

**Effect of *Lambda-cyhalothrin*, *Ageratum conyzoides*, *Cassia hirsuta* and *Occimum grattissimum* on the control of okra flea beetles and its subsequent effect on yield and yield components of okra.**

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**Abstract:** Aqueous leaf extract of *Cassia hirsuta* (Stinking cassia), *Ageratum conyzoides* (Goat weed) and *Occimum grattissimum* (Bitter basil) at three different levels (100%, 75% and 50%) and recommended rate of *Lambda-cyhalothrin* at 800ml/ha were used for the control of okra flea beetle at two locations (Ayetoro and Ikorodu). Results obtained indicated that the botanicals tested in Ayetoro had significant effects ( $P=0.05$ ) on number of fruits per plant, fruit per plot, pods per hectare and total fruit yield in tons per hectare over that in Ikorodu. Insecticides method of extraction and their concentration had significant effects ( $P=0.05$ ) on the yield and yield components measured. *Lambda-cyhalothrin* performance exceeded cold and hot water method of extraction in all the parameters. Control plot was the least followed by *O. grattissimum*. *A. conyzoides* performed best amongst the botanicals in total fruit yield per hectare and *C. hirsuta* produced the best result in terms of number of fruits per plant, fruits per plot and number of pods per hectare.

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## 1. Introduction

Recent research, having passed through several golden ages, is now in a renaissance of integrating chemicals and biological approach for sustainable pest control with human safety (Casida *et al.*, 1998). Mathew (1979) noted that the enormous success of synthetic organic pesticides has tended to mask the significance of biological control. The use of chemicals and other methods like classical biological, autocidal and microbial control methods are foreign and so require special skill acquisition and huge financial outlay. Chemicals are expensive; the unit price of packages is high (although they can be used on larger area of land) and cannot be afforded by the small-scale farmers whose level of production is low. When the use of chemical is adopted, equipments are also expensive to acquire. Use and maintenance of equipment is also difficult because of the level of education of peasant farmers (Fadayomi, 1991). People do have too much belief in the superiority of chemicals to the extent that chemical products are abused such that every insect noticed is a pest and application of chemical materials is the next step to control it (Kumar, 1984).

Traditional pest control practices are cheap, particularly when produced and provided by the farmers from local resources and coupled with cheap

labour that are often not costed. They are always harmless to human and animals because they are rarely toxic and hence do little harm. This study is designed to evaluate the effect of aqueous leaf extracts of *Ageratum conyzoides*, *Cassia hirsuta* and *Occimum grattissimum* and *Lambda-cyhalothrin* (karate) in the control of okra flea beetle and its subsequent effect on yield and yield components of okra plant.

## 2. Materials and Methods

Two sites with different ecologies were chosen for the study. The Teaching and Research Farm of the College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro lies roughly between latitude  $7^{\circ} 12'$  and longitude  $3^{\circ} 01'$  East of Greenwich meridian. The second site at the Department of Crop Production and Horticulture, Lagos State Polytechnic, Ikorodu, lies roughly between latitude  $5^{\circ} 7'$  and  $5^{\circ} 10'$  North and longitude  $3^{\circ} 16'$  and  $3^{\circ} 18'$  East of Greenwich meridian and lying between 90 and 120m above the sea level. The sites were chosen because of their different ecologies. Ayetoro is in the derived savannah/transitional savannah ecological zone, while Ikorodu is in the rainforest zone with Alagba series soil type. The rainfall pattern is similar to

that of any humid tropical climate, characterized by two peaks.

The experimental sites were ploughed twice with a two-week interval between the first and the second and stumped. The sites were pegged and lined out in a dimension of 3m x 4m to accommodate fifty-seven beds and 1m discards were left between beds and 2m between replicates to ease management operations and to guide against spray drift plot to plot. The gross experimental plot size is 77m x 18m (1386m<sup>2</sup>) and the net experimental plot area is 12m<sup>2</sup> (3m x 4m). Poultry manure was applied at the rate of 15 metric tonnes/ha (4.5kg/bed). The experiment was a 2 x 3 x 3 + 1 factorial arranged in a Randomized Complete Block Design (RCBD) with 3 replications giving a total of 57 experimental plots.

Seeds of an early maturing okra variety (NHae 47-4) obtained from National Horticultural Research Institute (NIHORT), Ibadan were soaked overnight to hasten germination. The seeds were sown at a spacing of 60cm x 50cm with two seeds per hole. The stands were thinned to one at 2 weeks after emergence (2 WAE) giving a plant population of 40 plants per plot and an equivalent of 33,333 plants/ha. Supplying was done 2 weeks after emergence. Weeding operation was carried out twice: first weeding was done at 3 weeks after emergence (3 WAE) and second at 6 weeks after emergence (6 WAE).

Extracts from the selected plants, *Ageratum conyzoides*, *Cassia hirsuta* and *Occimum gratissimum* were prepared using two methods of extraction - hot water and cold water. The cold extraction was adopted from the method of Omoloye *et al.*, (2002) and Obadofin *et al.*, (2006) by soaking 250g leaves in 1 litre of water for 24 hours. The hot water extraction was by boiling 250g of leaves in 1 litre of water for 20 minutes was adopted from the method of Benson *et al.* (2005). The extraction was prepared by macerating 1kg of fresh leaves in 5dm<sup>3</sup> of water and soaked for 24hours for cold extract and by heating the same quantity of leaves to boiling (100<sup>0</sup>C) for 20 minutes for the hot extraction. Each extract was filtered until all soluble compounds had been extracted, as judged solvent extraction was carried out only on *C.hirsuta* by putting 25g leaves in a soxhlet extractor containing 25dm<sup>3</sup> of 40% ethanol.

#### Insecticide application

Volume of extract of 320ml was applied per plot of 12m<sup>2</sup> on the field for 100% concentration; 240ml extract mixed with 160ml of water was applied as 75% concentration on plots and 160ml extract mixed with 160ml of water was applied as 50% concentration. *Lambda-cyhalothrin* (karate) was applied at manufacturer's rate of 800ml/ha in 320ml water per plot. All treatments were sprayed at 2 weeks interval

using 15-litre capacity CP15 knapsack sprayer from 2 weeks after planting (WAP) up to flowering stage.

#### Data collection and analysis

Data collected include days to 50% flowering, number of pods per plant, number of pods per hectare, 100 seed weight and fruit yield per hectare. For 100-seed weight, four samples of 100-seeds were removed from four tagged plants which were randomly selected from the harvest obtained from two middle rows of each plot. The seeds were sun dried to a constant weight and separately weighed to obtain seed weights compared with the control for their effects. Other parameters noted include number of holes bored on 3(three) upper leaves on the field. The effects of the applied insecticide on days to 50% flowering were carried out by observing the number of days it takes 50% of the plants to get to flowering. Number of pods per hectare and mean pod weight were also observed. Yield of okra was collected per plot and extrapolated per hectare for basis of comparison.

### 3. Results

Results obtained from the study indicated that the botanical insecticides (*Ageratum conyzoides*, *Cassia hirsuta* and *Occimum gratissimum*) tested in Ayetoro as shown in Table 1 had significant (p=0.05) effect on number of fruits per plant, fruit per plot, pods per hectare and total fruit yield in tons per hectare. Plots treated with *Lambda-cyhalothrin* treated plots performed best over other plots. Untreated plot (control) gave the least yield performance followed by *O. gratissimum* treated plots. *A. conyzoides* treated plots performed best amongst the botanicals treated plots in total fruit yield per hectare, while *C. hirsuta* produced best result in terms of number of fruits per plant, fruits per plot and number of pods per hectare.

Botanicals extraction methods and their concentrations had significant effect (p=0.05) on the yield components measured in the study. Among the botanicals, the cold water extraction gave the best performance in all parameters while within the concentrations, the 100% concentration gave the best followed by 50% and 75% concentrations respectively.

Results in Table 2 show the main effect of the botanicals/insecticides used in the experiments on Ikorodu site. The insecticides recorded significant effect (P=0.05) on number of fruits per plant, number of fruits per plot, number of pods per hectare and total fruit yield. Plots treated with *Lambda-cyhalothrin* consistently produced the highest yield of 5.89 tonnes(t)/ha, 2.36t/ha, 196t/ha, 296t/ha and 3.98t/ha in all variables measured followed by *A. conyzoides* for fruit yield per hectare (3.17t/ha) and plots treated with *O. gratissimum* recorded 3.04t/ha for number of pods per hectare. The least yield was from the control plots

(untreated) with 3.39 fruits per plant, 136 fruits per plot and 112963 fruits per hectare respectively.

The concentration of *Lambda-cyhalothrin* used gave a performance that was significantly higher ( $P=0.05$ ) than other treatments. Concentration at 75% produced significantly higher number of fruits per plot (199.50) and total fruit yield per hectare (3.20 tons/ha) than 100% concentration. Both levels were at par in respects of number of fruits per plant and number of pods per hectare. Control plots performed the least. Method of extraction in *Lambda-cyhalothrin* was significantly different ( $P=0.05$ ) from that of the botanicals. *Lambda-cyhalothrin* gave the highest yield in all parameters. There was a significant difference ( $P=0.05$ ) in the fruit yield per hectare from hot and cold water extraction. Hot method produced a fruit yield of 2.92t/ha as against 2.83t/ha from cold. A significant difference ( $P=0.05$ ) was recorded in the number of fruits produced by the insecticides. *O. grattissimum* at 75% concentration produced the highest number of fruits per plant (6.56) closely followed by *Lambda-*

*cyhalothrin* (5.89). The least number of fruit yield per plant was produced by hot *Cassia hirsuta* (3.28).

Combined main effect of insecticides on yield and yield components of Okra in Ikorodu and Ayetoro indicated that insecticides, insecticides' concentration and method of extraction had significant effects ( $P=0.05$ ) on the performance of okra (Table 3). Plots treated with *Lambda-cyhalothrin* consistently resulted in high yield followed by the plots treated with *C. hirsuta* in all yield components and plot treated with *A. conyzoides* in total fruit yield. *Lambda-cyhalothrin* insecticide performed very well over hot and cold method of extraction of the botanical insecticides. Although there was no significant difference between cold and hot method of extraction, yields were higher in cold. Yield produced by *Lambda-cyhalothrin* insecticide concentration were significantly different ( $P=0.05$ ) from that of other concentrations and the control. Location produced significant effects ( $P=0.05$ ) on the yield and yield components of okra. However, Okra growth and yield performed better in Ayetoro than in Ikorodu in all the parameters.

**Table 1: Main Effect of *Lambda-cyhalothrin*, *Ageratum conyzoides*, *Cassia hirsuta* and *Ocimum grattissimum* on yield and yield components of okra in Ayetoro.**

Treatment	Fruits per plant	Fruits per plot	Pods per Ha	Yield (Tons/ha)
<b>Insecticide</b>				
<i>Lambda-cyhalothrin</i>	7.94 <sup>a</sup>	318.00 <sup>a</sup>	264814 <sup>a</sup>	5.34 <sup>a</sup>
<i>A. conyzoides</i>	6.50 <sup>c</sup>	260.00 <sup>b</sup>	216680 <sup>b</sup>	4.78 <sup>b</sup>
<i>C. hirsuta</i>	7.69 <sup>b</sup>	320.50 <sup>a</sup>	256481 <sup>a</sup>	4.55 <sup>bc</sup>
<i>O. grattissimum</i>	5.87 <sup>d</sup>	234.67 <sup>c</sup>	195679 <sup>c</sup>	4.45 <sup>c</sup>
Control	5.72 <sup>d</sup>	229.00 <sup>d</sup>	190338 <sup>c</sup>	2.46 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.19	4.85	18312	0.25
<b>Concentration</b>				
1000	7.94 <sup>a</sup>	318.00 <sup>a</sup>	264814 <sup>a</sup>	5.34 <sup>a</sup>
100	7.04 <sup>b</sup>	281.83 <sup>b</sup>	234880 <sup>b</sup>	5.11 <sup>a</sup>
75	5.93 <sup>c</sup>	250.33 <sup>c</sup>	197850 <sup>c</sup>	3.97 <sup>c</sup>
50	7.08 <sup>b</sup>	283.00 <sup>b</sup>	234880 <sup>b</sup>	4.69 <sup>b</sup>
0	5.72 <sup>d</sup>	229.00 <sup>d</sup>	190338 <sup>c</sup>	2.46 <sup>d</sup>
	*	*	*	*
LSD (5%)	0.19	4.85	18312	0.25
<b>Temperature</b>				
<i>Lambda-cyhalothrin</i>	7.94 <sup>a</sup>	318.00 <sup>a</sup>	264814 <sup>a</sup>	5.34 <sup>a</sup>
Hot Extraction	6.34 <sup>c</sup>	261.56 <sup>c</sup>	228107 <sup>b</sup>	4.61 <sup>b</sup>
Cold Extraction	6.83 <sup>b</sup>	281.89 <sup>b</sup>	227787 <sup>b</sup>	4.58 <sup>b</sup>
Control	5.72 <sup>d</sup>	229.00 <sup>d</sup>	190338 <sup>c</sup>	2.46 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.20	5.12	19302	0.27

Means within columns followed by the same letter are not significantly different ( $P=0.05$ ; LSD)

\* - Significant at 5% probability level

Effect of treatments on number of pods per plant showed that the plots treated with 100% hot extract of *A. conyzoides* produced the highest number of fruits per plant in Ikorodu (6.61). This is closely followed by the plots treated with extraction of 75% cold *O. grattissimum* (6.56). The least number of fruits was produced by the plots treated with extraction of 100% hot *C. hirsuta*. In Ayetoro, the highest number of fruits (9.39) was obtained from the plots treated with 100% cold extraction of *C. hirsuta*, closely followed by the plots treated with 50% hot extraction of *A. conyzoides*. It was generally observed that all the insecticide treatments in Ikorodu produced more number of fruits than in Ayetoro. The same trend was maintained in number of pods per plot and pod per hectare (Table 4). There was a significant difference in the yield obtained from the insecticides.

The yield per hectare amongst the botanical in Ikorodu (Table 4) was obtained from the plots treated with 100% hot extraction of *A. conyzoides* (4.93t/ha). This was followed by the plots treated with 75% cold extraction of *O. grattissimum* (4.20t/ha) and the plots treated with *Lambda-cyhalothrin* which recorded

3.98t/ha. The least yield (1.81t/ha) was obtained from the plots treated with *A. conyzoides* at 50% hot extraction at Ayetoro. The highest yield was recorded on the plots treated with 50% hot extraction of *A. conyzoides*. It was followed by the plots treated with 100% cold extraction of *C. hirsuta* (5.28t). The least yield (2.46t/ha) was recorded from the control (untreated) plot. A combined analysis for the two sites (Table 5) showed that concentration at 100% cold extraction of *C. hirsuta* produced the largest number of fruits per plant (4.28) which is not significantly different ( $P=0.05$ ) from *Lambda-cyhalothrin* treated plots (6.92). The lowest number of pod (4.28) was identified with concentration of 75% hot extract of *A. conyzoides* (4.28). The same trend was noticed on number of fruits per plot and number of pods per hectare. It can however be said that generally *O. grattissimum* performed the least. The highest yield (4.81t) was produced by the plots treated with 100% hot *A. conyzoides* which was not significantly different ( $P=0.05$ ) from the plots treated with *Lambda-cyhalothrin* (4.66tha) while the lowest yield (2.28t) was from the control plot

**Table 2: Main Effect of Lambda-cyhalothrin, Ageratum conyzoides, Cassia hirsuta and Occimum grattissimum on yield and yield components of okra in Ikorodu**

Treatment	Fruits per plant	Fruits per plot	Pods per Ha	Yield (Tons/ha)
<b>Insecticide</b>				
<i>Lambda-cyhalothrin</i>	5.89 <sup>a</sup>	236.00 <sup>a</sup>	196296 <sup>a</sup>	3.98 <sup>a</sup>
<i>A. conyzoides</i>	4.78 <sup>b</sup>	191.17 <sup>c</sup>	159260 <sup>b</sup>	3.17 <sup>b</sup>
<i>C. hirsute</i>	3.76 <sup>c</sup>	150.50 <sup>d</sup>	125309 <sup>c</sup>	2.42 <sup>d</sup>
<i>O. grattissimum</i>	5.1 <sup>b</sup>	204.28 <sup>b</sup>	170370 <sup>b</sup>	3.04 <sup>c</sup>
Control	3.39 <sup>c</sup>	136.00 <sup>c</sup>	112963 <sup>c</sup>	2.10 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.38	8.04	18034	0.85
<b>Concentration</b>				
1000	5.89 <sup>a</sup>	2.36.00 <sup>a</sup>	196296 <sup>a</sup>	3.98 <sup>a</sup>
100	4.65 <sup>b</sup>	186.00 <sup>c</sup>	154938 <sup>b</sup>	2.97 <sup>c</sup>
75	4.99 <sup>b</sup>	195.50 <sup>b</sup>	166358 <sup>b</sup>	3.20 <sup>b</sup>
50	4.01 <sup>c</sup>	160.44 <sup>d</sup>	133643 <sup>c</sup>	2.45 <sup>d</sup>
0	3.39 <sup>d</sup>	136.00 <sup>c</sup>	112963 <sup>d</sup>	2.10 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.39	8.04	18034	0.85
<b>Temperature</b>				
<i>Lambda-cyhalothrin</i>	5.89 <sup>a</sup>	236.00 <sup>a</sup>	96296 <sup>a</sup>	3.98 <sup>a</sup>
Hot Extraction	4.59 <sup>b</sup>	183.41 <sup>b</sup>	152881 <sup>b</sup>	2.92 <sup>b</sup>
Cold Extraction	4.51 <sup>b</sup>	180.56 <sup>b</sup>	150412 <sup>b</sup>	2.83 <sup>c</sup>
Control	3.39 <sup>c</sup>	136.00 <sup>c</sup>	112963 <sup>c</sup>	2.10 <sup>d</sup>
	*	*	*	*
LSD (5%)	0.40	8.47	19009	0.09

Means within columns followed by the same letter are not significantly different ( $P=0.05$ ; LSD)

\* - Significant at 5% probability level

**Table 3: Combined Effect of Lambda-cyhalothrin, Ageratum conyzoides, Cassia hirsuta and Occimum grattissimum on yield and yield components of okra in Ikorodu and Ayetoro**

Treatment	Fruits per plant	Fruits per plot	Pods per Ha	Yield (Tons/ha)
<b>Insecticide</b>				
<i>Lambda-cyhalothrin</i>	6.92 <sup>a</sup>	2.77.00 <sup>a</sup>	230555 <sup>a</sup>	4.66 <sup>a</sup>
<i>A. conyzoides</i>	5.64 <sup>a</sup>	225.58 <sup>b</sup>	187970 <sup>b</sup>	3.98 <sup>b</sup>
<i>C. hirsute</i>	5.73 <sup>b</sup>	235.50 <sup>b</sup>	190895 <sup>b</sup>	3.48 <sup>b</sup>
<i>O. grattissimum</i>	5.49 <sup>b</sup>	219.47 <sup>bc</sup>	183025 <sup>bc</sup>	3.74 <sup>b</sup>
Control	4.56 <sup>c</sup>	182.50 <sup>c</sup>	151651 <sup>c</sup>	2.28 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.93	38.21	32384	0.56
<b>Concentration</b>				
1000	6.92 <sup>a</sup>	277.00 <sup>a</sup>	230555 <sup>a</sup>	4.66 <sup>a</sup>
100	5.85 <sup>b</sup>	233.92 <sup>b</sup>	194909 <sup>b</sup>	4.04 <sup>b</sup>
75	5.46 <sup>bc</sup>	224.92 <sup>b</sup>	182104 <sup>bc</sup>	3.59 <sup>b</sup>
50	5.55 <sup>b</sup>	221.72 <sup>b</sup>	184877 <sup>bc</sup>	3.57 <sup>b</sup>
0	4.56 <sup>c</sup>	180.50 <sup>c</sup>	151651 <sup>c</sup>	2.28 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.93	38.21	32384	0.56
<b>Temperature</b>				
<i>Lambda-cyhalothrin</i>	6.92 <sup>a</sup>	277.00 <sup>a</sup>	230555 <sup>a</sup>	4.66 <sup>a</sup>
Hot Extraction	5.56 <sup>b</sup>	222.48 <sup>bc</sup>	185494 <sup>bc</sup>	3.76 <sup>b</sup>
Cold Extraction	5.67 <sup>b</sup>	231.22 <sup>b</sup>	189099 <sup>b</sup>	3.70 <sup>b</sup>
Control	4.56 <sup>c</sup>	182.50 <sup>c</sup>	151651 <sup>c</sup>	2.28 <sup>c</sup>
	*	*	*	*
LSD (5%)	0.98	40.28	14136	0.59
<b>Location</b>				
Ikorodu	4.56 <sup>a</sup>	182.38 <sup>b</sup>	151945 <sup>b</sup>	2.89 <sup>b</sup>
Ayetoro	6.70 <sup>b</sup>	271.90 <sup>a</sup>	223410 <sup>a</sup>	4.52 <sup>a</sup>
	*	*	*	*
	0.42	17.09	14483	0.25

Means within columns followed by the same letter are not significantly different (P=0.05; LSD)

\* - Significant at 5% probability level

**Table 4: Effects of Lambda-cyhalothrin, Ageratum conyzoides, Cassia hirsuta and Occimum grattissimum on yield and yield components in okra at Ikorodu and Ayetoro.**

Insecticide	Conc.(%)	Number of Pods/Pltnt		Number of Pods/Plot		Number of Fruits/ ha		Fruit yield/ha (t)	
		Ikorodu	Ayetoro	Ikorodu	Ayetoro	Ikorodu	Ayetoro	Ikorodu	Ayetoro
<i>Lambda-cyhalothrin</i>	100	5.89 <sup>b</sup>	7.94 <sup>c</sup>	236.00 <sup>b</sup>	318.00 <sup>d</sup>	196296 <sup>ab</sup>	264814 <sup>b</sup>	3.98 <sup>c</sup>	5.34 <sup>c</sup>
<i>C. hirsuta</i>	50cold	3.39 <sup>j</sup>	8.00 <sup>c</sup>	136.00 <sup>kl</sup>	320.00 <sup>d</sup>	112963 <sup>hi</sup>	266666 <sup>b</sup>	2.07 <sup>kl</sup>	3.32 <sup>j</sup>
	50hot	3.89 <sup>ghj</sup>	6.22 <sup>g</sup>	156.00 <sup>hi</sup>	247.00 <sup>hi</sup>	129634 <sup>l-i</sup>	207407 <sup>def</sup>	2.71 <sup>gh</sup>	4.43 <sup>fg</sup>
	75cold	3.61 <sup>ij</sup>	6.78 <sup>c</sup>	144.00 <sup>jk</sup>	349.00 <sup>c</sup>	120370 <sup>ghh</sup>	225926 <sup>cd</sup>	1.97 <sup>kl</sup>	4.22 <sup>gh</sup>
	75hot	4.22 <sup>fg</sup>	7.22 <sup>d</sup>	169.00 <sup>g</sup>	289.00 <sup>c</sup>	140741 <sup>e-h</sup>	240741 <sup>bc</sup>	2.87 <sup>f</sup>	4.60 <sup>ef</sup>
<i>A. conyzoides</i>	100cold	4.17 <sup>ghi</sup>	9.94 <sup>a</sup>	167.00 <sup>gh</sup>	398.00 <sup>a</sup>	138889 <sup>e-i</sup>	331481 <sup>a</sup>	2.77 <sup>fg</sup>	5.82 <sup>b</sup>
	100hot	3.28 <sup>j</sup>	8.00 <sup>c</sup>	131.00 <sup>l</sup>	320.00 <sup>d</sup>	109259 <sup>j</sup>	266666 <sup>b</sup>	2.10 <sup>j</sup>	4.91 <sup>de</sup>
	50cold	4.94 <sup>de</sup>	6.56 <sup>ef</sup>	198.00 <sup>de</sup>	262.00 <sup>g</sup>	164815 <sup>cdk</sup>	218518 <sup>cdc</sup>	3.04 <sup>e</sup>	5.40 <sup>c</sup>
	50hot	3.44 <sup>j</sup>	9.39 <sup>b</sup>	138.00 <sup>kl</sup>	376.00 <sup>b</sup>	114815 <sup>hi</sup>	312963 <sup>d</sup>	1.87 <sup>j</sup>	6.47 <sup>d</sup>
	75cold	5.56 <sup>bc</sup>	6.11 <sup>g</sup>	222.00 <sup>c</sup>	244.00 <sup>j</sup>	185188 <sup>bc</sup>	203764 <sup>def</sup>	3.96 <sup>c</sup>	3.85 <sup>h</sup>
	75hot	4.39 <sup>efg</sup>	4.16 <sup>j</sup>	176.00 <sup>fg</sup>	167.00 <sup>m</sup>	146296 <sup>d-i</sup>	138889 <sup>j</sup>	2.57 <sup>j</sup>	3.14 <sup>j</sup>
<i>O. grattissimum</i>	100cold	3.72 <sup>hij</sup>	6.72 <sup>c</sup>	149.00 <sup>ij</sup>	269.00 <sup>fg</sup>	124073 <sup>ghi</sup>	224094 <sup>cd</sup>	2.63 <sup>hi</sup>	5.15 <sup>cd</sup>
	100hot	6.61 <sup>a</sup>	6.05 <sup>g</sup>	264.00 <sup>a</sup>	242.00 <sup>i</sup>	220370 <sup>a</sup>	201852 <sup>def</sup>	4.93 <sup>a</sup>	4.69 <sup>ef</sup>
	50 cold	3.78 <sup>hij</sup>	5.61 <sup>h</sup>	151.00 <sup>i</sup>	224.00 <sup>j</sup>	125926 <sup>f-i</sup>	187037 <sup>fg</sup>	2.16 <sup>j</sup>	3.83 <sup>h</sup>
	50 hot	4.61 <sup>ef</sup>	6.72 <sup>c</sup>	183.70 <sup>i</sup>	269.00 <sup>fg</sup>	153704 <sup>def</sup>	224074 <sup>cd</sup>	2.84 <sup>j</sup>	4.73 <sup>ef</sup>
	75cold	6.56 <sup>a</sup>	5.00 <sup>i</sup>	262.00 <sup>a</sup>	200.00 <sup>k</sup>	218518 <sup>a</sup>	166667 <sup>gh</sup>	4.20 <sup>b</sup>	4.16 <sup>gh</sup>
	75hot	5.61 <sup>bc</sup>	6.33 <sup>fg</sup>	224.00 <sup>c</sup>	253.00 <sup>h</sup>	187037 <sup>bc</sup>	211111 <sup>def</sup>	3.62 <sup>d</sup>	3.85 <sup>h</sup>
Nil	100cold	4.89 <sup>de</sup>	6.78 <sup>c</sup>	196.00 <sup>e</sup>	271.00 <sup>f</sup>	162963 <sup>cdc</sup>	225926 <sup>cd</sup>	2.63 <sup>hi</sup>	5.47 <sup>bc</sup>
	100hot	5.22 <sup>cd</sup>	4.77 <sup>i</sup>	209.00 <sup>d</sup>	191.00 <sup>j</sup>	174074 <sup>bcd</sup>	159259 <sup>hi</sup>	2.77 <sup>fg</sup>	4.64 <sup>ef</sup>
LSD (5%)	-	3.39 <sup>j</sup>	5.72 <sup>h</sup>	136.00 <sup>k</sup>	229.00 <sup>j</sup>	12963hi	190338 <sup>efg</sup>	2.10 <sup>j</sup>	2.46 <sup>j</sup>
		0.54	0.26	11.37	6.86	25504	25897	0.12	0.36

Means within columns followed by the same letter are not significantly different (P=0.05; LSD).

**Table 5: Combined effects of *Lambda-cyhalothrin*, *Ageratum conyzoides*, *Cassia hirsuta* and *Occimum grattissimum* on yield and yield components in okra.**

Insecticide	Conc. (%)	Number of Pods/Plant	Number of Pods/Plot	Number of Fruits/ha	Fresh fruit yield/ha (t)
<i>Lambda-cyhalothrin</i>	100	6.92 <sup>a</sup>	277.00 <sup>a</sup>	230555 <sup>a</sup>	4.66 <sup>ab</sup>
<i>C. hirsuta</i>	50cold	5.70 <sup>a-d</sup>	228.00 <sup>a-e</sup>	89815 <sup>a-e</sup>	2.70 <sup>lg</sup>
	50hot	5.06 <sup>bcd</sup>	201.50 <sup>b-e</sup>	168521 <sup>b-e</sup>	3.57 <sup>c-l</sup>
	75cold	5.20 <sup>bcd</sup>	246.50 <sup>a-d</sup>	173148 <sup>b-e</sup>	3.10 <sup>d-l</sup>
	75hot	5.72 <sup>a-d</sup>	229.00 <sup>a-e</sup>	190741 <sup>a-e</sup>	3.74 <sup>b-e</sup>
	100cold	7.06 <sup>a</sup>	282.50 <sup>a</sup>	235185 <sup>a</sup>	4.29 <sup>abc</sup>
	100hot	5.64 <sup>a-d</sup>	225.50 <sup>a-e</sup>	187963 <sup>ac</sup>	3.51 <sup>c-l</sup>
	50cold	5.75 <sup>a-d</sup>	230.00 <sup>a-e</sup>	191667 <sup>a-e</sup>	4.22 <sup>abc</sup>
<i>A. conyzoides</i>	50hot	6.42 <sup>ab</sup>	257.00 <sup>ab</sup>	213889 <sup>ab</sup>	4.17 <sup>abc</sup>
	75cold	5.84 <sup>a-d</sup>	233.00 <sup>a-e</sup>	194476 <sup>a-e</sup>	3.91 <sup>abcd</sup>
	75hot	4.28 <sup>d</sup>	171.50 <sup>e</sup>	142593 <sup>e</sup>	2.86 <sup>elg</sup>
	100cold	5.22 <sup>bcd</sup>	209.00 <sup>b-e</sup>	174084 <sup>b-e</sup>	3.89 <sup>abcd</sup>
	100hot	6.33 <sup>ab</sup>	253.00 <sup>abc</sup>	211111 <sup>a-c</sup>	4.810 <sup>a</sup>
	50cold	4.70 <sup>cd</sup>	187.50 <sup>cde</sup>	156482 <sup>cde</sup>	2.99 <sup>delg</sup>
	50hot	5.67 <sup>a-d</sup>	226.33 <sup>a-e</sup>	188889 <sup>a-e</sup>	3.79 <sup>bcde</sup>
<i>O. grattissimum</i>	75cold	5.78 <sup>a-d</sup>	231.00 <sup>a-e</sup>	192592 <sup>a-e</sup>	4.18 <sup>abc</sup>
	75hot	5.97 <sup>abc</sup>	238.50 <sup>a-d</sup>	199074 <sup>a-d</sup>	3.74 <sup>bcde</sup>
	100cold	5.84 <sup>a-d</sup>	233.50 <sup>a-e</sup>	194445 <sup>a-e</sup>	3.91 <sup>abcd</sup>
	100hot	4.91 <sup>bcd</sup>	200.00 <sup>b-e</sup>	166667 <sup>b-e</sup>	3.70 <sup>cde</sup>
	Control	-	4.56 <sup>cd</sup>	182.50 <sup>de</sup>	151651 <sup>de</sup>
LSD (5%)		1.31	54.04	45798	0.79

Means within columns followed by the same letter are not significantly different (P=0.05; LSD).

#### 4. Discussion

The performance of *Lambda-cyhalothrin* a synthetic insecticide over the botanical insecticide is an indication that solvent extraction method might be better than hot and cold method. The performance of *C. hirsuta* in all yield components over *A. conyzoides* might be an indication that *C. hirsuta* encourage the activities of pollinating insects with the resultant more flowers and fruits in addition to pest control. In addition, *C. hirsuta* extracted cold resulted in the best number of fruits per plant and per hectare compared to hot method. With hot method, an increase in the concentration above 75% resulted in reduced number of fruits and total yield.

On the other hand, *A. conyzoides* was opposite to that of *C. hirsuta*. *A. conyzoides* extracted cold gave a result similar to that of hot method in *C. hirsuta*. With *O. grattissimum*, the same trend was noticed with the method of extractions (cold and hot) as the law of diminishing return sets in at 75% concentration. At Ayetoro, the best yield was obtained from the cold method of extraction in all the botanicals at 100% concentration which proved to be better than 75% and 50% concentration, although the curve was sigmoidal in nature.

It was observed that there were fluctuations in the yield performance of the botanicals with the different methods of extraction. The yield obtained in Ayetoro generally surpassed that of Ikorodu. There was an extra

ordinary yield performance in *Lambda-cyhalothrin* and all the botanicals tested at Ayetoro over that in Ikorodu. This marked difference might be due to the continuous use of the site in Ikorodu and the fallowed period enjoyed at Ayetoro. It might also be due to the factors that normally aid the effectiveness of botanicals which include sunlight/ sun intensity, humidity and etcetera. Sunlight intensity in Ayetoro was more than that in Ikorodu.

Hence the botanical would better in Ayetoro. Also reduced humidity was associated with Ayetoro environment while it was the opposite in Ikorodu. It can therefore be concluded that *Ageratum conyzoides*, *Cassia hirsuta* and *Occimum grattissimum* (in order of importance) in this work can be routinely used as an alternative to any of the synthetic pyrethroids in the control of okra flea beetle. The recommended rates are 75% hot and 100% cold extract *Cassia hirsuta*, 50% cold and 100% hot extract of *Ageratum conyzoides* and 50% hot and 75% cold *Occimum grattissimum* when extracted from 1kg leaves in 1litre of water.

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