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Integrated Pest Management of Insect Pest Population through Different Technique Strategies in Okra Agro Eco-System

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Abstract
Studies on suppression of insect pest population through different technique strategies in okra eco-system" was evaluated at experimental area of Sindh Agriculture University Tandojam during the kharif season of 2013.
The results were revealed the in the case of IPM set-I. The seasonal population of insect pests total mean thrip (0.14 ± 0.03/leaf), jassid (1.10±0.24/leaf), whitefly (2.38±0.38/leaf), aphid (0.15 ±0.01/leaf) and spotted bollworm (0.57±0.04/plant) was recorded under the conditions of set I on okra crop. However, beneficial insects spider (3.19±0.07/plant), seven spotted beetle (0.31±0.07/plant), eleven spotted beetle (0.03±0.01/plant) and zigzag beetle (0.56±0.01/plant) was recorded on okra crop in the set I strategy. The results further indicated that in case of IPM set-II the insect pests and beneficial insects were recorded. Total mean population of thrips (2.27±0.32/leaf), Jassid (1.33±0.26/leaf), Whitefly (3.58± 0.63/leaf), aphid (2.59± 0.41/leaf) and spotted bollworm (1.45± 0.25/plant) was recorded in under the case of IPM set II on okra crop. However, the beneficial insect population such as, spider (3.84±0.68/plant), seven spotted beetle (0.72±0.14/plant), eleven spotted beetle (0.26±0.07/plant) and zigzag beetle (0.93±0.19) was recorded in set II. However, the results depicted, under IPM practices Set-III (untreated or control) the insect pests and benifical insects was recorded. The population of sucking insect pest thrip (5.13±0.30/leaf), jassid (4.57± 0.20/leaf), whitefly (17.79± 0.78/leaf), aphid (1.8o± 0.05) and (2.48± 0.07/plant) was recorded in under the case of IPM set III. However, the benifical insect population such as, seven spotted beetle (2.89± 0.03/plant), eleven spotted beetle (1.18± 0.04/plant), zig zag beetle (0.68± 0.03/plant) was also recorded in under the case of IPM set III. The results showed that IPM Set-I found superior in relation to IPM set-II, as compared IPM set III on okra eco-system. However, in set I okra trap with maize crop, release of natural enemies and spray of neem leaf extract with neem oil product caused greater reduction of insect pests as compared IPM set II, okra trapped with sunflower, marigold, and spray of only neem leaf extract. While the population of beneficial insects was more in IPM set III on okra crop due to more population of insect pests.
Keywords: Okra, Intercropping, Insects pests, Predators, Neem.

INTRODUCTION

Okra, (*Abelmoschus esculentus* L) most common and widely grown vegetables all over Pakistan (Javed *et al.*, 2009). The total area under okra in Pakistan is about 14.465 thousand hectares with total production of 109.239 thousand tones (Anonymous, 2006). It is attacked by a number of phytophagous insects, diseases and mites during different growth stages (Kumar *et al*., 2002; Gulati, 2004) but the spotted bollworms (*Earias vittella* Fab. and *Earias insulana* Boisd.) are the most important ones (Aziz *et al.,* 2011). *Earias* spp. attacks rigorously on okra both at the vegetative and fruiting stages, resulting in a serious decline in terms of quality and quantity of the produce. Due to high reproductive as well as damage potential and internal feeding habits of spotted bollworms, their management on okra has become increasingly difficult. Farmers heavily rely on the use of synthetic insecticides for the control of this pest. As vegetables like okra are consumed fresh in Pakistan use of highly toxic substances on okra is not desirable (Memon *et al*.,2002). There is a need to explore alternatives, encompassing available pest control methods and techniques in order to reduce the sole dependence to insecticides. For this purpose, integrated pest management seems to be the most appropriate approach to achieve sustainability in okra production. Trap crops have been evaluated for some time as a tactic to reduce the population of insect pests in field crops (McPherson and Newsom, 1984; Todd and Schumann,1988), and in a variety of other crops (Hokkanen, 1991; Javaid and Joshi, 1995; Ludwig and Kok, 1998; Rea *et al.,* 2002). In brief, a series of preferred host plants attract and concentrate insect pests and their natural enemies into the trap crop instead of the cash crop, enable population suppression by mechanical removal or other means in smaller plots, and thereby reduce the damage in the cash crop. Besides soybeans, many other plant species have also been tested as trap crops (Hokkanen, 1991; Javaid and Joshi, 1995). Mixed cropping which is widely practised in the humid tropics has been shown to be more efficient than sole cropping (Adelana, 1984). One of this is the possibility of reducing the incidence of pest and diseases and the significance of their damage (Southwood and Way, 1970). *Trichogramma* spp. is more or less universal parasites of eggs of the Lepidoptera and is recommended as an important component of IPM programme of okra against *Earias* spp. (Anonymous, 2001). *Azadirachta indica* (Neem) and their products are considered as effective botanical pesticides due to controlling wide variety of insect pest (Roopa, 2003). (Tebkew *et al.* 2002) reported that crude neem extracts prepared from

neem seeds collected from field has significantly reduced the population percentage insects; similarly pod damage on treated okra plot was lower than untreated plots (Gossa, 2007). Similarly, destruction of infested fruits and shoots as well as hoeing/ hand weeding as mechanical control operations occupy an important place in the IPM of okra (Anonymous, 2001). To ultimate objective of the integrated control approach is to get the maximum return at a minimum costs without disturbing the okra ecosystem (Ahmed, 1991). Keeping the above facts in view an experiment is carried out to determine the integrated management strategies of insect pests in okra ecosystem.

MATERIALS AND METHODS

Investigation on "suppression of insect pests population through different technique strategies in okra eco-system" was evaluated at experimental area of Sindh Agriculture University Tandojam during the kharif season of 2013. The sabz pari variety of okra were drilled in row 45 cm apart on well prepared seed bed. The sowing was done by using single coulter hand driven drill in three plots (i.e. IPM set –I , IPM set II and a Non-IPM set-III (control). The data of each IPM set was compared with non-IPM plot. The experimental area was 45x45 meter divided into three sets each set consist of 15x15 meter. The sowing of seed was made on 2nd week of March, 2013 and all agronomic practices were done. According to the recommendation dose of fertilizers was also applied uniquely in all sets. In the Set-I following techniques were used. The okra crop was trapped in the maize, release of natural enemies such as, *Chrysoperla carnea* and Trichogramma was made and spray of neem leaf extract with neem oil. In the Set-II following techniques were used. Okra crop was trapped with sunflower, marigold and spray of biopesticides such as only neem leaf extract. In the Set-III this set was kept as control plot however; no control operation was done for suppressions insects during cropping season.

Extraction of neem oil and leaf extract.

Neem seeds were dried in sunshine for ten days and the oil was extracted by using the conventional oil extraction method from local market and the extracted oil was allowed to stand undisturbed for two days, then the upper layer of the oil was skimmed and the pure neem oil was preserved for the trials. The fresh leaves were collected and washed with water to remove the dust and other contaminants in the laboratory and were kept in a muslin cloth for 10 minutes to drain water. These leaves were grinded in the electrical grinder with 01 ml. of water to make the paste which was again kept for one hour, after that the water was added to this paste to make the solution and passed through muslin cloth, the pure leaf extract was stored in the glass vials sealed by air tight lid. The observations on insect pests and beneficial insects 80 plants from each set was selected randomly and tagged, for sucking pest three leaves (each one from top, middle and bottom portion) and spotted bollworm and beneficial insects whole plant were examined carefully and averaged per plant. However, the observation and spray of biopesticide in set I and II were made weekly after 35-45 days of sowing till the end of the season. The data thus collected were subjected to statistical analysis of variance and LSD test was applied after Gomez and Gomez (1984). For the purpose a Microsoft Computer Package "MSTATC" was used.

RESULTS

The results of management strategies of insect pests and their impact on beneficial arthropods are presented below:

Data in Table show the activities of insect pests and beneficial arthropods in IPM set-I, respectively. The results in Table-1 showed that the population of thrip was appeared on 18th April which increased gradually and reaches to its peak (0.37/leaf) on 16th May than it declined. The overall population was low due to application of botanical product. The average population of thrip was (0.14±0.03/leaf) on okra. It was observed that jassid appeared during 20th April on okra crop. The population density increased thereafter and its abundance (2.90/leaf) was observed on 6th June on okra. The over all mean population (1.10±0.24/leaf) of jassid was observed okra crop. The results indicated that whitefly appeared in the 1st week of germination and gradually reached to its peak (5.00/leaf) on 13th June then it declined. The over all mean population (2.03± 0.38/leaf) of whitefly was recorded on okra. It may be seen from the data that aphid appeared on 16th May on okra. The population of aphid increases gradually and peaked (0.55/leaf) on 23rd May on okra. The over all mean population (0.15±0.01/leaf) of aphid was recorded on okra. The data indicated that spotted bollworm started feeding to okra crop on 9th May. The peak population (1.50/plant) of spotted bollworm on okra was observed on 20th June then declined. The over all mean population (0.57±0.04/plant) of spotted bollworm was recorded on okra.

Table-1 Mean population of insect pests and beneficial insect recorded on okra crop under IPM practices Set-I during 2013.

Observation Dates	Sucking Insect Pests					Beneficial Insects (Predators)			
	Thrip	Jassid	Whitefly	Aphid	Spotted bollworm	Spider	Seven spotted beetle	Eleven spotted beetle	Zigzag beetle
04-04-2013	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
11-04-2013	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00
18-04-2013	0.30	0.00	0.20	0.00	0.00	0.56	0.00	0.00	0.00
25-04-2013	0.35	0.20	1.73	0.00	0.00	0.75	0.00	0.00	0.00
02-05-2013	0.34	0.50	1.95	0.00	0.00	1.35	0.00	0.00	0.00
09-05-2013	0.30	0.38	2.78	0.50	0.20	1.92	0.15	0.03	0.20
16-05-2013	0.37	0.95	3.00	0.53	0.90	2.33	0.20	0.08	0.35
23-05-2013	0.32	1.15	3.15	0.55	1.15	3.56	0.28	0.09	0.45
30-05-2013	0.22	2.33	4.33	0.40	1.20	4.78	0.38	0.10	0.90
06-06-2013	0.20	2.90	4.00	0.33	1.35	6.35	0.50	0.07	1.30
13-06-2013	0.00	2.50	5.00	0.20	1.45	5.90	1.05	0.05	1.56
20-06-2013	0.00	2.80	3.15	0.10	1.50	5.15	0.75	0.03	1.60
27-06-2013	0.00	1.95	2.14	0.00	1.00	4.95	0.65	0.00	0.90
04-07-2013	0.00	1.15	1.15	0.00	0.33	4.33	0.41	0.00	0.80
11-07-2013	0.00	1.00	1.00	0.00	0.25	4.25	0.40	0.00	0.70
18-07-2013	0.00	0.80	0.30	0.00	0.20	4.35	0.32	0.00	0.50
25-07-2013	0.00	0.15	0.40	0.00	0.18	1.78	0.18	0.00	0.34
Mean + S E	0.14 ± 0.03	1.10 ± 0.24	2.38± 0.38	0.15 ± 0.01	0.57 ± 0.04	3.19 ± 0.07	0.31 ± 0.07	0.03 ± 0.01	0.56 ± 0.01

B. Beneficial Insects (Predators)

The population activities of beneficial arthropods in the IPM Set-I are shown in the Table-1. Three species of spiders were observed active in okra field. These were: *Hippasa agelenoides*, *Argyrodes argentatus* and *Drassodes* sp. were recorded. There population was counted collectively. The data revealed that the spiders started their activities on okra crop during 13th April. Their population was gradually reached to the peak (6.35/plant) on 6th June on okra. The over all mean population (3.19±0.07/plant) of spider was recorded on okra crop. It was apparent from the data that seven spotted beetle appeared on 9th May on okra and reached to it peak (1.05/plant on 13th June on okra), then it declined gradually. The over all mean population (0.31± 0.07/plant) of seven spotted beetle was recorded on okra. It was explicit from the data that eleven spotted beetle appeared on 9th May, that increases it population gradually and reached to the peak (0.10/plant) on 16th May on okra then declined. The over all mean population (0.03±0.01plant) of seven spotted beetle was recorded on okra. The results indicated that the population of zigzag beetle appeared on 9th May on okra crop; it increased gradually and reached to peak (1.60/plant) on 20th June on okra then declined. The over all mean population (0.56±0.01/plant) of zigzag beetle was observed on okra.

In the control plots where no IPM practices were applied to okra crop the average population of beneficial insects was as spider (2.86/plant), seven spotted beetle (0.83/plant), eleven spotted beetle (1.18/plant), zigzag beetle (0.68/plant). It was found that the density of beneficial insects, on untreated okra was slightly more than the IPM practices; this might be due to greater population of insect pests in the untreated okra crop. The analysis of variance indicated that there was significant difference in the population of beneficial insects between insect species and crop, although their interaction was non significant.

B. IPM Set-II

Data in Table 2 show the activities of insect pests and beneficial arthropods in IPM set-I, respectively. The results in Table-1 showed that the population of thrip increased gradually and reaches to its peak (4.75/leaf) on 6th June than it declined. The overall population was low due to application of botanical product. The overall mean population (2.27±0.32/leaf) of thrip was recorded on okra. It was observed that jassid appeared after 25th April on okra crop. The population density increased thereafter and its abundance was observed on 6th June (2.91/leaf) on okra. The over all mean population (1.33±0.26/leaf) of jassid was observed okra crop. The results indicated that whitefly appeared in the 1st week of germination and gradually reached to its peak on 13th June (7.75/leaf) then it declined. The over all mean population (3.58± 0.63/leaf).of whitefly was recorded on okra. It may be seen from the data that aphid appeared on 16th May on okra. The population of aphid increases gradually and peaked on 13th June (4.61/leaf) on okra. The over all mean population (2.59±0.41/leaf) of aphid was recorded on okra. The data indicated that spotted bollworm started feeding to okra crop on 8th May. The peak population of spotted bollworm on okra was observed on 20th June (2.92/plant) then declined. The over all mean

population (1.45±0.25/plant) of spotted bollworm was recorded on okra.

Table-2 Mean population of insect pests and beneficial insect recorded on okra crop under IPM practices Set-II during 2013.

Observation Dates	Sucking Insect Pests					Beneficial Insects (Predators)			
	Thrip	Jassid	Whitefly	Aphid	Spotted bollworm	Spider	Seven spotted beetle	Eleven spotted beetle	Zigzag beetle
04-04-2013	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
11-04-2013	**0.33**	**0.00**	**0.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
18-04-2013	**0.90**	**0.00**	**0.30**	**0.00**	**0.00**	**0.50**	**0.00**	**0.02**	**0.00**
25-04-2013	**1.33**	**0.20**	**1.35**	**0.20**	**0.20**	**0.90**	**0.00**	**0.06**	**0.00**
02-05-2013	**1.56**	**0.36**	**3.75**	**1.35**	**0.45**	**1.37**	**0.00**	**0.07**	**0.00**
09-05-2013	**2.34**	**0.92**	**4.15**	**2.74**	**0.80**	**2.44**	**0.50**	**0.09**	**0.20**
16-05-2013	**3.15**	**1.73**	**5.34**	**3.75**	**1.15**	**3.78**	**0.71**	**0.10**	**0.60**
23-05-2013	**3.25**	**2.56**	**6.15**	**4.00**	**1.60**	**4.20**	**0.82**	**0.15**	**0.80**
30-05-2013	**3.90**	**2.75**	**7.00**	**4.33**	**1.90**	**6.56**	**0.89**	**0.60**	**1.35**
06-06-2013	**4.75**	**2.91**	**7.15**	**4.50**	**2.32**	**7.41**	**1.05**	**0.70**	**1.90**
13-06-2013	**3.88**	**2.70**	**7.75**	**4.61**	**2.56**	**8.33**	**1.33**	**0.78**	**1.98**
20-06-2013	**3.65**	**2.41**	**4.95**	**3.95**	**2.92**	**7.56**	**1.41**	**0.80**	**2.00**
27-06-2013	**2.71**	**2.33**	**4.34**	**3.74**	**2.70**	**6.34**	**1.22**	**0.39**	**1.88**
04-07-2013	**2.00**	**1.22**	**3.90**	**3.50**	**2.60**	**6.20**	**1.00**	**0.40**	**1.75**
11-07-2013	**1.86**	**1.15**	**2.35**	**2.90**	**2.40**	**4.20**	**0.56**	**0.22**	**1.70**
18-07-2013	**1.50**	**1.00**	**1.20**	**2.33**	**1.70**	**3.50**	**1.95**	**0.05**	**1.00**
25-07-2013	**1.60**	**0.50**	**1.10**	**2.15**	**1.40**	**2.00**	**0.92**	**0.05**	**0.80**
Mean + S E	**2.27± 0.32**	**1.33± 0.26**	**3.58± 0.63**	**2.59± 0.41**	**1.45 ± 0.25**	**3.84 ± 0.68**	**0.72 ± 0.14**	**0.26 ± 0.07**	**0.93 ± 0.19**

B. Beneficial Insects (Predators)

The population activities of beneficial arthropods in the IPM Set-I are shown in the Table-2. The same spider species were observed active in this set, as these were recorded in the okra field of set- I. The populations of these spiders were counted and combined together as presented in Table 3. The data revealed that the spiders started their activities on okra crop during 13th April. Their population was gradually reached to the peak (8.33/plant) on 13th June on okra. The over all mean population (3.84±0.68/plant) of spiders was recorded on okra crop. It was apparent from the data that seven spotted beetle appeared on 9th May on okra and reached to it peak (1.95/plant) on 18th July on okra then it declined gradually. The over all mean population (0.72± 0.14/plant) of seven spotted beetle was recorded on okra. It was explicit from the data that eleven spotted beetle appeared on 18th April, the population increased gradually and reached to the peak (0.80/plant) on 20th June on okra then declined. The over all mean population (0.26±0.07plant) of seven spotted beetle was recorded on okra. The results indicated that the population of zigzag beetle appeared on 9th May on okra crop; it increased gradually and reached to peak (2.00/plant) on 20th June on okra then declined. The over all mean population (0.93±0.19/plant) of zigzag beetle was observed on okra.

Table-3 Mean population of insect pests and beneficial insect recorded on okra crop under IPM practices Set-III during 2013.

Observation Dates	Sucking Insect Pests					Beneficial Insects (Predators)			
	Thrip	Jassid	Whitefly	Aphid	Spotted bollworm	Spider	Seven spotted beetle	Eleven spotted beetle	Zigzag beetle
04-04-2013	0.15	0.00	1.35	0.33	0.00	0.00	0.00	0.00	0.00
11-04-2013	0.35	0.00	2.33	0.78	0.00	0.00	0.00	0.00	0.00
18-04-2013	0.86	0.35	4.56	0.95	0.00	0.00	0.00	0.00	0.00
25-04-2013	2.78	0.92	7.15	1.15	0.00	0.00	0.00	0.00	0.20
02-05-2013	3.58	1.78	15.35	1.33	0.00	0.00	0.15	0.10	0.25
09-05-2013	6.44	3.74	19.33	1.42	0.80	2.00	0.20	0.18	0.35
16-05-2013	10.73	5.44	30.78	1.50	1.35	2.35	0.90	0.82	0.41
23-05-2013	12.52	6.52	34.52	2.35	2.78	2.65	1.35	1.50	0.36
30-05-2013	10.33	6.33	38.44	2.95	3.56	4.32	1.40	1.58	0.80
06-06-2013	9.75	6.78	35.41	3.78	4.81	5.44	1.56	1.62	1.25
13-06-2013	7.78	7.00	30.00	3.20	5.65	8.65	1.34	2.00	1.85
20-06-2013	6.00	8.52	23.78	2.15	6.33	6.95	1.95	1.85	1.75
27-06-2013	4.50	6.78	21.52	2.00	4.52	6.20	1.80	1.85	1.20
04-07-2013	4.00	5.51	18.41	1.78	4.00	3.50	1.00	1.60	1.00
11-07-2013	3.78	4.00	10.33	1.56	3.56	2.41	0.92	1.52	0.83
18-07-2013	2.15	4.33	5.41	2.00	2.58	2.20	0.88	1.34	0.85
25-07-2013	1.52	4.50	3.78	1.34	2.25	1.95	0.65	0.90	0.70
Mean + S E	5.13 ± 0.30	4.57 ± 0.20	17.79 ± 0.78	1.80 ± 0.05	2.48 ± 0.07	2.86 ± 0.03	0.83 ± 0.02	1.18 ± 0.04	0.68 ± 0.03

DISCUSSION

The results of present studies carried out to determine the integrated management strategies of insect pests in okra ecosystem. The results indicated that in the IPM set-I where okra crop was trapped with maize crop and treated with pheromones, release of *Chrysoperla carnea* and *trichogramma* and spray of botanical products. However, in case of IPM set-II where okra crop trapped with sunflower, maize, and marigold and treated with sex pheromone, release of *Chrysoperla carnea* and *trichogramma*. These results are supported by the work done earlier by Mander *et al*. (2006) reported that integrated treatments were effective against insect pests in okra and were superior to recommended insecticide, they obtained maximum cost benefit ratio with mean cake + endosulfan. While Obengofori and Sackey (2003) applied aqueous neem at 30, 50, 75 and 100 g/litre beside other insecticidal treatments against insect pests of okra and found that there was no significant difference between the doses of neem, produced higher fruit yield than untreated control. Aderobani (1998) evaluated efficacy of plant extract against jassid and fruit borer in okra and found that all the treatment supposed both the jassid populated and fruit borer infestation. Chakraborti (2001) reported that bio rational integrated approach was very effective in checking the population build-up of the okra fruit borer recorded only a low level of infestation, the treatment also found effective against jassid and whitefly and superior to chemical control. Shivalingaswamy *et al*., (2002) studied the predatory interaction between jassid and *Paedorus varriicornis* in okra cultivars, and found that the population of jassid and *P. variicornis* increased gradually although at the highest population of *P. variicounis* the population of jassid decreased. Praveen and Dhandapani (2001) evaluated the effectiveness of biological control agents against the major insect pests of okra and observed that release/application of the predators *Chrysoperla carnea* (25000 larvae/ha) release eco neem (0.3% (0.5 l/ha) for the time of 15 days interval starting from 45 days after sowing was found to be effective in reducing the sucking pest as well as the fruit borer, the percent fruit damage in the treated plot was 8.61% and in the untreated it was 22.56%. Al Eryan (2001) reported that early release of coccinellid beetle which have been reared brone powder of honeybees and released on aphid under semi field condition. Predator prey ratio of 1:100, 2:100 and 4:100 resulted in reduction in aphid population by 99.6, 99.4 and 99.4% respectively. Our findings are almost similar to Kumar *et al.*, (2005) reported the spiders collected from bhendi were Xrgitipe pulchefla, Crvhnphorit cictilrdsa (Cyrtophora cicctlrnsa), Crybopharu citricola (Cyrfopharct citricala), Custeracunfha geminam, Gastemeuntha huhlu, llippasa (ycnsma, Leuctuigc ccidtcsiana, Neoscona, shillongensis, Neoscona naulica, Oxyopes sp., Peucetia prasina, Safucus sp. and Zygeilla melnnocrania (ZygieHa inelonocrtuiia) where as, the Sciilicus spider species were most potential and voracious predators and they consume huge number of sucking insect pests.

Conclusions

It may be concluded that IPM Set-I found superior in relation to IPM set-II, and okra trap with maize crop and treated with pheromones release of chrysoperla and trichogramma chilonis and spray of botanical product caused greater reduction of insect pests as compared to okra trapped with sunflower, maize, and marigold, and treated with sex pheromones release of chrysoperla and trichogramma. Although the population of beneficial insects was more in the untreated okra due to more population of insect pests.

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