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EFFICACY OF TYPE AND CONCENTRATION OF BOTANICAL INSECTICIDES (*Balanite aegyptiaca, Allium sativum and Capsicum annum*) IN THE CONTROL OF FIELD PEST (*Megalurothrips sjostedti* [*Tryborn*]) OF COWPEA (*Vigna unguiculata* [L. Walp])

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Abstract

Field experiment was carried out at the teaching and research farm of the School of Agricultural Technology, Federal Polytechnic, Bali, to determine the efficacy of three types of botanical insecticides applied at varying concentrations for the control of field pest (Megalurothrip sjostedti) of cowpea (Vigna unguiculata). Complete Randomized Block Design (CRBD) was adopted on a field measuring 15 m x 25 m, with nine stands of cowpea on each bed of size 2 m x 2 m and a total of 12 beds replicated into three. Extracts from Balanite aegypteaca (desert date), Allium sativum (Garlic) and Capsicum annum (Chilli pepper) fruits were applied at weekly intervals at the onset of flower buds as main treatments, while the varying rates of 50ml/lt, 100ml/lt and 150ml/lt as sub-treatment. Parameters assessed were weight of dried pod, weight of 100 seeds and number of pods per plant. The problematic insect pest (Megalurothrip sjostedti) were also collected and counted at the emergence of flower buds and just before the commencement of each treatment application. Data generated from the experiment were subjected to Analysis of Variance (ANOVA). Means were separated using Tukey's Honestly Significant Difference (HSD) at p = 0.05 with the help of "R" statistical package. The results showed that garlic extract recorded the highest efficacy at the rate of 100ml/lt for all the parameters assessed. Farmers are therefore, advised to use garlic extract for the control of thrips on cowpea.

KEYWORDS: Extract, *Vigna unguiculata, Megalurothrip sjostedti, Balanite aegyptiaca, Allium sativum, Capsicum annum.*

INTRODUCTION

Cowpea (*Vigna unguiculata* L.Walp) is a legume crop widely consumed in Nigeria. It is a cheap source of good quality protein which augment the most commonly consumed staple carbohydrate (Muoneke *et al*., 2012). Starting from the time of seedling emergence up to reproductive stage, cowpea is infested by different groups of insect and it is observed that careful and constant spray of insecticides is the most effective way of controlling the pests (Agbato, 2011). On a global basis, Nigeria ranks first in the production and consumption of cowpea, with 45% world output, however, 4% of the total annual output (30,000tn) get lost annually (Indahgiju *et al*., 2022). On the agricultural field, the pod sucking bug, bean thrips (*Megalurothrips sjostedti* Tryborn), pod borer and boll worms are responsible for substantial loss because they feed on flower green pods (Peter, 2022). If the thrip attacks the flower buds, it prevents anthesis and pod formation and affected plant may remain in vegetative stage for a long period of time.

Plants which are a good source of botanical insecticides are commonly found in the ecosystem, majority of which serve different purposes such as food or feed, medicines, ornamentals, and spices (Srijita, 2015). The availability of such plants makes them very cheap and easily integrated into farming systems as companion crops (Castillo-Sánchez, *et al*., 2015). Commercialized insecticides extracted from plants species such as neem, pyrethrum and sabadilla are considered to be least toxic particularly to non-targets species such as fish and pollinators (Dubey, 2010). This characteristic turns botanical pesticides most effective, reliable and acceptable in sustainable crop protection. Furthermore, they leave no residues on crop produce and the environment, hence, they ensure environmental conservation and safety to consumers (Dubey, 2008). Pests are not likely to show resistance because the interaction between botanical insecticides and the pests is naturally biochemical (Gaikwad *et al*., 2012, and Joseph and Sajatha, 2012). However, botanical insecticides are new techniques evolving for pest management because they are environmentally safe alternative for synthetic insecticides (Mokhtar *et al.,* 2021).

The chemical compounds and the essential oils obtained from the plant extracts are target specific which safeguard the non-target species particularly the beneficial organisms such as predators and pollinator bees (Hernandez-Moreno, 2013 and Nawaz *et al*., 2016). Botanical insecticides have little or no allelopathy effect on crops depending on the source plant species and the concentrations applied, (Arafat *et al*., 2015 and Sarkar *et al*., 2012). Efficacy of any bio pesticide depends on the species of the source plant, either fresh or dry, type of solvents used for extraction and the methods of extraction (Gurjar, *et al*., 2012). Various modes of action such as

repellence, toxicity, growth regulation and structural modification are exhibited by botanical pesticides on the target pests, which make them suitable alternatives in crop pests control (Kushram, *et al*., 2017 and Rattan, 2010). The plant metabolites affect the insect physiological activities, biochemical processes, metabolic pathways, morphology and insect behaviour. Essential oils (Eos) can also affect Octopamine receptors to modify neuron activity and numerous potential targets in the nervous system of an insect which makes EO components suitable candidates for bio-insecticides (Jankowska *et al*., 2017). Capsacin is the most abundant phenolic compound which constitutes 37.22% out of the total Capsinoid content in Chilli pepper (Wesolowska *et al*., in Nurliana (2017). The function of the metabolites is specific on the nature of effect produced on the pest, for instance, the chemosensory receptor cells in the mouth of lepidopteran larvae are blocked by terpenes from detecting glucose, while other plant essential oils show chemosterilant activity (Rattan, 2010). Most Eos are volatile and as such they are mostly used as fumigants on storage insects because they are active against various insects, they are also fast penetrating with no toxic residues harbouring in the treated products (Mossa, 2016). The efficacy of botanical insecticides extracted from plant metabolites vary depending on factors, such as dose, the method of application, and the species of pest set as target (Hoesain, 2023). The application method plays a vital role in determining the efficiency of botanical insecticides, because different methods depict different levels of exposure to the target pests (Hoesain, 2023).

Cloyd *et al*. (2009) tested garlic oil (*Allium sativum*) against two-spotted spider mite on citrus and discovered that it was very effective with ≥ 90% mortality. The active substance is 1,000 g/kg garlic extract as defined by its manufacturing process and Marker compounds (EFSA, 2020). Extracts from *Allium sativum* and other spices were also reported to have repellent and other insecticidal properties on many insect pests such as thrips (*Megalurothrip* sjostedti) and other pathogens (Lengai *et al.,* 2020). In a study carried out by Abdullahi (2011), *Balanite aegyptiaca* leaf extracts was found to be effective against survival of larvae and pupae as well as female oviposition of *Callosobruchus maculatus* at $p<0.005$. A research carried out by Nurliana *et al*., (2017) on the repellent and lethal effect of *Capsicum annum* extract on the odorous house ant revealed that at 25% (v/v) concentration, treatment with *C. annum* yielded > 90% repellence.

Although scientists have tested various phytochemicals and plant metabolites with clear assertion that they possess great quality in the control of insect pests, however, a gap remains as to the type and concentration (dose) of the metabolite required for the treatment of a particular insect species.

Statement of the problem- it is obvious that farmers suffer substantial loss of their farm produce due to infestation by field and storage insect pests. This poses threat to food security in this era of population explosion in Nigeria. Farmers in the study area have for years been battling with the field thrips (*Megalurothrip sjostedti*) which usually invade their farms when cowpea is at the stage of formation of flower buds. Therefore, for enough cowpea to be produced in commensurate with the current market demands, the activities of the pests must be contained through economically viable means on sustainable basis.

Significance of the study- farmers are constantly overburden by costly purchase of synthetic pesticides which affects the cost of production. The plant metabolites under study, which are readily available within the environment if harnessed, could serve as cheaper alternative to farmers. In addition, the adoption of botanical pesticides by our farmers can save our community from environmental pollution and the consequent health hazard pose by synthetic pesticides.

The objectives of this study are to compare the efficacy of three different plant species (garlic, chilli pepper and desert date or balanite) in the control of cowpea field pest (*Megalurothrips sjostedti*). Secondly, to determine the effective concentration for each treatment type to be used in the control of the pest.

METHODOLOGY

Study Area –

The research was carried out in Bali which is located in the central part of Taraba State between latitudes 7º 12/ N to 9º 00/ N of the equator and longitudes 10º 00/ E to 12º 00/ E of the Meridian. It has a land mass of 100,000 km^2 and lies within the Guinea Savanna ecological zone of Nigeria. The annual rainfall ranges from 750 mm to 1100 mm and the temperature ranges between 22º C-35º C. The soil is dominantly of ferruginous tropical type that lies on sandy parent materials (Dada *et al*., 2006). The physio-chemical properties of the soils in Bali on average basis were 256.7kg/ha N, 15.6kg/ha P, 333.0kg/ha K, 8.8kg/ha Sulfur, 0.93% organic carbon, 1.7% organic matter with pH of 4.9 and EC 0.48 (Danladi *et al*., 2019). Bali has a demographic population of 211,024 (NPC Census, 2006). The most cultivated cash crops in the area include soybean, groundnut and maize, while food crops include rice, corn, beans, sorghum, yam and cassava.

Materials –

Fruits of pepper, balanite and garlic, measuring cylinder, mechanical grinder, spatula, flat bottom flask, water trough, sieve (1.0 mm), electronic balance, hand sprayer, water, cowpea seeds, pegs, measuring tape, field, blue sticky traps and farm tools.

Experimental Design and Field Setup –

25 m x 15 m field was clear-felled and stumped in mid-July at the research farm in the School of Agricultural Technology, Federal Polytechnic; Bali. The field was ploughed and harrowed to form fine tilth. Pegs and tape were used to map the layout. Twelve (12) beds of 2 m x 2 m size were constructed with 0.5m pathways between them. The layout was replicated three (3) times (allowing 2m gaps between replications) which in turn gave a total of 36 beds. Randomized Complete Block Design (RCBD) was adopted and each bed contained nine (9) stands of cowpea, spaced 80 cm apart. Planting was done on 14th August, 2023 which was immediately followed by application of pre-emergence herbicide. Three seeds were drilled per hole and later thinned to one plant per stand.

Preparation of the treatment –

At the onset of the flower buds, balanite, garlic and pepper fruits were properly ground mechanically. 100 grams of the powdered fruits were separately dissolved in 1000 ml of clean water and stirred thoroughly for 15 minutes. The suspensions were allowed to stand for 24 hours and thereafter filtered through 1.0 mm sieves in accordance with Silas *et al.,* 2011 methodology. The filtrates were applied separately at three different concentrations of 50 ml/litre, 100 ml/litre and 150 ml/litre at weekly intervals for seven weeks, giving a total of 9 treated beds and 3 controls (untreated beds) in each replication. Insect counts were recorded for two consecutive weeks before the start of treatments application (where the average served as initial insect count). Application of the treatments continued weekly until harvest; however, each application was preceded by insect count as well (the average therefrom served as final insect count).

At harvest, parameters such as average weight of a dried pod, 100 seed weight and number of pods per plant were recorded as response variables. Data collected were analysed using two-way analysis of variance (ANOVA) with the help of the "R" statistical package. Means were separated using Tukey Honestly significant differences (HSD) at 5% level of significance.

RESULTS AND DISCUSSIONS –

RESULTS -

Table 1: Mean Performance of Cowpea after Treatment with Different types of Bio-Pesticides at varying concentrations

Source of Variation (Treatment)	Weight of dried pod (g)	Weight of 100 seeds (g)	Number of pods per plant
A. PESTICIDE TYPE			
Balanite	2.0750a	22.925a	3.864a

Garlic		2.0583a		24.825b		3.956a		
Pepper	2.0583a		23.925a		3.947a			
G. mean	2.063889			23.89167		3.921915		
SED		0.05611		0.4170			0.06045	
Prob. of F		0.059			10.390			1.407
LSD at $p = 0.05$	0.241			1.794			0.2600954	
B. CONCENTRATION (RATE)								
R1 (Control)		1.4889a		20.456a		3.574a		
R2 (50ml/lt/bed)	2.0444b		24.167b		3.768a			
R3 (100ml/lt/bed)	2.4222c		26.789c		4.265b			
R4 (150ml/lt/bed)	2.3000c		24.156b		4.081b			
G. mean	2.063889			23.89167		3.921915		
SED		0.06479		0.4815			0.06981	
Prob. Of F		81.819			58.503			39.410
LSD at $p = 0.05$	0.206			1.532			0.2221666	
CV		6.659121		4.275285			3.775746	
A X B		*			*			*

SOURCE: Field Experiment (2023)

KEY:

Means followed by the same letter on the same column are not statistically different at 5%; A X B = interactions between the type of pesticide applied and the rate of application; * = significant at 5%; CV = coefficient of variation.

The results showed that at $p = 0.05$ there were no significant differences among the three types of treatment for both the weight of dried pod and the number of pods per plant (table 1). Although treatment with balanite and pepper extracts did not differ significantly for the weight of 100 seeds, but there exists significant difference between them and treatment with garlic extract, where garlic recorded the highest mean value of 24.825g at $p = 0.05$ (table 1). Invariably, garlic extract yielded the best results for all the parameters assessed. This result agreed with the works of Cloyd *et al*., 2009 and Lengai *et al*., 2020 who respectively, reported high efficacy of garlic extract against two-spotted spider mite and *Megalurothrips sjostedti.*

There were generally, some variations among the three concentrations (rates) applied, even though there were no statistically significant differences between rate 3 (100ml/litre) and rate 4 (150ml/litre) for the weight of dried pod and number of pods per plant and between rate 2 (50ml/litre) and rate 4 for the weight of 100 seeds (table 1 [B]). However, there exist statistically significant differences between rate 2 and others for the weight of dried pod and number of pods per plant; rate 3 and others for the weight of 100 seeds (table 1 [B]). It is observed that rate 3 (100ml/litre) generally yielded the highest mean values of 2.42g, 26.79g and 4.27 for weight of dried pod, weight of 100 seeds and number of pods per plant respectively.

There were also significant interactions between the two sets of treatments at p = 0.05 (table 1). This implies that for every type of treatment applied, the concentration used played significant role.

CONCLUSION –

In conclusion, the three types of botanical pesticides generally showed varying degrees of insecticidal efficacies at different concentrations. However, it was observed that garlic extract was most effective in the control of the problematic thrips (*Megalurothrips sjostedti*). Furthermore, application of the garlic extract at the rate of 100ml/lt at weekly intervals from the onset of flower buds till harvest can yield the desired results.

RECOMMENDATIONS –

1. Farmers are advised to adopt the use of garlic extract as alternative to synthetic pesticides besides other integrated pest management strategies.
2. Farmers should apply the extract at the rate of 100ml/lt of water for every $12m^2$ weekly.
3. The essential plant metabolites responsible for insecticidal property of garlic should be identified and transformed to a stable compounds for farmers to use.
4. Farmers should be encouraged to embark on massive production of garlic for commercial extraction of the metabolites in industries.
5. Further research is required to explore other botanical sources, using other methods of extraction of plant metabolites and at varying rates.

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