

Insect pest damage to leaves of cowpea (*Vigna unguiculata* L. Walp): comparative effects of aqueous extracts of *Piper guineensis*, *Allium sativum* and *Myristica fragrans*

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Abstract: Utilization of plant extracts in pest management is a cheap, environmentally friendly alternative to chemical pesticides. This study was designed to investigate the effects of aqueous extracts of *Piper guineensis*, *Allium sativum* and *Myristica fragrans* on field insect pest damage to leaves of cowpea, prior to flowering. Ife brown cowpea seeds were cultivated on beds assigned to four treatment groups (including a control), in a completely randomized design. 200g/litre of each plant material was used to prepare the stock solution. Field application of extracts was done in the evenings, thrice a week for two months, and data on leaf parameters was collected monthly. Analysis of variance revealed significant differences between the treatment groups at 5% probability level. Only *Piper guineensis* treated cowpea plants had significantly higher total number of leaves and total leaf area than the control, as well as significantly lower number of damaged leaves, percentage leaf damage, and damaged leaf area, in both months. *Piper guineensis* was more effective in controlling insect pest damage to leaves of cowpea than *Allium sativum* and *Myristica fragrans*.

Key words: Leaf damage, Cowpea, *Piper guineensis*, *Allium sativum*, *Myristica fragrans*.

I. Introduction

Cowpea (*Vigna unguiculata* L. Walp) is an annual plant in the family Fabaceae [1]. The crop is distributed throughout the tropics, and is widely cultivated in Central and West Africa, with Nigeria being a leading producer [2]. As a food crop, it is important as a cheap source of plant protein; a nutritional requirement often inadequate in the diet of many families in developing countries [3]. With the ever increasing local and global food demand, sustained interest in its increased production and preservation is justifiable. A major challenge in cowpea production however, is the abundance of pests that attack different stages of the plant and transmit diseases; *Aphis craccivora* attacks all stages and parts of the plant; *Maruca vitrata* feeds on tender stems, flower buds and leaves; *Megalurothrips sjostedti* attacks the flowering stage, amongst others [4] [5] [6] [7]. And where adequate control is not in place, these pests cause much yield losses [8]. Although many chemical insecticides can effectively control pests of cowpea, there is currently a preference for “integrated pest management” and a reduction in complete reliance on chemical pesticides [9]. One approach being explored in this regard is the utilization of readily available plant materials to control pests [10]. A number of plants that have shown some efficacy against pests include *Piper guineensis* [11], *Zingiber officinale* [12], *Dennettia tripetala* [13], *Aframomum melegueta* [14], amongst others.

Many Nigerian spice plants are not widely cultivated, and so, are gradually becoming endangered [15] [16]. In order to prevent the extinction of indigenous spice plants as well as ensure their continued utilization, there is need to preserve their germplasm and promote their conservation in the environment [17]. Aside culinary and phytotherapeutic uses, finding alternative ways of utilizing these spice plants, for example as biopesticides, will make them more valuable and add impetus to efforts aimed at their conservation. Against this backdrop, and in view of the environmental and public health problems that could arise due to chemical pesticides toxicity [18], this study was designed to evaluate the effects of three spice plants (*Piper guineensis*, *Allium sativum* and *Myristica fragrans*) on insect pest damage to leaves of cowpea.

II. Materials and Methods

2.1 Cowpea planting

Cowpea seeds (Ife brown), bulbs of *Allium sativum* (garlic), seeds of *Myristica fragrans* (nutmeg), and seeds of *Piper guineensis* (black pepper) were procured locally from Watt market, Calabar, Nigeria. A table land was prepared manually, and twelve beds (180 × 150 cm) were made. In a Completely Randomized Design, the beds were divided into four treatment groups; A (control), B (black pepper), C (garlic), D (nutmeg). Each group was made up of three beds. Cowpea seeds were soaked for five minutes in tap water, the floating seeds were discarded and the viable ones were planted directly in the beds; four seeds per hole, thinned to two plants per

stand five days after germination. The planting distance was 60 × 30 cm, giving twelve stands on each bed, and thirty six for each treatment group. Weeding was done by hand when needed.

2.2 Preparation of aqueous spice extracts

200g of each sundried spice (seeds or bulbs) were pulverized in an electric blender. One litre of distilled water was added and it was left for twelve hours, after which the suspension was filtered to create a stock solution. The spray solution for each spice plant consisted of 80ml of the stock solution + 20ml of distilled water.

2.3 Field treatment

Beginning from ten days after germination, the cowpea plants were uniformly sprayed with the respective spray solutions (1litre/bed in the first month, and 2 litre/bed in the second month) using a knapsack sprayer. This was done in the evenings (5.00pm), thrice a week (Mondays, Wednesdays, and Fridays), for two months.

2.4 Data collection and analysis

Data was collected monthly on the following leaf parameters, per cowpea stand; total number of leaves, number of damaged leaves, percentage leaf damage, total leaf area, and damaged leaf area. Percentage leaf damage was determined as follows;

$$\frac{\text{Damaged leaf area}}{\text{Total leaf area}} \times 100 \quad (1)$$

All data generated were subjected to one way analysis of variance (ANOVA) to check for significant differences ($P < 0.05$) between the treatment groups, using SPSS 15.0. Duncans post hoc test was used to separate treatment group means, where significant differences were noticed.

III. Results and Discussion

The importance of substantial leaf integrity in crop production and yield of plants cannot be overemphasized. This is because without the maintenance of healthy leaves, no plant can yield to its full potential, as the leaf is the primary photosynthetic organ of plants [19]. Especially when they are tender, the leaves of many plants are an attraction for a great many field insect pests; and cowpea is no exception. Aside the physical and physiological harm done to the plant due to leaf damage by pests, secondary infection could arise much quickly, and lead to severe yield losses [20] [21]. This underscores the need for much interest in controlling leaf damage due to pests, as is currently the situation for cowpea storage pest (*Callosobruchus maculatus*) control; judging by the volume of publications on the use of botanicals in this regard [13] [11][22]. Table 1 show the leaf parameters of cowpea plants after one month of treatment with the aqueous extracts of *Piper guineensis* (black pepper), *Allium sativum* (garlic), and *Myristica fragrans* (nutmeg). Total number of leaves were significantly ($P < 0.05$) higher in the black pepper group (B), than in the control (A) and the garlic (C) treated groups. The same observation was made in the second month (See Table 2). Number of damaged leaves and percentage leaf damage were also significantly lower in group B, in the first and second month, than in the other groups. This is clear indication of the inhibition of pest activity due to *Piper guineensis* treatment. Group B had the highest total leaf area, in both months. Damaged leaf area was lowest in treatment group B, and these were statistically significant ($P < 0.05$). When viewed together, the values of all the leaf parameters in treatment group B show that aqueous extract of *Piper guineensis* as used in this study significantly reduced the activities of pre-flowering insect pests of cowpea. This is expected, as black pepper has been shown to possess phytochemicals that confer on it significant insect repellent and insecticidal activity [23] [11]. In contrast, cowpea in plots treated with the two other spice plants, exhibited leaf parameters that were not significantly different from those in the control plots. Evidently, *Piper guineensis* has a better potential for protecting cowpea from leaf damage due to pests, than both *Allium sativum* and *Myristica fragrans*. Insecticidal compounds in *Piper* species reportedly showed low residual persistence [23]. Evening application of the plant extracts, and increasing the volume per plot in the second month, obviously helped in ensuring the significant leaf protection noticed for *Piper guineensis*, in this study.

Table 1: Leaf parameters of cowpea after one month of treatment with aqueous extracts of spice plants

Parameters	Treatment Groups			
	A	B	C	D
Total number of leaves	131.83 ^a ± 6.64	164.50 ^b ± 5.50	128.66 ^a ± 4.74	146.53 ^{ab} ± 12.49
Number of damaged leaves	52.87 ^b ± 5.26	30.40 ^a ± 5.15	46.73 ^{ab} ± 4.47	56.73 ^b ± 6.90
Percentage leaf damage	39.90 ^b ± 2.08	18.72 ^a ± 3.72	36.30 ^b ± 3.07	38.61 ^b ± 2.66
Total leaf area (cm ²)	866.96 ^a ± 31.31	1104.73 ^b ± 50.97	805.78 ^a ± 46.11	842.70 ^a ± 38.94
Damaged leaf area (cm ²)	43.69 ^b ± 4.53	20.29 ^a ± 3.16	41.95 ^b ± 4.35	36.68 ^b ± 6.09

^{ab}Values across the table with similar superscript are not significantly different at 5% based on ANOVA. Values are mean ± SEM. A (Control); B(*Piper guineensis*); C(*Allium sativum*); D(*Myristica fragrans*).

Table 2: Leaf parameters of cowpea after two months of treatment with aqueous extracts of spice plants

Parameters	Treatment Groups			
	A	B	C	D
Total number of leaves	137.23 ^a ± 6.28	174.96 ^b ± 8.53	144.23 ^a ± 4.11	156.96 ^{ab} ± 9.43
Number of damaged leaves	57.57 ^b ± 6.18	37.40 ^a ± 4.50	51.50 ^{ab} ± 6.20	59.00 ^b ± 6.45
Percentage leaf damage	41.71 ^b ± 2.83	21.45 ^a ± 2.68	35.87 ^b ± 4.90	38.47 ^b ± 2.83
Total leaf area (cm ²)	1277.73 ^{ab} ± 50.17	1487.66 ^b ± 121.14	1191.13 ^a ± 91.77	1236.80 ^{ab} ± 37.40
Damaged leaf area (cm ²)	47.93 ^b ± 4.73	25.21 ^a ± 2.17	48.55 ^b ± 5.57	41.28 ^b ± 3.37

^{ab}Values across the table with similar superscript are not significantly different at 5% based on ANOVA. Values are mean ± SEM. A (Control); B(*Piper guineensis*); C(*Allium sativum*); D(*Myristica fragrans*).

IV. Conclusion

Going by the results obtained in this study, field administration of *Piper guineensis* (black pepper) aqueous extract can significantly protect cowpea plants from leaf damage due to pests, when applied in the evenings. We encourage its use for this purpose in the pre-flowering stage of the plant. Already, its use against *Callosobruchus maculatus*; a storage pest of cowpea, is quite popular. Aqueous extracts of *Allium sativum* and *Myristica fragrans* did not exhibit significant protective ability against leaf damage due to pests, in cowpea.

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