EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 5/ August 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Screening of Biopesticides against Insect Pests of Tomato

BHAI KHAN SOLANGI
Department of Entomology
Sindh Agriculture University Tandojam
Pakistan
VELO SUTHAR[1]
Department of Statistics
Sindh Agriculture University Tandojam
Pakistan
RIFFAT SULTANA
Department of Zoology
University of Sindh Jamshoro
Pakistan
ABDUL RASOOL ABASSI
Department of Fresh Water Biology and Fisheries
University of Sindh Jamshoro
Pakistan
MUHAMMAD NADEEM
MUHAMMAD NAWAZ SOLANGI
Department of Entomology
Sindh Agriculture University Tandojam
Pakistan

Abstract:

In order to examine the efficacy of different biopesticides against insect pests of tomato, a field study was determined at the experimental area of Entomology Section, Agriculture Research Institute, (ARI) Tandojam during kharif 2013. Treatments were based on different biopesticides Neem (Azadirachta indica), Dhatura (Dhatura stramonium), Tooh (Citrullus colocynthus Schrad) and Tobacco (Nicotiana tabacum); while the efficacy of these biopesticides

[1] Corresponding author: vsutahar@yahoo.co.uk

was compared with chemical control (Confidor SL200 @250 ml/acre) and untreated (check). Three insect pests were found infesting tomato including white fly, thrips and aphids. Pre-treatment- and post-treatment observations were recorded. The study showed that among biopesticides the efficacy of chemical control (confidor) was highest after 1st and 2nd spray against whitefly (85.95%) and (96.29%), against thrips (99.56%) and (98.94%) and against aphid (96.27%) and (89.73%), respectively. The efficacy of Neem based biopesticides ranked 2nd and after 1st and 2nd spray the efficacy against whitefly was (75.35%) and (82.56%), against thrips (81.00%) and (78.72%) and against aphid (79.71%) and (76.43%), respectively. The efficacy of Tooh based biopesticides ranked 3rd and after 1st and 2nd spray the efficacy against whitefly was (67.99%) and (76.87%), against thrips (74.50%) and (63.41%) and against aphid (69.15%) and (64.71%), respectively. The efficacy of Tobacco based biopesticides ranked 4th and after 1st and 2nd spray the efficacy against whitefly was (61.76%) and (70.88%), against thrips (64.95%) and (57.27%) and against aphid (60.40%) and (57.65%), respectively. The efficiency of Dhatura based product was lowest among the biopesticides applied. In untreated control, the insect pest infestation remained stabilized throughout the tomato season. All the biopesticides as well as synthetic pesticide effectively controlled the tomato insect pest infestation when compared with control. On the basis of results of the present research, it is suggested that biopesticides, particularly neem, tobacco and tooh based products may be applied against tomato insect pests, because the efficacy of neem based biopesticides remained highest throughout the study period against all the target pests. The application of biopesticides on tomato is not only provided effective control of insect pests, but due to residual effects of pesticides in tomato fruits, the human health is at risk, because indiscriminate use of the synthetic pesticides has caused several problems related to human health and other biological life.

Key words: biopesticides, insect pests of tomato

Introduction

Tomato plants are subject to infestation by the sucking insects, white fly (*B. tabaci*) and cotton aphid (*A. gossypii*). American bollworm (*Heliothis armigera*) attacks the ripped and pre-ripped fruits, contaminating them with fraises and exposing them to fungi and bacteria. Cotton leaf worm (*Spodoptera littoralis*) primarily damages the summer crops. It causes defoliation, but also it can bore into and feed on interior of fruits. Leaf miner (*L. trifolii*) attacks also tomato leaves causing various losses (Ahmed, 2000). For controlling insect pests of food crops, synthetic insecticides are widely used in most developing countries. This has contributed to the environmental pollution through air or as residues in food. In the last years is the use of environmentally biopesticides, such as plant extracts are widely increased. Extracts from the several trees and plants have been found effective against various insect pests and use of biopesticides have extensively been investigated in recent years, with demonstrated activity reported against more than 200 species of insects from several orders (Isman and Port. 1990). The diverse biological activities of plant extracts include feeding and oviposition deterrence, repellency, growth disruption, reduced fitness, and sterility (Schmutterer, 1990a). Despite of the sensitivity of insects of most orders to plant extracts, neem products are selective as they do not harm important natural enemies of pests. They are also non-toxic to warm-blooded animals (Schmutterer, 1990b). Neem-seed extracts have, therefore, a considerable potential for integrated pest control measures especially in developing but also in industrialized countries (Schmutterer 1988; Schmutterer, 1995). Some other potential biopesticides include the extract from *Citrullus colocynthus* Schrad. L.) (locally named as Tumma in Punjabi and Tooh in Sindhi) which belongs to Cucurbitaceae family and the fruits are generally fed to animals for deworming and fruit extract of *Citrullus*

colocynthus is also effective against various insect pests of different crops. *Calotropis procera* Alton. F. (locally named Akk) is a famous medicinal plant and extracts made from its leaves and flowers is used for treatment of various human and animal diseases and disorders. The akk extract is reportedly effective to control crop insect pests (Shazia Sultana *et al.* 2006).

The significance of botanical pesticides/plant extracts is highly recognized in the field of agriculture as botanical pesticides are cheap, safe and sound, hazardless, non-residual, and highly effective against various insect pests. It has been used for crops like cotton, rice, okra, chickpea, safflower, sunflower and numerous vegetables against bollworms, fruit borers, aphids, jassids, thrips, whitefly, leaf hopper, diamond back moth etc. It acts as repellant, anti-feedant and its seed contains certain chemicals, which inhibits the population of insect pests. Apart from Neem, Huing (Asfoetida), Dhatoora (Thorn apple) and Tobacco based products, Eucalyptus extracts are also effectively used for controlling the sucking complex (Hashmi, 1994). Since, biopesticides have been used in the field for many years against many insect pests. It is therefore become the need to test these extract against individual insect pest in the laboratory so that to measure their effect on the life of insect pests. The present research work was carried out on the screening of biopesticides (plant extracts) against insect pests of tomato at Tandojam.

Materials and Methods

A field experiment on the screening of biopesticides (plant extracts) and chemical control (confidor) against insect pests of Tomato was conducted during the year 2013. The experiment was designed in a three replicated Randomized Complete Block Design with sub-plot size of 6x7m ($42m^2$). The sowing dates and methods were observed according to the plan of work. The recommended planting rate of 5.0 kg ha^{-1} was applied; whereas

row to row distance of 75 cm and plant to plant distance of 25 cm was maintained. The tomato nursery will be arranged with the courtesy of Horticulture Department of Sindh Agriculture University Tandojam. There were six treatments were used for the extracts of the botanicals plants were used to investigate their efficacy against tomato insect pests.

Preparation of extract

For preparation of plant extract, 10 kg leaves each of Neem (*Azadirachta indica*), Tobacco (*Nicotiana tabacum*), Tooh (*Citrullus colocyanthus* Schrad. L.) and Datura (*Datura stramonium*) were collected and processed for getting the extract. Each treatments stock weight was 10 kg boiled in 10 liters of water. The leaves of each plant species were taken separately and filtered through muslin cloth. When water remained 5 liters stock solution was ready to spray. After preparing the extracts, the tomato plants were sprayed with a knapsack hand sprayer. In both sprays, pretreatment observations were recorded before spray and post treatment observations were recorded after 1day, 2, 3, 7 and 15 days of spray and compared with control. Recommended pesticide for tomato was sprayed for chemical control (confider) @ 250 ml / acre (2.59ml/plot) and bio pesticide 5liter/Acre (52ml/plot) were sprayed. The collected data were used for statistical analysis using analysis of variance to know the significance of differences in the population of various insect pests and infestation at different intervals after treatment, and LSD (Least Significance Difference) test was applied to compare different treatments for their efficacies against these insect pests.

Results

The efficacy of different biopesticides against insect pests of tomato was examined during kharif season 2013. The

experimental crop was sown in the experimental area of the Entomology Section, Agriculture Research Institute (ARI) Tandojam. In the study, four treatments were based on different botanical extracts including Neem (*Azadirachta indica)*, Dhatura (*Dhatura stramonium)*, Tooh (*Citrullus colocynthus* Schrad) and Tobacco (*Nicotiana tabacum)*; while the efficacy of these biopesticides was compared with Chemical control (confidor) of insect pests with recommended pesticides as well as with untreated (check). Three insect pests were found infesting tomato including white fly, thrips and aphids. Pre-treatment- and post-treatment observations were recorded.

Whitefly

First spray

Before first spray of biopesticides on tomato crop, the pre-treatment count of whitefly on per leaf basis was managed and the data showed that the whitefly population did not decrease significantly after 1-day of first spray ($F=1.72$; $DF=17$; $P>0.05$), but declined significantly ($P<0.05$) after 2-days of spray ($F=5.57$; $DF=17$, $P<0.05$), 3-days after spray ($F=13.15$; $DF=17$, $P<0.05$), 7-days after spray ($F=23.87$; $DF=17$, $P<0.05$) and 15-days after spray ($F=23.12$; $DF=17$, $P<0.05$); while non-significant for pre-treatment ($F=0.21$; $DF=17$; $P>0.05$). The data (Table-1) showed that the chemical control (confidor) was most effective to combat whitefly with highest efficacy (85.95%); where the pre-treatment whitefly population (7.66/leaf) reduced to 5.36, 3.81, 2.32, 1.04 and 1.08/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Neem based biopesticide ranked 2nd by efficacy (75.35%) reducing pre-treatment whitefly population (7.86/leaf) to 5.66, 4.13, 2.60, 1.30 and 1.94/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The tooh based biopesticides ranked 3rd by efficacy (67.99%) reducing pre-treatment whitefly population (8.67/leaf) to 6.33, 4.75, 3.13, 1.66 and 2.78/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Similarly, tobacco

biopesticide ranked 4th by efficacy (61.76%) reducing pre-treatment whitefly population (8.36/leaf) to 6.52, 5.02, 3.41, 1.98 and 3.20/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (51.73%) reducing pre-treatment whitefly population (7.80/leaf) to 6.16, 4.81, 3.32, 1.96 and 3.77/leaf after 1, 2, 3, 7 and 15 days of spray, respectively.

Table-1: Efficacy of various biopesticides against whitefly infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after first spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
Chemical control (confidor)	7.66	5.36	3.81	2.32	1.04	1.08	85.95
Tooh	8.67	6.33	4.75	3.13	1.66	2.78	67.99
Dhatura	7.80	6.16	4.81	3.32	1.96	3.77	51.73
Neem	7.86	5.66	4.13	2.60	1.30	1.94	75.35
Tobacco	8.36	6.52	5.02	3.41	1.98	3.20	61.76
Untreated control	8.40	8.14	8.06	7.82	7.66	7.59	9.63
S.E.	1.263	1.049	0.913	0.792	0.725	0.722	-
LSD 0.05	NS	NS	2.035	1.765	1.616	1.608	-
CV%	19.05	20.20	21.96	25.75	34.17	33.19	-

It was observed that all the biopesticides as well as the synthetic pesticide lost their efficacy after 15 days of spray, and the population was lowest when monitored after 7 days of spray, which increased considerably when monitored after 15 days of spray. It was observed that all the biopesticides as well as synthetic pesticide effectively controlled the whitefly infestation when compared with control where the whitefly population sustained throughout the period of study. However, neem and tooh based biopesticides showed remarkable control of whitefly and dhatura based biopesticide remained the lowest. The situation regarding the efficacy was Chemical control (confidor), Neem, Tooh, Tobacco, Dhatura and Untreated control.

Second spray

The data (Table-2) indicated that the decrease in whitefly population was non-significant after one-day of second spray (F=0.54; DF=17; P>0.05) and two-days of spray (F=2.07; DF=17; P>0.05), but the whitefly population decreased significantly after 3-days after spray (F=4.03; DF=17, P<0.05), 7-days after spray (F=35.79; DF=17, P<0.05) and 15-days after spray (F=66.38; DF=17, P<0.05); while non-significant for pre-treatment (F=0.20; DF=17; P>0.05). The Chemical control (confidor) was most effective to control whitefly with highest efficacy (96.29%); where the pre-treatment whitefly population (43.80/leaf) reduced to 35.04, 28.38, 22.99, 7.71 and 1.62/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Neem based biopesticide ranked 2nd by efficacy (82.56%) reducing pre-treatment whitefly population (38.99/leaf) to31.97, 26.54, 22.03, 8.59, and 6.80/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The tooh based biopesticide ranked 3rd by efficacy (76.87%) reducing pre-treatment whitefly population (36.85/leaf) to 30.50, 26.30, 22.62, 9.73 and 8.52/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Similarly, tobacco biopesticide ranked 4th by efficacy (70.88%) reducing pre-treatment whitefly population (41.32/leaf) to 34.71, 30.54, 26.88, 12.09 and 12.03/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (61.33%) reducing pre-treatment whitefly population (38.39/leaf) to 33.40, 29.72, 26.45, 12.96 and 14.84/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. In control (check) plots, pre-treatment whitefly population was (42.26/leaf) and 43.74, 43.30, 43.56, 44.39 and 43.95/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The results showed that all the biopesticides and synthetic pesticide controlled the whitefly population effectively, but the highest efficacy was showed by neem based biopesticde, followed by tooh based biopesticide, synthetic pesticide and tobacco based biopesticide, and lowest by the untreated check. Moreover, the pesticide effectively

maintained their efficacy upto the 15 days after spray. On the basis of efficacy level the pesticides were effective as: Chemical control (confidor), Neem, Tooh, Tobacco, Dhatura and Untreated control.

Table-2: Efficacy of various biopesticides against whitefly infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after second Spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
Chemical control (confidor)	43.80	35.04	28.38	22.99	7.71	1.62	96.29
Tooh	36.85	30.59	26.30	22.62	9.73	8.52	76.87
Dhatura	38.39	33.40	29.72	26.45	12.96	14.84	61.33
Neem	38.99	31.97	26.54	22.03	8.59	6.80	82.56
Tobacco	41.32	34.71	30.54	26.88	12.09	12.03	70.88
Untreated control	42.26	43.74	43.30	43.56	44.39	43.95	- 4.00
S.E.	0.957	0.767	0.649	0.580	0.373	0.334	
LSD 0.05	NS	NS	NS	1.293	0.831	0.745	
CV%	22.58	21.02	20.11	20.42	23.23	34.50	

Thrip

First spray

The results indicated that the thrips population decreased significantly after 1-day of first spray ($F=19.76$; $DF=17$; $P<0.05$), 2-days after spray ($F=66.25$; $DF=17$, $P<0.05$), 3-days after spray ($F=124.21$; $DF=17$, $P<0.05$), 7-days after spray ($F=403.38$; $DF=17$, $P<0.05$) and 15-days after spray ($F=436.77$; $DF=17$, $P<0.05$); while non-significant for pre-treatment ($F=2.23$; $DF=17$; $P>0.05$). Table-3 reveals the chemical control (confidor) was most effectively controlled the thrips infestation on tomato crop with highest efficacy (99.56%); where the pre-treatment thrips population (43.80/leaf) reduced to 28.47, 20.21, 10.31, 1.75 and 0.19/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The neem based biopesticide ranked 2nd by efficacy (81.00%) reducing pre-treatment thrips population (38.99/leaf) to 26.91, 19.64, 18.27, 3.84 and 7.41/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Tooh based biopesticide ranked 3rd

by efficacy (74.50%) reducing pre-treatment thrips population (36.85/leaf) to 25.06, 18.04, 9.38, 1.22 and 9.40/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Similarly, tobacco biopesticide ranked 4th by efficacy (64.95%) reducing pre-treatment thrips population (41.32/leaf) to 28.92, 21.40, 12.41, 8.07 and 14.48/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (53.87%) reducing pre-treatment thrips population (38.39/leaf) to 27.64, 20.73, 20.31, 11.99 and 17.71/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The results further indicated that all the biopesticides as well as synthetic pesticide effectively controlled the thrips infestation when compared with control where the thrips population sustained throughout the period of study. The population was lowest in all treatments when monitored after 15 days of spray. However, neem and tooh based biopesticides showed remarkable control of thrips and dhatura based biopesticide remained the lowest when compared with the chemical control. The efficacy was categorized on the basis of results as: Chemical control (confidor), Neem, Tooh, Tobacco, Dhatura and Untreated control.

Second spray

The thrips population decreased significantly after 1-day of second spray ($F=13.67$; $DF=17$; $P<0.05$), 2-days after spray ($F=19.25$; $DF=17$, $P<0.05$), 3-days after spray ($F=44.49$; $DF=17$, $P<0.05$), 7-days after spray ($F=53.19$; $DF=17$, $P<0.05$) and 15-days after spray ($F=68.79$; $DF=17$, $P<0.05$); while non-significant for pre-treatment ($F=0.20$; $DF=17$; $P>0.05$). The data (Table-4) indicated that highest efficacy against thrips on tomato was resulted by chemical control (confidor) (98.94%); where the pre-treatment thrips population (24.42/leaf) reduced to 11.17, 10.16, 7.22, 2.38 and 0.26/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Neem biopesticide ranked 2nd by efficacy (78.72%) reducing pre-treatment thrips population

(22.77/leaf) to 11.39, 9.56, 3.63, 0.91 and 4.95/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The tooh based biopesticide ranked 3rd by efficacy (63.41%) reducing pre-treatment thrips population (23.68/leaf) to 12.31, 10.47, 3.38, 2.44 and 8.66/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Tobacco based biopesticide ranked 4th by efficacy (57.27%) reducing pre-treatment thrips population (23.28/leaf) to 13.03, 11.21, 10.76, 7.64 and 9.73/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (45.51%) reducing pre-treatment thrips population (23.28/leaf) to 13.27, 12.61, 12.35, 11.00 and 12.68/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. All the biopesticides as well as synthetic pesticide effectively controlled the thrips infestation when compared with control where the thrips population sustained throughout the period of study. The population was lowest in all treatments when monitored after 15 days of spray. However, neem and tobacco and tooh based biopesticides showed remarkable control of thrips and Dhatura based biopesticide remained the lowest when compared with the chemical control and untreated (check). The efficacy was categorized on the basis of results as: Chemical control, Neem, Tobacco, Tooh, Dhatura and Untreated control. Differences were negligible in efficacy between neem, tooh, tobacco, dhatura based biopesticides and chemical control confidor.

Aphids

First spray

The data (Table-5) showed that the aphid population declined significantly after 1-day of first spray ($F=10.19$; $DF=17$; $P<0.05$), 2-days after spray ($F=20.59$; $DF=17$, $P<0.05$), 3-days after spray ($F=31.09$; $DF=17$, $P<0.05$), 7-days after spray ($F=51.72$; $DF=17$, $P<0.05$) and 15-days after spray ($F=51.36$; $DF=17$, $P<0.05$); while non-significant for pre-treatment ($F=0.23$; $DF=17$; $P>0.05$). The chemical control (confidor)

resulted in a remarkable control of aphid infestation on tomato with highest efficacy (96.27%); where the pre-treatment insect population (18.15/leaf) reduced to 9.26, 5.65, 3.44, 0.45 and 0.68/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The neem based biopesticide ranked 2nd by efficacy (79.71%) reducing pre-treatment aphids population (20.05/leaf) to 11.03, 7.17, 4.44, 1.02 and 4.07/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Similarly, tooh based biopesticide ranked 3rd by efficacy (69.15%) reducing pre-treatment aphid population (20.51/leaf) to 16.00, 12.48, 9.73, 1.48 and 6.33/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Tobacco based biopesticide ranked 4th by efficacy (60.40%) reducing pre-treatment aphids population (18.79/leaf) to 11.08, 7.32, 4.83, 3.43 and 7.44/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (41.19%) reducing pre-treatment aphid population (19.31/leaf) to 9.08, 8.62, 8.45, 7.52 and 11.36/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. It was noted that all the biopesticides as well as synthetic pesticide effectively controlled the aphid infestation when compared with control where the aphid population remained stabled throughout the period of study. However, the all the pesticides lost their efficacy when monitored after 15 days after treatment; and the insect again started buildup two weeks after spray; as the lowest infestation was recorded after 7 days of spray. However, neem and tooh based biopesticides showed remarkable control of aphid and dhatura based biopesticide remained the lowest when compared with the chemical control. On the basis of efficacy, the treatments stood for effectiveness as: Chemical control (confidor), Neem, Tooh, Tobacco, Dhatura and Untreated control.

Table-3: Efficacy of various biopesticides against thrips infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after first spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
hemical control (confidor)	43.80	28.47	20.21	10.31	1.75	0.19	99.56
Neem	38.99	26.91	19.64	18.27	3.84	7.41	81.00
Dhatura	38.39	27.64	20.73	20.31	11.99	17.71	53.87
Tooh	36.85	25.06	18.04	9.38	1.22	9.40	74.50
Tobacco	41.32	28.92	21.40	12.41	8.07	14.48	64.95
Untreated control	42.26	41.20	40.78	39.82	43.01	41.29	2.29
S.E.	2.4818	1.8433	1.5064	1.4416	1.1196	1.0982	
LSD 0.05	NS	4.1071	3.3565	3.2121	2.4945	2.4470	
CV%	7.55	7.60	7.85	9.59	11.71	14.31	

Table-4: Efficacy of various biopesticides against thrips infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after second spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
Chemical control (confidor)	24.82	11.17	10.16	7.22	2.38	0.26	98.94
Tooh	23.68	12.31	10.47	3.35	2.44	8.66	63.41
Dhatura	23.28	13.27	12.61	12.35	11.00	12.68	45.51
Tobacco	22.77	11.39	9.56	3.63	0.91	9.73	57.27
Neem	23.28	13.03	11.21	10.76	7.64	4.95	78.72
Untreated control	24.39	23.41	23.18	22.94	23.84	22.89	6.17
S.E.	2.401	1.775	1.723	1.545	1.674	1.581	
LSD 0.05	NS	3.955	3.840	3.445	3.733	3.522	
CV%	12.41	15.42	16.31	18.86	25.52	32.82	

Second spray

The results indicated that the aphid population decreased remarkably after 1-day of second spray ($F=17.32$; $DF=17$; $P<0.05$), 2-days after spray ($F=29.82$; $DF=17$, $P<0.05$), 3-days after spray ($F=16.53$; $DF=17$, $P<0.05$), 7-days after spray ($F=61.96$; $DF=17$, $P<0.05$) and 15-days after spray ($F=52.93$; $DF=17$, $P<0.05$); while non-significant for pre-treatment ($F=1.06$; $DF=17$; $P>0.05$). The results (Table-6) show that chemical control (confidor) produced excellent pest control on tomato with highest efficacy (89.73%); where the pre-treatment insect population (25.07/leaf) reduced to 22.82, 18.48, 13.12, 1.71 and 2.58/leaf after 1, 2, 3, 7 and 15 days of spray,

respectively. The neem based biopesticide ranked 2nd by efficacy (76.43%) reducing pre-treatment aphid population (21.53/leaf) to 13.99, 9.80, 6.66, 1.48 and 5.07/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Similarly, tooh based biopesticide ranked 3rd by efficacy (64.71%) reducing pre-treatment aphid population (22.66/leaf) to 17.66, 13.79, 10.75, 1.61 and 8.00/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Tobacco based biopesticide ranked 4th by efficacy (57.65%) reducing pre-treatment aphids population (24.16/leaf) to 16.67, 7.67, 4.29, 2.19 and 10.23/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. Dhatura based biopesticide ranked 5th by efficacy (47.10%) reducing pre-treatment aphid population (22.36/leaf) to 10.51, 9.98, 9.78, 8.71 and 11.83/leaf after 1, 2, 3, 7 and 15 days of spray, respectively. The results showed that all the biopesticides as well as synthetic pesticide were effective to control aphid on tomato as compared to control. However, the all the pesticides lost their efficacy after 15 days of spray; and the aphid population witnessed increasing after two weeks of spray; while the lowest infestation was recorded after 7 days of spray. However, neem, tobacco and tooh based biopesticides resulted excellent aphid control, but Dhatura based biopesticide could produce good control of tomato aphid. On the basis of efficacy, the treatments stood for effectiveness as: Chemical control (confidor), Neem, , Tooh, Tobacco, Dhatura and Untreated check.

Table-5: Efficacy of various biopesticides against aphids infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after first spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
Chemical control (confidor)	18.15	9.26	5.65	3.44	0.45	0.68	96.27
Neem	20.05	11.03	7.17	4.44	1.02	4.07	79.71
Dhatura	19.31	9.08	8.62	8.45	7.52	11.36	41.19
Tobacco	18.79	11.08	7.32	4.83	3.43	7.44	60.40
Tooh	20.51	16.00	12.48	9.73	1.46	6.33	69.15
Untreated control	19.11	18.73	18.54	18.35	17.61	16.91	11.52
S.E.	2.525	1.743	1.538	1.405	1.294	1.280	

LSD 0.05	5.526	3.426	3.426	3.131	2.884	2.852	
CV%	16.01	17.04	18.79	20.97	30.20	24.84	

Table-6: Efficacy of various biopesticides against aphids infestation on Tomato as compared to chemical control (Synthetic pesticide) at different intervals after second spray.

Treatments	Pre-treatment	Post treatment observation/plant after:					Reduction (%)
		1-Day	2-Days	3-Days	7 Days	15 days	
Chemical control (confidor)	25.07	22.82	18.48	13.12	1.71	2.58	89.73
Neem	21.53	13.99	9.80	6.66	2.92	5.07	76.43
Dhatura	22.36	10.51	9.98	9.78	16.77	11.83	47.10
Tobacco	24.16	16.67	7.67	4.29	6.78	10.23	57.65
Tooh	22.66	17.68	13.79	10.75	5.30	8.00	64.71
Untreated control	25.02	24.52	24.27	24.02	23.06	23.52	5.99
S.E.	2.0423	1.7930	1.6778	1.6223	1.5451	1.6251	
LSD 0.05	NS	3.9950	3.7383	3.6147	3.4426	3.6226	
CV%	10.66	12.41	14.59	17.42	29.30	29.72	

Discussion

Although the chemical control is an effective measure to control insect pests, but due to residual effects of these chemicals, particularly on vegetables, the human health and other biological life is at risk. Hence, it is imperative to develop suitable control measures to minimize these risks. The research on biopesticides has proved that the plant extracts are effective to control crop insect pests and their application is safe for the human and other biological life. Hence, the study was carried out during kharif 2013 to examine the efficacy of different biopesticides against insect pests of tomato. Four treatments were based on different biopesticides Neem (*Azadirachta indica)*, Dhatura (*Dhatura stramonium)*, Tooh (*Citrullus colocynthus* Schrad) and Tobacco (*Nicotiana tabacum*); while the efficacy of these biopesticides was compared with chemical control (confidor SL200 @250 ml/acre) and untreated (check). The findings of the present study showed that among biopesticides the efficacy of chemical control (confidor) was highest after 1st and 2nd spray against whitefly (85.95%) and

(96.29%), against thrips (99.56%) and (98.94%) and against aphid (96.27 and 89.73%), respectively. The efficacy of neem based biopesticides ranked 2nd and after 1st and 2nd spray the efficacy against whitefly was (75.35%) and (82.56%), against thrips (81.00%) and (78.72%) and against aphid (79.71%) and (76.43%), respectively. The efficacy of tooh based biopesticides ranked 3rd and after 1st and 2nd spray the efficacy against whitefly was (67.99%) and (76.87%), against thrips (74.50%) and (63.41%) and against aphid (69.15%) and (64.71%), respectively. The efficacy of tobacco based biopesticides ranked 4th and after 1st and 2nd spray the efficacy against whitefly was (61.76%) and (70.88%), against thrips (64.95%) and (57.27%) and against aphid (60.40%) and (57.65%), respectively. The efficiency of dhatura based product was lowest among the biopesticides applied.In untreated control, the insect pest infestation remained stabilized throughout the tomato season. The results are further supported by Lowery and Isman (1994) who reported 50% mortality of aphids by spraying neem based biopesticide; while Kumar and Singh (2001) reported that neem seed kernel extract was effective in controlling insect pests with highest cost:benefit ratio. Similarly, Singh and Kumar (2003) determined the efficacy of neem (*Azadirachta indica)* based pesticides against sucking complex and neem kernel extract was the most effective in controlling the aphid and jassid. Binage *et al.* (2004) found that 5% neem seed extract showed the lowest infestation of aphids and maximum crop yield. Tiwari and Srivastava (2005) examined the efficacy of some plant extracts, i.e. neem, eucalyptus, bougainvillea, mint, dhatura, lantana, ramphal, sitaphal, mehandi, tulsi and ginger against crop pests in the laboratory and reported that all extracts exhibited significant antifungal activity. Similarly, Haq (2006) examined the efficacy of different neem products (botanical pesticides) against sucking complex (Thrip, Aphid, Jassid, and Whitefly) on okra crop and concluded that thrips,

jassid and whitefly population was remarkably controlled with the application of different neem products.

Conclusions

All the biopesticides as well as synthetic pesticide effectively controlled the whitefly infestation when compared with control. The Chemical pesticides were highly effective to control whitefly, thrips and aphids on tomato; but neem extract showed nearly relate results for its efficacy against the target insect pests when compared with chemical control. Neem extract and Tooh extract also showed remarkable results for their efficacy against tomato whitefly, thrips and aphids during both the sprays.Although, the Dhatura extract was also effective to control the tomato insect pests, but its efficacy was lowest among all the other biopesticides and chemical control. By overall efficacy of biopesticides against whitefly, thrips and aphids after first and second spray, the treatments ranked as: chemical control, neem extract, tooh extract, tobacco extract and dhatura extract.

REFERENCES

Ahmed, M.M.M. 2000. *Studies on the Control of Insect Pests in Vegetables (Okra, Tomato, and Onion) in Sudan with Special Reference to Neem preparations*. University of Giessen, Germany, Pp.13-31.

Arain, M.I. 2009. *Effect of Botanical pesticides against mealy bug on cotton.* M.Sc. Thesis submitted to Sindh Agriculture University Tandojam. Pp. 23-30.

Binage, A. B., D. S. Suryawanshi, A. T. Munde, P. D. Mane, S. G. Salunke. 2004. "Studies on efficacy of some botanicals against major pests of cabbage." *J. Soils and Crops*. 14 (1): 163-165.

Bindu, Panickar, Bharpoda, T. M., Patel, J. R. and Patel, J. J. 2003. "Evaluation of various schedules based on botanical and synthetic insecticides in okra ecology." *Indian J. of Entomol.* 65(3):344-346.

Biopesticide Industry Alliance. 2011. Biochemical Biopesticides: Plant Extracts. http://www.biopesticideindustryalliance.org/biochemicalplant.php

Dutt, U. 2007. "Mealy Bug Infestation In Punjab: Bt. Cotton Falls Flat." Kheti Virasat Mission. Jaitu, Faridkot district based environmental NGO in Punjab.

Haq, A. 2006. *Efficacy of different neem products against sucking complex on okra Abelmoschus esculentus (l.).* M.Sc. Thesis (Entomology) submitted to Sindh Agriculture Unievrsity Tandojam. Pp.17-25.

Hashmi, R.A. 1994. *Insect Pest Management, cereal and cash crops.* Pak. Agric. Res. Council Islamabad. 317

Hassan, M., F. Ahmad, A. Ali and M. Ahmad. 2006. "Some studies on the effect of synthetic growth regulators and neem plant materials against sucking insect pests of cotton." *Pakistan Entomologist* 11(3): 75-79.

Isman, M. Z. and G.R. Port. 1990. "Systemic action of neem seed substances against Pieris brassicae." *Entomol. exp. appl.* 54: 297-300.

Khaskheli, M.A. 2007. "Mealy bug: An emerging threat to cotton crop." Model Farming, Pakissan.com, Pp.1-5.

Khattak, M.K., M. Rashid, S.A.S. Hussain and T. Islam. 2006. "Comparative effect of neem (*Azadirachta indica*) oil, neem seed water extract and Baythroid against whitefly, Jassids and Thrips on cotton." *Pak. Entomol.* 28 (1): 31-37.

Kumar, M. and A.K. Singh. 2001. "Bioefficacy of insecticides against the cotton jassid, *Amrasca biguttula* (Ishida), on okra." *Pest Management and Economic Zoology* 9 (1): 55-58.

Lowery, D.T. and M. B. Isman. 1994. "Insect growth regulating effects of neem extract and azadirachtin on aphids." *Entomologia Experimentalis et Applicata* 72 (1): 77–84.

Pingali, P. L. 1992. "Impact of pesticides on the lowland paddy eco-system: results from a multidisciplinary study in the Philippines." Paper presented at the Workshop on Measuring the Health and Environmental Effects of Pesticides. Pp. 5-10.

Rukhsana, A., S.M. Mughal, M. Munir, K. Sultana, R. Qureshi, M. Arshad and A.K. Laghari. 2010. "Mycoflora associated with seeds of different sunflower cultivars and its management." *Pakistan J. Botany*. 42(1): 435-445.

Saker, I., R. Suliman and D. Namora. 2003. "Importance of plant extracts in managing *Aphis fabae*." Abst. Eighth Arab Congress of Plant Protection, 12-16 October 2003, El-Beida, Libya.

Schmutterer, H. 1988. "Potential of azadirachtin-containing pesticides for integrated pest control in developing and industrialized countries." *J. Insect Physiology*. 34: 713-719.

Schmutterer, H. 1990a. "Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*." *Annual Review of Entomol*. 35: 271-297.

Schmutterer, H. 1995. *The neem tree, Azadirachta indica A. Juss and other Meliaceous plants Sources of unique natural products for integrated pest management, medicines, industry and other purposes*. VCH Publishers Inc., New York, USA, Pp. 253.

Schmutterer, H.1990b. "Future task of neem research in relation to agricultural needs worldwide." In. *Neem's Potential in Pest Management Programs, Proc. USDA Neem Workshop*. Eds. J. C. Locke and R. H. Lawson. USDA ARS-86, Pp. 15-22.

Shazia, Sultana, Mir Ajab Khan, Mushtaq Ahmad and Muhammad Zafar. 2006. "Indigenous Knowledge of Folk Herbal Medicines by the Women of District Chakwal, Pakistan." *Ethnobotanical Leaflets* 10: 243-253.

Singh, A.K. and M. Kumar. 2003. "Efficacy and economics of neem based products against cotton jassid, *Amrasca biguttulla* Ishida in okra." *Crop Research (Hisar)* 26, (2) : 271-274.

Teng, P.S. 1990. "Integrated pest management in rice: an analysis of the status quo with recommendations for action." Report prepared for a Task Force of the Technical Advisory Committee of the Consultative Group on International Agricultural Research reviewing international activities in IPM. University of Hawaii, Honolulu, USA. 64 p.

Tiwari and K.J. Srivastava 2005. "Studies on bio-efficacy of some plant extracts against Pathogens of onion." *J. crop Science* 24 (1): 6-10.

Yadav, J.B., R.S. Singh and R.A. Tripathi. 2008. "Evaluation of Bio-pesticides against pest complex of Okra." *Annals of Plant Protection Sci.*, 16 (1): 492-498.