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Zakir Ali Bhutto
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Fida Hussain Magsi
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Abid Ali Soomro
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Maqsood Ahmed Chandio
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Naveed Ali Channa
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Shahid Hussain Lashari
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Sanaullah Mangi
Department of Agronomy.,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Ashfaque Ahmed Junejo
Department of Agronomy.,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Correspondence
Fida Hussain Magsi
Department of Entomology,
Sindh Agriculture University
Tandojam, Sindh, Pakistan

Integrated pest management of Okra insect pests

Zakir Ali Bhutto, Fida Hussain Magsi, Abid Ali Soomro, Maqsood Ahmed Chandio, Naveed Ali Channa, Shahid Hussain Lashari, Sanaullah Mangi and Ashfaque Ahmed Junejo

Abstract
Field study on integrated pest management of Okra insect pests was carried out at experimental area of Faculty of Crop Protection, Sindh Agriculture University, Tandojam during the year 2016. The okra crop variety Rama Krishma was sown on RCBD with three replications by drilling method along agronomical practices. The results revealed that the reduced pest population of jassid, aphid and white fly after different IPM treatments on okra crop except control. Treatments were applied T1 (Biosal applications), T2 (Tobacco extract application), T3 (Natural enemies) T4 (Conventional farming practices) and T5 (untreated plots). The pest population of jassid, aphid and white fly also decreased gradually after each spray except control treatment. The post treatment observations were taken after 48 hours each spray respectively. The results indicated that the lowest mean pest population of Jassid (1.84), aphid (2.07) and white fly (0.31) per leaf was recorded on T1 (Biosal application), followed by population of jassid (1.93), aphid (2.18) and white fly (0.42) per leaf which was noted from T2 (Tobacco extract). However, moderate population of jassid (2.03), aphid (2.23) and white fly (0.43) per leaf was obtained from T3 (Natural enemies) as well second moderate pest population of jassid (2.06), aphid (2.36) and white fly (0.49) was recorded in T4 (conventional farming practices). Moreover, highest pest population of jassid (2.15), aphid (2.42) and white fly (0.57) per leaf was observed on T5 untreated plots (control). Furthermore the results revealed that in T1 (biosal application) reduced pest population was recorded other than rest of other treatments as well in control treatment. The post treatment of biosal applications found to be more effective as compared to other treatments.

Keywords: Okra, IPM, Insect Pests, Natural enemies, Pakistan

1. Introduction
That Okra (*Abelmoschus esculentus* L.) is one of the most common and widely grown vegetable in Pakistan [1]. It considered as African tropical vegetable, many countries are cultivating okra crop in the world [2]. Okra crop is known by in various names as okra, okro, bhindee, ladyfinger and quinbambo [3]. Okra seeds are good source of protein, vegetable oil and rich in vitamin A and B, phosphorus and iodine, which play viral role in human diet [4]. Okra is a powerhouse of valuable nutrients, soluble and insoluble fiber, which helps to lower serum cholesterol, risk of heart disease, keeps the intestinal tract healthy and decrease colorectal cancer [5]. Okra crop is suffering from number of biotic and abiotic factors, including insect pests and diseases [6]. It is attacked by a number of phytophagous insects, diseases and mites during different growth stages [7]. Number of insect pest from sowing to harvesting such as Aphid, Jassid, Whitefly, Thrip, Spotted bollworms and Mites. Whitefly, Bemisia tabaci (Genn.) is the most important insect pest of okra crop. These pests are damaging crop by sucking the sap directly and by transmitting a large number of viral diseases indirectly [8]. Jassid found a very damaging sucking insect pest of many crops in the majority areas of the growing countries of the world and has been found damaging many crops in the world. It has been observed that, both adults and nymphs cause damage while sucking sap of plants. Due to sucking the color becomes grayish or by injecting toxic saliva into the plant tissues of okra crops and fall down (Crinkling) which is the characteristic feature of jassid attack [9]. The species of Aphididae, Coccidae and Pseudococcidae families such as A. gossypii (Glover), C. ceriferus (Fabricius) and P. solenopsis (Tinsley) cause damage to crops by various ways attacking on leaves, steams, fruits and roots [10]. Predatory spiders are found effective controlling agent and suggested for controlling jassids [11]. The effective method at present for the control of these pests is, however, by the use of synthetic insecticides that are widely used since a long time, but recent investigations have proved that the use of synthetic pesticides is

hazardous to human health and have long residual effects. Beside these, the chemicals create harmful effects over the population of predatory spiders, ants and lady bird beetles [12]. The natural bio-pesticides in commercial agriculture and horticulture is being practiced since long to circumvent the problems associated with indiscriminate use of pesticides and are earning reputation among the researchers and growers [13]. The bio-pesticides offer desirable alternative derived from animals, plants, bacteria and certain minerals. Bio-pesticides are less toxic to non-targeted natural enemies and generally affect only the target pest [14]. Bio pesticides are effective even in small quantities and often decompose quickly resulting in lower exposures and less effects of pollution problems. The seeds of neem tree (Azadirachta indica A. juss.) have numerous effects on pests and have minimal toxicity to non-target organisms [15]. The use of botanical products e.g. tobacco extract, neem oil and extract, found cheap and it is in the reach of rural areas people which can be easily collected in rural areas, and also found promising and useful for pest control [16]. The agriculture workers are highly vulnerable to these pesticides during handling and usage. It was mentioned that two million people became affected and 40,000 died due to insecticide poisoning [17]. Therefore, for controlling over pest it is necessary to go through ecological factors. In this present scenario, people are facing very difficulties to overcome insect pests of crops. Thus, it is need have today that, for controlling pests necessary to acquire best controlling methods which considered safe for human beings as well as environment. By above facts avoid to use most health hazardous insecticides and to use bio control measurements for the betterment of environmental protection. Hence, botanical insecticides, and their essential oils, are among the most efficient botanicals [18].

2. Materials and Methods

Okra variety (Rama Krishna) was cultivated under five treatments in spring 2015: i.e. T1 = IPM plot with Biosal application. T2 = IPM plot with Tobacco extract application, T3 = IPM plot with release of natural enemies, T4 = Farmer cultivated plot and T5 = Untreated control plot. Observation of sucking complex on IPM and traditionally practiced crop was carried out on okra crop. The IPM plot sprayed with biopesticides and tobacco extract on weekly basis. The natural enemies such as *Trichogramma* and *Chrysoperla* were released in IPM plot on weekly basis. The Traditional practiced plot of farmer was sprayed with different insecticides on weekly basis. Post treatment data was recorded after 48 hours of the respective spray. Yield compared on IPM and non IPM plots.

Statistical analysis

The data was collected and subjected to statistical analysis to analyses the variance in treatment means. L.S.D (Least Significant Difference) test was applied to observe the statistical differences within treatments following the method developed by [19]. Reference?

3. Results

The data regarding of jassid, aphid and white fly on okra crop after each spray respectively with various IPM treatments, which was recorded after 48 hours, are presented in Table 1-6. However, the data of each spray on each treatment and pest population was counted.

The results revealed that in Table-1 of Jassid, aphid and white fly as effects biosal application on okra crop. After each spray of biosal application gradually reduced pest population of Jassid, aphid and white fly. The Jassid population ranged between (2.12-1.53) per leaf in post treatment of biosal treatment observation from 15th February to 11th April. However, overall mean population of Jassid (1.84) per leaf was recorded after biosal application. The aphid population ranged between (2.35-1.86) per leaf in post treatment of biosal treatment observation from 15th February to 11th April. However, overall mean population of aphid (2.07) per leaf was recorded after biosal application. The white fly population ranged between (0.45-0.19) per leaf in post treatment of biosal treatment observation from 15th February to 11th April. However, overall mean population of white fly (0.31) per leaf was recorded after biosal application.

Table 1: IPM plots with biosal application on pest population of okra crop

No of spray	Observation dates	Complex pest population		
		Jassid	Aphid	White fly
1	15-2-15	2.12	2.35	0.45
2	23-2-15	2.04	2.31	0.42
3	02-3-15	1.99	2.17	0.40
4	10-3-15	1.88	2.09	0.34
5	18-3-15	1.82	1.99	0.29
6	26-3-15	1.72	1.95	0.24
7	03-4-15	1.63	1.90	0.21
8	11-4-15	1.53	1.86	0.19
Mean		**1.84**	**2.07**	**0.31**

The results showed that in Table-2 of Jassid, aphid and white fly as effects tobacco extract application on okra crop. After each spray of tobacco extract application slightly reduced pest population of Jassid, aphid and white fly. The Jassid population ranged between (2.27-1.59) per leaf in post treatment of tobacco extract treatment observation from 15th February to 11th April. However, overall mean population of Jassid (1.93) per leaf was recorded after tobacco extract application. The aphid population ranged between (2.38-1.93) per leaf in post treatment of tobacco treatment observations from 15th February to 11th April. However, overall mean population of aphid (2.18) per leaf was recorded after tobacco extract application. The white fly population ranged between (0.59-0.24) per leaf in post treatment of tobacco extract application treatment observation from 15th February to 11th April. However, overall mean population of white fly (0.42) per leaf was recorded after tobacco extract application.

Table 2: IPM plots with tobacco extract application on complex pest population of okra crop

No of spray	Observation dates	Complex pest population		
		Jassid	Aphid	White fly
1	15-2-15	2.27	2.38	0.59
2	23-2-15	2.24	2.36	0.57
3	02-3-15	2.19	2.32	0.55
4	10-3-15	1.93	2.26	0.47
5	18-3-15	1.84	2.19	0.41
6	26-3-15	1.76	2.07	0.33
7	03-4-15	1.69	1.96	0.26
8	11-4-15	1.59	1.93	0.24
Mean		1.93	2.18	0.42

The results indicated that in Table-3 of Jassid, aphid and

white fly as effects natural enemies on okra crop. After each released natural enemies gradually reduced pest population of Jassid, aphid and white fly. The Jassid population ranged between (2.33-1.73) per leaf in post treatment of natural enemies observation from 15th February to 11th April. However, overall mean population of Jassid (2.03) per leaf was recorded after release natural enemeis. The aphid population ranged between (3.48-1.97) per leaf in post treatment of natural enemies observation from 15th February to 11th April. However, overall mean population of aphid (2.23) per leaf was recorded after release natural enemies. The white fly population ranged between (0.64-0.25) per leaf in post treatment of release natural enemies observation from 15th February to 11th April. However, overall mean population of white fly (0.43) per leaf was recorded after release natural enemies application.

Table 3: IPM plots with release natural enemies on complex pest population of okra crop

No of release natural enemies	Observation dates	Complex pest population		
		Jassid	Aphid	White fly
1	15-2-15	2.33	3.48	0.64
2	23-2-15	2.28	2.39	0.62
3	02-3-15	2.25	2.38	0.57
4	10-3-15	2.06	2.29	0.43
5	18-3-15	1.94	2.22	0.35
6	26-3-15	1.85	2.12	0.33
7	03-4-15	1.78	2.04	0.26
8	11-4-15	1.73	1.97	0.25
Mean		2.03	2.23	0.43

The results exposed that in Table-4 of Jassid, aphid and white fly as effects farming practices on okra crop. After each spray of farming practices gradually reduced pest population of Jassid, aphid and white fly. The Jassid population ranged between (2.36-1.75) per leaf in post treatment of farming practices observation from 15th February to 11th April. However, overall mean population of Jassid (2.06) per leaf was recorded after farming practices. The aphid population ranged between (2.55-2.04) per leaf in post treatment of farming practices observation from 15th February to 11th April. However, overall mean population of aphid (2.36) per leaf was recorded after farming practices. The white fly population ranged between (0.68-0.28) per leaf in post treatment of farming practices observation from 15th February to 11th April. However, overall mean population of white fly (0.49) per leaf was recorded after farming practices.

Table 4: IPM plots with conventional farmer practices on complex pest population of okra crop

No of spray	Observation dates	Complex pest population		
		Jassid	Aphid	White fly
1	15-2-15	2.36	2.55	0.68
2	23-2-15	2.32	2.51	0.66
3	02-3-15	2.30	2.47	0.65
4	10-3-15	2.13	2.35	0.56
5	18-3-15	1.96	2.26	0.50
6	26-3-15	1.88	2.18	0.37
7	03-4-15	1.80	2.12	0.29
8	11-4-15	1.75	2.04	0.28
Mean		2.06	2.36	0.49

The results revealed that in Table-5 of Jassid, aphid and white fly untreated plots on okra crop. Pest population of Jassid, aphid and white fly slightly increased each observation. The Jassid population ranged between (1.84) per leaf in untreated plots observation from 15th February to 11th April. However, overall mean population of Jassid (2.15) per leaf was recorded in control. The aphid population ranged between (2.56-2.12) per leaf in control treatment observation from 15th February to 11th April. However, overall mean population of aphid (2.42) per leaf was observed in untreated plots. The white fly population ranged between (0.79-0.32) per leaf in untreated plots observation from 15th February to 11th April. However, overall mean population of white fly (0.57) per leaf was recorded from control.

Table 5: IPM plots with untreated control on complex pest population of okra crop

No of spray	Observation dates	Complex pest population		
		Jassid	Aphid	White fly
1	15-2-15	1.84	2.12	0.32
2	23-2-15	1.97	2.14	0.34
3	02-3-15	2.16	2.22	0.42
4	10-3-15	2.51	2.33	0.59
5	18-3-15	2.54	2.38	0.62
6	26-3-15	2.56	2.53	0.75
7	03-4-15	2.57	2.54	0.77
8	11-4-15	2.59	2.56	0.79
Mean		2.15	2.42	0.57

Table 6: Overall mean population of Jassid, Aphid and white fly after various IPM treatments

Treatments	Complex pest population		
	Jassid	Aphid	White fly
T_1 Biosal application	1.84	2.07	0.31
T_2 Tobacco extract	1.93	2.18	0.42
T_3 Natural enemies	2.03	2.23	0.43
T_4 Conventional farming practices	2.06	2.36	0.49
T_5 Untreated plots (control)	2.15	2.42	0.57
Mean	2.002	2.252	0.444

Table 7: Yield obtained from treated and untreated plots of okra crop.

Dates of Okra picking	Yield per plot (Kgs)	
	Treated plots	Untreated plots
25-2-15	32	17
02-3-15	45	18
07-3-15	51	14
13-3-15	58	15
20-3-15	62	10
27-3-15	68	12
03-4-15	64	15
11-4-15	55	11
Total	435 Kgs	112 Kgs

4. Discussion

The studies on the "integrated pest management of insect pests of okra crop" on complex sucking insect in various IPM treatments were observed during 2015. It was experimental that the investigated different IPM treatments to control sucking insect pests on Okra crop.

The result showed that the Jassid, aphid and white fly population reduced in the T1 biosal application as compared to other treatments. The pest population of Jassid, aphid and white fly was significant (P>0.5). The weekly mean pest population of Jassid, aphid and white fly on five Treatments

viz; T1 (Biosaal application), T2 (Tobacco extract), T3 (Release natural enemies), T4 (Conventional farming practices) and T5 (Untreated plots). The overall lowest pest population of jassid (1.84), aphid (2.07) and white fly (0.31) per leaf was recorded in T1 (Biosaal application). Followed by jassid (1.93), aphid (2.18) and white fly (0.42) per leaf and jassid (2.03), aphid (2.23) and white fly (0.43) per leaf were recorded on T2 (Tobacco extract) and T3 (Release natural enemies) respectively. While, moderate pest population of jassid (2.06), aphid (2.36) and white fly (0.49) per leaf were noted on conventional farming practices. Moreover, highest Jassid, aphid and white fly population (2.15), (2.42) and (0.57) per leaf respectively were observed in T5 Control (untreated plots).

These results occurrence with those of other researchers [20] reported that leaf extracts of tobacco (2%), *Ipomoea carnea* (5%) and a seed extract of *Azadirachtaindica* and *Pongamiaglabra, P. pinnata* (both at 5%) gave a similar level of control compared to endosulfan (0.6%) and monocrotophos (0.05%). [21] investigated Achook (0.7%) and NSKE (3%), was the most effective in controlling the okra Jassid White fly and thrips. Achook-treated plots gave the highest yield of 50.06 q/ha. [22] Stated that the Neem preparations significantly reduced the attack of 4 pests studies, i.e. *Aphis gossypii, Bemisia tabaci, Earias vittela and Podagrica puncticollis*.

5. Conclusion

It is concluded from the study that IPM treatments influenced maximum mean population reduction of complex sucking pests on Okra crop. Among five treatments of IPM treatment T1 (biosal application) gave better results than other treatments against sucking pests of okra. The control (untreated plots) received higher mean number of pest population than treated plots throughout the period under study. The population of insects pest increased up to harvest in control plots. Maximum mean yield KGs was recorded in treated plots than control. More studies on IPM treatments of Biosal application on okra crop against pest need to be investigated.

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7. References

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