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Determination of the Efficacy of Neem Products for Control of Field Insect Pests of White Beans (*Vigna unguiculata*) in Bali Local Government Area, Taraba State – Nigeria

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Abstract: *Experiment was carried out in August, 2019, at the teaching and research plot of Department of Crop Production Technology, Federal Polytechnic, Bali; to determine the efficacy of neem products for control of field insect pests of white beans (kanannado). Sixty-four (64) beds measuring 3 m x 3 m were raised on a plot measuring 54 m x 15 m, which comprised of four replicates of 16 beds each. Individual bed contained nine (9) stands of cowpea plant spaced 1m apart. Treatments applied were extracts from neem leaf, neem bark and neem seed oil. Randomized Complete Block Design (RCBD) was adopted for the application of the treatments. Parameters assessed include ten pods weight, ten seed weight and total weight of pods per bed. Data collected were analysed using two-way analysis of variance (ANOVA) with the help of "R" statistical package. Means were separated using least significant differences (LSD) at 5% level of significance.*

***Key words:* efficacy, neem products, control, pests, beans**

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I. Introduction

Cowpea is an annual legume crop which matures in 3-4 months, which also belongs to the family Leguminoceae (Inusa, 2019). It grows very well on a good and friable soil which receives moderate rainfall of 760 mm to 1500 mm; and this is why it is commonly cultivated in Semi-Arid northern Nigeria (Singh *et al*., 1997). Nigeria is the largest producer of cowpea in Sub-Saharan Africa and 56% of the world total production of cowpea comes therefrom (Lowerberg-Deboer *et al*., 2003).Sigmund *et al*. (1991) reported that one-third of the world's population consume diet deficient in protein and this deficiency is more pronounced in humid tropical countries. Sigmund *et al*. (1991) further observed that these deficiencies could be balanced by combination of various food items; hence, it was suggested that a diet with 1/3 beans and 2/3 maize could give a biological value of 100. Being a cheap leguminous crop which provides good quality protein, cowpea augments the staple carbohydrate widely consumed in Nigeria (Muoneke *et al*., 2012). Cowpea attracts many insect pests which reduce the grain yield and quality, and most disastrous among them is the flower bud thrips (*Megalurothrips sjostedti* Tryborn) which causes serious damage at the flowering stage (Nandang, *et al*., 2011). Maina *et al*. (2012) reported that before harvest and during storage cowpea seeds are prone to a large number of species of insect pests, which constitute a major setback in its production. Therefore, preserving agricultural products for future use is the most important pre and post-harvest operation; however, this is impeded by the actions of field and storage insect pests.

Pests of Cowpea – bruchids in the family Bruchidae are serious pests of grain legumes in storage (Lale *et al*., 2002). They cause substantial losses through seed perforation, reduction in weight, market value and germination ability of seeds (El-Atta, 1993). For instance, the larvae of *Callosobruchus maculatus* feed and develop exclusively on the seed of legumes (Fabaceae), while the adults do not require food or water and spend their life span (one-two weeks) mating and laying eggs on beans (Myers *et al*., 2006). The adult female is generally larger and darker than the male and similarly, the plate covering the end of the abdomen is larger and darker in the former (Inusa, 2019). Profit (1997) reported that about 5% of cowpea pods are infested by cowpea weevils in northern Nigeria and during inoculation, the larvae hatch directly from the egg and burrow through the pod wall and finally into the seed where they develop and puppet.

Pests Control –Cowpea is infected by various groups of insects from emergence to reproduction up to storage. Therefore, careful spray of insecticides is the most economic and reliable means of pest control (Agbato, 2011). However, environmental pollution and health hazard posed by synthetic pesticides makes it necessary for farmers to adopt the use of alternative and safer means of combating problems of insect pests. Several control measures were postulated by different workers, which include use of wood ash, solarisation, conventional insecticides to botanical insecticides (Zittler*et al*., 1997). For instance, neem products are botanical insecticides which affect insect vigour, longevity and fecundity; and about 450-500 species of insects were tested with neem products globally, out of which 413 were reportedly susceptible at various concentrations (Dhaliwal *et al*., 2013). Furthermore, entomologists all over the world now proposed that neem has greater qualities for controlling insect pests and is likely to offer itself in a new era of natural pesticides (Ghosh, 2014). Dhaliwal *et al.* (2013) further reported that neem seed extract was recommended for sweet potato white fly control in India and its successful use was reported. However, cowpea farmers in the Semi-Arid region of northern Nigeria suffer great loss due to incessant attack by field insect pests and frequent use of costly and harmful synthetic pesticides. Therefore, to provide a soft-landing and sustainable alternative, the objective of this research is to:

Objective of the Study:

1. Determine the efficacy of neem products for control of field insect pests of cowpea.

Null Hypotheses:

$Ho_{1=}$ Neem products have no effects in the control of field insect pests of cowpea.

Ho_2 = No interaction effects between main and sub-treatments applied.

II. Materials and Methods

Study Area - The research will be conducted in Bali Local Government Area. Bali is located in central part of Taraba State between latitudes 7^o 12$^/$ N to 9^o 00$^/$ N of the equator and longitudes 10^o 00$^/$ E to 12^o 00$^/$ E of the Meridian. It has a land mass of 100,000 km^2 and lies within Guinea Savanna ecological zone of Nigeria. The annual rainfall ranges from 750 mm to 1100 mm, the temperature ranges between 22^o C-35^o C. the soil is dominantly of ferruginous tropical type that lies on sandy parent materials (Data *et al*., 2006). 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 – materials used include measuring tape, pegs, “kanannado” beans, pre-emergence herbicide, hoe, neem seed oil, neem leaf, neem bark, pestle and mortar, jerry can,plastic basins, plastic drum, knapsack sprayer, cellophane bags, weigh balance, measuring cylinder sieve and water.

Methods–60m x 30m field was clear-felled and stumped in mid-July when rain was well established. The field was ploughed and harrowed to form fine tilth. Pegs and tape were used to map the layout. Sixteen (16) beds of 3m x 3m size were constructed with 0.5m pathways between them, which gave a total of 15m^2. The layout was replicated four (4) times (allowing 2m gaps between them) which in turn gave a total of 54m x 15m. Randomized Complete Block Design (RCBD) was adopted and each bed contained nine (9) stands of cowpea, spaced 1m apart which gave a total of 64 beds.

Planting was done on 14th August, 2019 which was immediately followed by application of pre-emergence herbicide. Three seeds were drilled per hole and later thinned to one plant per stand. At the onset of the flower buds, neem leaf and bark were macerated and soaked in 20 litter of water each. The suspensions were left overnight to release their chemical contents. Another suspension of 500ml of neem seed oil was also prepared early in the morning and each of the three suspensions was applied separately onto four seed beds, giving a total of 12 treated beds in each replication. The remaining four untreated beds served as control. Application of these treatments continued weekly until harvest.

At harvest, total weight of the pods produced per bed was recorded; ten pods weight and ten seed weight were also recorded as response variables. Data collected were analysed using two-way analysis of variance (ANOVA) with the help of “R” statistical package. Means were separated using least significant differences (LSD) at 5% level of significance.

III. Results and Discussions

Table 1 shows the mean weights of the cowpea pods and seeds after the application of all the treatments and subsequent harvest at the end of the growing season. In a general term, the mean weight of the cowpea treated with neem seed oil (0.20032, 23.381 and 2.45 for total bed weight, ten pod weight and ten seed weight respectively) are greater than those treated with bark and leaf extracts. This concurred with the work of Rajab, *et al.* (2020) who investigated the efficacy of neem products on storage pests and reported that treatment with neem seed produced best results compared to neem leaf and bark. Moreover, replication 1 (as sub-treatment) recorded the highest mean values (0.16674, 21.927 and 2.3044) for all the parameters assessed, while replication 4 gave the lowest mean values of 0.15056, 20.988 and 2.2612. however, further statistical analyses to establish the least significant differences (LSD) among the means revealed that the differences among the treatments were statistically not significant.

Table 2 shows the sum squares, mean squares, probability of “F” and the interaction terms of main and sub-treatments applied. It could be deduced from the table that significant interactions exist among the main and sub-treatments for both total bed weight (0.0319**) and ten pod weight (0.0998*) at p = 0.01 and p = 0.05 respectively. However, no such interaction was observed on the third parameter (ten seed weight) moreover, the main treatments did not show any statistical difference (0.371) either. In a nut shell, the results generally showed that the main treatments (neem products applied) were not singlehandedlyresponsible for the differences in the mean weights and mean squares observed on tables 1 and 2 respectively. In another words, the observed differences were significantly influenced by the interactions of the main and sub-treatments.

IV. Conclusion

In conclusion, although little differences were observed (on the parameters assessed) among all the treatments applied, such differences were statistically insignificant. Therefore, the null hypothesis which says neem products have no effects in the control of field insect pests of cowpea cannot be rejected. However, the null hypothesis which says there is no interaction effects between main and sub-treatments would be rejected at $p = 0.01$ and $p = 0.05$ for total bed weight and ten pod weight respectively to the exclusion of ten seed weight. Therefore, the mean differences observed was not solely a result of the main treatments applied but rather interactions of both main and sub-treatments.

V. Recommendations

1. Further research should be conducted using the neem products, with initial and final insect counts as response (dependent) variables instead of pods and seed weight parameters.
2. Proximate analyses of the chemical content of neem seed oil should be conducted to ascertain the cause of dotted burnt or discolorations appearing on cowpea leaves when treated with neem seed oil.

Table 1: Mean Weight of Cowpea Pods and Seeds from the Analysis of Variance after Ten Weeks of Application of the Treatments

Treatment		Tot. bed wt (kg)	Ten pods wt (g)	Ten seed wt (g)
A.	**Main treatment (neem products)**			
1.	Bark	0.16992	21.600	2.3187
2.	Control	0.13509	21.019	2.0875
3.	Leaf	0.12927	19.831	2.2750
4.	Seed	0.20032	23.381	2.4500
Probability of F		0.2318	0.4230	0.371
B.	**Sub-treatment (replication)**			
Rep. 1		0.16674	21.927	2.3044
Rep. 2		0.16135	21.614	2.2900
Rep. 3		0.15595	21.301	2.2756
Rep. 4		0.15056	20.988	2.2612
Probability of F		0.0736**	0.0624**	0.365
Grand mean		0.1586502	21.4581	2.282812
SED		0.03852	2.145	0.2053
LSD		0.07866834	4.380674	0.4192785
		NS	NS	NS

SOURCE: Field experiment (2019)

Table 2: Showing the mean squares, error terms (residuals) and interactions between main and sub-treatments from the analysis of variance

Source of var.	df	ss	ms	F value	Pr (>f)
Total pod weight per bed					
Main treatment:					
Neem products (A)	3	0.0525	0.01750	1.474	0.2318
Sub-treatment:					
Bed (B)	1	0.0019	0.00189	0.159	0.6918
Rep (C)	1	0.0395	0.03954	3.330	0.0736**
A X B X C	4	0.1358	0.03396	2.861	0.0319***
Residuals (errors)	54	0.6411	0.01187		
Total	63	0.8708			
SED (0.03852)					
LSD (0.07866834)					
Ten pods weight					
Main treatment:					
Neem products (A)	3	104.9	34.98	0.950	0.4230
Sub-treatment:					
Bed (B)	1	19.0	18.98	0.515	0.4759
Rep (C)	1	133.3	133.34	3.622	0.0624**
A X B X C	4	302	75.59	2.053	0.0998**
Residuals (errors)	54	1988.1	36.82		
Total	63	2547.7			
SED (2.145)					
LSD (4.380674)					
Ten seed weight					

Main treatment:									
Neem product (A)	3	1.079		0.3597		1.067		0.371	
Sub-treatment:									
Bed (B)	1	0.005		0.0048		0.014		0.906	
Rep (C)	1	0.281		0.2810		0.834		0.365	
A X B X C		4	1.503		0.3757		1.114		0.359
Residuals (errors)	54	18.203		0.3371					
Total		63	21.071						
SED (0.2053)									
LSD (0.4192785)									

SOURCE: field experiment (2019)

KEY: AXBXC = interactions, NS = not significant, **= significant at 5%, *** = significant at 1%, ss = sum squares, ms = mean squares, wt = weight, Rep. = replication, df = degree of freedom, SED = standard error for difference in means, LSD = least significant difference

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