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Efficacy of Plant Extracts on Major Insect Pests of Selected Leaf Vegetables in Southwestern Nigeria

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Abstract: Insect pest infestations are perhaps the most important constraint to production of vegetables in Nigeria and one of the primary causes of low quality and yields. Field experiments were conducted at the Teaching and Research Farm of the Federal University of Technology, Akure, in the rainforest zone of Southwestern Nigeria, during the late and early seasons of 2005 and 2006. To evaluate the efficacy of aqueous plant extracts of neem (*Azadirachta indica*) bark and WestAfrican black pepper (*Piper guineese*)seeds as a pest control strategy of the selected leaf vegetables viz *Amaranthus hybridus* L., *Celosia argentea* L. and *Corchorus olitorius* L. The selected vegetables were planted as sole and mixed crops. The plots were infested naturally and spraying with aqueous extracts of *A. indica*, *P. guineese* and synthetic insecticide, Cymbush commenced at 4 weeks after planting (WAP). Spraying the three selected vegetables under sole and mixed cropping with the aqueous plant extracts at 200 g L^{-1} significantly reduced the population of the insect pests and their associated damage compared to the control. *A. indica* extract was more efficacious in protecting the vegetables from insect pest infestation than *P. guineense* extract. However, the efficacy of *A. indica* extract was comparable to that of cymbushR.

Key words: Efficacy, plant ectracts, major insect, pests, leaf vegetable, Nigeria

INTRODUCTION

The damage by insect pests has often been mentioned as one of the major constraints to the production of vegetables. Wherever and whenever vegetables are grown, the foliage, stems, buds, flowers, fruits and seeds continue to provide food for a wide range of different insect pests resulting in reduced quality and yield (Olasantan, 1992).

Although, the management of insect pests in vegetables has been achieved successfully with the use of conventional pesticides, health risks and environmental pollution emanating from these synthetic insecticides necessitate the development of alternative strategies for sustainable pests management in vegetable production (Dales, 1996). According to Schmutterer (2002), World Health Organisation (WHO) figure suggests that at least 3 million and perhaps as many as 25 million agricultural workers are poisoned each year by pesticides and some 20,000 deaths attributed to the use of agrochemicals.

In order to counter this trend, research has been geared towards identifying non-chemical methods of pest control, which are safe, cheap, easy to apply and accessible to farmers (Jilani and Su, 1983). Also, because fresh produce from vegetables may be consumed raw in salad, it is important to develop pest control methods that are safe, besides being cheap and simple to adopt.

The need to develop non-toxic, safe and effective biodegradable alternatives to synthetic insecticides led to global efforts at screening various plants for bioactivity against insect pest infestations. A number of tropical plant species have been observed to have medicinal properties, which suggest that natural insecticides may be derived from them (Onifade, 2000). Reports by various authors have shown that *A. indica* and *Piper guineense* have considerable potentials for use in the control of insect pests (NRC, 1992; Adedire and Lajide, 2001; Ofuya *et al*., 2005; Gahukaar, 2006). However, most of these have centred on the control of storage pests, with limited information on leaf vegetables (Lale, 1994; Ofuya and Salami, 2002; Ofuya and Adedire, 2004). The aim of this study therefore, was to assess the efficacy of the plant extracts from *A. indica* and *P. guineense*) on the control of insect pests of the selected leaf vegetables viz. *Amaranthus hybridus*, *Celosia argentea* and *Corchorus olitorius*.

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MATERIALS AND METHODS

The experiment was conducted during the late and early rainy seasons of 2005 and 2006 at the Teaching and Research Farm of the Federal University of Technology, Akure (327 m above sea level; 7° 16'N, 5° 120' E) in the rainforest zone of southwestern Nigeria. The land area used for the experiment was 556 m^2 (69.5×8 m). The land was manually cleared and the debris packed to the borders to obtain a clean bed for sowing the crops. There were 3 blocks of 2 m length each with an alleyway of 1 m between adjacent blocks. The treatments were arranged in a randomized complete block design with 3 replications. Each block contained 28 plots (2×2 m) with 0.5 m spacing between plots. In each experiment, seeds of the selected vegetables crops, namely *A. hybridus*, *C. argentea* and *C. olitorius* were obtained from the Ondo State Agricultural Development Programme (ODSADEP), Akure. They were randomly assigned to plots as *Amaranthus* sole, *Celosia* sole, *Corchorus* sole, *Amaranthus* + *Celosia*, *Corchorus* + *Celosia*, *Corchorus* + *Amaranthus*, *Corchorus* + *Celosia* + *Amaranthus* were sown in mixtures. At 3 weeks after planting, the seedlings were thinned to the recommended spacing of 30×40 cm (Tindall, 1986).

Sampling of pest population: The pest populations from the different plots were sampled very early in the morning when the insects were less active throughout the study period, starting from 4 WAP. The samples were collected on diagonal lines in each plot on 30 randomly selected plants and three leaves were selected at random from the selected plant one each from top, middle and bottom parts of the plant. The numbers of insects on the plant were recorded using direct method to enable the quantitative estimation of pest incidence on the vegetable.

Preparation of the extract sprays: Fresh bark samples of *A. indica* were ground to a crumb in a mortar while the sun dried seeds of *P. guineense* were pulverized into a fine powder. Thereafter, 200 g of the samples were measured using a sensitive Metler top-loading balance and separately soaked in 1 L of water. After 24 h, the extract solutions were sieved with a cheese cloth to obtain clear extract solutions. Cypermethrin (synthetic pesticide Cymbush®) was prepared according to the manufacturer's specification (2 L/1000 L of water, equivalent to 2 mL L^{-1} of water). The Harry® hand sprayer was used to apply the sprays and spraying with prepared extracts for each treatment commenced at 4 WAP.

Data collection: The insect densities from each plot were recorded 1 day before and one day after spraying. The Henderson Tilton formula (Aladesanwa, 2006) was used to determine the efficacy (%) of the extract solutions.

$$\text{Efficacy (\%)} = 1- \left(\frac{T_a}{C_a} \times \frac{C_b}{T_b}\right) \times 100$$

Where,

Ta = Infestation in the treated plot after application.
Ca = Infestation in the check plot after application.
Tb = Infestation in the treated plot before application.
sCb = Infestation in the check plot before application.

Data analysis: The data collected were transformed using the arc $\sin^{-1}$ formula and then subjected to Analysis of Variance (ANOVA). Means were separated using the Duncan Multiple Range Test (DMRT). All analyses were carried out using the Statistical Package for Social Scientists (Version 10).

RESULTS AND DISCUSSION

There were different species of insects found on the vegetables, samples of which were collected and taken to the laboratory for preliminary identification, while unfamiliar species were sent to National Institute of Horticultural Research (NIHORT), Ibadan for identification and confirmation. These include *Podagrica sjostedti*, *P. uniforma*, *Nezara viridula*, *Asbecosta* sp., *Logria* sp., *Lixus* sp., *Alaucophora* sp., *Gasterodisus rhomboidalis*, *Dsydercus superstiotus*, *Sylepta derogata Aphis craccivora*, *Aspavia armigera*, *Helopeltis schoutedeni*, *Ootheca mutabilis*, *Psara bipunctalis*, *Acraea eponina*, *Bemisia tabaci*, *Diopsis thoracica*, *Zonocerus* sp. and *Mealybuggs.*

The results of the study confirmed the insect control characteristics of the plants extracts screened. At all times crops in plots sprayed with aqueous plant extracts were less infested by the insect pests than those in the unsprayed checks (control).

A. indica and *P. guineense* extracts were efficient in protecting the crops from the various insect pests (Table 1 and 2). However, the efficacy of aqueous *A. indica* extract was higher than *P.guineese* for the protection of the leaf vegetables against the insect pests. Also, the efficacy of *A.indica* was comparable to that of the synthetic insecticide (Cymbush[R]). The results support the findings of Basedow *et al.* (2002) which showed that *A. indica*-based products were effective, or even more effective, than synthetic insecticides in the

Table 1: Percentage efficacy of plant extracts against insect pest species (Late Seasons, 2005)

Crop mixtures	Plant extracts	4WAP[1]	5WAP[1]	6WAP[1]	7WAP[1]
C. olitorius	Neem	56.33a	79.49b	81.67b	85.00b
	Piper	45.67a	51.78a	59.08a	66.29a
	Cyper	90.00c	90.00b	90.00b	90.00b
A. hybridus	Neem	55.76a	70.33b	83.06b	90.00b
	Piper	48.00a	50.58a	56.91a	65.40a
	Cyper	90.00b	83.83b	90.00b	90.00b
C. argentea	Neem	54.74a	70.33b	79.37b	90.00b
	Piper	47.82a	50.61a	66.61a	67.59a
	Cyper	90.00b	90.00c	90.00b	90.00b
Cor + ama	Neem	63.24b	70.16b	85.33b	90.00b
	Piper	44.89a	51.98a	69.73a	75.69a
	Cyper	79.49b	90.00c	90.00b	90.00b
Cor + cel	Neem	65.37b	75.04b	84.28b	86.03b
	Piper	46.28a	58.19a	68.19a	68.48a
	Cyper	90.00c	90.00b	90.00b	90.00b
Ama + cel	Neem	57.21a	71.89ab	78.16ab	87.52ab
	Piper	48.41a	68.26a	72.36a	77.21a
	Cyper	90.00b	90.00b	90.00b	90.00b
Cor +ama+cel	Neem	51.57a	78.25b	81.57ab	88.25ab
	Piper	45.25a	61.89a	75.35a	71.57a
	Cyper	90.00b	90.00b	90.00b	90.00b

Values followed by the same letter within a column are not significantly different ($p>0.05$), [1]WAP = weeks after planting

Table 2: Percentage efficacy of plant extracts against insect pest species (Early Seasons, 2006)

Crop mixtures	Plant extracts	4WAP	5WAP	6WAP	7WAP
C. olitorius	Neem	61.57b	65.94a	70.35a	80.19b
	Piper	45.69a	58.69a	62.34a	66.37a
	Cyper	90.00c	90.00b	90.00b	90.00b
A.hybridus	Neem	66.79b	72.49b	75.98ab	80.63b
	Piper	45.79a	50.55a	65.59a	69.11a
	Cyper	90.00c	90.00c	90.00b	90.00b
C.argentea	Neem	60.51b	72.58b	76.59b	82.21b
	Piper	47.98a	51.12a	63.01a	63.81a
	Cyper	90.00c	90.00b	90.00b	90.00b
Cor+Ama	Neem	60.58a	70.68b	75.98b	84.26b
	Piper	42.28a	58.00a	60.82a	63.81a
	Cyper	90.00b	90.00c	90.00b	90.00b
Cor+Cel	Neem	56.17a	65.78b	79.34b	84.32b
	Piper	48.64a	59.09a	61.55a	68.37a
	Cyper	90.00b	90.00c	90.00b	90.00b
Ama+Cel	Neem	64.56a	67.29a	72.82a	84.32b
	Piper	55.35a	56.46a	66.18a	65.40a
	Cyper	90.00b	90.00b	90.00b	90.00b
Cor+Ama+Cel	Neem	54.51a	69.10a	73.37ab	85.12b
	Piper	49.41a	51.02a	64.74a	64.56a
	Cyper	90.00b	90.00b	90.00b	90.00b

Values followed by the same letter within a column are not significantly different ($p<0.05$)

control of aphids and whiteflies (Ivbijaro and Bolaji, 1991) and Schmutterer (1995) also confirmed the potential of products from the *A. indica* tree for the control of field insect pests of egg plant and okra.

The bioactivity of neem has been attributed to various chemical compounds which include of diterpenoids, triterpenoids, trinortriterpenoid-D-Lactores, tetranortritepenoids, pentanortriterpenoids, hexanortri-terpenoids, octanortriterpenoids and enneanoortri-terpenoids, numbering over 250. These bioactive compounds act in concert, thereby giving no room for the development of pest resistance. They exhibit significant anti-feedant, pesticidal, microbial and insect growth disrupting properties. They incite sterility in some insects, impair egg fertility, deter oviposition and have insect repellency (Kraus, 2002; Schmutterer, 2002). They also cause reduction in pest activity, feeding, fecundity and adult longevity thereby causing reduction in pest population and deterring settling of insect pest on hosts (Schmutterer and Singh, 2002).

P. guineense has been found to contain isobutylamides, a plant secondary compounds that act as neurotoxins in insects (Adedire and Ajayi, 1996). These materials are considered safe to mammals because *Piper* sp. had been used for centuries as a spice and for medicinal purposes. It formulates also had a repellent activity, thus protecting plant leaves.

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