Sons, New York. 680pp.

IITA (International Institute of Tropical Agriculture) (2002). Proceeding of World Cowpea Conference III, Ibadan, Nigeria, 4-8 September.

Ivbijaro M.F. (1983). Preservation of Cowpea (*Vigna unguiculata)* and *Capsicum* species on the cowpea *Callosobruchus maculatus* (F). *Insect science and its Application* 7(4): 521-524.

Jackai, L.E.N, Singh S.R., Dos Santos J.H.R and Adalla, C.B. (1990). Insects of Cowpea In: Singh S.R(Ed). Proceeding of Insect Pest of Tropical Food Legumes. John Wiley and Sons, Chichester London, pp. 43-90.

Jilani, G; Kabeh, J.D and Malik, M. (1973). Studies on Neem Plant on Repellant Against Stored Grain Insects. *Pakistan Scientific and Industrial Research* 16:6.

Murdock, L. and Babalola, O. (1990). Preservation of Post Harvest Cowpea by Subsistence Farmers in Cameroon. In: Proceeding of the International Research Meeting of the Bean/Cowpea Collaborative Support Programme pp. 11-15.

Odunlami, A.T. (1992). Control of Cowpea Seed Bruchid (*C. maculatus* F.) with Some Natural Plant Materials, Bachelor of Agriculture Thesis, University of Agriculture, Makurdi. 58pp.

Ogbaji, M.I. (2002). Genetics of Resistance of Cowpea, *Vigna unquiculata* (L.) Walp to the Pod-Sucking Bug, *Clavigralla*

tomentosicollis (Stal.) Hemipetera: Coreidae). *Journal of Sustainable Tropical Agricultural Research* 3:28-32.

Ogbaji, M.I. and Ndam, O. (2002). Response of some Cowpea, (*Vigna unguiculata* L. Walp) Varieties to Insect Pests in Makurdi, a Location in the Southern Guinea Savanna. *Nigerian Journal Sustainable Tropical Agricultural Research* 3:28-32.

Ogunwolu, E.O. (1996). Suppression of seed Bruchid *(Collasobruchus maculatus)* (F) Development and Damage on Cowpea with Zanthoxylum Zanthoxyloids (Lam). *Western Protection*. 15(7): 663-607.

Olitodun, O.G (2001). Six Plant Powders as Protestants of Stored Cowpea Against *Callosobruchus maculatus* Fabricus (Coleoptera; Bruchidae), *Nigeria Journal of Plant Protection* 19:1-30.

Rachie, K.O. (1985). Introduction: Singh, S.R and K.O Rachie Ed. Cowpea Research Production and
Utilization. John Wiley and Sons New York, pp1-4.

Schmuhener, H. and Ascher, K.R.S. (1984). Natural Pesticides from the Neem Tree and other Tropical Plants. Proc. 2nd Int. Neem Conference, Rouschotzhouzen, 1983. GTZ Eschborn, pp.7-10.

Tooley, T.A. (1971). Crop Production. In: Food and Drug Chemistry in Industry, Series John Murray
Publishers, Albermale Street London, pp 92-158.