



Preliminary Evaluation of Onion Bulb and Tobacco Leaf Extracts for Insect Control and Yield of Cowpea in the Southern Guinea Savanna of Nigeria

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Abstract

The study evaluated the effects of onion (*Allium cepa*) bulb and tobacco (*Nicotiana tabacum*) leaf extract on the insect pests and yield components of cowpea. The extracts were tested on number of the flower thrips, *Megalurothrips sjostedti* Trybom, the pod-sucking bug, *Clavigralla tomentosicollis* Stal, the pod borer, *Maruca vitrata* (F.) and cowpea aphid, *Aphis craccivora* Koch. Also evaluated were the dry seed weight, 100-seed weight, pod length, number of pods per plant, number of seeds per pod, pod load, pod damage and pod evaluation index. Field experiment was conducted in the Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria. Plots were laid out in a randomized complete block design with three replications. Treatments included 10% (w/v) of each of onion bulb and tobacco leaf extracts, synthetic insecticide (Cypermethrin 1 L/ha) and untreated control. Results revealed that cowpea treated with the plant extracts had significantly ($p < 0.05$) lower insect pest population than plants in untreated plots which suffered greater insect pest attack. However, plots treated with Cypermethrin produced significantly higher number of seeds per pod than other treatments. Nevertheless, tobacco leaf extract produced significantly ($p < 0.05$) heavier 100-seed weight than other treatments including the control. It could be concluded that the plant extracts had potential to replace the synthetic insecticide for control of insect pests of cowpea, thus ensuring environmental safety.

Keywords: Cypermethrin, extracts, insects, onion, tobacco, yield.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is an important legume mainly grown as vegetables, grains and fodder in the tropical and sub-tropical regions (Horn *et al.* 2022). It is one of the most important and widely

cultivated legumes in the world, particularly in Africa, Latin America, and some parts of Asia and the United States (Xiong *et al.* 2016) in view of its high palatability and protein content required by humans and their animals. Cowpea is a very important source

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of carbohydrate (63%), proteins (25%), with low fat content (1.5%), and is rich in vitamins, minerals (Ca, P, Fe), folate, thiamin and riboflavin (Xiong *et al.* 2016). The crop does not require nitrogenous fertilizer because of its ability to fix atmospheric nitrogen into the soil. In Nigeria, the major cowpea producing areas include Niger, Kwara, Kaduna, Borno, Taraba and Yobe States in the northern part while Oyo, Ogun and Ondo States in the southern part of the country also produce appreciable quantities (IITA, 2013). FAOSTAT (2021) reported that Nigeria was the largest producer of cowpea (~ 3.9 million tons) in 2019; followed by Niger and Burkina Faso in sub-Saharan Africa (Omomowo and Babalola, 2021). Factors posing threats to agricultural productivity have been identified to include burgeoning human population, climate change, the loss of fertile agricultural land to urbanization, the challenges of phytopathogens and pests, abiotic challenges; high levels of salinity and drought (Omomowo and Babalola, 2021).

The key field pests of cowpea are flower thrips, *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae), the pod borer, *Maruca vitrata* Fabricius (Lepidoptera: Pyralidae) and the brown coreid bug, *Clavigralla tomentosicollis* Stal (Heteroptera: Coreidae) (Samaila, Degri and Mshlia, 2019). Pest control with synthetic chemicals is usually adopted although often with a resultant serious environmental hazard and detrimental effects on man and livestock (Kwaifa *et al.* 2012). In view of the environmental and ecological concerns, human health hazards and increasing insect resistance, many insecticides have been banned or replaced by safer molecules (El-Bakry *et al.*, 2016; Rajashekar *et al.*, 2016). Considering the drawbacks associated with synthetic insecticides, there is renewed interest in the application of botanical

pesticides for crop protection (Ngegba *et al.* 2022). Hence, this study justifies the evaluation of onion bulb and tobacco leaf extracts for control of field insect pests of cowpea.

MATERIALS AND METHODS

Field study was conducted in the open area behind the screen house of the Department of Crop Protection, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria. The location lies on longitude 4° 35'E and latitude 8° 30'N. Ilorin falls under the southern Guinea Savannah agro-ecological zone of Nigeria. The land was prepared manually using hoes. Ilorin has an annual rainfall of 1000 to 1500 mm and a temperature range of 19°C to 35°C (Ande *et al.* 2012).

Onion (*Allium sativum*) bulbs and tobacco (*Nicotiana tabaccum*) leaves were purchased from Ipata market, Ilorin, Kwara State, Nigeria. Onion bulb is commonly consumed as food and medicine while the choice of tobacco leaves for empirical study against insect pests was due to the importance of its chemical constituents as traditional medicine. The plant materials were air-dried, weighed and ground separately using mortar and pestle. A 200 g sample of each pulverized plant material was weighed and introduced into plastic bowls containing 2 L of water. The mixtures were thereafter shaken thoroughly for about 5 minutes and allowed to stand for 24 hours. Each solution was agitated again and filtered using a muslin cloth. A 100 g/L sample from the solution was expressed as percentage to obtain 10% w/v concentration used as treatment. Cypermethrin (1 L/ha) was used as standard check, while water only was applied as control treatment.

Cowpea seeds (variety TVx 3236) were obtained from Wale Agro-allied Shop in Ilorin, Nigeria. In order to protect seeds from

soil-borne pathogens, the seeds were pre-treated with Fernasan D applied at 1 sachet per 3 kg seeds. Three cowpea seeds were sown per hole at a depth of 3 cm. The seedlings were later thinned to 2 plants per stand at 2 weeks after sowing (WAS). Each plot size was 3 m x 3 m with 1 m alley between plots. Each plot consisted of four rows 5 m long and 0.75 m apart. Single superphosphate fertilizer was applied at 30 kg P₂O₅/ha at 2 WAS by spot placement. Treatments were laid out in a randomized complete block design with three replications. Weeding was manually done at 3 and 7 WAS but the plants were allowed to be naturally infested by the insects. Application of the plant extracts to cowpea was done on weekly basis using 2 L hand-held knapsack sprayer.

Data collection involved scoring and counting of insects observed on the cowpea on weekly basis after spraying between 8.00-9.00 a.m. (i.e. before the insects became active in the afternoon) and thereafter compared with the number of insects recorded in the control treatment. Data were also collected on yield, 100 seeds weight, number of pods per plant, pod length and number of seeds per pod.

Data on thrips, *M. sjostedti* population commenced from 8 WAS and followed at 1 week interval. Cowpea flowers were sampled from ten plants in the two middle rows in each plot and placed in properly labelled vials containing 30% ethanol and then taken to the laboratory where the flowers were dissected and number of *M. sjostedti* was counted and recorded. The duration for data on *M. sjostedti* abundance was from 8 to 11 WAS.

On aphids, *Aphis craccivora* population, observations commenced 4 WAS and continued at 1 week interval. Ten cowpea plants were selected randomly from the two middle rows of each plot. The insect colony

was visually scored, based on a rating scale (Table 1). The duration for data on *A. craccivora* abundance was from 4 to 8 WAS. On pod sucking bug, *C. tomentosicollis*, observations commenced at 8 WAS and continued at 1 week intervals. Cowpea flowers were randomly selected from the two middle rows of each plot. Pod sucking bugs were counted and recorded. The duration for data on *C. tomentosicollis* abundance was from 8 to 11 WAS.

Table 1: Scale for rating *Aphis craccivora* infestation on cowpea

Rating	Number of aphids	Appearance
0	0	No infestation
1	1-5	Few aphid counts
3	6-20	Few isolated colonies
5	21-100	Several colonies
7	> 101	Large colonies

Yield and Yield components

Yield (kg): Cowpea pods from the middle rows in each plot were harvested, packed into labelled polythene bags, taken to the laboratory and weighed.

One hundred seed weight (g): One hundred seeds were picked from the seeds in each plot, weighed and recorded.

Number of pods per plant: This was determined from the two middle rows of each plot. One metre (1 m) length of cowpea was taken with 1 m rule. The length was marked with two sticks. Cowpea and its pods that fell within the distance were counted. The number of pods was then divided by the number of cowpea and the value recorded (Egho, 2011).

No. of pods/plant = No. of pods/No. of plants

Pod length (cm): From the two middle rows of each plot, 20 pods were randomly

selected, measured using a thread which when placed by the side of a meter rule gave the pod length.

Data analysis

Data on insect count were transformed using natural logarithm. The transformed data, yield components and yields were subjected to one-way analysis of variance using SAS statistical package and the means were separated using Least Significant Difference test (LSD, $p=0.05$).

RESULTS

Insect Pest Population

It was observed that the population of thrips began to build up during the flowering stage of cowpea at 8 WAP (Table 2). The build-up was significantly higher in the control than in the treated plots ranging from 55 to 66.67 thrips/plant at 9 and 10 WAS, respectively. All the sprayed plots had significant control of thrips compared with the untreated control. However, the minimum population of thrips/plant was in plots treated with Cypermethrin. Significantly ($p<0.05$) higher population was recorded in plots treated with onion bulb extract than tobacco leaf extract. Onion bulb and tobacco leaf extracts competed favourably with the Cypermethrin against thrips population at 11 WAS, while the

untreated control suffered greater insect pest attack.

In Table 3, very low number of aphids per plant, if present were observed in the treated plots. Cypermethrin and tobacco leaf extract effectively prevented aphid population at 8 WAS while control was the least to control aphid population. There was no significant ($p>0.05$) difference in aphid population among the different treated plots at 4, 5 and 8 WAS.

Higher number of aphids per cowpea was recorded in the untreated control than extract and Cypermethrin-treated plots. However, treatment means showed that onion bulb extract recorded the highest number of aphids and Cypermethrin recorded the lowest number of aphids.

Table 4 shows that pod sucking bug, *C. tomentosicollis* population was not significantly different from each other in all the treatments examined at 8 and 9 WAS. However, the plot treated with onion bulb extract had the highest insect population during the study, though there were no significant ($p>0.05$) differences between the treatments including the control. The result also shows that at 10 and 11 WAS, the plant extracts and Cypermethrin gave a significant ($p<0.05$) reduction in pod sucking bug population compared with the control. However, synthetic insecticide had the lowest number of insect population.

Table 2: Effect of treatment on *Megalurothrips sjostedti* population on cowpea

Treatment	Mean No. of <i>Megalurothrips sjostedti</i> (WAS)			
	8	9	10	11
Onion bulb extract	45.33 ^b	44.33 ^b	42.00 ^b	30.00 ^b
Tobacco leaf extract	40.00 ^c	42.67 ^b	38.67 ^b	28.67 ^b
Cypermethrin	19.67 ^d	19.67 ^c	20.33 ^c	23.00 ^b
Control	56.00 ^a	55.00 ^a	66.67 ^a	55.33 ^a
SED	1.73	3.18	3.28	2.92
LSD _(0.05)	4.23	7.78	8.03	7.15

Values in the same column with the same superscript are not significantly different at $p = 0.05$ using Least Significant Difference.

Table 3: Effect of treatment on *Aphis craccivora* population on cowpea

Treatment	Mean No. of <i>Aphis craccivora</i> (WAS)				
	4	5	6	7	8
Onion bulb extract	0.62 ^{ab}	1.34 ^a	1.26 ^{ab}	1.19 ^a	0.28 ^b
Tobacco leaf extract	0.28 ^b	0.56 ^a	0.75 ^{bc}	0.16 ^c	0.00 ^b
Cypermethrin	0.00 ^b	0.78 ^a	0.50 ^c	0.77 ^{bc}	0.00 ^b
Control	1.07 ^a	1.74 ^a	1.73 ^a	1.42 ^a	0.77 ^a
SED	0.26	0.94	0.31	0.35	0.31
LSD _(0.05)	1.44	Ns	0.76	0.86	0.76

Values in the same column with the same superscript(s) are not significantly different at $p = 0.05$ using Least Significant Difference.

Table 4: Mean number of *Clavigralla tomentosicollis* with aqueous plant extracts on cowpea

Treatment	Mean No. of <i>C. tomentosicollis</i> (WAS)			
	8	9	10	11
Onion bulb extract	1.56 ^a	1.95 ^a	1.44 ^b	1.44 ^b
Tobacco leaf extract	1.34 ^a	1.76 ^a	1.23 ^b	0.88 ^b
Cypermethrin	1.05 ^a	1.56 ^a	1.17 ^b	1.17 ^b
Control	1.86 ^a	1.64 ^a	2.04 ^a	2.40 ^a
SED	0.31	0.24	0.21	0.24
LSD _(0.05)	Ns	Ns	0.51	0.59

Values in the same column with the same superscript are not significantly different at $p=0.05$ using Least Significant Difference.

Yield and yield components

The performance of the treatments on the cowpea in terms of dry seeds yield, 100 seeds weight, number of pods per plant, pod length and number of seeds per pod is shown in Table 5. Significant differences ($p < 0.05$) were observed in the treatments studied with Cypermethrin performing significantly better in dry seeds yield, pod length and number of seeds per pod than plant extracts. Plant extract and Cypermethrin sprayed plots produced significant dry seed yield when compared with the control. Consistent to the insect infestation, the highest dry seed yield, number of pods per plant and number of seeds per pod were obtained in the plots treated with Cypermethrin.

Number of pods

Cypermethrin treated plot recorded the highest number of pods followed by tobacco leaf and onion bulb

extracts and the untreated control was the least (Table 5). The number of pods produced per plant was not significantly ($p > 0.05$) different among the treated plots and the control.

Pod length: Cypermethrin sprayed plots produced significantly longer pod length than plant extracts and control (Table 5).

100 seeds weight per plant: Tobacco treatment recorded significantly heavier 100 seeds weight than other treatments and the control (Table 5). However, onion, Cypermethrin and control recorded statistically similar weights, while control recorded the least weight.

Dry seed yield: When the dry seed yields among the treatments were compared, it was observed that Cypermethrin-sprayed plots

had significantly ($p < 0.05$) higher dry seed yield while other treatments were not significantly different from each other (Table 5). Results on yield components showed that plant extracts were significantly better in dry seed yield than the control.

Number of seeds per pod: Cypermethrin sprayed plots produced significantly ($p < 0.05$) more seeds per pod than other treatments including the control (Table 5). Plots treated with Cypermethrin produced significantly higher number of seeds per pod than other treatments.

Table 5: Effect of treatment on yield parameters of cowpea

Treatment	Dry seed yield (kg/ha)	100 seeds wt. (g)	No. of pods per plant	Pod length (cm)	No. of seeds per pod
Onion bulb extract	53.50 ^{ab}	11.67 ^b	6.14 ^a	14.49 ^b	12.07 ^b
Tobacco leaf extract	53.73 ^a	14.33 ^a	6.54 ^a	14.18 ^b	13.20 ^b
Cypermethrin	66.75 ^a	11.33 ^b	6.75 ^a	20.39 ^a	16.15 ^a
Control	48.50 ^b	11.00 ^b	5.56 ^a	13.94 ^b	11.15 ^b
SED	3.63	0.45	0.43	1.44	1.10
LSD _(0.05)	14.77	1.12	1.29	3.52	2.69

Values in the same column with the same superscript(s) are not significantly different at $p = 0.05$ using Least Significant Different.

DISCUSSION

Onion and tobacco plants are available in Nigeria; farmers would be able to prepare these plants for use against field insect pests. The cowpea stands sprayed with 10% w/v concentration of onion bulb and tobacco leaf extracts and Cypermethrin had reduced number of insect pests from post-flowering insect pests compared to the untreated control. Tobacco leaf extract and cypermethrin resulted in complete protection of cowpea against *A. craccivora* at 8 WAS. However, the present study has demonstrated that onion bulb and tobacco leaf extracts were less effective than cypermethrin in this study. Amatobi (2000) reported that crude extracts of cashew leaves and nuts at 10, 15 and 20% killed *A. craccivora*, *C. tomentisicollis*, *A. curvipes*, and *M. vitrata* very quickly reduced their population by 70% compared to untreated control. The results are consistent with previous reports (Bahar *et al.* 2007). The repellent action of onion has been reported by Debra and Misheck (2014). The

results agree with the study which indicated that some species of the genus *Allium* have consequently shown repellent and insecticidal properties (Vazquez-Armenta *et al.* 2016). Crushed wild onion levels repel *Diaphorina ctri* adults due to the presence of sulphur volatiles from *Allium* spp. (Chakraborty *et al.* 2022). Onion contains several chemical contents, such as essential oils, cycloalilin, metialilin, dihydroalilin and other compounds such as flavonoids, phenolics, terpenoids, anthrocyanins and aminoacids (Adnani *et al.* 2022). The insecticidal toxicity of tobacco leaf extracts to the rice weevil, *Sitophilus oryzae* has been attributed to its constituent compounds which include nicotine, nicotine-nitrile, nornicotine, nicotinic acid, neo-nicotine, cotinine, indole, farnesol, sclareol, 9, 12-octadecadienoic acid, squalene, palmitic acid, and 15- tetracosanoic acid methyl ester (Kanmani *et al.*, 2021).

Results of the experiment have shown that plant extracts were significantly better against thrips than control treatment. Onion

and tobacco extracts performance was at par with cypermethrin in terms of mean numbers of insects, while the untreated control suffered greater insect pest attack. Tobacco leaf extract produced higher dry seed yield, number of pods per plant and number of seeds per pod than onion bulb extract. Results of this finding therefore, suggest the use of tobacco leaf extract was significantly better in the control of flowering insect pests of cowpea than onion bulb extract. Hamman *et al.* (2012) reported that the application of basil and tobacco recorded good grain yield for cowpea in comparison with cypermethrin. In another study, Rosulu *et al.* (2022) reported that the crude extract of chili pepper and tobacco treatments significantly ($p < 0.05$) reduced the population of legume pod borer, *M. vitrata*.

The results have shown that the synthetic insecticide and aqueous extracts of onion and tobacco are capable of reducing post-flowering or podding stage insect population. The mode of action of plant extracts has been suggested to include contact action and possibly antifeedant/repellent action (Adesina, 2014). In this study, the extracts increased the dry seed yield of cowpea in having the capacity to minimize insect population following repeated spraying. The findings in this study are in agreement with the report of Traore *et al.* (2019), that synthetic insecticides were more effective than botanical insecticides when both were applied under the same field conditions. The effectiveness of the extracts and cypermethrin might be ascribed to concentration of active ingredients and the field condition. It was likely that flowers might have absorbed liquids from the extracts via osmotic pressure differences, causing the insects to stop feeding and resulting in death (Kwaifa *et al.* 2012). The reduction in number of thrips caused increase in dry seed yield and 100 seed weight though least

number of pods in the untreated control which was not significantly different from other treatments. Traore *et al.* (2019) reported that neem and tobacco products showed efficacy against the pod borer *M. vitrata*, pod sucking bug, *C. tomentosicollis*. The results have shown that the insect numbers on cowpea following the extract and cypermethrin applications, affected 100 seed weight differently from the control. This finding is at variance with the report of Hamman *et al.* (2012).

CONCLUSION

It was concluded that cypermethrin had better control of the field insect pests than the plant extracts. In this study, tobacco leaf extract produced better and promising results over onion bulb extract. Farmers could adopt the incorporation of the extracts as plausible alternative to cypermethrin. It could be concluded that the plant extracts had potential to substitute synthetic insecticide for control of insect pests of cowpea and therefore recommended for further empirical investigation to ascertain their insecticidal activity.

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