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Comparative efficacy of some bio and synthetic insecticide against *Bemisia tabaci* (genn) on okra crop

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Abstract
The trial on the efficacy of some bio and synthetic insecticides against okra whitefly *Bemisia tabaci* under field was done at Agriculture Research Institute, Tandojam during kharif season 2015. The trial was design in Randomized Complete Block Design (RCBD) with five applications and four replications. Okra "Sabazpari" variety was cultivated for this trial. Some bio and synthetic insecticides at different applications viz., T1= Confidor (Imidacloprid) 200SL 250ml/acre; T2= Tobacco extract (Hazropattar) 200/acre; T3= Tobacco extract (Pattay wala) 200/acre; T4= Azadirachta indica (Neem oil 1 Liter/acre) and T5= untreated control were applied four times against okra whitefly (*Bemisia tabaci*). The data indicates that the mean per plant count of okra whitefly (*Bemisia tabaci*) after first spray of some bio and synthetic insecticides (treatments) were (2.32), (3.03), (3.61) and (2.72) though for second spray (2.3), (3), (3.57) and (2.69), for the third spray (2.28), (2.98), (3.56) and (2.66) and fourth treatment, the mean population were (2.25), (2.95), (3.53) and (2.58) respectively, when equated with the control of some bio and synthetic insecticides spray (4.27), (4.45), (4.52) and (4.61). The ANOVA results after each spray indicated that, pest population of okra whitefly on okra differ significantly at (P=>0.0000) with some bio and synthetic insecticides after 24 hours, 48 hours, 72 hours and one-week. Accordingly, in this trial there are some bio and synthetic insecticides for okra whitefly while our study signifies that the Confidor (Imidacloprid) 200SL 250ml/acre was found to be the most effective to decrease the population of whitefly (*Bemisia tabaci*) under field.

Keywords: Comparative efficacy, bio and synthetic insecticides, *Bemisia tabaci*, okra, field condition

1. Introduction
In the subtropical and tropical regions of the world okra (*Abelmoschus esculentas* L. Moench) is a valuable vegetable crop [1], [2], [3], [4]. Okra is cultivated in Pakistan on an area of about 15.081 thousand/ha with total production of 114.657 thousand tones in which Sindh contributes an area 36.2 hectares with 220 thousand tons per year [5]. Its tender fruits are used as boiled vegetable into fried slices for cooking [6]. Its stem is used for paper making in paper mills. The flowers are also edible. Okra dried seeds, nutritious matter that can be used to prepare vegetable curds, or roasted and ground to be used as coffee additive or substitute [7]. Okra is cultivated at a commercial scale but insect and mite pest damage constitutes a limiting factor in successful production [8]. *Abelmoschus esculentas* L. is attacked by different insect pests [9] from sowing up to harvesting. It is highly susceptible to jassid, whitefly, aphid, thrip, spotted bollworm, american bollworm etc. Among sucking insect pests whitefly are more serious [10] and transmit certain viral diseases. Moreover, they cause a great damage by sucking the plant sap. Insect pests cause 35-40% crop yield losses and ultimately increase the level of damage up to 60-70% in optimal conditions [11].
Less toxic and more environmentally safe insecticides was the botanical insecticides such as; Neemax (neem seed kernel extract) and Multineem (neem oil) regulated populations of this white fly [12]. Different groups of insecticides have been recommended to control this white fly [13], [14]. Studied the efficacy of the insecticides imadacloprid and abamectin and reported they were safer to use in the presence of coccinellid predators [15].
Keeping in view the dietary and economic value of *Abelmoschus esculentas* L. crop and detrimental effects of synthetic chemicals on human health, the study was premeditated; to assess the effectiveness of bio-chemicals in comparison with synthetic insecticide against whitefly on *Abelmoschus esculentas* L. crop. In conclusion to establish the suitability of bio-

chemicals as a safe and environment friendly pest management tool for sustainable vegetable production.

2. Materials and Methods

2.1 Location of the experimental plot

The experiment was conducted at Agriculture Research Institute, Tandojam during kharif 2015. The site is located at ARI, Tandojam in Sindh Agriculture University, Tandojam.

2.2 Design

The study was conducted with five treatments. The experiment was laid out in a Randomized Complete Block Design (RCBD).

2.3 Treatments

The comparative effectiveness of the following five treatments for okra whitefly was evaluated on the basis of reduction of this pest.

T_1 = Confidor (Imidacloprid) 200SL 250ml/acre
T_2 = Tobacco extract (Hazropattar) 200/acre
T_3 = Tobacco extract (Pattay wala) 200/acre
T_4 = Azadirachta indica (Neem oil 1 Liter/acre)
T_5 = Untreated control

2.4 Applicaton of the treatments

All agricultural practices were maintained when required, the treatments were adjusted at par with the plot size, and insecticides were calibrated according to the plot size. Spraying was done at 12.00 pm to avoid moisture on leaves. The selected insecticides with their calibrated doses were applied to their respective plots after 55 days of germination. Calibration was made by using the formula dose/43560(sqft in acrea)* plot size. Treatments were applied at 7 days interval. Spraying was done by knapsack sprayer having a pressure of 4.5kg/cm^2. To get complete coverage of plant spraying was done uniformly on the entire plant with special care. In case of untreated control, only fresh water was sprayed for respective plots and each treatment was replicated four times having net plot size was 1,518sqft respectively.

2.5 Data collection

Data on infestation by okra whitefly under different treatments were recorded.

Twenty plants per-treatment were randomly selected to observe the efficacy of some bio and synthetic insecticides against okra whitefly. For the pest counting pre-treatment observations were taken 24 hours before the application of some bio and synthetic insecticides and post treatment observations were taken at 24hrs, 48 hrs, 72hrs and one-week at the interval after the spray of some bio and synthetic insecticides.

2.6 Statistical analysis of data

The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of computer package statistics-8.1 software

3. Layout Plan of the Experiment

Design: Randomized Complete Block Design (RCBD)
Numbers of Treatment: 5
Numbers of Replication: 4
Plote size: 1518sqft
1 meter: 3.3 feet
T_1: Confidor (Imidacloprid) 200SL 250ml/acre
T_2: Tobacco extract (Hazropattar) 200/acre
T_3: Tobacco extract (Pattay wala) 200/acre
T_4: Azadirachta indica (Neem oil 1 Liter/acre)
T_5: Control
80ft
60ft

R-1		R-II		R-III		R-IV
T_1		T_3		T_4		T_1
T_2	**Sub-Channel**	T_1	**Walking Path**	T_3	**Sub-Channel**	T_2
T_3		T_4		T_2		T_3
T_4		T_2		T_1		T_4
T_5		T_5		T_5		T_5
Mian Channel						

4. Results

The experiment was carried out during kharif season, 2015. To assess the efficacy of some bio and synthetic insecticides on okra whitefly under field conditions. The experiment was conducted at the Agriculture Research Institute, Tandojam. The treatments included four different insecticides viz., T_1= Confidor (Imidacloprid) 200SL 250ml/acre, T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre) and T_5=control. The post-treatment observations were recorded on total number of pest population after 24 hours, 48 hours, 72 hours and one-week. The pre-treatment observation was also recorded before the spray.

4.1 Mean population of okra whitefly after first spray

Table 1 showed the pre-treatment observations of okra whitefly on sub plots were (4.07, 4.36, 4.5, 4.22 and 4.03) per plant, respectively. The observation after 72 hours of the treatment showed that the mean pest count in T_1, T_2, T_3, T_4 and T_5 (treatments) were (1.66, 2.47, 3.25, 2.21 and 4.29) per plant respectively, which signifies that the effect of some bio and synthetic insecticides against okra whitefly *Bemisia tabaci* was T_1 = Confidor (Imidacloprid) 200SL 250ml/acre, T_2 = Tobacco extract (Hazropattar) 200/acre, T_3 = Tobacco extract (Pattay wala) 200/acre, T_4 = Azadirachta indica (Neem oil 1 Liter/acre) and T_5= control. The data shows that after 72 hours that the applied some bio and synthetic insecticides, T_1= Confidor (Imidacloprid) 200SL 250ml/acre was proven to be more effective on okra whitefly (*Bemisia tabaci*) than the others. The after spray effect of some bio and synthetic insecticides with the different durations and showed the reoccurrence of the pest in different treatments as T_1 (4.02), T_2 (4.42), T_3 (4.58), T_4 (4.26) and T_5 (control) (4.38) after one-week, respectively. The overall performance of some bio and synthetic insecticides showed that T_1 = Confidor (Imidacloprid) 200SL 250ml/acre performed well, followed by T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre). The average population of okra whitefly (*Bemisia tabaci*) was (2.32, 3.03, 3.61, 2.72 and 4.27) per

plant, respectively. The ANOVA signifies that after the first spray pest population of whitefly on okra vegetable differ significantly, (P<0.0000) with some bio and synthetic insecticides. The F values for the first spray after 24 hours, (F= 686.27), 48 hours (F= 2528.48), 72 hours (F= 694.90) and one-week (F= 8.85) respectively.

Table 1: Mean population of okra whitefly (*Bemisia tabaci*) after 1st spray with some bio and synthetic insecticides under field conditions

Treatments	C.Name	Doses	P-treatment	Post-treatment				Mean
				24hrs	48hrs	72hrs	168hrs	
T_1/Confidor 200SL	Imidacloprid	250ml/acre	4.07	1.9	1.7	1.66	4.02	2.32
T_2/Tobacco Extract	Hazropattar	200/acre	4.36	2.64	2.6	2.47	4.42	3.03
T_3/Tobacco Extract	Pattay Wala	200/acre	4.5	3.35	3.28	3.25	4.58	3.61
T_4/Azadirachta indica	Neem Oil	1 Liter/acre	4.22	2.24	2.19	2.21	4.26	2.72
T_5/Control			4.03	4.13	4.28	4.29	4.38	4.27

4.2 Mean population of okra whitefly after second spray

The pre-treatment observations of okra whitefly were (4.12, 4.45, 4.61, 4.29 and 4.4) per plant, Table 2. After 72 hours of the treatment indicated that the mean pest
population in T_1, T_2, T_3, T_4 and T_5 (applications) were (1.62, 2.43, 3.21, 2.17 and 4.47) per plant, which showed that the impact of some bio and synthetic insecticides against okra whitefly (*Bemisia tabaci*) was T_1 = Confidor (Imidacloprid) 200SL 250ml/acre, T_2 = Tobacco extract (Hazropattar) 200/acre, T_3 = Tobacco extract (Pattay wala) 200/acre, T_4 = Azadirachta indica (Neem oil 1 Liter/acre) and T_5 = control. The result indicates that after 72 hours that the some bio and synthetic insecticides, T_1 = Confidor (Imidacloprid) 200SL 250ml/acre was more effective on okra whitefly than the others. The pest appeared after one-week in different treatments as T_1 (4.08), T_2 (4.41), T_3 (4.57), T_4 (4.25) and T_5 (control) (4.48). Some bio and synthetic insecticides showed that T_1= Confidor (Imidacloprid) 200SL 250ml/acre performed well, subsequent by T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre). The mean count of okra whitefly (*Bemisia tabaci*) was (2.3, 3, 3.57, 2.69 and 4.45) per plant. The ANOVA shows that after the second spray pest whitefly *Bemisia tabaci* on okra vegetable vary significantly, (P<0.0000) with some bio and synthetic insecticides. The F values for the second spray after 24 hours, (F= 354.28), 48 hours (F= 404.44), 72 hours (F= 356.90) and one-week (F= 9.75) respectively

Table 2: Mean population of okra whitefly (*Bemisia tabaci*) after 2nd spray with some bio and synthetic insecticides under field conditions

Treatments	C. Name	Doses	P-treatment	Post-treatment				Mean
				24hrs	48hrs	72hrs	168hrs	
T_1/Confidor 200SL	Imidacloprid	250ml/acre	4.12	1.86	1.66	1.62	4.08	2.3
T_2/Tobacco Extract	Hazropattar	200/acre	4.45	2.59	2.56	2.43	4.41	3
T_3/Tobacco Extract	Pattay Wala	200/acre	4.61	3.28	3.24	3.21	4.57	3.57
T_4/Azadirachta indica	Neem Oil	1 Liter/acre	4.29	2.19	2.15	2.17	4.25	2.69
T_5/Control			4.4	4.42	4.44	4.47	4.48	4.45

4.3 Mean population of okra whitefly after third spray

The data in table 3 showed that the pest population before the spray on sub plots was (4.13, 4.46, 4.62, 4.3 and 4.5) per plant, respectively. The results after 72 hours of the treatment revealed that the mean pest population in T_1, T_2, T_3, T_4 and T_5 (treatments) were (1.59, 2.39, 3.18, 2.14 and 4.53) per plant, which indicates that the effect of some bio and synthetic insecticides against okra whitefly (*Bemisia tabaci*) was T_1 = Confidor (Imidacloprid) 200SL 250ml/acre, T_2 = Tobacco extract (Hazropattar) 200/acre, T_3 = Tobacco extract (Pattay wala) 200/acre, T_4 = Azadirachta indica (Neem oil 1 Liter/acre) and T_5 (control). The after 72 hours that the some bio and synthetic insecticides, T_1= Confidor (Imidacloprid) 200SL 250ml/acre was effective on okra whitefly (*Bemisia tabaci*) than the others. After one-week some bio and synthetic insecticides showed that the reoccurrence of the pest in different applications as T_1 (4.09), T_2 (4.42), T_3 (4.58), T_4 (4.26) and T_5 (control) (4.54). The overall performance of some bio and synthetic insecticides indicated that T_1= Confidor (Imidacloprid) 200SL 250ml/acre performed well, followed by T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre). Per plant mean population of whitefly were (2.28, 2.98, 3.56, 2.66 and 4.52), respectively. After the third spray insect count of whitefly *Bemisia tabaci* on okra vegetable differ significantly, (P<0.0000) with some bio and synthetic insecticides. The F values for the third spray after 24 hours, (F= 389.04), 48 hours (F= 439.50), 72 hours (F= 375.86) and one-week (F= 10.75) respectively showed in ANOVA.

Table 3: Mean population of okra whitefly (*Bemisia tabaci*) after 3rd spray with some bio and synthetic insecticides under field conditions

Treatments	C.Name	Doses	P-treatment	Post-treatment				Mean
				24hrs	48hrs	72hrs	168hrs	
T_1/Confidor 200SL	Imidacloprid	250ml/acre	4.13	1.83	1.63	1.59	4.09	2.28
T_2/Tobacco Extract	Hazropattar	200/acre	4.46	2.57	2.53	2.39	4.42	2.98
T_3/Tobacco Extract	Pattay Wala	200/acre	4.62	3.26	3.22	3.18	4.58	3.56
T_4/Azadirachta indica	Neem Oil	1 Liter/acre	4.3	2.17	2.1	2.14	4.26	2.66
T_5/Control			4.5	4.51	4.52	4.53	4.54	4.52

4.4 Mean population of okra whitefly after fourth spray

Results of okra whitefly on sub plots were (4.15, 4.48, 4.64, 4.32 and 4.56) per plant, at treatment in Table 4). The count after 72 hours of the treatment showed that the mean of pest in T_1, T_2, T_3, T_4 and T_5 were (1.56, 2.36, 3.15, 2.11 and 4.62) per plant, which signifies that the impact of some bio and synthetic insecticides against okra whitefly was T_1= Confidor (Imidacloprid) 200SL 250ml/acre, T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre) and T_5 (control). The result shows that after 72 hours that the some bio and synthetic insecticides, T_1= Confidor (Imidacloprid) 200SL 250ml/acre was found to be more effectual on okra whitefly (*Bemisia tabaci*) than the others. The after spray impact of some bio and synthetic insecticides indicated that the reoccurrence of the pest in different treatments as T_1 (4.06), T_2 (4.4), T_3 (4.55), T_4 (4.23) and T_5 (control) (4.64) after one-week. Some bio and synthetic insecticides spray indicated that T_1= Confidor (Imidacloprid) 200SL 250ml/acre performed well, subsequent by T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre). The mean pest count of okra whitefly (*Bemisia tabaci*) was (2.25, 2.95, 3.53, 2.58 and 4.61) per plant. The ANOVA result for the whitefly *Bemisia tabaci* on okra differ significantly, (P<0.0000) with some bio and synthetic insecticides. The F values for the fourth spray after 24 hours, (F= 418.08), 48 hours (F= 90.24), 72 hours (F= 407.30) and one-week (F= 14.72) respectively.

Table 4: Mean population of okra whitefly (*Bemisia tabaci*) after 4th spray with some bio and synthetic insecticides under field conditions

Treatments	C.Name	Doses	P-treatment	Post-treatment				Mean
				24hrs	48hrs	72hrs	168hrs	
T_1/Confidor 200SL	Imidacloprid	250ml/acre	4.15	1.8	1.61	1.56	4.06	2.25
T_2/Tobacco Extract	Hazropattar	200/acre	4.48	2.54	2.51	2.36	4.4	2.95
T_3/Tobacco Extract	Pattay Wala	200/acre	4.64	3.23	3.2	3.15	4.55	3.53
T_4/Azadirachta indica	Neem Oil	1 Liter/acre	4.32	2.14	1.87	2.11	4.23	2.58
T_5/Control			4.56	4.58	4.6	4.62	4.64	4.61

5. Discussion

The study was conducted to observe the comparative efficacy of some bio and synthetic insecticides, against okra whitefly on okra, under field conditions. The study showed that there was significant effect of some bio and synthetic insecticides against the okra whitefly. The study further showed that T_1= Confidor (Imidacloprid) 200SL 250ml/acre proved the maximum effect on pest reduction, followed by T_2= Tobacco extract (Hazropattar) 200/acre, T_3= Tobacco extract (Pattay wala) 200/acre, T_4= Azadirachta indica (Neem oil 1 Liter/acre). The overall effect on pest population reduction was significant than the control. The present work further verified that effect of T_1= Confidor (Imidacloprid) 200SL 250ml/acre was continued till 72 hours after that the pest population density started increasing and all the applications were significantly different.

Similar work was done by [16] who performed experiment to evaluate the efficacy of IGR, Neonicotinoid and other insecticides against the whitefly. Buprofezin was proved to be effective against nymphs and acetamiprid, diafenthiuron and imidacloprid were effective against the whitefly adults during the year 2003 and 2004.

Correspondingly [17] determined four okra cultivars (pahuja, safal, subz pari and surkh bhindi) to evaluate the efficacy of pesticide/bio-pesticide against insect vector *Bemisia tabaci* genn. The imidaccloprid significantly reduced the whitefly population. Neem extract and bio-control (em) were also found to be effective against *Bemisia tabaci* compared to distilled water and untreated control.

Similarly [18] study was conducted to determine comparative efficacy of new insecticides against *Bemisia tabaci* (Genn.) on cotton Bt- 121. The insecticides were sprayed when population of whitefly reached to economic threshold level (ETL) whitefly 4–5/ leaf. Imidacloprid, diafenthiuron, acetamiprid and thiamethoxam proved to be the most effective insecticides against whitefly up to seven days after application.

Our work was consistence with [19] investigate the comparative efficacy of neem leaf extracts and lambdacyhalothrin against whitefly in okra field. Four okra cultivars were grown in field with four replications. Five neem oil concentrations and a synthetic insecticide (Lambdacyhalothrin 2.5EC) @ 330 mL acre−1 were applied to evaluate efficacy effects on targeted insect's population. Distilled water was used as control. The plots treated with synthetic insecticide and the leaf extracts against targeted pests had significantly (P>0.05) suppressed insect population as compared to control.

6. Conclusion

It is concluded that the most effective selected insecticide was Confidor (Imidacloprid) 200SL 250ml/acre to suppress the okra whitefly population. Although, some bio and synthetic insecticides applied weekly, the okra whitefly (*Bemasia tabaci*) population was reducing up to 72 hours after each spray and later started rising after one-week.

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