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National Academy of Agricultural Science (NAAS) Rating : 3. 03

Efficacy of Some Botanicals Against Major Insect Pests of Okra

Esther Zonunpuii and I. T. Asangla Jamir*

Abstract: *Field experiment laid out in Randomized block design (RBD) with three replications and nine treatments at Experimental farm School of Agricultural sciences and Rural Development Medziphema, Nagalandto study the incidence andefficacy of some botanicals against insect pests of okra has revealed that twelve insect pest was recorded during the course of investigation, The highest incidence of aphid was observed on 15th August (33rd std. Week), Jassid 8th August (32nd std. Week), blister beetle 25th July (30th std week) and Shoot and fruit borer 22nd August (34th std. Week) respectively. Efficacy of different treatments revealed that Melia azedarach leaf extract (2%), Neem oil (0. 5%) and Neem oil (0. 4%)was most effective against aphid, Neem oil (0. 5%) and Neem oil (0. 4%) against jassid, Neem oil (0. 5 %) and Melia azedarach leaf extract (2%) against blister beetle and Neem oil (0. 5%)was found to be most effective against shoot and fruit borer followed by Melia azedarach leaf extract (2%). It was also evident that all the plant products was more or less effective in minimising the pest population.*

Key words: *Okra, Pests, Botanicals, Efficacy*

INTRODUCTION

One of the important limiting factors in okra cultivation is insect pests. About 72 species of insects have been recorded on okra (Srinivas Rao and Rajendran, 2003). Apart from synthetic pesticides, botanicals also possess an array of properties and considered an ecologicallyviable proposition to overcome the excessive use of chemicals including insecticidal activity and insect growth regulator activity against insect and mite pests (Prakash and Rao, 1986). Since okra is a fresh vegetable harvested at regular intervals for consumption purpose, it is essential to have safer alternatives (botanicals) for managing the pests which do not leave any pesticidal residue. Thus keeping the importance of proper selection of pesticides and its effectiveness in pest management, the present investigation was carried out

METHODOLOGY

The experiment was conducted at Experimental farm School of Agricultural sciences and Rural Development Medziphema, Nagaland. The experimental field was laid out in Randomized block design (RBD) with three replications and nine treatments. The cultivar F1Kranti was used for carrying out the experiment. Five locally and cheaply available plant products viz. Costus (*Costus speciosus* J. Koenig) rhizome extract, Litsea (*Litsea citrata* Bl Vern) bark extract, Chinaberry (*Melia azedarach* Linn) leaf extract, Ginger (*Zingiber officinale* Linn) rhizome extract and Zanthoxyllum (*Zanthoxyllum oxyphyllum* Edgw) seed coat extract were collected to use as treatments. The plant materials were chopped into thin slices and were shade dried for a week and grinding them into powdered form. The powder thus obtained was extracted with the help of Soxhlet apparatus. Five plants were randomly selected and tagged;the population count of the insect pests was carried out at weekly intervals throughout the cropping period. Observations on the efficacy of certain plant products employed for carrying out the experiment were recorded as pre-treatment and post-treatment count. The different treatments *L. citrata* bark as (T_1)with 20ml/litre water, *C. speciosus* rhizome as (T_2) 20ml/litre water, *M. azedarach* leaf as (T_3) 20ml/litre water, *Z. officinale* rhizome as (T_4) 20ml/litre water, *Z. oxyphyllum* seed coat as (T_5) 20ml/litre water, Neem oil (T_6) with 4ml/ litrewater, Neem oil (T_7) 5ml/ litrewater, Monocrotophos as (T_8)with 1. 5 ml/ litre

* Department of Entomology, SASRD, Nagaland University, Medziphema campus, Medziphema (797106), Nagaland, India, *E-mail: itasanglajamir@yahoo. in*

water and control as (T_9) respectively was used as treatments. The efficacies of the treatments were recorded by counting the population before and after the treatments.

The data collected were subjected to the square root transformation.

$$\sqrt{X} + 0.5$$

The transformed values were subjected to analysis of variance (ANOVA) by Randomised Block Design (RBD). 'F' test was used to determine the significance and non-significance of the variance due to different treatments at 0. 05% level of significance. The different treatments was compared by using Duncan's MultipleRange Test (DMRT).

RESULTS AND DISCUSSION

Pest complex observed during the cropping season

Twelve insect pests were recorded during the period of investigation as presented (Table 1). They were Aphid *A. gossypii*, jassid *A. biguttula biguttula* Ishida, flea beetle *Podagrica spp*, blister beetle *M. pustulata*, shoot and fruit borer *E. vittella*, whitefly *B. tabaci*, red cotton bug *D. koenigii*, grasshopper *O. japonica*, green semi looper *A. flava*, leaf roller *S. derogata*, green plant bug *N. viridula*, and grey weevil *M. undecimpustulatas*. The present findings are in conformity with the findings of Dhamdhere *et al.* (1984) who reported twelve insect pests which attacked okra at different crop stages. Kushwaha (1983), Dadheech *et al.* (1977) and Sangha and Mavi (1995) also reported that jassids, shoot and fruit borer, aphids, leafroller, red cotton bug and whitefly attacked okra throughout the cropping period.

Incidence of major insect pests of okra and its correlation with abiotic factors

Incidence of aphid, A. gossypiiand its correlation with abiotic factors

The incidence of aphid, *A. gossypii* was observed from 18th July (29th std. week) with 1. 07 aphids per leaf (Table 2). There was an increasing trend in the population built up of the pest reaching a peak on 15th August (33rd std. week) with 4. 00 aphids per leaf. The present findings is in confirmation with the findings of Purohit *et al.* (2006) who observed that incidence of aphids started from first fortnight of July. Similar finding was reported by Abou and Ethagag (1998) that maximum level of abundance was observed during second fortnight of August. Aphid population showed a non significant correlation with all abiotic factors like temperature, rainfall and relative humidity (Table 3). Thefinding is in confirmation with the findings of Tariq *et al.* (1990) who reported that population dynamics of aphids were not affected significantly by maximum or minimum temperature, relative humidity and rainfall.

Incidence of Jassid, A. biguttula biguttulaand its correlation with abiotic factors

The peak incidence was observed on 1st August (31st std. week) with 3. 67 jassids per leaf (Table 2). The jassids per leaf was declined (1. 67)at the last cropping stage. A similar finding was reported by Sharma and Sharma (1997) indicated the incidence of jassid on first week of July and reached the highest population densityon first week of August. Correlation of jassid with weather parameters revealed that there was a negative non significant correlation with minimum temperature and relative humidity whereas maximum temperature and rainfall showed a positive non significant correlation (Table 3). The present findings is in conformity with the findings of Mahmood *et al.* (1990) and Jamshaid *et al.* (2010) who reported that the activity of jassid was observed in the field till the end of the cropping period and neither rainfall nor relative humidity had significant influence on jassid population.

Incidence of blister beetle, M. pustulata and its correlation with abiotic factors

The incidence of blister beetle, *M. pustulata* was observed from 25th July (30th std. week) starting from flowering stage (Table 2). There was a gradual increase in their population and attained a peak on 22nd August (34th std. week) with 4. 60 beetles per plant and was observed feeding on the flowers and fruits causing heavy defoliation. The present finding is in line with Patil *et al.* (1980), Sangha and Mavi (1995) reported activities of blister beetle during July to November feeding on okra crop. Weather parameters revealed a significant negative correlation with relative humidity and non significant positive correlation with maximum temperature and rainfall (Table 3) which is in line with the findings of Narendra *et al.* (2001) who reported that blister beetle showed a significant negative correlation with relative humidity.

Incidence of shoot and fruit borer, E. vittella and its correlation with abiotic factors

The incidence of shoot and fruit borer, *E. vittella*was observed (0. 20 larvae per plant) on 18th July (29th std.

Table 1
Insect pests complex in okra wet season crop (June – September, 2011)

Sl. No.	*Crop stage*	*Duration*	*Pests recorded*	*Scientific Name*	*Damaging stage of pests*	*Damaged plant parts*
1.	Vegetative stage	1-30 days after sowing	Aphids	*Aphis gossypii* Glover	Nymph and adult	Leaf and stem
			Jassids	*Amrasca biguttula biguttula* Ishida	Nymph and adult	Leaf
			Whitefly	*Bemisia tabaci* Genn.	Nymph and adult	Leaf
			Flea beetle	*Podagrica* sp	Adult	Leaf and stem
			Grasshopper	*Oxya japonica* Fab.	Adult	Leaf
			Green semi looper	*Anomis flava* Fab.	Larva	Leaf
			Leaf roller	*Sylepta derogata* Fab.	Larva	Leaf
			Grey weevil	*Myllocerus undecimpustulatas* Fab.	Adult	Leaf
			Green plant bug	*Nezara viridula* (Linn)	Adult	Leaf
2.	Flowering stage	31-44 days after sowing	Blister beetle	*Mylabris pustulata* Thunb.	Adult	Flower
			Aphids	*Aphis gossypii* Glover	Nymph and adult	Leaf and stem
			Jassids	*Amrasca biguttula biguttula* Ishida	Nymph and adult	Leaf
			Whitefly	*Bemisia tabaci* Genn.	Nymph and adult	Leaf
			Flea beetle	*Podagrica* sp	Adult	Leaf and stem
			Red cotton bug	*Dysdercus koenigii* Fab.	Adult	Leaf
			Grasshopper	*Oxya japonica* Fab	Larva	Leaf
			Leaf roller	*Sylepta derogata* Fab.	Larva	Leaf
			Green plant bug	*Nezara viridula* (Linn)	Adult	Leaf
			Grey weevil	*Myllocerus undecimpustulatas* Fab.	Adult	Leaf
			Shoot and fruit borer	*Earias vittella* Fab.	Larva	Flower bud
3.	Harvesting stage	45 – 90 days after sowing.	Blister beetle	*Mylabris pustulata* Thunb.	Adult	Flower and fruit
			Aphids	*Aphis gossypii* Glover	Nymph and adult	Leaf
			Jassids	*Amrasca biguttula biguttula* Ishida	Nymph and adult	Leaf
			Whitefly	*Bemisia tabaci* Genn.	Nymph and adult	Leaf
			Flea beetle	*Podagrica* sp	Adult	Leaf and stem
			Red cottonbug	*Dysdercus koenigii* Fab.	Adult	Leaf and fruit

Table 2
Incidence of major insect pests of okra during July- September, 2011

	Temperature(°C)				** Number per leaf*		*Number per plant*	
Standard Weeks	*Maximum*	*Minimum*	*Relative humidity (%)*	*Rainfall (mm)*	*Aphis gossypii*	*Amrasca biguttula biguttula*	*Mylabris pustulata*	*Earias vittella*
29	32.40	24.80	88.50	3.60	1.07	1.30	0.00	0.20
30	34.00	24.00	88.00	16.20	2.87	1.53	0.80	0.20
31	34.00	25.00	87.50	7.21	2.67	3.67	1.80	0.36
32	33.00	23.20	87.20	18.00	2.93	3.40	2.60	0.50
33	33.50	23.80	82.50	12.30	4.00	3.23	4.06	0.64
34	32.70	23.20	81.50	19.70	2.80	3.27	4.60	0.66
35	34.50	24.80	77.50	2.90	1.40	2.87	3.66	0.53
36	33.40	23.50	82.50	8.70	0.73	1.77	2.53	0.40
37	32.60	23.60	83.50	10.80	0.53	1.67	1.40	0.33

Note: *Mean value of five plants

Table 3
Correlation coefficient (r) of pests population with weather parameters

Weather parameters	*A. gossypii*	*A. biguttula biguttula*	*M. pustulata*	*E. vittella*
Maximum Temperature (°C)	0.243^{NS}	0.290^{NS}	0.202^{NS}	0.070^{NS}
Minimum Temperature (°C)	-0.162^{NS}	-0.052^{NS}	-0.394^{NS}	-0.415^{NS}
Relative humidity (%)	0.163^{NS}	-0.225^{NS}	-0.752*	-0.669*
Rainfall (mm)	0.565^{NS}	0.268^{NS}	0.324^{NS}	0.340^{NS}

Note: *Significant at 5% level of significance.

Table 4
Efficacy of certain plant products on the population of aphid, *Aphis gossypii*

Treatments	Concentration (%)	Number of aphid per leaf 1st Spray				2nd Spray				3rd Spray				
		1 DBS	1 DAS	3 DAS	7 DAS	1 DBS	1 DAS	3 DAS	7 DAS	1 DBS	1 DAS	3 DAS	7 DAS	Mean
L. citrata bark	2	3.06^{e}	2.60^{de}	2.53^{d}	2.26^{d}	2.53^{c}	2.26^{c}	2.33^{c}	2.46^{c}	0.73^{bc}	0.40^{b}	0.53^{c}	0.26^{b}	***2.05***
		(1.89)	(1.76)	(1.72)	(1.66)	(1.72)	(1.66)	(1.68)	(1.72)	(1.10)	(0.95)	(1.01)	(0.87)	
C. speciosus rhizome	2	3.00^{e}	2.73^{d}	2.60^{d}	2.73^{c}	3.20^{a}	2.73^{b}	2.86^{b}	2.93^{b}	1.53^{a}	1.33^{a}	1.73^{a}	1.26^{a}	***2.32***
		(1.87)	(1.79)	(1.76)	(1.79)	(1.92)	(1.78)	(1.83)	(1.85)	(1.41)	(1.35)	(1.48)	(1.32)	
M. azedarach leaf	2	3.80^{c}	2.46^{e}	1.53^{f}	0.93^{f}	1.40^{f}	0.73^{e}	0.40^{f}	0.20^{f}	0.40^{cd}	0.20^{bc}	0.13^{de}	0.06^{c}	***0.74***
		(2.07)	(1.66)	(1.42)	(1.19)	(1.37)	(1.10)	(0.95)	(0.84)	(0.95)	(0.83)	(0.79)	(0.75)	
Z. officinale rhizome	2	3.66^{c}	3.33^{b}	3.53^{b}	3.40^{b}	1.20^{g}	0.80^{e}	0.73^{e}	0.73^{e}	0.40^{cd}	0.20^{bc}	0.20^{de}	0.20^{bc}	***1.46***
		(2.04)	(1.96)	(2.01)	(1.97)	(1.30)	(1.14)	(1.10)	(1.10)	(0.95)	(0.83)	(0.83)	(0.83)	
Z. oxyphyllum	2	3.46^{d}	3.00^{c}	3.20^{c}	3.26^{b}	1.86^{e}	1.26^{d}	1.53^{d}	1.53^{d}	0.60^{c}	0.26^{bc}	0.13^{de}	0.06^{c}	***1.58***
seed coat		(1.99)	(1.87)	(1.92)	(1.94)	(1.52)	(1.32)	(1.42)	(1.42)	(1.05)	(0.87)	(0.79)	(0.75)	
Neem oil	0.4	4.73^{b}	2.60^{de}	2.20^{e}	1.33^{e}	2.22^{d}	0.93^{e}	0.13^{h}	0.06^{g}	0.46^{cd}	0.06^{c}	0.26^{d}	0.00^{c}	***0.84***
		(2.28)	(1.76)	(1.64)	(1.35)	(1.64)	(1.19)	(0.79)	(0.75)	(0.97)	(0.75)	(0.87)	(0.70)	
Neem oil	0.5	5.20^{a}	3.06^{c}	2.13^{e}	1.00^{f}	2.22^{d}	0.86^{e}	0.20^{gh}	0.13^{fg}	0.33^{d}	0.00^{c}	0.06^{de}	0.00^{c}	***0.83***
		(2.39)	(1.89)	(1.62)	(1.22)	(1.64)	(1.16)	(0.83)	(0.79)	(0.90)	(0.70)	(0.75)	(0.70)	
Monocrotophos	0.05	3.66^{c}	0.20^{f}	0.60^{g}	0.13^{g}	2.00^{e}	0.33^{f}	0.26^{g}	0.00^{g}	0.86^{b}	0.13^{c}	0.00^{e}	0.00^{c}	***0.18***
		(2.04)	(0.83)	(1.05)	(0.79)	(1.58)	(0.90)	(0.75)	(0.70)	(1.16)	(0.79)	(0.70)	(0.70)	
Control	-	4.66^{b}	4.16^{a}	4.46^{a}	5.13^{a}	3.00^{b}	3.13^{a}	3.33^{a}	3.66^{a}	1.66^{a}	1.40^{a}	1.26^{b}	1.40^{a}	***3.10***
		(2.27)	(2.16)	(2.22)	(2.37)	(1.87)	(1.90)	(1.96)	(2.04)	(1.47)	(1.37)	(1.32)	(1.37)	
SEm ±		0.05	0.06	0.07	0.05	0.06	0.07	0.04	0.04	0.07	0.07	0.07	0.06	-
CD (p=0.05)		0.15	0.18	0.21	0.15	0.18	0.21	0.12	0.12	0.21	0.21	0.21	0.18	-

Note: Figures in the columns are mean values and those in parenthesis are square root transformed values.
DBS = Day before spraying. DAS = Days after spraying.
Same small letter(s) in a column after mean values indicates non-significant different from each other at 5% level of significance.

Table 5
Efficacy of certain plants products on the population of Jassid, *Amrasca biguttula biguttula*

Treatments	*Concentration (%)*	*Number of jassid per leaf*												
		1st Spray				*2nd Spray*				*3rd Spray*				
		1 DBS	*1 DAS*	*3 DAS*	*7 DAS*	*1 DBS*	*1 DAS*	*3 DAS*	*7 DAS*	*1 DBS*	*1 DAS*	*3 DAS*	*7 DAS*	*Mean*
L. citrata bark	2	2.80^{de} (1.80)	2.26^{d} (1.66)	1.26^{f} (1.33)	1.86^{e} (1.54)	3.66^{a} (2.04)	3.13^{a} (1.90)	2.13^{d} (1.62)	2.06^{e} (1.60)	3.67^{c} (2.12)	2.73^{b} (1.80)	1.80^{d} (1.51)	3.13^{a} (1.90)	***2.34***
C. speciosus rhizome	2	3.93^{b} (2.10)	3.40^{b} (1.99)	2.40^{d} (1.67)	3.33^{b} (1.95)	2.66^{cd} (1.78)	2.26^{b} (1.66)	3.06^{b} (1.88)	2.53^{c} (1.74)	3.33^{d} (1.95)	2.86^{ab} (1.83)	2.80^{a} (1.81)	2.46^{b} (1.72)	***2.79***
M. azedarach leaf	2	2.66^{e} (1.78)	1.80^{e} (1.51)	1.80^{e} (1.51)	2.00^{e} (1.58)	2.27^{e} (1.66)	1.73^{c} (1.49)	2.06^{d} (1.59)	2.33^{d} (1.68)	3.00^{e} (1.87)	1.93^{d} (1.56)	1.73^{d} (1.49)	1.46^{e} (1.40)	***1.87***
Z. officinale rhizome	2	1.46^{f} (1.40)	2.26^{d} (1.66)	3.06^{b} (1.88)	3.13^{c} (1.90)	2.33^{e} (1.68)	1.86^{c} (1.54)	1.73^{e} (1.48)	2.46^{cd} (1.72)	1.80^{g} (1.51)	2.26^{c} (1.66)	2.46^{b} (1.72)	1.86^{c} (1.54)	***2.34***
Z. oxyphyllum seed coat	2	3.46^{c} (1.98)	2.73^{c} (1.80)	2.73^{c} (1.80)	2.46^{d} (1.72)	2.53^{d} (1.74)	2.20^{b} (1.64)	2.53^{c} (1.73)	2.73^{b} (1.80)	4.53^{a} (2.24)	3.00^{a} (1.87)	1.46^{e} (1.40)	2.60^{b} (1.76)	***2.49***
Neem oil	0.4	4.53^{a} (2.24)	2.80^{c} (1.81)	2.06^{e} (1.60)	1.40^{f} (1.38)	1.53^{f} (1.42)	1.46^{d} (1.40)	1.13^{f} (1.27)	1.00^{f} (1.22)	2.73^{f} (1.80)	2.13^{cd} (1.62)	2.06^{c} (1.59)	1.66^{d} (1.47)	***1.75***
Neem oil	0.5	3.06^{d} (1.88)	2.06^{d} (1.60)	1.46^{f} (1.40)	1.00^{g} (1.22)	3.66^{a} (2.04)	2.26^{b} (1.66)	1.33^{f} (1.35)	0.80^{g} (1.14)	3.86^{b} (2.09)	1.93^{d} (1.56)	2.93^{a} (1.85)	1.80^{cd} (1.51)	***1.73***
Monocrotophos	0.05	4.33^{a} (2.20)	1.20^{f} (1.30)	0.86^{g} (1.17)	0.26^{h} (0.87)	2.80^{c} (1.81)	0.33^{e} (0.91)	0.06^{g} (0.75)	0.13^{h} (0.79)	3.13^{e} (1.90)	1.33^{e} (1.35)	0.93^{f} (1.19)	0.33^{f} (0.91)	***0.60***
Control	-	3.36^{c} (2.02)	4.00^{a} (2.12)	3.53^{a} (2.00)	4.06^{a} (2.14)	3.26^{b} (1.94)	3.06^{a} (1.88)	3.33^{a} (1.95)	3.60^{a} (2.02)	3.67^{c} (2.12)	3.00^{a} (1.87)	3.00^{a} (1.87)	3.26^{a} (1.94)	***3.48***
SEm ±		0.09	0.08	0.10	0.05	0.06	0.07	0.08	0.06	0.06	0.07	0.07	0.06	-
CD (p=0.05)		0.27	0.24	0.30	0.15	0.18	0.21	0.24	0.18	0.18	0.21	0.21	0.18	-

Note: Figures in the columns are mean values and those in parenthesis are square root transformed values.
DBS = Day before spraying. DAS = Days after spraying.
Same small letter(s) in a column after mean values indicates non-significant different from each other at 5% level of significance.

week) and the same trend was observed on 25th July (30th std. week) (Table 2). There was a slight increase in their population as the fruits reached maturity, attaining maximum number on 22nd August (34th std. week) with 0. 66 larvae per plant and declined with 0. 33 larvae per plant at the last cropping stage (37th std. week). This may be due to the sowing time as well as the role of abiotic factors that affect the population built up of the pest. Kumar and Urs (1998) reported that *E. vittella* is a serious pest of okra and cause heavy infestation depending on the season. The shoot and fruit borer population showed a negative significant correlation with relative humidity and negative non significant correlation with minimum temperature (Table 3). A non significant positive correlation was observed with maximum temperature and rainfallwhich is inconformity with the findings of Sharma *et al.* (2010) who reported that *E. vittella* population was negatively correlated with relative humidity but not significantly and negatively correlated with rainfall.

Efficacy of certain plant products against insect pests of okra

The efficacy of these plant materials was compared with monocrotophos,

(a) ***Efficacy of certain plant products on the population of aphid, Aphis gossypii:*** It is evident that all the treatments had significantly reduced the aphid population in all the three spray schedules as compared to control (Table 4). Among the plant products lowest aphid population was recorded in *Melia azedarach* leaf extract (2%) (2. 46, 1. 53 and 0. 93) first spray and (0. 73, 0. 40 and 0. 20) in second spray respectively. However, during the third spray Neem oil (0. 4 and 0. 5%) proved to be the most superior in reducing aphid population. In the mean data *Melia azedarach* leaf extract (2%) proved to be significantly superior in controlling aphid(0. 74 no. per leaf). Similar finding was reported byChandel *et al.* (1995) that crude extract of *Melia azedarach* leaf showed most potent antifeedant activity against sap sucking pest. Raja *et al.* (1998) also stated that Neem oil decreased the pest damage in okra as compared to control.

(b) ***Efficacy of certain plant products on the population of jassid, Amrasca biguttula biguttula:*** It is evident (Table 5)that among the plant products, Neem oil proved to be significantly superior in controlling jassid population. The mean data of the three sprays imposed on okra targeting jassids indicated that Neem oil 0. 5% proved to be the most effective in reducing jassid population (1.73no. per leaf). It was followed by Neem oil 0. 4 % (1. 75 no. per leaf), *Melia azeddarach* leaf extract (2%) (1. 87 no. per leaf), and Z. Oxyphyllum sead coat (2%) giving the least (2. 49 no. per leaf). But all the treatments were superior to Control. A similar finding was reported by Tariq Niaz (2011) and Mandal *et al.* (2007) who reported that Neem oil@ 0. 5% and in combination with soil application of neem cake was effective against jassid in okra.

(c) ***Efficacy of certain plant products on the population of blister beetle, Mylabris pustulata:*** Neem oil 0. 5% harboured minimumblister beetle population (Table 6)in all the three spray schedules (1. 57 no. per leaf) followed by *Melia azedarach* leaf extract (2%) (1. 66 no. per leaf). Lowest (2. 35 no. per leaf) efficacy was indicated in*Litsea citrata* bark extract (2%). Berenguer (2005) andDodia *et al.* (2008)also reported similar finding. Similar finding on the efficacy of *Melia azedarach* leaf extract (2%) was reported by Chandel *et al*. (1995) who stated that crude extract of *Melia Azedarach* showed most potent antifeedant activity against beetles.

(d) ***Efficacy of certain plant products on the population of shoot and fruit borer, Earias vittella:*** The mean data of the three spray schedules revealed that among the plant products; Neem oil (0.5%) was the most effective (0.20 no. of fruit and shoot borer) followed by *Melia azedarach* leaf extract (2%) (0.23 no. of fruit and shoot borer) and neem oil (0. 4%) (0.26 no. of fruit and shoot borer). However, *Z. oxyphyllum* seed coat extract (2%) had reduced larval population only during second and third spray and was inferior as compared to other treatments(0. 40 no. of fruit and shoot borer). However all the treatments were effectiveas compared to control and they were mostly at par with one another. Rosaiah (2001) andThara and Kingsly (2001) reported that spraying of neem oil 0. 5% was significantly superior in reducing shoot and fruit borer population on okra.

The standard check, monocrotophos (0. 05%) was found to be superior over the plant products in controlling all the pests. In case of Aphid it is in conformity with Kulkarni and Mote (1996). Thakur and Singh (1999) reported the effectiveness of monocrotophos 0.04% to check jassid population. Chandel and Sood (1996) and Prasad and Dimri (1998) reported that monocrotophos 0. 05% gave good result in controlling blister beetle population. Yadhav and Nawale (1980) reported that application of monocrotophos (0.05%) starting from, flowering stage is effective in controlling *E. vittella.*

Table 6
Efficacy of certain plant products on the population of blister beetle, *Mylabris pustulata*

Treatments	*Concentration (%)*	*Number of blister beetle per plant*						
		1 Spray		*2 Spray*		*3 Spray*		
		1 DBS	*5 DAS*	*1 DBS*	*5 DAS*	*1 DBS*	*5 DAS*	*Mean*
L. citrata bark	2	0.80[d] (1.14)	0.73[c] (1.11)	4.13[b] (1.83)	3.66[b] (2.04)	3.13[b] (1.90)	2.66[b] (1.77)	***2.35***
C. speciosus rhizome	2	1.20[c] (1.30)	0.60[cd] (1.04)	3.66[c] (2.04)	3.26[c] (1.94)	2.33[d] (1.68)	1.87[de] (1.54)	***1.91***
M. azedarach leaf	2	1.20[c] (1.30)	0.66[cd] (1.08)	2.93[e] (1.85)	2.80[d] (1.81)	2.60[c] (1.76)	1.53[f] (1.41)	***1.66***
Z. officinale rhizome	2	1.33[c] (1.35)	1.20[b] (1.30)	3.20[d] (1.92)	2.73[d] (1.80)	2.67[c] (1.78)	2.53[b] (1.74)	***2.15***
Z. oxyphyllum seed coat	2	1.60[bc] (1.44)	1.26[b] (1.32)	3.06[de] (1.89)	2.80[d] (1.82)	2.40[d] (1.85)	2.26[c] (1.66)	***2.11***
Neem oil	0.4	1.20[c] (1.30)	0.53[cd] (1.01)	4.73[a] (2.29)	2.86[d] (1.84)	2.53[cd] (1.74)	2.00[d] (1.58)	***1.80***
Neem oil	0.5	1.13[c] (1.27)	0.46[d] (0.98)	3.00[de] (1.87)	2.53[e] (1.74)	2.26[d] (1.66)	1.73[ef] (1.49)	***1.57***
Monocrotophos	0.05	2.00[a] (1.58)	0.33[d] (0.91)	3.53[c] (2.00)	1.26[f] (1.35)	1.13[e] (1.27)	1.00[g] (1.22)	***0.86***
Control	-	1.73[ab] (1.49)	2.00[a] (1.58)	4.06[b] (2.14)	4.60[a] (2.26)	3.66[a] (2.04)	3.13[a] (1.90)	***3.24***
SEm ±		0.09	0.07	0.07	0.06	0.05	0.07	-
CD (p=0.05)		NS	0.21	0.21	0.18	0.15	0.21	-

Note: Figures in the columns are mean values and those in parenthesis are square root transformed values.
DBS = Day before spraying. DAS = Days after spraying.
NS= Non-significant at 5% level of significance.
Same small letter(s) in a column after mean values indicates non-significant different from each other at 5% level of significance.

Table 7
Efficacy of certain plant products on the population of shoot and fruit borer, *Earias vittella*

Treatments	*Concentration(%)*	*Number of shoot and fruit borerper plant*						
		1 Spray		*2 Spray*		*3 Spray*		
		1 DBS	*7 DAS*	*1 DBS*	*7 DAS*	*1 DBS*	*7 DAS*	*Mean*
L. citrata bark	2	0.33[c] (0.91)	0.27[b] (0.88)	0.33[cd] (0.91)	0.27[c] (0.88)	0.23[c] (0.84)	0.20[c] (0.83)	***0.25***
C. speciosus rhizome	2	0.27[c] (0.88)	0.33[b] (0.91)	0.42[bcd] (1.04)	0.40[bc] (0.95)	0.30[bc] (0.89)	0.27[bc] (0.88)	***0.33***
M. azedarach leaf	2	0.33[c] (0.91)	0.20[b] (0.83)	0.32[d] (0.89)	0.30[bc] (0.89)	0.27[c] (0.88)	0.20[c] (0.83)	***0.23***
Z. officinale rhizome	2	0.40[bc] (0.95)	0.33[b] (0.91)	0.46[bc] (0.98)	0.36[bc] (0.93)	0.30[bc] (0.89)	0.30[b] (0.89)	***0.33***
Z. oxyphyllum seed coat	2	0.27[c] (0.88)	0.46[a] (0.98)	0.53[ab] (1.02)	0.42[b] (0.96)	0.40[b] (0.95)	0.33[ab] (0.91)	***0.40***
Neem oil	0.4	0.40[bc] (0.95)	0.27[b] (0.88)	0.43[bcd] (0.97)	0.30[bc] (0.89)	0.26[c] (0.85)	0.20[c] (0.83)	***0.26***
Neem oil	0.5	0.53[ab] (1.02)	0.22[b] (0.84)	0.35[cd] (0.98)	0.26[c] (0.87)	0.23[c] (0.86)	0.13[cd] (0.80)	***0.20***
Monocrotophos	0.05	0.60[a] (1.01)	0.13[c] (0.80)	0.33[cd] (0.91)	0.13[d] (0.80)	0.20[c] (0.83)	0.07[d] (0.75)	***0.11***
Control	-	0.40[bc] (0.95)	0.50[a] (1.05)	0.64[a] (1.11)	0.66[a] (1.08)	0.53[a] (1.02)	0.40[a] (0.95)	***0.52***
SEm ±		0.05	0.04	0.04	0.04	0.04	0.03	-
CD (p=0.05)		NS	0.12	NS	0.12	NS	0.09	-

Note: Figures in the columns are mean values and those in parenthesis are square root transformed values.
DBS = Day before spraying. DAS = Days after spraying.
NS= Non-significant at 5% level of significance.
Same small letter(s) in a column after mean values indicates non-significant different from each other at 5% level of significance.

CONCLUSION

Costus speciosus, Litsea*citrata*, Chinaberry, Ginger and Zanthoxyllum *oxyphyllum* has immense bio-pesticidal properties against insect pests which can be harnessed with further research and investigation.

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