RESPONSE OF FOUR LOCAL VARIETIES OF COWPEA TO WATER EXTRACTS OF *CHROMOLAENA ODORATA* (KING AND ROBINSON) AND *VERNONIA AMYGDALINA* (L.)

By

Adebayo, R. A, Idoko, J. E and Adetuyi, R. O

Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Ondo State, Nigeria.

Correspondence author, 07038661128, raphael.adebayo@yahoo.com

Abstract

Investigation was carried out on four varieties of cowpea; Drum, Ife brown, Oloyin and Sokoto white to evaluate their response to Cypermethrin, water extracts of Chromolaena odorata (King and Robinson) and Vernonia amygdalina (L.). The experiment was conducted at the Crop Type Museum of Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Nigeria. Some common field insect pests were observed on the cowpeas during the period of the study. The results from the investigation showed no significant differences ($p>0.05$) in the growth parameters of the four varieties used at two, four and six weeks after planting while effect of the treatments after spraying revealed Cypermethrin to be significantly different ($p>0.05$) from the two botanicals and control. The highest mean number of pod was recorded on Cypermethrin treated plot at one and two weeks after spraying. On the yield of cowpea, Cypermethrin performed significantly better than the water extracts of Vernonia amygdalina and Chromolaena odorata. The study compared the performance of plant botanicals and also indicated the importance of synthetic chemicals in increasing the yield of crop if correctly applied. Based on the findings of this study, it is recommended that more plant botanicals be screened for their insecticidal activities on the field insect pests of cowpea.

Keywords: Cowpea varieties, *Chromolaena odorata*, *Vernonia amygdalina*, Cypermethrin

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Introduction

Cowpea (*Vigna unguiculata* L. Walp.) is an indigenous African annual legume which is also called southern pea, blackeye pea, crowder pea, lubia, niebe, coupe or frijole (Davis *et al*., 1991; Langyintuo *et al*., 2003). Its tender green leaves, immature pods and green seeds, as well as dry mature seeds, serve as human food, and after the harvest of the pods the rest of the plant can be used as animal fodder (Davis *et al*., 1991; IITA, 2006). The grain contains about 24% protein and 62% carbohydrates (Lambot, 2002). The plant is more drought tolerant than common bean (Davis *et al.*, 1991) and can be grown on an improved poor soils (IITA, 2006). Even though the plant is very susceptible to pests and diseases (IITA, 2006) and the grain to beetles (Lambot, 2002), cowpeas are important in many parts of West and Central Africa as a source of protein for those who cannot afford meat or fish (IITA, 2006), as "a food security crop" (Lambot, 2002) for populations that consume cowpeas as a traditional staple food, and as "a major cash crop" (Langyintuo *et al.*, 2003). Used as a cover crop, it suppresses weeds and can encourage populations of beneficial insects to defend cash crops from insect pests.

Cowpea is a hardy crop but it hosts many pests that attack vegetables, including leafminers, whiteflies, leafhoppers, mites, thrips, and aphids (IITA, 2006). Yields are however, generally low (Olatunde *et al*., 1991), sometimes total yield losses and crop failure occur (Singh and Jackai, 1985) due to the activities of a spectrum of insect pests which ravage the crop in the field at different growth stages (Singh and van Emdem, 1979). Due to the attendant problems resulting from the excessive use of synthetic insecticides, the use of botanicals in crop protection has now gained a popular ground in the world of agriculture as an alternative to the use of toxic, persistent and synthetic compounds (Lale, 1995).

Factors responsible for making the use of alternative methods more attractive include, limited external reserves and poor exchange rates of the currency of the developing nations which limit the quantity of pesticides that can be imported (Ivbijaro, 1990) and the complete removal of subsides on synthetic herbicides, insecticides and fungicides have made them inaccessible to the majority of farmers in many African countries (Ivbijaro and Agbaje, 1986). Since majority of farmers are illiterate, misuse of these chemicals frequently occur. These chemicals also contaminate stored food commodity, leaving behind harmful residues, especially when an application dosages are not properly followed (Amuah, 1989; Ofuya, 2003). Therefore, this study seeks to investigate response of four local varieties of cowpea to the application of plant botanicals and a synthetic insecticide.

Materials and Methods

Study Area

The study was carried out at the Crop Type Museum of the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure ($7^{o}15^{1}$N, $5^{o}5^{1}$E), Ondo State from January to May 2011. Three of the cowpea varieties used were obtained from the local market in Akure while Ife-brown seeds were collected from the Seeds Unit of Ondo State Agricultural Development Project, Akure, Ondo State. Cypermethrin, a synthetic insecticide was purchased at an agrochemical store in Akure while *Chromolaena odorata* and *Vernonia amygdalina* leaves were collected from the Teaching and Research Farm of The Federal University of Technology, Akure.

Cowpea Establishment

The experiment was laid out in a Complete Randomized Design. Experimental unit consisted of 48 pots which were allocated to the four varieties of cowpea with each replicated three times. All the units were treated alike in every respect other than the treatment applied. Seeds of each cowpea variety were surface sterilized separately in 10% sodium hypochlorite for 3 minutes prior to sowing. Cowpea varieties were sown at the rate of 3 seeds per pot at a spacing of 25cm x 30cm. Total stands of hundred and forty four (144) plant were observed. Three plant stands were selected and number of leaves counted at 2, 4 and 6 weeks after planting while plant height was measured using tape rule. Measurement was taking from the soil level to the tip of the last leaf.

Preparation of Treatments

Fresh and mature leaves (500g) of *Chromolaena odorata* and *Vernonia amygdalina* were separately weighed using weighing balance into a wooden mortar and pounded. The pounded materials were placed separately into plastic buckets, thereafter 4 litres of water was added to each of the bucket, which was thoroughly stirred and allowed to stand for 16 hours to allow the active ingredients to be extracted. The solutions were filtered with muslin cloth into separately labeled clean buckets. The buckets containing

the aqueous solutions were taken to the field for spraying. Twenty five millimeter of Cypermethrin was also diluted with 4 litres of water.

Application of treatments

Field applications of Cypermethrin and aqueous extracts of *Chromolaena odorata* and *Vernonia amygdalina* commenced at 6weeks after planting (WAP) which coincided with the period of onset of flowering in the cowpea varieties. Spraying was done from 10.00 a.m to 12.00 p.m each day after insects sampling using 8-Litres sprayer. The pesticides were sprayed once fortnightly for four weeks.

Sampling of insect pests

Insect pests sampling was done from 7.00 a.m to 9.30 a.m every two days. Flower buds were sampled for thrips while other insects were sampled by random picking from plant parts in each plot. Assessment of both nymphs and adult coreid bugs was based on visual observation. Insect species collected were preserved in 70% alcohol for identification.

Data Analysis

Square root transformation was performed on data obtained from the counts. All data were analyzed using SPSS package and analysis of Variance (ANOVA) carried out to detect differences. Means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

Results

The seed characteristics of the cowpea varieties used are presented in Table 1.

Table 1: Seed characteristics of the cowpea varieties

Variety	Colour	Texture
Drum	Rusty brown	Rough
Ife brown	Brown	Smooth
Oloyin	Brown	Smooth
Sokoto White	White	Rough

Insect pests observed on the cowpeas are presented below (Table 2)

Table 2: Insect species collected on the cowpea varieties

S/N	Common name	Biological name
1	Cowpea Aphid	*Aphis craccivora* Koch (Homoptera : Aphididae)
2	Flower bud thrips	*Megalurothrips sjostedti* Trybom (Thiraptera : Thripidae)
3	Stink bug	*Nezara viridula* (Hemiptera : Pentatomidae)
4	Pod sucking bug	*Clavigralla tomentosicollis* Stal. (Hemiptera : Coreidae)
5	Shield bug	*Riptortus spp.* (Hemiptera)

There were no significant differences in the mean number of leaves and branches on the varieties of cowpea at 2WAP (Table 3). Though highest number of leaves was recorded on Sokoto White while the lowest was recorded on Ife brown, there were no significant differences ($p \leq 0.05$). Also, there was no significant difference ($p \leq 0.05$) in the mean number of branches on the varieties, with Oloyin having the highest mean number while Ife brown and Sokoto White having the lowest mean number. However, significant differences existed in the plant height, Ife brown was significantly shorter ($p \leq 0.05$) than Oloyin with highest plant height (Table 3).

Table 3: Growth parameters of the cowpea varieties at 2 Weeks After Planting (2WAP)

Variety	Number of Leaves	Plant Height (cm)	Number of Branches
Drum	2.36a	15.55ab	1.05a
Ife brown	2.35a	13.35c	0.92a
Oloyin	2.45a	17.24a	0.97a
Sokoto White	2.48a	14.97bc	0.92a

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT).

From Table 4, there were no significant differences ($p \leq 0.05$) in the mean values of the growth parameters on the different cowpea varieties at 4WAP. Highest mean number of leaves, plant height and branches were recorded in Drum while the lowest mean number of leaves and branches were recorded in Oloyin and lowest plant height was recorded in Sokoto White.

Table 4: Growth parameters of the cowpea varieties at 4 Weeks After Planting (4WAP)

Variety	Number of Leaves	Plant Height (cm)	Number of Branches
Drum	4.10a	20.34a	2.30a
Ife brown	3.90a	19.63a	2.18a
Oloyin	3.80a	20.25a	2.11a
Sokoto White	4.04a	19.31a	2.26a

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT).

Although, there were increases in the growth parameters, statistical analysis showed no significant differences ($p \leq 0.05$) on the number of leaves, branches and plant height at 6WAP produced by the different varieties (Table 5). The highest mean number of leaves, branches and plant height were recorded on Drum while the lowest were recorded on Oloyin variety.

Table 5: Growth parameters of the cowpea varieties at 6 Weeks After Planting (6WAP)

Variety	Number of Leaves	Plant Height (cm)	Number of Branches
Drum	5.56a	24.15a	3.16a
Ife brown	5.22a	23.27a	2.95a
Oloyin	5.16a	21.16a	2.92a
Sokoto White	5.37a	22.71a	3.04a

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT).

Although, highest mean number of pod was recorded in Cypermethrin-treated pots while the lowest was recorded in *V. amygdalina*-treated pots at first spraying and two weeks after spraying (Table 6), there were no significant differences ($p \leq 0.05$) on the different treatments used at spraying while significant difference ($p \leq 0.05$) in the yield parameters measured was observed at one week and two weeks after spraying. Cypermethrin was significantly different from other treatments. Cypermethrin sprayed pots recorded the least pod damage of all the treated pots while the *V. amygdalina* sprayed pots had the highest number of damaged pod at two weeks after spraying. High mean number of pods was recorded on the untreated pots (control) than the two botanicals used a week after spraying, though was not significantly different at $p \leq 0.05$. However, cypermethrin performed best at 2WAS and was significantly different ($p \leq 0.05$) from other treatments.

Table 6: Effect of treatments on mean number of pod at spraying, a week and two weeks after spraying

Treatment	Mean number of pod at 1st spraying	Mean number of pod A WAS	Mean number of pod 2WAS
Chromolaena odorata	2.24a	2.37b	1.96b
Vernonia amygdalina	2.10a	2.40b	1.89b
Cypermethrin	2.49a	3.39a	2.77a
Control	2.41a	2.74b	1.94b

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT). WAS – Week After Spraying.

Cypermethrin showed significant differences ($p \leq 0.05$) in the mean weight of seed with pod and total seed weight compared with the other treatments (Table 7). Highest mean weight of seed with pod and total seed weight were recorded on Cypermethrin while lowest weight was recorded on *V.amygdalina*. Although, the four treatments do not differ significantly ($p \leq 0.05$) in the mean number of seed per pod and length of pod, highest mean numbers were recorded on Cypermethrin while the lowest numbers were recorded on cowpea treated with *Chromolaena odorata.* However, Cypermethrin-sprayed plots recorded the highest grain yield compared to the other plant extracts and control.

Table 7: Effect of treatments on weight of seeds/pod, number of seeds/pod and length of pod 4 weeks after spraying

Treatment	Weight of seed with pod (g)	Average number of seed / pod	Average length of pod (cm)	Total seed weight (g)
Chromolaena odorata	21.75b	3.07a	14.93a	17.75b
Vernonia amygdalina	20.00b	3.18a	15.00a	15.75b
Cypermethrin	42.00a	3.31a	15.75a	35.25a
Control	28.25b	3.15a	15.33a	23.00b

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT).

Table 8 showed no significant differences ($p \leq 0.05$) in the mean weight of seed with pod produced by different cowpea varieties. Oloyin recorded the highest mean weight of seed with pod than Drum, Ife brown and Sokoto white. Highest mean number of seed per pod was recorded on Sokoto white while the lowest was produced by Drum, though no significant differences ($p \leq 0.05$) existed in the mean number of seed per pod produced by the four cowpea varieties. There were no significant differences ($p \leq 0.05$) in the mean total seed weight produced by the different varieties, but highest mean number was recorded on Drum and Oloyin while the lowest was recorded in Sokoto white. Ife brown showed significant difference ($p \leq 0.05$) with the lowest mean length of pod compared with other varieties.

Table 8: Effect of treatments on weight of seeds/pod, number of seeds/pod and length of pod 6 weeks after spraying

Variety	Weight of seed with pod (g)	Number of seed / pod	Length of pod (cm)	Total seed weight (g)
Drum	29.00a	2.99a	15.38a	24.25a
Ife brown	28.00a	3.22a	14.15b	22.50a
Oloyin	30.25a	3.18a	15.90a	24.25a
Sokoto white	24.75a	3.32a	15.58a	20.75a

Means followed by the same letter in column are not significantly different at 5% using Duncan Multiple Range Test (DMRT).

Discussion

Cowpea plants in all the pots were infested by *Aphis craccivora* Koch as early as 2 weeks after planting. This agrees with the earlier report that *A. craccivora* infestation occurred on cowpea in the early season in weed-free cowpea plots in Akure located in rain forest vegetation zone of Nigeria (Jackai *et.al*., 1988; Ofuya, 1989). Result of this study also confirms the report that most plant botanicals are either weak insecticidally or may require other plant species with different mode of action (depending on the ratio and rate of application) to increase their potency (Sommers, 1983; Oparaeke, 2004).

However, results obtained for the two botanicals used in this study opposed the earlier work conducted by previous researchers which showed that plant extracts increase the yield of vegetables and pea plants by protecting them from insect pests (Stoll, 1988; William and Ambridge, 1996; Panhwar, 2002). Similarly, Gaby (1998) revealed that

application of plant extracts in powder or solution form significantly increased the yield of cowpea plants while Fuglie (1998) showed that a timely application of the plant extracts especially at the onset of flowering and pod formation prevented an initial build up of infestation pressure and consequently increased the yield of the crops. This might not be the case for all plant extracts as shown with some of the plants used in this study. This contradicts the earlier work of Panhwar (2002) which reported that the application of plant extracts at flowering and pod formation stages reduced the level of infestation of insect pests and increased yield of plants, especially for *C. odorata* treated plots.

Stern (1973) opined that total abandonment of synthetic chemicals could spell doom to man as this will worsen the present food insecurity situation. Chemicals could be judiciously used in consonance with other control measures so as to minimize the large number of sprays in farms. The study also revealed that the synthetic insecticide was effective in reducing population of insects as the untreated plots had higher damage than insecticide protected plots. This is consistent with the report that application of insecticides generally reduced cowpea pest infestation and markedly increases crop yields (Jackai and Daoust, 1986; Karungi *et al.*, 2000).

Conclusion

The observations from this study confirmed that insect pests (thrips and pod sucking bugs) are major constraints to cowpea production in South Western Nigeria. Several insects belonging to heteroptera, homoptera and thriptera were collected during this study. Plant botanicals applied showed less performance when compared with synthetic chemical applied. It was also observed from the result of the study that local varieties of cowpea, Oloyin and Drum performed relatively better than Ife brown and Sokoto white in many of the parameters measured. Spraying of synthetic insecticide (Cypermethrin) once at flowering increased yield of cowpea in all the varieties used, however plant botanicals did not increase the yield as such. It is therefore concluded that instead of total abandonment of synthetic chemicals as a control method on the field insect pests of cowpea, its judicious use and proper application should be further studied.

References

Amuah, R.T.. Fungitoxic effect of extract of some West African plants. *Ann. Applied Biol.*, Vol.115 (1989), pp. 451- 452.

Davis, D.W.; Oelke, E.A.; Oplinger, E.S. Doll, J.D.; Hanson, C.V. and Putnam, D.H.. Cowpea Exploration. In University of Wisconsin-Extension, Cooperative Extension and Alternative Field Crops Manual. 1991

Fuglie, S. L.. Producing Food without Pesticides; Local Solution to Crop Pest Control in West Africa. *Church World Service, Dakar Senegal*; 1998140 pp.

Gaby, S.. Natural Crop Protection in the Tropics. Margraf verlag, press; 1995 152pp.

Ivibijaro, M.F. and Agbaje M.. Insecticidal properties of *Piper guineese* Schum and Thonn and *Capsicum spp* on the cowpea Bruchid, *Callosobruchus maculatus* F. *Insect, Science and its Application*, Vol. 7: (1986), pp., 521-524

Ivbijaro, M.F.. Natural pesticides: Role and production potential in Nigeria. Paper presented at the national Workshop on the pesticides industry in Nigeria, University of Ibadan, September 24-27, 1990 27pp.

Jackai, L. E. N. and Daoust, R. A. Insect pests of cowpeas. *Annual Review of Entomology*. Vol. 3 (1986), pp., 95 – 119.

Jackai, L.E.N., Roberts, J.M.F. and Singh, S.R. Cowpea seed treatment with carbosulfan potential for control of seedling pests. *Crop Protection Vol.*7 (1988)., pp 384-390.

Karungi, J., Adipala, E., Ogenga-latigo, M.W., Kyamanywa, S. and Oyobo, N.. Pest management in cowpea. Part 1.Influence of planting time and plant density on cowpea field pests infestation in eastern Uganda. *Crop Protection Vol.* 19, (2000), pp.,231-236.

Lale, N.E.S.. An overview of the use of plant products in the management of stored products Coleoptera in the tropics. *Post-harvest News and Information*, Vol.6 (1995), pp., 69-75.

Langyintuo, A.S., Lowenberg-DeBoer, J., Faye, M., *et al* Lambert, D., Ibro, G., Moussa, B., *et al*.,. Cowpea supply and demand in West and Central Africa. *Field Crops Research*.82. 2003 215-231pp.

Lambot, C.. Industrial potential of cowpea. In: C.A. Fatokun, S.A. Tarawali,B.B. Singh, P.M. Kormawa, and M. Tamo (Eds.), Challenges and Opportunities for enchancing sustainable cowpea production. Proceedings of the World Cowpea Conference III at the International Institute of Tropical Agriculture, Ibadan, Nigeria. 2002 367-375pp.

Ofuya, T. I.. Effect of weeds on colonization of cowpea by *Aphis craccivora* Koch (Homoptera: Aphididae) and its major predators in Nigeria. *Tropical Pest Management*, Vol.35(4) (2008), pp.,403-405pp.

Ofuya, T.I. (2003). Beans, Insect and Man. Inaugural Lecture Series 35. The Federal University of Technology, Akure, Nigeria. 1989 45pp.

Olatunde, J.A.; Chiang, H.S.; and Jackai, L.E.N.. Identification of sources of resistance in cowpea, *Vigna unguiculata L.* Walp to *Clavigralla tomentosicollis* Stal. (Hemiptera: Coreidae). *Insect Sci. Applic*., Vol. 12(4): (1991), pp., 455-461.

Oparaeke, A. M.. Collection, Identification and Screening of herbal extracts and waste matter for control of insect pests of cowpea, *Vigna unguiculata* (L.) Walp. *Ph. D. Thesis*, Ed.: Ahmadu Bello University, Zaria. 2004 330pp.

Panhwar, S.B.. Famers' adoption of plant materials for insect's control. International Service for National Agricultural Research, Haque, Neitherland (4): 2002 61-68pp.

Singh, S.R and van Emdem, H.F.. Insect pest of grain legumes. *Annual review of Entomology*, Vol. 24 (1979), pp.,255-278.

Singh, S.R. and Jackai, L.E.N.. Insect pests of cowpea in Africa: their lifecycle, economic importance and potential for control. Cowpea Research, Production and Utilization; John Wiley and Ssons, Manchester. 1985 217-232pp.

Sommers, P.. Low cost farming in the Humid Tropics: An illustrated handbook; Island Publishing House Inc., Manila, Philippines. 1983 217pp.

Stern, V.M.. Economic thresholds. *Annual Review of Entomology* Vol. 18: (1973), pp.,259-280.

Stoll, G.. Natural Crop Protection in the Tropics; AGRECOL, Margraf Publishers: 1988 188pp.

William, A. and Ambridge, L.. Guide to insect pests of Nigerian crops. Identification: Biology and Control. Natural Resource Institute /Overseas Development Administration, 1996 253pp.