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MANAGEMENT OF *Clavigralla tomentosicollis* (HEMIPTERA: COREIDAE) AND *Megalurothrips spp* (THYSANOPTERA:TRIPIDAE) ON PIGEON PEA (*Cajanus cajan* (L.) Millspaugh) WITH *Petiveria alliacea*

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ABSTRACT

Pest resistance, non-target toxicity and environmental implications are major issues with the use of synthetic pesticides. However, the need for alternative and sustainable insect pest control is very germane. This study evaluated the potential of *Petiveria alliacea,* a botanical known for its insecticidal properties, in the control of a pod sucking bug (*Clavigralla tomentosicollis)* and flower thrips (*Megallurotrips* spp) that are major yield-limiting pests of pigeon pea. Field trials were conducted over two cropping seasons 2019 and 2020 at the Institute of Agricultural Research and Training, Ibadan. Aqueous Extract of*Petiveria alliacea* obtained by mixing 100 g *Petiveria alliacea* powder with 10 L *of* water and Black Soap solution as surfactant was applied fortnightly at 90, 105, 120 and 135 days after sowing as 1, 2, 3 and 4 applications. A randomised complete block design with three replicates assessed their efficacy on pest suppression, pod damage and seed yield. Phytochemical screening of *P. alliacea* was also conducted. Four applications of *P. alliacea* with black soap significantly reduced pest populations, minimised pod damage (1.4%) and produced the highest seed weight (585 kg/ha). Control plots recorded the highest pest incidence and lowest yields. Phytochemicals such as saponins, flavonoids and alkaloids were confirmed in the plant extract. *Petiveria alliacea* extract with black soap could be applied at least three to four times during flowering and pod formation for effective pest management. Its use is recommended as a potential low-cost, eco-friendly solution for farmers.

KEYWORDS: Pigeon pea; Pest control; *Petiveria alliacea*; *Clavigralla tomentosicollis*; *Megallurothrips* spp; Eco-friendly

INTRODUCTION

Pigeon pea (*Cajanus cajan* (L.) Millsp) is one of the major leguminous food crops grown in the tropical and subtropical climates. It is a plant species in the family of widely cultivated genus *Cajanus* (Cheiboi *et al*., 2016; Sarkar *et al*., 2018). The crop is an essential grain legume grown in the South-east and

South-south regions of Nigeria (Dialoke, 2010). It is classified as one of the neglected and underutilised crops in Nigeria, though it is locally available and affordable (Adjei-Nsiah, 2012; Esan and Ojemola, 2018). Every part of pigeon pea is useful. It can be cultivated on marginal lands to improve soil fertility, protect soil from erosion and favour biodiversity (FAO, 2016). It also plays a significant role in sustaining the livelihood of rural populations in some parts of Nigeria by improving food availability, including protein uptake (Dialoke *et al*., 2018).

It has been identified that pest infestations are among the factors hindering the cultivation of Pigeon pea in Nigeria (Dialoke *et al*., 2018). Brown spiny bug, *Clavigralla tomentosicollis* Stall (Hemiptera: Coreidae) nymphs and adults feed by piercing the pod walls, sucking sap and obtaining nutrients from the growing grains. This results in shrivelling, early drying, pod deformation, shedding of pods and drying of grain/seed, thus reducing the grain yield quality and quantity of pigeon pea (Srujana and Keval, 2014; Bharat *et al.,* 2019). Infestation of *Clavigralla tomentosicollis,* a pod-sucking bug and a major pest of Pigeon pea starts from the flowering stage (Dialoke *et al.,* 2013) and can result to yield loss of 44 – 80% in Nigeria (Dialoke *et al*., 2010). The pod-sucking bugs are among the most prevalent insect pests of legumes in Africa, causing considerable damage to immature seeds and significant economic loss (Rachappa *et al*., 2018). The pod-sucking bugs (particularly the Coreidae bugs) have specialised mouthpieces (proboscis) that enable them penetrate and suck the succulent content of the plant tissue.

Clavigralla tomentosicollis primarily feeds during the pod-filling and pod-maturation stage and acts as a parasitic sink by diverting photosynthetic assimilate intended for seed filling using its piercing and sucking mouth parts to extract nutrients directly from the developing pods and consequently disrupting the sink-source relation (Saxena *et al*., 2020). *Clavigralla tomentosicollis* has been reported to be highly devastating and responsible for significant pod damage between 21% - 26%; grain damage of 1.96 - 16.97 % and yield loss of up to 20 – 100 % in pigeon pea (Dabire, 2005; Dzemo *et al*., 2010; Ganguly *et al*., 2016). *Clavigralla tomentosicollis* is known to transmit fungal diseases (e.g., *Nematospora phaseoli*) leading to seed rot. *Clavigralla tomentosicollis* feeding activities on pigeon pea pods trigger abscission formation response from the plant, leading to premature dropping/shedding and drying of pods and consequent reduction in the number of pods per plant. On older pods, feeding of the bug leads to shrivelling and deformed seeds, while punctures on pods serve as an entry point for pathogens, leading to fungal disease and staining, which further decreases seed quality and weight. The physiological damage done to the seed often results in reduced seed germination capacity (Purohit *et al*., 2018).

Megalurothrips spp is another bug that affects productivity of pigeon pea, unlike *Clavigralla tomentosicollis,* a late-stage grain destroyer; *Megalurothrips* is an early-stage reproductive reducer. The mode of action includes rasping of the surface of flowers and young buds and sucking of plant juices (Edde, 2022). *Megalurothrips* attacks the plant from the pre-flowering to the flowering stages, causing severe shedding of buds and flowers, leading to "brown-staining" or "black-heads" (drying of the floral tip). Both the nymphs and adults lacerate epidermal plant cell sap and pollen. The frass deposited leads to significant metabolic stress, tissue necrosis, reduced flower production, twisted and deformed pods with red-brown scars leading to severe reduction in pod set and yield losses of about 100% in extreme cases (Edde, 2022). *Megalurothrip*s feed on floral buds and developing flowers, reducing pollen production, premature drying of floral buds and reducing the setting of pods. The activities of *Megalurothrip*s are more severe under hot and dry condition especially during the peak of flowering and pod filling. The bug also transmits diseases such as the yellow strain of cowpea mosaic virus CPMV, a seed-borne disease that can cause pod damage, yield reduction from 60-100% reduced market and yield quality (Ogol, 1988 and Shipps *et al.,* 2000).

In Nigeria, the use of synthetic pesticides such as organochlorine, organophosphate, carbamates, and recently pyrethroids in controlling these pests in different zones has been well documented (Awolola *et al*., 2007). However, continuous use of synthetic insecticides has caused several other problems, including the development of resistant insect strains, ecological imbalance, harm to mammals, and non-target arthropods (Oguntola 2023). It therefore becomes important to seek alternative management practices that will be less harmful and environmentally friendly to manage these pests. As part of traditional healthcare, medicinal plants have been used in most parts of the world for thousands of years. *Petiveria alliacea* is a perennial shrub, belonging to the family of Phytolacaceae (Cronquist, 2002). It is freely found in Benin and Nigeria, where it is referred to as the Tarzon plant or Soro weed in south-west Nigeria (Alegre and Clavo, 2007). It contains anti-seizure, insect repellent and acaricide qualities (Benevides *et al*., 2001; Schmelzer and Gurib-Fakim, 2008; Luz *et al*., 2016). It is also used in traditional medicine to treat different diseases and nutritionally to boost immune systems (Lawal *et al*., 2024). It has also been shown to have an antifeedant effect against the grasshopper, *Zonocerus variegatus*. Adult longhorn beetles (Hypothenemus hampei) and sweet potato beetles (Cylas formicarius) are toxically affected by dibenzyl trisulfide (de Andrade, 2012) and Asarone which is present in P. alliacea (Sathiyabalan *et al*., 2014).

This study, therefore investigate these potentials of *Petiveria alliacea* in the management of the two important pests of pigeon pea, *Clavigralla tomentosicollis* (Hemiptera: Coreidae) *and Megalurothrips spp* (Thysanoptera: Tripidae) within two seasons in Ibadan.

MATERIALS AND METHODS

Collection of Plant Materials

Fresh stems and leaves of *P. alliacea* were collected in March, 2019, from Ibadan (7^{o} 22^{1} 33.7^{11} N. 3 ° 50^{1} 23.43^{11}E. The materials were authenticated at the Forest Herbarium at the Forest Research Institute of Nigeria, Ibadan, with the taxonomy identification number FHI 1142097. The plants were air-dried for 30 days using the method of Akintan and Akinleye (2020). The dried plant material was ground into powder form using a grinding machine (model Polymix PX-MFC 90D). Phytochemical screening of *P. alliacea* was conducted using ethanol as the solvent.

Preparation of the Aqueous Extract:

One hundred grams (100 g) of the ground leaf was poured into 10 litres of water and left for 72 hours for proper dissolution of the active ingredients of the plant material. The extracted solution was filtered using a muslin cloth. Thereafter, black soap of 10g was dissolved in one litre of water. Black soap solution was added to the aqueous extract of *Petiveria alliecae* before application as a surfactant to improve *P. alliecae's* ability to adhere to the target pest. Wetting agent such as soap, acted as a surfactant to reduce the surface tension of the liquid and allow the aqueous agent to better penetrate the pest exoskeletons, making the insecticide more effective.

Test for Efficacy of *Petiveria alliecae* on the control of *Clavigralla tomentosicollis* and *Megallurothrips* spp

The experiment was cited on a 24 m by 11 m plot of land; the site was mechanically ploughed and debris removed. The plot was laid out in a Randomized Complete Block Design, replicated three times. The experiment consisted of six treatments as follows:

T1 = *P. alliecae* extract combined with black soap applied once at 90 days after planting (DAS);

T2 = *P. alliecae* extract combined with black soap applied twice at 90 and 105 DAS

T3 = *P. alliecae* extract combined with black soap applied three times at 90, 105 and 120 DAS;

T4 = *P. alliecae* extract combined with black soap applied four times at 90, 105, 120, and 135 DAS;

T5= Laraforce (recommended dose) as check

T6 = Black soap solution only (Sulfact

T7= Water only (control)

The first application was done at 50% flowering (90 days after sowing) and the subsequent sprayings were carried out at two weeks interval.

Data collection

Data collection was initiated at flowering stage and was carried out at two weeks interval in the morning, between the hours of 8 and 10 am. In order to obtain the level of infestation of the pests, both adult and nymph of *C. tomentosicollis* were found feeding on five tagged plants/plot were visually counted and recorded at every time of obtaining the data, while insect Extraction by Ethanol Washing procedure was used to obtain the rate of infestation of *Megallurothrips*. Twenty (20) flowers were collected randomly from the plants in the outer rows and put inside vials, 30% ethanol was added and shaken vigorously for a few minutes to enable the insects come out of the flowers into the ethanol. The liquid was then drained and the insects were transferred into a white plain sheet where they were counted and recorded.

Mature pods from five plants randomly selected from each plot at harvest were examined for the pod and seed damage by *Clavigralla tomentosicollis* based on symptoms, shrivelling of pods and dried immature seeds. The total number of pods and the number of pods damaged by bugs were counted and the percentage of damaged pods was estimated using the formula:

$$Percentage\ bug\ infested\ pod = \left(\frac{Number\ of\ infested\ pods}{Total\ number\ of\ pods}\right) x\ 100 \ldots\ldots\ldots\ldots\ldots Eq\ 1$$

Pod weight per plot was determined by measuring the weight of pod harvested from each plot using a Camry® high-precision weighing scale. The pods were sun-dried and shelled. The seeds were allowed to dry to 10% moisture content. Seed yield per plant was determined by taking the weight of the seeds from tagged plants in each plot. Pod weight and seed weight were extrapolated to hectares.

Data obtained were analysed with the Statistical Analysis Software (SAS). Standard deviation and means separation were carried out at 5% of significant difference using Duncan New Multiple Range Test.

RESULTS

The phytochemicals in Petiveria alliacea

The phytochemical screening of *P. alliacea* showed positive results for Phenol, tannins, flavonoids, saponins, glycocides, alkaloids, steroids and terpenoids. There were also some other highly toxic compounds such as 1-hexazylhdrazide, benzoic acid, piperine, n -hexadecanoid acid and 2- benzylhdrzide were also isolated after the analysis (Table 1).

Effect of application of Petiveria alliacea on the population of Clavigralla tomentosicollis on Pigeon pea plant in 2019 and 2020 cropping Season

There was a highly significant difference among the treatments (Table 2); the check Laraforce and *P. alliacea* + black soap applied 4 times had the lowest count of 1.03 and 1.16 of *Clavigralla tomentosicollis* per plant, respectively, followed by *P. alliacea* + black soap (applied 3 times) and *P. alliacea* + black soap applied 2 times, 3.76 and 6.76, respectively. The control treatment had the highest number of *Clavigralla tomentosicollis* per plant (28.00). There was no significant difference between the check and Petiveria alliacea + black soap applied 4 times. Observations in 2019 were not different from those obtained in 2020, except that the insect population increased. Across two years, the population of *C. tomentosicollis* was significantly higher in the control plot than in the *P. alliacae* and black soap plots. The treatment *Petiveria alliaceae* + black soap applied 4 times had the lowest population of *Clavigralla tomentosicollis (*1.6), while the control treatment had the highest number of *Clavigralla tomentosicollis* of 35.4 (Table 2).

Effect of Application of Botanicals on the Control of *Megallurothrips* spp on pigeon pea in 2019 and 2020 Cropping Season

There was a significant difference in the number of thrips per plant (Table 3). The lowest thrips population was observed with *P. alliacea* combined with back soap applied 4 times, with an average of 6.3 thrips per plant was obtained followed by *Petiveria alliacea* combined with black soap (3 application) 7.7 thrips per plant. As the number of applications reduced from 4 to 1, thrips population significantly increased with the control plot consistently having the highest thrips count (50.3), indicating high infestation. The control treatment remained the most infested (59.3), affirming treatment consistency across years. Combining result from both years, 4-application treatment of *P. alliacea* + black soap gave the lowest average thrips infestation (5.6). The mixture of the botanicals (*P. alliacea* and black soap gave better results; black soap alone had limited effect compared to botanical mix; the check had fewer number of insects of 5.0 but not significantly lower than from what was obtained with *Petiveria alliacea* + black soap applied 4 times (5.6), while the control treatment suffered the most damage with 51.0 (Table 3).

Table 1: Quanlitative phytobiochemical screening of *Petiveria alliaceae* leaf

Phytochemicals determined	Qualitative analysis
Tanning	+
Phenols	+
Alkaloids	++
Glycosides	-
Terpenoids	+
Saponins	++
Steroids	++
Flavonoids	+
Antraquinone	+
Piperine	+
Benzoic acid	+

-absent; +trace; ++moderate; +++abundant.

Table 2: Effect of Application of Botanicals on the Control of *C. tomentosicollis* in 2019 and 2020 Cropping Season (Number of *Clavigralla tomentocicollis* count per plant)

Treatment	90 DAS	105 DAS	120 DAS	135 DAS	Mean
2019					
P. alliacea + black soap (4 applications)	1.33 b	3.00b	0.33c	0.00c	1.16d
P. alliacea + black soap (3 applications)	3.00 b	4.00b	0.33 c	6.67 b	3.75c
P. alliacea + black soap (2 applications)	2.67 b	5.33b	7.33b	11.3 b	6.7bc
P. alliacea + black soap (1 application)	7.3ab	19.33a	16.7ab	19.3 ab	14.9b
Lambda-Cyhalotrin 0.5litres/ha (Laraforce)	2.00b	1.33b	0.80c	0.00c	1.03d
Black soap	9.7ab	10.0b	12.3ab	4.0b	9.0bc
Control	23.3a	25.33a	27.3a	36.3a	28.0a
2020					
P. alliacea + black soap (4 applications)	4.0a	3.00b	1.33c	0.0d	2.1c
P. alliacea + black soap (3 applications)	4.0 a	3.25 c	1.67c	4.3d	3.3c
P. alliacea + black soap (2 applications)	5.5 a	2.75 c	8.0c	12.7c	9.7b
P. alliacea + black soap (1 application)	4.7 a	26.00ab	14.3b	25.3b	17.6b
Lambda-Cyhalotrin 0.5 litres/ha (Laraforce)	2.02a	2.25c	0.66	0.0d	1.24c
Black soap	3.4a	15.6b	12.7b	18.7b	12.6b
Control	8.0 a	37.67 a	46.7a	58.3a	42.7a
Across years					
P. alliacea + black soap (4 applications)	2.7b	3.0bc	0.8c	0.0d	1.6c
P. alliacea + black soap (3 applications)	3.5b	3.6b	1.0c	2.8c	4.2b
P. alliacea + black soap (2 applications)	4.09b	9.0b	7.7b	12.0b	8.2b
P. alliacea + black soap (1 application)	6.0b	22.7ab	15.5ab	22.3b	16.3b
Lambda-Cyhalotrin 0.5litres/ha (Laraforce)	2.0b	1.79c	0.7c	0.1d	1.1c
Black soap	13.7a	24.8ab	24.5ab	38.3b	26.3ab
Control	15.7a	31.5a	37.0a	47.3a	35.4a

Means with the same letter along the columns are not significantly different at $p<0.001$

Table 3: Effect of Application of Botanicals on the Control of *Megallurothrips* spp in 2019 and 2020 Cropping Season

Treatment	90DAS	105 DAS	120DAS	135DAS	Mean
2019					
P.alliacea+black soap (4 applications)	6.30b	10.30b	4.30c	4.30c	6.30c
P. alliacea + black soap (3 applications)	4.70b	11.30b	6.30b	8.30c	7.70c
P. alliacea + black soap (2 applications)	3.30b	18.70ab	13.70b	32.00b	16.90b
P. alliacea + black soap (1 application)	3.70b	22.70ab	26.70b	33.00b	21.50b
Lambda-Cyhalotrin 0.5litres/ha (Laraforce)	5.00b	5.30c	6.70b	9.30c	6.60c
Black soap	12.70ab	26.70ab	28.30ab	68.30a	30.90a
Control	18.70a	34.30a	58.70a	89.70a	50.30a
2020					
P. alliacea + black soap (4 applications)	6.30b	4.70c	3.70c	4.70d	4.80c
P. alliacea + black soap (3 applications)	8.30b	5.70c	4.30c	16.30c	8.70b
P. alliacea + black soap (2 applications)	8.70b	5.30c	24.30b	26.00c	16.10b
P. alliacea + black soap (1 application)	6.70b	18.70b	38.70b	53.70b	29.50ab
Lambda-Cyhalotrin 0.5litres/ha (Laraforce)	6.00b	5.60c	0.00d	2.50c	3.53c
Black soap	22.30ab	26.30b	28.30b	55.30b	33.10ab
Control	36.70a	44.30a	65.30a	90.70a	59.30a
Across years					
P. alliacea + black soap (4 applications)	6.30b	7.50c	4.00d	4.50d	5.60c
P. alliacea + black soap (3 applications)	6.50b	8.50c	5.30d	12.30c	8.20b
P. alliacea + black soap (2 applications)	6.00b	12.00c	19.00c	29.50bc	16.80b
P. alliacea + black soap (1 application)	6.20b	20.70b	32.70b	43.70b	26.90b
Lambda-Cyhalotrin 0.5 litres/ha (Laraforce)	5.50b	5.40c	3.30d	5.80d	5.00c
Black soap	17.50ab	26.50b	28.30b	61.80ab	33.40ab
Control	22.70a	34.20a	62.00a	85.20a	51.00a

Means with the same letter along the columns are not significantly different at $p<0.05$

Effect of Application of Petiveria alliacea on the Yield of Pigeon pea Evaluated in 2019 and 2020 Cropping Season

.. In both 2019 and 2020, as well as across the two years, percentage of damaged pods in the treatment *P. alliacea* combined with black soap (1 application) plots (56.3) was higher than the percentage pods damaged per plant in the control plot (49.44) in 2019 (Table 4). The percentage of damaged pods due to insect pests (3.2) and bug (1.2) were only found in lower numbers in the *P. alliacae* + black soap (4 applications) plots. However, among the treatment combinations, highest yield of 972.0 kg of Pigeon pea was recorded in the check plot (Laraforce), followed by combination of *P. alliaceae* and black soap with 4 applications (773.3 kg), but there was no significant difference between the two treatments, followed by *P. alliaceae* + black soap applied three times (530 kg). There was no significant difference in the number of pod per branch among the treatments. I In 2019, the combination of *P. alliaceae* and black soap (4 applications) had the highest yield of 773.3 kg per plot, followed by the treatment *P. alliaceae* + black soap three applications with grain yield of 652 kg per plot. The result also showed significant difference in the number of pods damaged by flower thrips and number of pods damaged by bugs. The control treatment had the highest number percentage of damaged pod of 43.2 (Table 4)

DISCUSSION

Effectiveness of the use of botanicals on the control of *Clavigralla tomentosicolliss and Flower thrips* in pigeon pea accessions revealed that the combination of *Petiveria alliacae* and black soap was the most effective when applied four times on the experimental plots and it was not significantly different from the result obtained when Lambda-Cyhalotrin (Laraforce) was applied, followed by the combination of *P. alliacae* and black soap when applied three times on the experimental plots in both years at the reproductive stage (from flowering to podding stage). This makes application three times optimum. Crude extracts of *P. alliaceae* have been reported to contain volatile constituents such as Dibenzyl-trisulfide, Benzyldehyde, Benzopyran astilbin, and Coumarin (Akintan *et al.*, 2021). Extracts from *P. alliaceae* have also been reported to have a toxic effect on the adult sweet potato weevil (*Cylas formicarius*) and adult coffee borer beetle- *Hypothenemus hampei* (Schmelzer and Gurib-Fakim, 2008). The chemical constituents of the plant extracts may have caused neurological disorder in the adult *C. tomentosicollis*, elucidating the potency of *P. alliaceae* on *C. tomentosicolliss* (Ibanez *et al.*, 2012). The popular household item "black soap" has been around for several centuries. It is produced locally using the ashes of millet straw, plantain husk and fruit shafts from palm trees; it acts as a surfactant to pesticide (Ikotun *et al.*, 2017b). Egho and Emosairue (2010) reported that black soap is effective in the management of some insect pests. The findings of Egho and Enujeke (2012) on the control of major insect pests and yield of cowpea in Asaba, Southern Nigeria, revealed that black soap was effective in the control of *A. craccivora* and pod-sucking bugs (*C. tomentosicolliss*). As part of an integrated pest management (IPM) program, the results obtained in this study suggest that possible use of the affordable and easily accessible botanicals for control of *C. tomentosicolliss* and *Megalurothrips* spp be considered, due to the potential cost savings and decreased risk to the environment and human health.

Table 4: Effect of Application of Botanicals on Yield of Pigeon pea Evaluated in 2019 and 2020 Cropping Seasons

Treatment	%Pod damage by insect pests	% pod damage by bug only	Number of pod/ branch	Pod weight (kg/ ha)	Seed weight (kg/ha)
P. alliacea + black soap (4 applications)	4.70d	3.50c	67.70a	743.30a	396.60a
P. alliacea + black soap (3 applications)	12.60c	5.30c	52.00a	376.00b	136.70ab
P. alliacea + black soap (2 applications)	24.10b	8.70b	55.30a	453.30b	273.30b
P. alliacea + black soap (1 application)	53.30a	15.70ab	56.30a	233.30c	103.30b
LambdaCyhalotrin0.5litres/ha Laraforce	4.30d	3.80c	79.00a	850.00a	450.00a
Black soap	15.00c	7.70b	58.00a	203.00c	70.00c
Control	49.40a	23.00a	67.30a	166.70c	53.30bc
		2020			
P. alliacea + black soap (4 applications)	3.20c	1.20c	98.80a	1250.0a	773.30a
P. alliacea + black soap (3 applications)	7.60c	3.50c	89.00a	980.0b	530.0b
P. alliacea + black soap (2 applications)	15.00b	2.10c	81.30a	866.7b	463.30b
P. alliacea + black soap (1 application)	24.60b	14.20a	81.00a	503.3c	203.30c
LambdaCyhalotrin0.5litres/ha Laraforce	6.20c	1.40c	102.50a	1362.4a	972.00a
Black soap	16.30b	6.90b	87.70a	503.3c	203.00c
Control	43.20a	18.90a	67.50b	300.0c	90.00d
		Across years			
P. alliacea + black soap (4 applications)	3.95c	2.35c	83.25a	996.7ab	585.0a
P. alliacea + black soap (3 applications)	10.10b	4.50c	70.50a	678.0b	333.3b
P. alliacea + black soap (2 applications)	18.50b	5.40b	63.30a	660.0b	368.3b
P. alliacea + black soap (1 application)	38.50ab	14.80a	68.70a	368.3b	153.3bc
LambdaCyhalotrin0.5litres/ha Laraforce	5.00c	3.80c	90.50a	1106.2a	711.0a
Black soap	15.50b	7.30b	35.80b	351.8b	93.30b
Control	46.32a	18.90a	42.42b	233.4b	71.70b

Mean values with the same letter(s) in a column are not significantly different at $p<0.05$

CONCLUSIONS

A combination of *Petiveria alliacae* and black soap, applied four times during the reproductive stage, resulted in a significant reduction in pest populations.

The botanical treatment suppressed *Clavigralla* spp and *Megallurothrip* spp. infestation as well as contributing a marked increase in pigeon pea yield.

Higher concentrations of *Petiveria alliacea* extracts exhibited strong insecticidal properties,leading to high mortality rates of *Clavigralla tomentosicollis*. Thus, it offers a practical and potentially sustainable approach to mitigating pest damage, providing a valuable contribution to the agricultural practices of Pigeon pea farmers in south-western, Nigeria.

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