



**FIELD EVALUATION OF THREE MICROBIALS AND TWO BOTANICALS AGAINST
INFESTATION AND DAMAGE BY TWO KEY FIELD INSECT PESTS OF COWPEA
(*VIGNA UNGUICULATA* (L.) WALP.) IN KANO, NIGERIA**

¹Yusuf, S. R., ¹Mohammed, U., ¹Sule, H. and ²Dattijo, S. A.

¹Department of Crop Protection, Faculty of Agriculture, Bayero University, Kano

²Department of Pest Management Technology, Audu Bako College of Agriculture Dambatta,
P. M. B. 3159, Kano, Kano State, Nigeria

Corresponding Author's Email: saniryusuf@gmail.com, **GSM:** 08036512257

ABSTRACT

Field experiment was conducted during the 2021 and 2022 cropping seasons at the Teaching and Research Farm of the Centre for Dryland Agriculture (CDA), Bayero University, Kano. The aim was to evaluate the performance of two botanicals viz:- Neemsol GA (*Azadirachtin*) and Zeropest GA (*Karanjin*) and three microbial insecticides viz:- Powerfist GA (*Lecanicillium muscarium*), Fixit GA (*Beauveria bassiana*) and Freeze GA (*Hirsutella* sp.) tested along-side a synthetic insecticide (Imidacloprid) the management of cowpea flower thrips (*Megalorothrips sjostedti*) and pod borer (*Maruca vitrata*) on a medium maturing cowpea variety IT99K-573-1-1. Results showed that, Powerfist GA, followed by Neemsol GA treatments were not as effective as the synthetic insecticide in reducing flower and pod damages by the two key pests in 2021 and 2022 cropping season. However, these two treatments performed better than the other remaining bio-insecticides, which were in turn better than untreated control. Similarly, three applications of Powerfist-GA produced appreciably higher increase in yield than all the other bio-insecticides in both years and was statistically lower (523.0 kg/ha), but comparable (695.0 kg/ha) to that produced by Imidacloprid treated cowpea in 2021 (898.0 kg/ha) and 2022 (704.0 kg/ha), respectively. In conclusion, three sprays of Powerfist GA bio-insecticide effectively reduced the population of thrips and pod damage by the legume pod borer and is thus recommended for cowpea yield optimization and environmental quality at the study location.

Keywords: Cowpea, Microbials, Botanicals, Flower thrips and legume pod borer.

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp.] is an important grain legume in the tropics and sub-tropics. It is a native to Central Africa and belongs to the family Fabaceae (Oyewale *et al.*, 2014) and is eaten in the form of grain, green pods and leaves. The roots are eaten in Sudan and Ethiopia, while the peduncles and stems are used as fibres in Nigeria (Adejumo, 2012). Cowpea is known as vegetable meat due to high amount of protein in the grain with better biological value on dry weight basis. The grain contains 26.61 % protein, 3.99 % lipid, 56.24 % carbohydrates, 8.60 % moisture, 3.84 % ash, 1.38 % crude fibre, 1.51 % gross energy and 54.85% nitrogen free extract (Owolabi *et al.*, 2012). Cowpea crop is usually preferred by farmers because of its role in increasing soil fertility through nitrogen fixation (Asiwe, 2006) and production of nutritious fodder for livestock. Cowpea is mainly grown in tropical and sub-tropical regions in the world for vegetable and grain and to lesser extent as a fodder crop. Food and Agriculture Organization (FAO) reported that about 5.4 million tons of cowpea were produced annually with Africa producing nearly 5.2 million tons (FAO, 2017). Nigeria is among the world largest cowpea producers and consumers, accounting for 61 % of production in Africa and 58% worldwide (FAO, 2017). According to FAO (2011), cowpea remains as the most versatile pulse crop because of its smothering nature, drought tolerant characters, soil restoring properties and multipurpose uses. It is the most important indigenous legume in the dry savanna of the tropics cultivated on about 12.5 million/ha with annual production of about 3 million tons (FAO, 2005). However, various constraints seriously limit cowpea production, with insect pests recognized as the most serious constraint to its production (Samaila, *et al.*, 2019). Cowpea is a hardy crop, but it remains a host to many insect pests, which includes the legume pod borer - *Maruca vitrata* Fabricus (Lepidoptera: Crambidae), flower bud thrips – *Megalurothrips sjostedti* Tryb. (Thysanoptera: Thripidae), pod sucking bugs complex dominated by *Clavigralla tomentosicollis* Stal. (Heteroptera: Coreidae), Aphids – *Aphis craccivora*, *Ootheca* sp., leaf miners, whiteflies – *Bemisia tabaci*, Leafhoppers – *Empoasca* sp., and mites – *Tetranychus* spp. (Oyewale and Bamaiyi, 2013), with *Maruca vitrata* Fab., *Clavigralla tomentosicollis* Stal, *Anoplocnemis curvipes*



(F.), *Aphis craccivora* Koch and *Megalurothrips sjostedti* Trybom being the most important field pests of the crop in northern Nigeria.

Infestation rate of *M. vitrata* could get up to 80%, thereby causing up to 50% seed damage in the absence of any control measure (Oyewale and Bamaïyi, 2013). The incidence of *Maruca* larvae is a very serious constraint to cowpea production, as each larvae attacks several organs of the same plant: Flowers, leaves, flower buds and green pods before migrating to another plant (Liao and Liu, 2000). The caterpillars destroy both cowpea flowers and pods causing yield losses up to 80 % (Tamò *et al.*, 2010). The feeding activities of *M. sjostedti* causes necrosis that subsequently leads to shading of cowpea flowers and buds. The cowpea yield losses due to *M. sjostedti* infestation are estimated at between 20 – 70 % (Ngakou *et al.*, 2008). Control of legume pod borer damage is mainly by timely application insecticides, but their effectiveness is hindered by the tight larval webbing that reduces pesticide exposure (Grigolli *et al.*, 2015). Similarly, the legume flower thrips control is mainly by use of chemical insecticides like deltamethrin, malathion, monocrothos, pirimiphos - methyl cypermethrin, dimethoate, and lambda-cyhalothrin which mostly reduces infestation and distinctly increase crop yields (Kusi *et al.*, 2019). Overall, the use of synthetic insecticides, plant products and cultural controls has been found to be effective in improving cowpea yield in recent years, use of resistant varieties and also by early sowing (Amatobi *et al.*, 2005; Sharah and Ali, 2008; Dzemo *et al.*, 2010). These notwithstanding, insecticide application remains the major insect pests control practice on cowpea in most African countries including Nigeria. It is a fact that, Nigerian farmers have been relying heavily on pesticides for the control of various weeds, insect pests and diseases (Schwab, *et al.*, 2010), leading to the high importation of these products and their price have become so high that it is becoming impossible for local farmers to afford. However, chemicals application is no more attractive considering its many side effects that includes environmental pollution and human health hazards, pest resistance and resurgence, secondary pest outbreaks, effects on non-target organisms and loss of biodiversity (Atachi *et al.*, 2007). Additionally, issues about food safety and consequences of the toxic effects of synthetic pesticides in food production have increased the demand for organically produced food, which demands the evaluation of relatively safer alternatives having to do with the evaluation of concert of bio-pesticides in crop pests management as safer and eco-friendly alternatives to synthetic insecticides (Akbar *et al.*, 2010). As a result, the present study was undertaken to test the field efficacy of the selected group of bio-insecticides (i.e. three microbials and two botanicals) alongside a synthetic insecticide in the reduction of infestation and damage by flower thrips and the legume pod borer on cowpea at the study area.

MATERIALS AND METHODS

The field experiment was conducted at the Teaching and Research Farm of the Center for Dry Land Agriculture (CDA), Bayero University, Kano, during 2021 and 2022 cropping seasons. The experiment consisted of following treatments: - Powerfist GA, Fixit GA, Freeze-GA, Neemsol GA, Zeropest GA and Synthetic Insecticide (SS) (Table 1). Each of the treatments, inclusive with the untreated control were replicated three times and laid out in a Randomized Complete Block Design (RCBD), giving a total of twenty-one (21) experimental plots.



Table 1: Pesticide Types and their Characteristics

Insecticide	Active Ingredients	Type	Targeted Insect Pests
Zeropest GA	<i>Karanjin 2500 ppm</i>	Liquid	A broad-spectrum bio-insecticide for the control of sucking insect pests like Thrips, Jassids, Aphids, Whiteflies, Flea Beetles, Armoured Scales and other sucking insects.
Neemsol GA	<i>Azadirachtin 2500 ppm</i>	Liquid	A broad-spectrum bio-insecticide for the control of insects like <i>Helicoverpa armigera</i> , <i>Helicoverpa zea</i> , <i>Spodoptera litura</i> , <i>Spodoptera exigua</i> , <i>Earias spp.</i> , cut worm and so on.
Powerfist GA	<i>Lecanicillium muscarium</i> (Verticillium lecanii) CGA	Powder	A bio-fungicide for the control of sucking insect pests on crops like tomato, potato, cotton chillies, cowpea, water melon, etc.
Fixit GA	<i>Beauveria bassiana</i> . CGA	Powder	Entomo-pathogenic fungi for the control of Lepidopterous caterpillars including <i>Helicoverpa</i> , <i>Spodoptera</i> , other Borers and hairy caterpillars.
Freeze GA	<i>Hirsutella sp.</i> CGA	Powder	A broad-spectrum bio-insecticide for the control of soft bodied sucking pests like red spider mites, Ping mites, purple mites, scarlet mites and other sucking pests.
Imiforce	Imadacloprid	Liquid	For the control of sucking insects including rice hoppers, aphids, thrips, whiteflies, termites and some beetles.

Before the commencement of sowing, the field was ploughed, harrowed and ridged. The sowing was carried out in August and June, during the cropping season of 2021 and 2022, respectively. Three seeds were sown at a depth of 2–3cm on a row at a spacing of 20 cm and an inter row spacing of 75cm. The stands were later thinned to two (2) plants per hole at two weeks after sowing (WAS), within each plot consisting of six (6) ridges of thirty (30) stands per plot, manual hoe weeding and other agronomic practices of raising good cowpea plants were carried out.

The field layout measured 6 m × 4.5 m per plot, with 0.5m pathway in between the adjoining plots and 1m distance between the blocks, giving a total gross area of 990m².

Bio-Pesticide Preparation and Application

The microbial insecticides (Powerfist GA, Fixit GA and Freeze GA) were prepared in advance to initiate conidial germination 24 hours prior to application of the treatment. The microbials (Powerfist GA, Fixit GA and Freeze GA) were sprayed at 15, 25, 45 and 60 days after sowing (DAS), while the spraying of the botanicals (Neemsol GA and Zeropest GA) commenced at 21 DAS, 50 % flowering and 50 % podding at the rate of 20 ml and 30 ml/10 litres of water, respectively, as recommended by the manufacturer.

The synthetic insecticide (Imiforce) was applied at 21 DAS, 50% flowering and 50% podding at the rate of 22 ml / 10 litres of water as recommended by the manufacturer, while the untreated plots were left unsprayed. During spraying of the pesticides, polythene sheet was held between the plot boundaries, aimed at minimizing insecticide drift to plots that were not intended for the spray as described by Kamara *et al.* (2007).

Data Collection

Flower infestation by the Legume Pod Borer and Thrips

The sampling for infestation by *M. vitrata* larvae and thrips were carried out during the early morning hours of between 7:00 to 9:00 am at 7 days interval from 50 % flowering to 50 % podding on five flowers from five randomly tagged plants in each plot. The sampled flowers were placed in a labeled vial of 25 ml capacity containing 30 % ethanol as described by Yusuf (2005), then taken to the Entomology laboratory of the Department of Crop Protection, where they were dissected under a microscope and the numbers of both *M. vitrata* larva and thrips (nymphs and adults) found counted and recorded. Sampled pods were placed in labeled paper bags as described by Asante *et al.*, (2001), then taken to the Entomology Laboratory of the Department of Crop Protection, where they were dissected and the numbers of *M. vitrata* larva found counted and recorded.



Pod Damage by the Legume Pod Borer

The sampling to assess pod damage by these two key pests commenced at 50 % podding and continued at an interval of 7 days. Five pods were randomly examined from five plants per plot for *M. vitrata* damage. The pods were placed in a labeled paper bags for laboratory assessment of the parameter at the Entomology laboratory of the Department of Crop Protection. Pod damage was examined based on presence of entry/exit holes, frass deposition as well as presence of life or dead larva. Borer damaged pods were separated from the undamaged ones. The percentage pod damage obtained as described by Abdulhadi *et al.*, (2019) with a slight modification.

Cowpea Grain Yield

The grain yield was determined by harvesting pods of the cowpea plants within the middle rows in each plot. Pods were sun dried for two days, threshed, weighed and seed yield in Kg/ha obtained as described by Yusuf and Isma'il (2013).

$$\text{Seed yield (kg/ha)} = \frac{a \times 10000}{b \times 1000}$$

Where;

a = plot/sample yield (g)

b = plot size (m²)

Data Analysis

The data collected were transformed using square root transformation, while data in percentage were arcsine transformed and were then subjected to analysis of variance (ANOVA) using GENSTAT Discovery 17th Edition statistical package. Significant treatment means were separated using Student Newman Keuls (SNK) test at 5% level of probability.

RESULTS AND DISCUSSION

Effect of two Botanicals and Three Microbial Insecticides on Cowpea Flower Infestation by *M. sjostedti* and *M. vitrata* during 2021 and 2022 Cropping Seasons in Kano

Application of all the control treatments had no any significant influence on flower infestation by the pod borer in both 2021 and 2022 cropping seasons as presented in Table 2. However, the six different control treatments differed significantly among each other on flower infestation by thrips on the cowpea crop in both years at the study location. The Neemsol treatment, followed by the Powerfist were statistically comparable to the synthetic insecticide treatment in reducing flower infestation by thrips and all the three, performed significantly better than untreated control in both years (Table 2), which recorded a significantly higher number of flower infestation by thrips than all other control treatments during the 2021 and 2022 cropping season in Kano.

Table 2: Effect of Two Botanical and Three Microbial Insecticides on Thrips and Legume Pod Borer Infestation on Cowpea Flowers during 2021 and 2022 Cropping Seasons

Treatments	<i>M. vitrata</i>		<i>M. sjostedti</i>	
	2021	2022	2021	2022
Powerfist GA	0.11	0.89	0.78 ^a	13.2 ^a
Fixit GA	0.11	1.33	2.44 ^c	38.8 ^{bc}
Freeze GA	0.00	1.00	2.33 ^{bc}	22.8 ^{ab}
Neemsol GA	0.33	1.11	0.78 ^a	10.0 ^a
Zerapest GA	0.33	1.78	2.22 ^{bc}	20.0 ^{ab}
Imiforce	0.33	1.22	0.44 ^a	9.00 ^a
Untreated	0.44	2.00	2.78 ^c	50.6 ^c
Level of significance	ns	ns	**	***

Means followed by same superscripts within a column are not significantly different using SNK at 5% level of significance.

Although not as effective as the synthetic insecticide treatment, the microbial (Powerfist GA) and botanical (Neemsol GA) insecticides were observed to be a good and safer alternative in reducing infestation by the two key pests of cowpea in the study area, in both 2021 and 2022 cropping seasons. Earlier, a report by Mehinto *et al.* (2020) pointed out the effectiveness of bio-insecticides in managing the larval stages of several cowpea pests and added that the synthetic insecticide was effective in controlling the larval stages of major pests of cowpea. However, a study by Downham (2003) have indicated the effectiveness of the tested synthetic insecticide in reducing infestation by thrips in cowpea flowers than a bio-insecticide (Downham, 2003).



Flower and Pod Damage by Legume Pod Borer as Affected by the Application of Two Botanicals and Three Microbial Insecticides in 2021 and 2022 Cropping Seasons in Kano

The result as presented in Table 3 revealed that, there was a significant difference in flower damage by *M. vitrata* among the different treatments applied in 2021 cropping season. The Powerfist and Neemsol, followed by Zeropest treatment were statistically similar each other in reducing flower damage and these three treatments were in turn statistically comparable to that of the synthetic insecticide, which had the lowest number of damaged flowers than all others in 2021. On the other hand, the Zeropest treatment, followed by Fixit and Freeze treatments were not significantly better than the untreated control, which had the highest number of damaged flowers by *M. vitrata* during the 2021 cropping season.

Furthermore, the flower damage by *M. vitrata* was not significantly affected by the application of each of the six different control treatments on the cowpea crop in 2022 cropping season (Table 3). In a similar manner, the number of damaged pods by *M. vitrata* was statistically similar among all the control treatments applied in both years (Table 3). With numerically lower number damaged pods observed in the Powerfist and Neemsol treatments than those of the other remaining bio-insecticides, which were relatively comparable to that of the synthetic insecticide. The lower pod damage recorded could probably be attributed to the detrimental activity of the microbial and botanical insecticides against these two major cowpea pests as observed by Kavitha and Vijayaraghavan (2025) and Devkota *et al.* (2026). In a later study, application of insecticides at 50% cowpea podding has helped in reducing infestation and damage by the legume pod borer, flower bud thrips and even the complex of pod sucking bugs in West Africa (Abudulai *et al.*, 2017).

Table 3: Effect of Two Botanicals and Three Microbial Insecticides on Flower and Pod Damage by *M. vitrata* during 2021 and 2022 Cropping Seasons

Treatments	Flower		Pod	
	2021	2022	2021	2022
Powerfist GA	2.20 ^a	22.20	0.11	0.11
Fixit – GA	6.70 ^b	28.90	0.44	0.44
Freeze GA	6.70 ^b	26.70	0.22	0.33
Neemsol GA	2.20 ^a	20.00	0.11	0.11
Zeropest GA	4.40 ^{ab}	24.40	0.22	0.33
Imiforce	0.00 ^a	17.80	0.00	0.11
Untreated	11.1 ^b	40.00	0.44	0.44
Level of significance	*	ns	ns	ns

Means followed by same superscripts within a column are not significantly different using SNK at 5% level of significance.

Grain Yield as Affected by the Application of Two botanicals and Three Microbial Insecticides during the 2021 and 2022 Cropping Season in Kano

The result as presented in Table 4 revealed a significant difference among all the treatments in the cowpea grain production in both 2021 and 2022 cropping seasons. Among other non-synthetic insecticide treatments, the Powerfist treated plot produced numerically higher grain yield than all other microbials and the untreated control, which had produced significantly lower grain yield in both 2021 and 2022 seasons. However, all the microbials and botanical were not as effective as the synthetic insecticides, in the production of grains in 2021 (Table 4). A similar trend was observed in the 2022 cropping season, with the Powerfist treated plots producing significantly higher grain yield than all other two microbial and Zeropest treatments, but was statistically comparable to that of Neemsol and to even that of the synthetic insecticide treated plots (Table 4). As reported by Panhwar (2002), the application of bio-insecticides in powder or solution form significantly increased cowpea yields as shown by the performance of the different control materials tested.



Table 4: Cowpea Grain Yield (kg/ha) as Affected by the Application of Two Botanicals and Three Microbial Insecticides during 2021 and 2022 Cropping Seasons

Treatments	2021	2022
	Grain Yield (kg/ha)	Grain Yield (kg/ha)
Powerfist GA	523.0 ^b	695.0 ^a
Fixit – GA	370.0 ^b	475.0 ^b
Freeze GA	420.0 ^b	484.0 ^b
Neemsol GA	486.0 ^b	676.0 ^a
Zeropest GA	474.0 ^b	502.0 ^b
Imiforce	898.0 ^a	704.0 ^a
Untreated	343.0 ^b	386.0 ^c
Level of significance	*	**

Means followed by same superscripts within a column are not significantly different using SNK at 5% level of significance.

Furthermore, the present investigation shows that *M. sjostedti* and *M. vitrata* still remain of significant economic importance to cowpea production in the study area. Consequently, these two key field insect pests of have been reported as a major limiting factor in cowpea production in other African countries, with Nigeria inclusive (Karungi *et al.*, 2000). Among other bio-insecticides, an appreciably higher grain yield of 523.0 kg/ha in 2021 and 704.0 kg/ha in 2022 was produced by the microbial insecticide (i.e. Powerfist-GA), thereby making it to compare favourably with even that of the Imiforce treatment. Such performance by three applications of this said microbial may probably be similar or close to that of the other synthetic insecticides used as protectants by our farmers, as this was earlier noted by Asante *et al.*, (2001) that two sprays of synthetic insecticides (Cypermethrin + Imidacloprid/Dimethoate) increased grain yield from 225 to 900 kg/ha for cowpea planted in July and August in Kano. However, other workers (Ajeigbe and Singh, 2006; Kamara *et al.*, 2010) have reported that three strategic sprays of insecticides were found effective in the control of insect pest of cowpea as carried out in this study.

CONCLUSION AND RECOMMENDATION

The investigation clearly demonstrated the promising performance of Powerfist-GA (microbial), which was closely followed by the Neemsol-GA (botanical) in specifically reducing flower/pod infestation and damage on rainfed cowpea by the flower thrips and the legume pod borer during the study period in Kano. Thus, indicated that under a good and well – coordinated system cowpea protected with three applications of bio-insecticides at 21 days after planting, 50% flowering and 50% podding offered a noticeable protection against flower thrips and legume pod borer. This resulted in a significant reduction in grain damage and high increase in yield produced by the Powerfist-GA in 2021 (523.0 kg/ha) and 2022 (695.0 kg/ha), compared to the performances of the synthetic insecticide and the untreated control.

In conclusion, the three applications of the microbial (Powerfist GA) insecticide have effectively reduced the flower population of thrips and pod damage by the legume pod borer, which resulted in a substantial increase in grain yield than all the other remaining bio-insecticides tested. Therefore, resource poor farmers that mostly apply between five to even ten sprays of synthetic insecticide sprays on cowpea crop in a cropping season, could use a minimum of three sprays of Powerfist GA at the study area, for considerable increase in cowpea grain yield.

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