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The Effect of Different Rates of Tobacco Leaf Extract in Insect Pests Control in Cowpea Production

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***Abstract* - Field experiment was conducted under rain fed condition at the College of Education school farm Akamkpa, Cross River State during the 2021 cropping season to investigate the effect of different tobacco (*Nicotianatobaccum L.*) leaf extract in the control of field pests in cowpea. A randomized Complete Block Design (RCBD) was used with five treatments and three replicates. Treatments (T) consist of T_1 (No application), T_2 (0.05kg of tobacco extract + 100g caustic in 5 liter of water, T_3 (1kg tobacco extract + 100g caustic soda in 5 liter of water, T_4 (1.5kg of tobacco extract + 100g of caustic soda in 5 liter of water), T_5 (karate insecticide at 2.5ml/l) Growth parameters (Plant height and number of branches per plant) and yield parameters (Number of pods/plant, number of seeds/pod, 100 seeds weight and net yield) were determined. Result showed that there was significant ($P<0.05$) plant height and number of branches at 40 days after planting. There was significant ($P<0.05$) difference in number pods/plant, 100 seeds weight and net yield among the treatments. Treatment five (T_5) gave the highest rate of return per naira among the treatments followed by treatment three (T_3). Therefore, based on this study if tobacco extract were to be used, treatment three [(T_3) 1.00 kg (tobacco extract) is recommended.**

Keywords: Tobacco, Botanical Insecticide, Insect pest, Synthetic insecticide, Cowpea.

1. Introduction

Protein energy malnutrition is one of the most severe public health problems in many developing countries. Child malnutrition was associated with 54% of deaths in children in developing countries. Cowpea (*vignauguculata L. Walp*) provides food for millions of people and is important in alleviating protein – calorie malnutrition. It is a good source of essential amino acids because of its high protein content. Its adaptability to different types of soils and intercropping systems, its tolerance to drought and its ability to improve soil fertility and prevent soil erosion makes it an important economic crop in many developing countries.

In Sub-sahara Africa cowpea grain yield is as high as 3,000kg/ha in the research stations but at farmers plots yields are disappointedly low averaging 400 – 700kg/ha [24]. Insect pests are considered to be largely responsible for this as their attack can result in up to 90 - 100% yield reduction [5]. Major insect pests of cowpea include aphids (Aphis craccivora), pod borers (Marucavitrata and Helicoverpaarmigera) and the pod-sucking bug (PSB) complex of which Clavigralla spp., Anoplocnemiscurvipes and Mirperusjaculus are the most damaging.[14] investigated the critical period of carrying out pesticide treatment in cowpea production and observed phyto-sanitary period against cowpea pests is between 28 – 42 days after planting that this is period of flower bud initiation, pod formation and pod filling. Chemical insecticides are believed to be the most effective control measures against cowpea insect pests [10]. However, but its application has proven to cause negative impacts on the environment, non-target organisms, and people's health, which has stimulated the search for alternative ways of controlling pests [12]. Insecticides are heavily used to control insects by killing them or preventing them from eating in undesirable behaviors [1]. There is a global concern about environmental pollution, toxicity to non-target organisms, and pesticide residues. Botanicals are a promising source of pest control compounds as the pool of plants possessing insecticidal substances are enormous and have generated extraordinary interest in recent years as potential sources of natural insect control agents [6].

Botanical insecticides are widely used by subsistence and transitional farmers in low-income countries. Their use is often driven by the limited availability or cost of commercial pesticides. Homemade botanical insecticides are often recommended by agricultural extension services and some development organizations. Globally, yield losses due to arthropods, diseases, and weeds are estimated to account for about 35% in major crops. Losses may exceed 50% in developing regions where pest control options are limited [9].

Synthetic pesticides are intensively used in developed and transitional countries, many subsistence and transitional farmers do not have access to synthetic pesticides, or cannot

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afford them [20]. Similarly, commercial preparations of alternatives, such as biological control agents or botanical pesticides ("botanicals"), are often not available and may also be expensive [9].

The efficacy of insecticides is commonly understood as their ability to kill a target pest. Some botanicals, such as pyrethrum or tobacco, contain compounds that have a neurotoxic activity, causing the rapid death of insect pests. However, a large number of botanicals and their compounds act in a more subtle way. For instance, azadirachtin, the main active ingredient of neem, affects the metabolism of insects, leading to female infertility and disruption of the molting process. Neem and chinaberry, as well as other botanicals of the *Lamiaceae* and *Asteraceae* family, have been shown to possess antifeedant properties. Other botanicals, such as citronella (*Cymbopogon spp.*), have repellent properties [13].

Nicotine (Tobacco) is one of the oldest known plant origin insecticides, and an extremely fast-acting nerve toxin which possesses remarkable insecticidal activity. Nicotine kills the insects rapidly within an hour causing intensive tremors, convulsions, and then paralysis. It competes with acetylcholine, the major neurotransmitter, by bonding to acetylcholine receptors at nerve synapses and causing uncontrolled nerve firing. This disruption of normal nerve impulse activity results in rapid failure of those body systems that depend on nervous input for proper functioning [11]. It has been proved that nicotine being an alkaloid, besides causing acute toxicity, leads to the disruption of biological membranes, malfunction of internal organs and metabolism, redox imbalance, and disturbances in the development and reproduction processes in insects or cause inhibition of food intake [8].

[3] On Comparative assessment of insecticidal potency of tobacco leaves extract, Black Pepper Seeds Extract and African Pepper Seeds Extract, showed 80% potency of tobacco leaf extract when compared to synthetic insecticide. [3] on the efficacy of single and combine powder extract of tobacco in management of insect pests of Maize, showed significant decrease in stem borer (stitiphiuszeamais - Motchulkys), increase in number of cobs and yield. [12] study the toxicity of tobacco extract as an alternative to synthetic insecticide, their result revealed that tobacco leaf extract was moderately to strongly toxic depending on the concentration, route of application and surfactant used.[21]evaluating some early maturing cowpea as affected bybotanical insecticide observed significant increase in number of branches and plant height in spraying regime between 35 – 45 days after planting. [16] found that spraying regime does not have effect on growth parameters between 20 – 25 days after planting that effect of infestation becomes pronounce from four weeks after planting in cowpea production.[15]also investigated time of spraying effects on insect pests and yield parameters in cowpea. They observed that critical time of which cowpea response to pesticide application for high yield is during flower initiation and early pod formation that at this period the insect infestation / population is always high and if not control economic loss may set in.

For botanical extract to stick to the surfaces of foliage surfactants are normally used. Surfactants physically change the properties of the spray solution and droplets. They help improve the pesticide's ability to emulsify, disperse, spread, and stick by reducing surface tension. The goal of this process is to reduce surface tension, which increases a spray droplet's ability to remain in contact with the leaf surface longer, allowing more pesticide to be absorbed [26]. Surfactants have long been used as wetting, spreading, emulsifying and sticking agents to improve the effectiveness and coverage of many pesticides. Many surfactants, however, exhibit insecticidal effects themselves and could be used as an alternative to insecticides [17]. The insecticidal activities of four surfactants, a dishwashing detergent (New Day), a mineral oil (Sunspray oil), cotton seed oil and a vegetable oil, alone or in combination, were tested against nymphs of Bemisiaargentifolii Bellows &Perring on collards and tomato. Results indicate that these surfactants and oils have good potential for controlling B argentifolii signifying that they have insecticidal [7].

Experiments have been conducted using different quantity/rate of tobacco extract in management of insect pests. [24]in their study used 0, 1, 2 and 3kg paste of tobacco leaves extract with 50mls of liquid soap in 6liters of water while [3]used 1kg of powder tobacco with different surfactants in 3 liters of water.

1.1 Statement of the problem

Protein intake is geared towards body building as to repair worn out tissues. Protein derived from animal is cost intensive in comparison to protein of plant source. One of the common sources of plant derived protein is cowpea (bean) with a protein content of 25%.Nevertheless, despite cowpea nutritional values; its susceptibility to pest attack poses constraints in the cultivation of the crop. In Sub-sahara Africa cowpea grain yield is as high as 3,000kg/ha in the research stations but at farmers plots yields are disappointedly low averaging 400 – 700kg/ha, [24]. Insect pests cause up to 70% grain yield reduction in cowpea. Chemical insecticides are believed to be the most effective control measures against cowpea insect pests. However, synthetic insecticides are expensive, toxic and when used excessively maybe harmful to human health and the environment. Therefore, there is need to

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design pest management option that have limited adverse effect on the environment, eco - friendly and are effective against targeted insects. One of such option is the use of natural (Botanical) insecticide in the control of field pests in cowpea. This study is aimed at assessing the effect of tobacco extract in the control of field pests in cowpea.

1.2 Purpose of Study

The main purpose of this study is to evaluate the effectiveness of different rates of tobacco extract in cow pea field pest control. Specifically the objectives were to determine.

1) Whether tobacco extract has any insecticidal effect on cowpea pests.
2) At which quantity/rate that will give maximum protection and maximize economic returns to the cowpea crop.

1.3 Research Question

The study was design to give answer to following questions,

1) Is there any difference between plots treated with tobacco extract and the untreated plots
2) What is the difference between the various quantity/rate of tobacco extracts and which maximize protection and economic returns?

2. Methodology

Field trial was conducted during the 2021 cropping season at the school farm of college of education Akamkpa Cross River State to determine the effect of different rates of tobacco extract in cowpea production.

The experiment was a Randomize Complete Block Design (RCBD) replicated three times with five treatments giving a total of fifteen sub plots. Each sub plot measures 4m x 4m ($16m^2$) giving an area of $380m^2$ (0,038ha). Five (5) ridges 4m long were constructed per sub plot.

Procedure for production of extract was adopted as and used by [18]. Fresh mature tobacco leaves were weighed into groups of 500g (0.5kg), 1000g (1kg) and 1500g (1.5kg). These were pounded separately into paste, 5litre of water was added stirred and 100g of caustic soda(act as surfactant/sticker to help the solution adhere to the foliage) was made to dissolve in the solution and kept for 12 hours for easy extraction of the active ingredient from the paste. The mixture was filtered to get the following treatment (T)

T_1 = No application of tobacco extract (Control).

T_2 = 0.5kg of tobacco extract + 100g caustic soda + 5litre of water.

T3 = 1.00 kg of tobacco extract + 100g caustic soda + 5litre of water.

T_4 = 1.5kg of tobacco extract + 100g caustic soda + 5liter of water.

T_5 = karate insecticide at 2.5ml/L

Data Collection

In the course of the trial the following parameters were observed

(I) Plant height at 20, 40 and 60 days after planting (DAP)
(II) Number of branches at 20, 40 and 60 days after planting (DAP)
(III) Number of pods per plant at 20, 40 and 60 days after planting (DAP)
(IV) 100 seeds weight per treatment
(V) Net yield

3. Data Analysis

Data were statistically analyzed using GENSTAT (Release Rothamsted Experimental Station) copy eight 2011. Least Significant Difference (LSD) at $P < 0.05$ was used for mean separation where ever difference between means was observed following the procedure of [22].

Profitability analysis was carried out as recommended by [23].

This was expressed as:

$$NR = GR - TC, \quad R/N = NR/TC.$$

Where NR = Net Return, GR = Gross Return, TC = Total Cost, R/N = Return per Naira

Table 1 Mean plant height at 20, 40 and 60 days after planting (cm)

Treatment	20 DAP	40 DAP	60 DAP
T_1 = No application	24.60	62.70	72.76
T_2 = 0.5kg tobacco extract	23.64	62.93	73.14
T_3 = 1.0kg tobacco extract	24.91	65.42	74.10
T_4 = 1.5kg tobacco extract	24.30	65.80	74.35
T_5 = karate at 2.5ml/L	24.74	67.25	76.77
$LSD_{0.05}$	NS	0.62	0.78

NS = Non Significant, DAP = Days after Planting.

The result obtained in this study showed that plant height was strongly influenced by the tobacco extract at 40 and 60 days after planting (Table 1). Generally plant height increase with increase in the rate of tobacco extract applied. There was significant ($P < 0.05$) difference between plots applied tobacco extract and the control. Treatment three (1kg leaves extract) significantly differed from treatment one (T_1) and two (T_2).

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Whereas there was no statistical difference between treatment three (T_3) and treatment four (T_4). There was significant difference between treatments five and all other treatments. No significant effect was observed at 20 days after planting.

Table 2 Mean number of branches per plant

Treatment	20 DAP	40 DAP	60 DAP
T_1 = No application	4.21	7.00	9.02
T_2 = 0.5kg tobacco extract	4.60	8.13	10.02
T_3 = 1.0kg tobacco extract	4.30	9.40	11.11
T_5 = karate at 2.5ml/L	4.33	11.40	11.77
$LSD_{0.05}$	NS	0.9	0.58

NS = Non Significant, DAP = Days after Planting

Result on number of branches per plant (Table 2) showed that there was increased in branch numbers as the rate of tobacco extract was increased at 40 and days after planting. However, treatment four (T_4) did not followed this trend. Whereas there was significant ($P< 0.05$) difference between plots treated with tobacco extract and untreated (T_1) plots, there was no significant difference between treatment two (T_3) and treatment four (T_4). However, treatment five (T_5) differed significantly from all other treatments.

Table 3 Number of Pods/Plant, Seeds/Plant, 100 seeds weight and net yield

Treatment	No. Pods/Plant	No. Seeds/Pod	100 seeds Wt (g)	Net Yield (kg)
T_1= No application	7.20	6.68	14.20	0.88
T_2 = 0.5kg tobacco extract	7.70	7.00	14.61	1.40
T_3 = 1.0kg tobacco extract	10.50	6.69	14.59	1.67
T_4 = 1.5kg tobacco extract	10.53	7.01	14.11	1.69
T_5 = karate at 2.5ml/L	12.33	7.0	14.66	1.92
$LSD_{0.05}$	1.5	NS	NS	0.15

NS = Non Significant, DAP = Days after Planting

Number of pods/plant were significantly ($P<0.05$) influence by tobacco treatments. Lower number of pods were obtained in the untreated than treated plots (Table 3). Number of pods significantly ($P<0.05$) increased with increase in rate of tobacco extract. However, treatment four (T_4) was not significantly ($P<0.05$) different from treatment three (T_3). Treatment five ($_5$) produced higher number of pods and significantly different from other treatments.

On number of seeds per pod, there was no significant difference among treatments (Table 3). There was also no significant difference in 100 seeds weight among the treatments.

The yield of cowpea grain varied among the treatments. Yield increase with increase in rate of tobacco extract application. There was significant ($P<0.05$) differences between tobacco extract treated plots and the untreated plots (Table 3). Whereas there was significant difference between treatment two (T_2) and the other two tobacco treatments (T_3 and T_4), however, there was no significant difference between treatment three (T_3) and treatment four (T_4). Treatment five (5) gave the highest grain yield and differed significantly from other treatments.

Table 4 Economic analysis of different rates of Tobacco Extract used (#)

Budget Element	Rate of Tobacco Extract applied (Botanical)				Karate (synthetic)
	control	0.05kg	1.0kg	1.5kg	2.5ml/L
Cost of production (#/ha)	266,000.00	276.000.00	282,000.00	286,000.00	298,000.00
Mean yield Kg/ha	370.50	875.00	1,041.00	1,050.00	1,224.00
Gross benefit(#/ha)	296,000.00	350,000.00	416,400.00	420,000.00	489,600.00
Net benefit (#/ha)	50.000.00	74,000.00	135,400.00	134,000.00	191,600.00
Rate of Return per Naira(R/N)	0.19	0.27	0.49	0.47	0.64

Total cost of production, mean yield, gross benefit, net benefit and rate of return per naira of the different rates of tobacco extract applied and the synthetic is as presented in table 4.

Average yield of different rates was higher in the tobacco extract applied plots than the plots not applied tobacco extract (control). The lowest rate of tobacco extract (0.5kg) had a gross benefit of #350,000.00 and net benefit of #74,000.00 as against #296,000.00 gross benefit and #50,000.00 net benefit of the control (zero application). Also rate of return per naira was higher (0.27) in the lowest rate than the control (0.19).Gross benefit of 1kg tobacco extract was #416,400.00 and net benefit of #135,400.00 with rate of return per naira of0.49, while that of 1,5kg tobacco extract for gross benefit was #420,000.00 and net benefit of 134,000.00 with rate of return per naira of 0.47. Average yield of synthetic insecticide was highest (1,224kg/ha) that gave gross benefit of #489,600.00 with net benefit of #191,600.00 and rate of return per naira of 0.64.

Whereas gross benefit increase with increase in rate of tobacco extract applied, net benefit and rate of return per naira peaked at 1kg of tobacco extract (#135,400.00and 0.49) and decreases as the rate was further increased (#134,000.00 and 0.47).

4. Discussion

Cowpea growth parameters from plots that received pesticides (synthetic and botanical) during the early growth stage (20 DAP) did not show any significance in the treatments applied. This may be due to the fact that at this stage the pest population or infestation is low because more insect pests are found during flowering, bud initiation and pod formation stages. [16]found that spray regime does not have

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effect on growth parameters between 20 – 25 days after planting, [16] found that spray regime between 20-25 days after planting does not have much significant effect on growth parameters, that the effect of infestation become pronounce four weeks after planting.

There was significant difference in number of branches and plant height at 40 days after planting. This is the period of flowering, bud initiation and pod formation and the effect of pest infestation is mostly incidence here. The work agreed with the findings of [21] and [14] who observed significant differences in number of branches and plant height at 35-45 days after planting when botanical insecticide was applied on cowpea.

Yield of cowpea increased with increased rates of tobacco extract applied. This showed that tobacco extract has the efficacy to control pests of cowpea. [24] Stated that the efficacy of any insecticide is commonly understood by its ability to kill targeted pests that botanical insecticides like tobacco contain compounds that have neurotoxic activity causing rapid dead of pest and [16] observed increase in yield of cowpea as rates of tobacco extract was increased. Synthetic insecticide increased growth and yield parameters of cowpea substantially as compared to tobacco extract. This result is in line with the work of [24] where synthetic insecticide was found to be more effective than botanical insecticide. Cost of production using botanical insecticide was lower than that of synthetic insecticide. However, the final yield and net benefit of synthetic was higher than that of botanical, this collaborate the work of [9]who opined that synthetic pesticides although costly may provide better control of pests and a net gain for farmers at the end of the season. Treatment three (3) 1kg tobacco extract scored higher net and higher rate of return per naira. This result is consistent with the findings of [24] who observed 1kg of tobacco extract to perform better economically.

5. Conclusion and Recommendation

On the basis of the result of this present study, it is highly encouraging to note that the use of tobacco leaf extract with its excellent insecticidal activities would be economically feasible to alleviate the cowpea pests' problem; this is because the products are relatively producible, cheap and easy to prepare and apply when compared to synthetic insecticides. However, to make these botanicals economically viable:

1) Farmers must be taught how to collect or grow and process this botanical insecticide.
2) Since botanical insecticides are easily degradable, they need frequent application.
3) Risk linked to pesticides use depends on their toxicity and on the exposure of applicator. Farmers should be taught to observe all pesticide protective code to avoid human hazard.

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