Original Research Article

Efficacy of turmeric (*Curcuma longa*) and lambda-cyhalothrin on insect pest infestation and performance of okra in Ado-Ekiti, Nigeria

Abstract

Okra, an economically important vegetable crop with numerous benefits to human, is often attacked by large number of insect species. These insect species cause direct damage to okra plants and also serve as vectors of diseases resulting in economic loss. Control of these insect pests given reducing hunger and poverty, and fostering agricultural ecosystems becomes imperative. This study aimed at the use of indigenous medicinal plant and a sub-lethal dose of synthetic insecticide to check the invasion of pests and performance of okra. The field laid in a randomized complete block design of four treatments replicated three times. The treatments included; *Curcuma longa* 5%, *Curcuma longa* 20%, lambda-cyhalothrin, and a control. Data were collected on insect pest species recovered after treatment application and yield of okra. All data were subjected to analysis of variance and differences between the treatment means were separated using Duncan's multiple range test. *C. longa* (20%) compared effectively with the sub-lethal dose of lambdacyhalothin (0.5ml/l) in their attack against the targeted pests. Although higher number and weight of pods were harvested from synthetically treated plots, the *C. longa* treated plots produced significantly higher number and weight of harvested pods when compared with untreated plots. ~~Documented reports have suggested that the efficacy of *C. longa* might be solvent-dependent.~~ Water extract of the rhizomes also conferred some protection against okra pests; we recommend that farmers in Ekiti State adopt this botanical against the notorious flea beetles especially when the profits accrue from okra sales outweigh their net investment.

Keywords: *Curcuma longa*, insect pest, infestation, okra, lambdacyhalothrin

Introduction

Okra (*Abelmoschus esculentus*) is an important fruit vegetable grown throughout Nigeria for its soft edible green fruits or pods, which contain a glutinous, sticky substance that thicken soups and stews [1]. It is known by different names like "Ila" in Yoruba language, "Okwuru" in Igbo language and "Kubewa" in Hausa language. [2]. Okra is a multipurpose crop because its fresh leaves, buds, flowers, pods, stems, and seeds can be put to various uses [3] its immature pods serve as ingredients of soup among the Yoruba tribe in Nigeria and the leaves are eaten as pot herbs. Okra is one of the nutrient-packed and highly beneficial vegetables for maintaining a healthy body. It contains vitamin A and beta-carotene that are essential nutrients for maintaining good eyesight. Okra pods contain fibre, protein, iron, calcium, and zinc which are essential nutrients for the body [4]. Okra helps to curb magnesium and calcium deficiency as regular intake of okra provides calcium and magnesium for the body; supplying the body with antioxidants – flavonoids and polyphenols – which promote glycogen storage in the liver [5]; and also helps to control hunger owing to its rich content of soluble fibre that gives a feeling of fullness. Okra equally helps in the fight against cancer as it contains lectin a nutrient known to inhibit cancer cells' growth by about 63 percent [6]. It as well strengthens the bones and prevents osteoporosis, a disease of the bone. Okra seed oil is a rich source of linoleic acid, a polyunsaturated fatty acid essential for human nutrition [7]. With the availability of minimum funding and adequate attention, okra farming is a venture that yields huge returns within 60 days. Despite the economic value of this important vegetable crop, its potential as a wealth creator especially among the teeming unemployed population in Nigeria is hampered by improper management practices especially in the control of insects that are responsible for about 69% loss in the marketable yield [8]. The most terrible and economic insect pests causing significant loss in terms of quality and quantity include spiny bollworms, cotton aphids, okra shoot, and fruit borer, okra jassid and whitefly [9]. Majority of the Nigerian Small-holders' farmers have resulted to the use of synthetic insecticides to combat these notorious pests, but the extensive use of these chemical synthetics have led to problems of pest resistance to several pesticides, high level of pesticide residues in food, threat to human health and the environment [10]. With increasing concern for environmentally sound strategies in the control of pests, the development of alternative natural pesticides has now become an imperative need. Turmeric (*Curcuma longa*) is an important medicinal plant with reported insecticidal activity but with limited information on its efficacy against okra insect pests. This study therefore aims at investigating the efficacy of turmeric and sub-lethal dose of lambda-cyhalothrin on insect pests' infestation and performance of okra.

Materials and Methods

Description of Study Site and Field Procedure

The study was carried out at the Teaching and Research Farm of the Ekiti State University, Ado-Ekiti, Nigeria (Latitude 7º 31N and Longitude 5º 13E and Altitude 730 m above sea level) in the rain forest agro-ecological zone during 2017 cropping season. The experimental field was laid out in a randomized complete block design of four treatments and replicated three times. The treatments were: *Curcuma longa* 5%, *Curcuma longa* 20%, lambdacyhalothrin, and a control. Each plot measured 3 m x 3 m with spacing of 1 m in-between the rows, and 0.5 m within the row to give a plant population of 28 plants per plot. The okra seeds were planted two seeds per hole and were later thinned to one plant per hole one week after germination. Manual weeding was carried out at three weeks interval throughout the experiment.

Source of Materials

Okra seed, Clemson spineless was procured from Premier Seeds, Ado-Ekiti. This susceptible variety of okra was controlled with lambdacyhalothrin (2.5 E.C) (procured from a chemical store), turmeric (procured from a local market).

Preparation of Aqueous Extract of *Curcuma longa*

250g rhizome of *Curcuma longa* was weighed on a scale and pounded using mortar and pestle. The paste of the plant was dissolved in 1000ml of distilled water and mixed thoroughly after which it was left for 24 hours. The aqueous solution was filtered with a muslin cloth, and the filtrate was kept in the refrigerator as stock solution. 20 ml each of *Curcuma longa* extract was measured from the stock solution out of which 5 and 20% concentrations were calculated.

Application of the treatments

The Foliar application was done using manually operated hand sprayers. The treatments were applied in the morning to prevent photodecomposition of the extracts and application of treatments commenced two weeks after planting and was repeated weekly for five weeks. The control (unsprayed plots) and lambdacyhalothrin were included for comparison.

Data Collection

Insect Pest Infestation

The efficacy of the treatments was assessed through visual counting of pest population densities on five selected stands each from the two middle rows of each plot. The counting was carefully done at the early hours in the morning between 6:30 and 7:30 am by observing the leaves, stem, and pods of the selected plants. This exercise was carried out a day after application of treatment.

Yield Attributes

The number and weights of okra fruits harvested from the plots were counted and weighed respectively.

Data Analysis

Data on insect counts were transformed using square root transformation before analyzing them. Growth and yield parameters recorded were subjected to analysis of variance and means of the significant treatments was compared by Duncan Multiple Range Test at α 5%.

Result and Discussion

Table 1 show that the cocktail of pests infesting the field was majorly from the order Coleoptera. An array of beetles was observed which include the Flea beetles; *Phyllotreta striolata* and *Podagrica* spp as well as the flower or pollen beetles; *Coryna* spp., and *Mylabris* spp. Other observed pests include the hairy caterpillar and some lacewing (*Chrysoperla carnea*). *Phyllotreta striolata* and *Podagrica* spp were the most prominent pests attacking the foliage. Out of the several important pests (*Aphis gossypii, Amrasca spp., Zonocerus variegatus, Bemisia tabaci, Tetranhchus cinnabarius, Podagrica spp.,*) reported to attack okra, *Podagrica spp* are of great economic importance [11]. These beetles appear in large numbers making characteristic small holes on okra leaves. At the beginning of their infestation, they peel the leaf epidermis, and damaged tissues appear sieve-like. This feeding activity by *Podagrica spp* reduces the photosynthetic surface area of the leaves and results in great reduction in okra yield [12]. This beetle was also implicated as a vector of okra mosaic virus [13] which causes yield losses of up to 90% in okra [14]. The blister beetle's name, derived from its secretions which normally cause blister on the skin. The adults of this pest are either found feeding on the leaves biting off irregular patches or on the flowers where they reduce pod set.

Table 1: Insect Pests Attacking Okra Field

S/N	Scientific Name	Common Name	Stage of Infestation
1	*Podagrica* spp	Flea beetles	Vegetative and Reproductive
2	*Phyllotreta striolata*	Flea beetles	Vegetative and Reproductive
3	*Coryna* spp	Blister beetle	Vegetative and Reproductive
4.	Caterpillar	Bollworm	Vegetative
5.	*Chrysoperla carnea*	lacewing	Vegetative

Table 2 shows the effect of treatments on the population densities of *P. striolata*. At first, second, third to fifth week after treatment application (WAT), plots treated to Lambdacyhalothrin consistently had lowest population density of *P. striolata*. Plots treated to 20% v/v concentration of *C. longa* had lower number of *P. striolata* infestation when compared to those plots treated to 5% v/v concentration of *C. longa.* However, all the plots treated to either *C. longa* (5% v/v and 20% v/v) or lambdacyhalothrin had significantly reduced the number of these pests attacking them when compared to the untreated plots.

As shown in Table 3, lambdacyhalothrin and *C. longa* (both at 5% and 20% v/v concentrations) exhibited insecticidal control against *Podagrica* spp. Although the population of *Podagrica* spp was lower on lambdacyhalothrin treated plots, *Curcuma longa* treated plots relatively competed effectively with the synthetic insecticide. Aqueous extracts of plants have been evaluated for their toxicity against flea beetles by several researchers [14,15,16,17,18]. Plants including *Acorus calamus, Ageratum conyzoides, Azadirachta indica, Duranta repens, Spilanthes acmella* and *Urtica dioca* have been reported for their high mortality and repellency against flea beetles. Neem- based products were reported effective with high mortality against the crucifer flea beetle. Tumeric, *C. longa* has also shown some pesticidal activities against the flea beetle. This pesticidal property may be due to the active compound curcuminoids found in its rhizome [19].

Table 2. Effect of treatments on the population densities of *P. striolata*

Treatment	Weeks After Treatment				
	1	2	3	4	5
Control	11.67a	9.67a	9.67a	6.33a	5.00a
C. longa$_{5\%}$	3.00b	3.67b	4.00ab	2.67b	3.00ab
C. longa$_{20\%}$	2.67b	2.67bc	2.67ab	0.67b	0.67b
Lambdacyhalothrin	1.33b	2.33c	1.33b	1.50b	0.83b

Table 3. Effect of treatments on the population densities of *Podagrica* spp.

Treatment	Weeks After Treatment				
	1	2	3	4	5
Control	13.00a	12.67a	8.33a	8.67a	5.00a
C. longa$_{5\%}$	4.33b	3.00b	2.67a	1.33b	1.33b
C. longa$_{20\%}$	3.33b	2.33bc	3.33a	1.00b	1.00b
Lambdacyhalothrin	0.67b	1.67c	1.33a	1.00b	0.83b

Table 4 shows the effects of the treatments on okra yield. The highest number and greatest weight of pods were harvested from the plots treated to synthetic chemical. *C. longa* treated plots (at 20% concentration) were next in the ranking. Though the yield recorded in *C. longa* treated plots was significantly lower than that of the synthetic treated plots, they differ significantly from the plots which no treatment was applied. The efficacy of *C. longa* in controlling insect pests, which is expected to culminate into optimal plant performance, might be dependent on some intrinsic qualities. Jilani and Su [20] reported that petroleum ether extracts from the rhizomes of *C. longa* were more effective than acetone and ethanol extracts when tested against *Tribolium* castaneum. Surface treatment of wheat seeds with turmeric extracts of different solvents was reported not effective against adults of *Sitophilus* oryzae and *Rhizopertha dominica* except for petroleum ether extracts which gave low mortality percentage against *Sitophilus* oryzae and greater percentage mortality against *Rhizopertha dominica* at 4% concentration [21]. These documented reports suggest that the efficacy of *C. longa* might be solvent dependent. The water extract of rhizomes exhibited some insecticidal control and could be a potent insecticide in protecting okra plant against infestation by the flea beetles which attack both the leaves and the flowers leading into fruit abortion and consequently a reduction in fruit yield [22]. Bearing in mind the cost implication of applying synthetic and its negative environmental impacts, we suggest that farmers in Ekiti State adopt this botanical especially when the profits accrue from okra sales outweigh their net investments at harvest.

Table 4. Effects of treatment on the yield of okra

Treatments	Number of Pods	Weight of Pods
Control	9.33d	117.80d
Curcuma longa 5%	29.33c	389.17c
Curcuma longa 20%	42.00b	634.63b
Lambdacyhalothrin	56.33a	843.37a

Conclusion

This result shows that *Curcuma longa* is a potential botanical pesticide for the management of field insect pests of okra and the observed variations in efficacy and yield between lambdacyhalothrin and *C. longa* suggested that the efficacy of *C. longa* might be solvent dependent. Comparatively, *C. longa* compete effectively with lambdacyhalothrin in checking pest infestation and produced significantly higher yields than the untreated plots. Therefore, we recommend that farmers in Ekiti consider its use as an eco-botanical pesticide.

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