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Screening of Biopesticides Against Insect Pests of Brinjal

Authors

T. J.Ursani[1], S. Malik[1], J.I.Chandio[2], Z.A.Palh[3], N.M. Soomro[1], K.H.Lashari[3]

M.A.Baloch[4], B.K.Solangi[4], M.N. Solangi[4], G.M. Mastoi[5]

[1]Department of Zoology, University of Sindh Jamshoro
[2] Department of Statistics, University of Sindh Jamshoro
[3]Department of Fresh Water Biology and Fisheries, University of Sindh Jamshoro
[4]Department of Entomology, Sindh Agriculture University, Tando Jam
[5]*Center for Environmental Sciences, University of Sindh, Jamshoro, Sindh, Pakistan*
Corresponding Author
Z.A.Palh
University of Sindh Jamshoro Email: *zameer_ali110@hotmail.com*

ABSTRACT
A field study was carried out during 2013 at the experimental area of Entomology Section, Agriculture Research Institute, (ARI) Tandojam to examined the efficacy of different biopesticides against insect pests of brinjal . Seven treatments with three replictions were applied. The treatments were: T1=chemical control (confidor/Nissuran), T2=Neem (Azadirachta indica), T3=Akk (Calotropis procera Alton. F.), T4=Tooh (Citrullus colocynthus Schrad. L.), T5=Datura (Datura stramonium) T6=Tabacco (Nicotiana tabacum) and T7=Control (untreated). Three insect pests were found infesting brinjal including white fly ,mites and jassid. Pre treatment- and post-treatment observations were recorded.

The results revealed that against white fly the first spray of chemical control(confidor) showed highest efficacy (98.51%), followed by Neem extract (95.96%), Tobacco extract (94.70%), Tooh extract (92.78%), Akk extract (89.17%) and lowest for Dhatura extract (87.68%); while in the second spray also, chemical control(confidor) showed highest efficacy against white fly (82.50%); followed by Neem extract (81.38%), Tobacco extract (79.93%), Tooh extract (77.11%) akk extract(77.42%) and least by Dhatura extract (71.78%). Against mites, chemical control (Nissuran) showed highest efficacy (83.53%) as observed during 1st spray, followed neem extract,(77.74%) Tobacco extract,(71.81%),tooh extract (67.95%),akk extract(62.01%) and Dhatura extract (56.52%), while after second spray also, chemical control (Nissuran) showed highest efficacy (80.57%), followed by Neem extract (72.80%), Tobacco extract (67.48%), Tooh extract (65.84%), Akk extract (52.96%) and the lowest efficacy was resulted by Dhatura extract (48.26%). Against jassid population on brinjal the first spray results showed that chemical control(confidor) showed highest efficacy (97.95%), followed by Neem extract (96.08%), Tobacco extract (95.63%), Tooh extract (86.17%),akk extract(81.19%) and Dhatura (70.94%) and least efficacy resulted by After second spray, chemical control(confidor) showed highest efficacy (99.64%), followed by Neem extract (98.36%), Tobacco extract (93.75%), Tooh extract (88.73%), Akk extract (83.62%) and the lowest efficacy was resulted by Dhatura extract (69.03%) respectively. Chemical control (confidor/Nissuran),showed its superiority in efficacy to combat all the insect pests studied in brinjal, followed by Neem extract Tobacco extract. Tooh extract, Akk extract and Dhatura remained the least.

Keywords: *Entomology, biopesticides, Tobacco, brinjal, Tooh extract, Akk extract and Dhatura remained the least.*

INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the most important vegetable crops; is relatively inexpensive and is available throughout the year. Though brinjal is a summer crop, it is being grown throughout the year under irrigated condition. Hence, it is subjected to attack by number of insect pests, right from nursery stage till harvesting (Regupathy *et al*. 1997). Brinjal is attacked by insect and mite pests starting from seedling stage to senescence. The white fly, cotton leaf hopper, *Amrasca biguttula* biguttula Ishida and epilachna beetle, *Henosepilachna (Epilachna) vigintioctopunctata Fabricius* are the destructive pests on brinjal in Asia. Independently, in the entire South Asian region the shoot and fruit borer were identified as the primary limiting factor in brinjal production. Occasionally, brinjal is severely infested by mites, *Tetranychus* sp., aphids, *Aphis gossypii* Glover and whiteflies including *Bemisia tabaci* Guenee and *Trialeurodes* sp. In Himachal Pradesh, among 27 different insect species and one mite species reported to be associated with brinjal crop (Patil and Mehta, 2008), shoot and fruit borer, *L. orbonalis* (Lepidoptera: Pyralidae) is the key pest throughout Asia (Allam *et al*., 1982). This pest has a vast distribution and has been categorized as the most destructive and most serious pest causing huge losses in brinjal (Patil and Mehta, 2008). The larvae bore into tender shoots in the early stage resulting in drooping shoots,which are readily visible in the infested fields. At the later stage, caterpillars bore into flower buds and fruits, rendering the fruit unfit for consumption and marketing resulting in direct yield losses. Further studies show that *Leucinodes orbonalis* (Guen.), whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Amrasca biguttula* biguttula (Ishida), Epilachna beetle, *Henosepilachna vigintioctopunctata* (Fab.) and non insect pest, red spider mite, *Tetranychus macfurlanei* are the major insect pests of brinjal (Soto *et al.* 2010; Eswara and Srinivasa, 2001). These insect pests are known to damage shoot and fruit of brinjal in all stages of its growth. The yield loss due to these pests is to the extent of 70-92 percent. Brinjal is mainly infested by lepidopteran insect pests which cause extensive damage to the growing shoot tips and fruits, thereby drastically reducing the marketable fruit yield (Eswara Reddy and Srinivas, 2004). Synthetic pesticides are widely used to control insect pests of brinjal, which may adversely affect human health and there is need to introduce/adopt environmentally safe, effective and ecofriendly strategies to control these insect pests (McGaughey *et al*. 1998).With the advent of chemical pesticides, this crisis was resolved to a great extent. But the over dependence on chemical pesticides and eventual uninhibited use of them has necessitated for alternatives mainly for environmental concerns. Degraded soils and groundwater pollution has resulted in nutritionally imbalanced and unproductive lands. Violative pesticide residues also sometimes raise food safety concerns among domestic consumers and pose trade impediments for export crops. Therefore, an ecofriendly alternative is the need of the hour. Biopesticides, a contraction of biological pesticides, include several types of pest management intervention through predatory, parasitic or chemical relationships. The term has been associated historically with biological control and by implication the manipulation of living organisms. Biopesticides are plant substances to control insect pests (Nzanza and Mashela, 2012) and these naturally occurring substances control pests by non-toxic mechanisms (Bardin *et al.* 2008); while toxic effects of synthetic pesticides cannot be tolerated (Knott, 1998); hence safer insect pest control may be possible by biopesticides application (Adalbert *et al.* 2013). Generally in brinjal, fruit and shoot borers, jassids and mites are major threat and application of pesticides showed effective control of these insect pests (Bardin *et al.* 2008; Nzanza and Mashela, 2012; Adalbert *et al.* 2013). The biopesticides are effective in suppressing the larval population of borers and jassids (Prasad and Devappa, 2006); and many other insect pests infesting vegetables (Jeyarani and Kennedy, 2004; Waghmare *et al*., 2006; Hemchandra and Singh 2006; Shukla and Kumar, 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. The biopesticides have been used for almost all field crops and vegetables against bollworms, fruit borers, aphids, jassids, thrips, whitefly, leaf hopper, diamond back moth etc. The plant extracts act 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 (Eswara Reddy and Srinivas, 2004)). Since, biopesticides have been used in the field for many years against many insect pests. The present study was carried out to screen out plant extracts being used as biopesticides against insect pests of Brinjal (*Solanum melongena* L.) at Tandojam.

MATERIALS AND METHODS

The screening of biopesticides (plant extracts) against insect pests of Brinjal, was carried out during the year 2013. The experiment was laid out in a three replicated Randomized Complete Block Design in a sub-plot size of 3m x 3 ($9m^2$). A total of 21 plots were prepared and divided into three separate blocks as replications to manage seven treatments.

Land preparation

However, the land was prepared in off-season. Initially, the hard pan of the experimental soil was removed by running disc plow and left for 15 days. Later, the clods were crushed using tractor drawn clod crusher, and leveling was performed. After soaking dose, when the land came in condition, the plots were finally prepared by giving separation strips and forming feeding channels.The row to row distance was maintained at 60 cm and plant to plant distance of 30 cm.

Sowing

The nursery of brinjal variety "Pusa Purple Round"were obtained by the courtesy of Sindh Horticulture Research Institute, Mirpurkhas and transplanting were done on 25th April, 2013. The irrigation was applied initially just before transplanting, and afterwards when felt necessary.

Treatments 07

T1 Chemical control (confidor/ Nissuran)

T2 Neem (*Azadirachta indica*)
T3 Tobacco (*Nicotiana tabacum*
T4 Tooh (*Citrullus colocynthus* Schrad.L)
T5 Akk (*Calotropis procera* Alton. F.)
T6 Dhatura (*Datura stramonium*)
T7 Control (untreated)

Preparation of botanical extracts

Preparation of plant extract, 10 kg leaves each of Neem (*Azadirachta indica*), Tobacco(*Nicotiana tabacum*), Akk (*Calotropis procera* Alton. F.),Tooh (*Citrullus colocyanthus* Schrad. L.) and Dhatura (*Dhatura stramonium*) were collected and processed for getting the extract. Each treatments plant material were boiled in 10 liters of water.When water remained 5 liters,the prepared stock solution filtered through muslin cloth.The extracts of different plants material were sprayed with a knapsack hand sprayer.The two sprays were carried out, and observed their efficacy after 24, 48, 72, 96 hours 1 week and 2 weeks of spray and compared with control. Recommended pesticides for brinjal was sprayed for chemical control Confidor /Nissuran @ 250 ml / 250 gm /acre (0.56ml/0.56gm /plot) and bio pesticide 5liter/acre (12ml/plot) was sprayed.

The data thus collected were subjected to 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

Use of botanical substances for control of insect pests has been found most effective way to balance the ecosystem. The experiments were

conducted during 2013 at the experimental area of Entomology Section, Agriculture Research Institute (ARI) Tandojam to investigate the efficacy of different biopesticides against insect pests of brinjal; using of Chemical control(confidor/ Nissuran) Neem (*Azadirachta indica*), Tobacco (*Nicotiana tabacum*), Akk (*Calotropis procera* Alton. F.), Tooh (*Citrullus colocynthus* Schrad.L) and Datura (*Datura stramonium*), while their efficacy was compared with Tobacco (*Nicotiana tabacum*) and an untreated control was also maintained. Three insect pests posing threat to brinjal production (white fly, mites and jassid) were monitored and the data are shown in Tables 1 to 6.

WHITE FLY

First spray

The analysis of variance showed that the efficacy of different biopesticides against white fly varied significantly ($P<0.05$) when monitored after 48 hours after first spray ($F=7.38$; $DF=20$; $P<0.05$), 72 hours after spray ($F=13.35$; $DF=20$; $P<0.05$); 96 hours of spray ($F=50.31$; $DF=20$; $P<0.05$); week after spray ($F=87.45$; $DF=20$; $P<0.05$), two weeks after spray ($F=127.03$; $DF=20$; $P<0.05$); and non-significant ($P>0.05$) when monitored for pre-treatment ($F=0.28$; $DF=20$; $P>0.05$) and after 24 hours of spray ($F=2.56$; $DF=20$; $P>0.05$).

The data in Table-1 showed that all the biopesticides showed their efficacy throughout the observational period of two weeks after first spray against whit fly in brinjal; and in plots sprayed with chmical control (confidor), white fly infestation reduced from 4.48/plant to 0.07/plant after two weeks of spray showing the highest efficacy of 98.51%; while the the neem extract ranked 2nd reducing white fly infestation from 4.75/plant to 0.19/plant showing efficacy of 95.96 % Tobacco extract ranked 3rd reducing white fly infestation from 4.55/plant to 0.25/plant showing efficacy of 94.70% while Tooh extract ranked 4th reducing white fly population from 4.93/plant to 0.34/plant showing efficacy of 93.04%. Similarly, the Akk extract ranked 5th, reducing pest population from 4.86/plant to 0.51/plant after 2 weeks of spray showing efficacy of 89.17% while Dhatura extract ranked least among biopesticides decreasing white fly population from 4.66/plant to 0.58/plant with lowest efficacy of 87.68%.

Table-1 Efficacy of different biopesticides against white fly infestation on brinjal as compared to chemical control (confidor) at different intervals after first spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical control (confidor)	4.48	3.49	2.66	2.12	0.76	0.34	0.07	4.41	98.51
Neem extract	4.75	3.90	3.04	2.49	1.40	0.77	0.19	4.56	95.96
Tabacco extract	4.55	3.78	3.02	2.54	1.50	0.87	0.25	4.30	94.70
Tooh extract	4.93	4.19	3.43	2.95	1.83	0.95	0.34	4.58	92.78

Akk extract	4.86	4.33	3.63	3.20	2.11	1.31	0.51	4.35	89.17
Dhatura extract	4.66	4.19	3.60	3.24	2.24	1.41	0.58	4.08	87.68
Untreated	4.96	5.01	4.81	4.66	4.71	4.76	4.71	0.25	00
S.E.±	0.4913	0.4269	0.3608	0.3193	0.2514	0.2245	0.2092		
LSD 0.05	-	-	0.7861	0.6956	0.5477	0.4891	0.4558		
LSD 0.01	-	-	1.1060	0.9752	0.7678	0.6857	0.6390		

Second spray

The analysis of variance indicated that the efficacy of different biopesticides against white fly varied significantly ($P<0.05$) when monitored after 48 hours after second spray ($F=4.79$; $DF=20$; $P<0.05$), 72 hours after spray ($F=7.61$; $DF=20$; $P<0.05$); 96 hours of spray ($F=10.06$; $DF=20$; $P<0.05$); one week after spray ($F=22.28$; $DF=20$; $P<0.05$), two weeks after spray ($F=71.28$; $DF=20$; $P<0.05$); and non-significant ($P>0.05$) for pre-treatment ($F=0.99$; $DF=20$; $P>0.05$) and when insect population was monitored after 24 hours of spray ($F=1.34$; $DF=20$; $P>0.05$).

The data in Table-2 showed that after second spray, the biopesticides remained effective throughout the period of two weeks after second spray against white fly in brinjal; and chemical control (confidor) ranked 1st reducing white fly infestation from 3.34/plant to 0.59/plant after two weeks of spray showing the highest efficacy of 82.50%; while the the Neem extract ranked 2nd reducing white fly infestation from 3.00/plant to 0.53/plant showing efficacy of 81.38%. Tobacco extract ranked 3rd reducing white fly infestation from 3.27/plant to 0.64/plant showing efficacy of 79.93%.; while Tooh extract ranked 4th reducing white fly population from 3.35/plant to 0.73/plant showing efficacy of 77.11%. Similarly, the Akk extract ranked 5th, reducing pest population from 2.93/plant to 0.72/plant after 2 weeks of spray showing efficacy of 75.61%. while Dhatura extract ranked least among biopesticides decreasing white fly population from 3.40/plant to 0.90/plant with lowest efficacy of 71.78%. after second spray.

Table-2 Efficacy of different biopesticides against white fly infestation on brinjal as compared to chemical control (confidor) at different intervals after second spray.

Plant extracts	Pre-treatment	Post treatment observation/ leaf after:						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical control (confidor)	3.34	2.94	2.53	2.15	1.85	1.40	0.59	2.75	82.50

Neem extract	3.00	2.76	2.13	1.83	1.61	1.24	0.53	2.47	81.38
Tabacco extract	3.27	3.04	2.37	2.06	1.88	1.46	0.64	2.63	79.93
Tooh extract	3.35	3.15	2.49	2.19	2.06	1.62	0.73	2.62	77.11
Akk extract	2.93	2.79	2.23	1.98	1.94	1.56	0.72	2.22	77.42
Dhatura extract	3.40	3.27	2.65	2.41	2.36	1.91	0.90	2.50	71.78
Untreated	3.40	3.30	3.20	3.07	2.98	3.07	3.19	0.21	00
S.E.±	0.2762	0.2630	0.2272	0.2089	0.2010	0.1845	0.1598	-	-
LSD 0.05	-	-	0.4950	0.4551	0.4379	0.4020	0.3482	-	-
LSD 0.01	-	-	0.6939	0.6380	0.6140	0.5635	0.4882	-	-

MITES (*Tetranychus* sp.)

First spray

The analysis of variance indicated that the efficacy of different biopesticides against mites (*Tetranychus* sp.) differed significantly ($P<0.05$) when observed after 48 hours after first spray ($F=7.78$; $DF=20$; $P<0.05$), 72 hours after spray ($F=12.64$; $DF=20$; $P<0.05$); 96 hours of spray ($F=48.39$; $DF=20$; $P<0.05$); week after spray ($F=69.47$; $DF=20$; $P<0.05$), two weeks after spray ($F=212.24$; $DF=20$; $P<0.05$); and non-significant ($P>0.05$) when observed for pre-treatment ($F=0.40$; $DF=20$; $P>0.05$) and after 24 hours of spray ($F=2.33$; $DF=20$; $P>0.05$).

The data (Table-3) indicated that the biopesticides remained effective to combat the mites on brinjal throughout the observational period of 2 weeks after spray; and in plots sprayed with chemical control(Nissuran)mites infestation reduced from 6.93/plant to 1.11/plant showing the highest efficacy of 83.53%; and chemical control and neem extrac ranked 2nd reducing mites infestation from 6.79/plant to 1.50/plant showing efficacy of 83.53%. The results further showed that the tobacco extract ranked 3rd in efficacy reducing insect infestation from 7.20/plant to 1.90/plant showing efficacy of 71.81%; while Tooh extract ranked 4th reducing insect population from 7.26/plant to 2.16/plant showing efficacy of 67.95%. Similarly, the Akk extract ranked 5th, reducing pest population from 6.93/plant to 2.56/plant after 2 weeks of spray showing efficacy of 62.01% while Dhatura extract ranked least among biopesticides decreasing mites population from 6.78/plant to 2.93/plant with lowest efficacy of 56.52%. Relatively lower efficacy was observed against mites; however, regular sprays

could keep the mites population below economic injury level.

Table-3 Efficacy of different biopesticides against mites on brinjal as compared to chemical control (Nissuran)at different intervals after first spary.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical control (Nissuran)	6.93	5.68	4.88	4.40	2.90	2.18	1.11	5.82	83.53
Neem extract	6.79	5.84	5.14	4.73	3.22	2.73	1.50	5.29	77.74
Tobacco extract	7.20	6.26	5.64	5.30	3.66	3.22	1.90	5.30	71.81
Tooh extract	7.26	6.46	5.95	5.71	4.00	3.28	2.16	5.10	67.95
Akk extract	6.93	6.44	6.06	5.94	4.27	3.93	2.56	4.37	62.01
Dhatura extract	6.78	6.38	6.12	6.00	4.44	4.13	2.93	3.85	56.52
Untreated	7.15	6.93	7.00	6.93	6.79	6.39	6.74	0.40	00
S.E.±	0.4366	0.3869	0.3546	0.3381	0.2598	0.2311	0.1830		
LSD 0.05	-	-	0.7727	0.7367	0.5661	0.5035	0.3987		
LSD 0.01	-	-	1.0832	1.0328	0.7936	0.7059	0.5589		

Second spray

The analysis of variance showed that the efficacy of various biopesticides after second spray against mites (*Tetranychus* sp.) affected the pest population significantly ($P<0.05$) when monitored after 48 hours after first spray ($F=3.69$; $DF=20$; $P<0.05$), 72 hours after spray ($F=4.80$; $DF=20$; $P<0.05$); 96 hours of spray ($F=19.97$; $DF=20$; $P<0.05$); week after spray ($F=35.57$; $DF=20$; $P<0.05$), two weeks after spray ($F=176.77$; $DF=20$; $P<0.05$); and non-significant ($P>0.05$) when observed for pre-treatment ($F=1.16$; $DF=20$; $P>0.05$) and after 24 hours of second spray ($F=1.95$; $DF=20$; $P>0.05$).

The data (Table-4) showed that the botanical pesticides as well as synthetic pesticide showed remarkable efficacy against the mites and kept the target pest under control throughout the period of two weeks after spray. The mites population on brinjal plants sprayed with chemical control reduced from 4.74/plant to 0.95/plant showing the highest efficacy of 80.57%; and neem extract ranked 2nd reducing mites infestation from 4.85/plant to 1.33/plant showing efficacy of 72.80%. The results further showed that the tobacco extract ranked 3rd in efficacy reducing insect infestation from 4.85plant to 1.59/plant showing efficacy of 67.48% while Tooh extract ranked 4th reducing insect population from 4.63/plant to 1.67/plant showing efficacy of 65.84%. Similarly, the Akk extract ranked 5th, reducing pest population from 5.51/plant to 2.30/plant after 2 weeks of spray showing efficacy of 52.96%; while Dhatura extract ranked least among biopesticides decreasing mites population from 5.34/plant to 2.53/plant with lowest efficacy of 48.26%.

Table-4 Efficacy of different biopesticides against mites on brinjal as compared to chemical control (Nissuran)at different intervals after second spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical Control (Nissuran)	4.74	4.36	3.97	3.77	2.49	1.87	0.95	3.79	80.57
Neem extract	4.85	4.65	4.33	4.20	2.85	2.43	1.33	3.51	72.80
Tobacco extract	4.85	4.71	4.47	4.43	3.06	2.69	1.59	3.27	67.48
Tooh extract	4.63	4.58	4.44	4.40	3.08	2.52	1.67	2.96	65.84
Akk extract	5.51	5.46	5.40	5.35	3.85	3.54	2.30	3.21	52.96
Dhatura extract	5.34	5.29	5.24	5.18	3.84	3.57	2.53	2.81	48.26
Untreated	4.97	5.02	4.92	5.02	4.92	4.63	4.89	0.09	00
S.E.±	0.4257	0.4047	0.3828	0.3725	0.2601	0.2206	0.1395	-	-
LSD 0.05	-	-	0.8341	0.8117	0.5668	0.4807	0.303	-	-

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LSD 0.01	-	-	1.1694	1.1379	0.7946	0.6739	0.4260	-	-

JASSID (*Amrasca devastans* Dist)

First spray

The analysis of variance indicated that the efficacy of different biopesticides against jassid as compared to chemical control affected the jassid infestation on brinjal significantly (P<0.05) when examined after 48 hours after first spray (F=3.76; DF=20; P<0.05), 72 hours after spray (F=5.89; DF=20; P<0.05); 96 hours of spray (F=10.00; DF=20; P<0.05); week after spray (F=209.51; DF=20; P<0.05), two weeks after spray (F=140.90; DF=20; P<0.05); and non-significant (P>0.05) when observed for pre-treatment (F=0.79; DF=20; P>0.05) and after 24 hours of first spray (F=1.39; DF=20; P>0.05)

The results (Table-5) indicated that the bio pesticides and synthetic pesticide produced remarkable efficacy against jassid and the jassid remained under control throughout the period of two weeks after spray. The jassid infestation on brinjal plants sprayed with chemical control reduced from 43.99/plant to 0.83/plant showing the highest efficacy of 97.95%; and neem extract ranked 2nd reducing jassid infestation from 39.78/plant to 1.59/plant showing efficacy of 96.08%. The data further indicated that the tobacco extract ranked 3rd in efficacy reducing jassid infestation from 40.69plant to 1.77/plant showing efficacy of 95.63%. while Tooh extract ranked 4th reducing insect population from 43.71/plant to 5.61/plant showing efficacy of 86.17%.The Akk extract ranked 5th in effectiveness against jassid population reducing pest population from 42.23/plant to 7.63/plant when monitored after 2 weeks of spray showing efficacy of 81.19% However, Dhatura extract ranked least among bio pesticides decreasing jassid population from 42.33/plant to 11.79/plant with lowest efficacy of 70.94%.

Table-5 Efficacy of different biopesticides against Jassid infestation on Brinjal as compared to chemical control (confidor) at different intervals after first spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after:						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical Control (confidor)	43.99	40.47	36.83	34.98	30.09	7.52	0.83	43.16	97.95
Neem extract	39.78	38.19	35.51	34.45	30.31	10.61	1.59	38.19	96.08
Tobacco extract	40.69	39.47	37.50	37.12	33.04	2.99	1.77	38.93	95.63
Tooh extract	43.71	43.27	42.84	42.41	39.02	16.39	5.61	38.09	86.17

Akk extract	42.23	41.80	40.55	40.14	36.13	11.56	7.63	34.60	81.19
Dhatura extract	42.33	41.91	41.49	41.08	38.61	16.60	11.79	30.55	70.94
Untreated	42.66	43.09	42.23	43.07	39.63	38.44	40.58	2.08	00
S.E.±	2.4095	2.2600	2.1183	2.0490	1.8383	1.1174	1.6750		
LSD 0.05	-	-	4.6155	4.4644	4.0053	2.4347	3.6494		
LSD 0.01	-	-	6.4706	6.2588	5.6152	3.4133	5.1162		

Second spray

The analysis of variance showed that the efficacy of various biopesticides against jassid as compared to chemical control to combat jassid population on brinjal was significant ($P<0.05$) when examined after 24 hours of second spray ($F=4.21$; $DF=20$; $P>0.05$), 48 hours after second spray ($F=5.62$; $DF=20$; $P<0.05$), 72 hours after spray ($F=7.08$; $DF=20$; $P<0.05$); 96 hours of spray ($F=9.26$; $DF=20$; $P<0.05$); one week after spray ($F=322.89$; $DF=20$; $P<0.05$) and two weeks after spray ($F=314.54$; $DF=20$; $P<0.05$); against pre-treatment count ($F=2.15$; $DF=20$; $P>0.05$).

The data (Table-6) showed that the biopesticides were highly effective to control jassid population in brinjal plants sprayed with chemical control confidor reduced jassid population from 32.18/plant to 0.12/plant showing the highest efficacy of 99.64%; and neem extract ranked 2nd reducing jassid infestation from 32.63/plant to 0.56/plant showing efficacy of 98.36%. The data further indicated that the tobacco extract ranked 3rd in efficacy reducing jassid infestation from 27.95/plant to 2.14/plant showing efficacy of 93.75%; while Tooh extract ranked 4th reducing insect population from 35.90/plant to 3.86/plant showing efficacy of 88.73%. The Akk extract ranked 5th in efficacy against jassid population reducing pest population from 29.13/plant to 5.61/plant when monitored after 2 weeks of spray showing efficacy of 83.62%. However, Dhatura extract ranked least among biopesticides decreasing jassid population from 34.93/plant to 10.61/plant with lowest efficacy of 69.03%.

Table-6 Efficacy of different biopesticides against Jassid infestation on Brinjal as compared to chemical control (confidor) at different intervals after second spray.

Plant extracts	Pre-treatment	Post treatment observation/leaf after						Pest Reduction /leaf	Reduction %
		24hrs	48hrs	72hrs	96hrs	1week	2week		
Chemical Control	32.18	29.61	26.94	25.60	22.01	1.10	0.12	32.06	99.64

(confidor)									
Neem extract	32.63	31.33	29.14	28.26	24.87	3.73	0.56	32.07	98.36
Tobacco extract	27.95	27.11	25.76	25.50	22.69	3.63	2.14	25.81	93.75
Tooh extract	35.90	35.54	34.48	34.13	30.72	5.84	3.86	32.05	88.73
Akk extract	29.13	28.84	28.55	28.26	26.00	5.72	5.61	23.52	83.62
Dhatura extract	34.93	34.58	34.23	33.89	31.86	14.94	10.61	24.32	69.03
Untreated	35.72	36.08	35.36	36.06	33.18	32.40	34.27	1.45	00
S.E.±	2.5197	2.4480	2.3610	2.3184	2.1110	0.8533	0.9502		
LSD 0.05	-	5.3337	5.1441	5.0514	4.5995	1.8593	2.0703		
LSD 0.01	-	7.4775	7.2117	7.0816	6.4482	2.6066	2.9025		

DISCUSSION

Mostly the vegetables are harvested frequently and the picked vegetables are marketed for human consumption immediately without any analysis for residual effects of the pesticides. However, toxic effects of synthetic pesticides are a real threat to human health. The biopesticides are safe and their application not only suppresses the insect pests effectively, but there is no risk of residual effects for the consumers. Hence, the study was carried out to examine the efficacy of various biopesticides against insect pests of brinjal.

The present study showed that against white fly the first spray of chemical control(confidor) showed highest efficacy 98.51%, followed by neem extract 95.96%, tobacco extract 94.70%, Tooh extract 92.78%, Akk extract 89.17% and lowest for Dhatura extract 87.68%; while in the second spray also, Chemical control showed highest efficacy against white fly 82.50%; followed by neem extract 81.38%, Tobacco extract 79.93%, Tooh extract 77.11%akk extract 77.42% and least by Dhatura extract 71.78%. Against mites, chemical control showed highest efficacy 83.53% as observed after 1st spray, followed neem extract 77.74%, Tobacco extract 71.81% Tooh extract 67.95% akk extract 62.01%and least efficacy for Dhatura extract 56.52%; while after second spray also, chemical control showed highest efficacy 80.57%, followed by neem extract 72.80%, Tobacco extract 67.48%, Tooh extract 65.84%, Akk extract 52.96% and the lowest efficacy was resulted by Dhatura extract 48.26%. Against jassid population on brinjal the first spray results showed that chemical control showed highest efficacy 97.95% Neem extract,96.08%.Tobacco extract,95.63%.tooh extract,86.17%.Akk extract,81.19%,and Dhatura extract,70.94% second spray results showed that

chemical control showed highest 99.64%Neem extract,98.36%.Tobacco extract,93.75.%.Tooh extract,88.73%.Akk extract,83.62%,and Dhatura extract,69.03%. Regardless the biopesticides, the highest efficacy was observed against Jassid during both the sprays. Mites persists more than white fly and jassid to remain in the brinjal fields. For effective and safe control of brinjal insect pests in the field, the crop may be preferably be sprayed with neem extract followed by Tobacco and Tooh extract; and atleast one spray monthly is essential to keep the insect pests below economic ionjury level. There is no need to apply chemical control, because neem extract resulted better than the chemical control. The results of the present study are further confirmed by those of Singh and Kumar (2003) who found that efficacy of neem based pesticides against white fly and jassid was higher than other treatmernts and Achook and NSKE (3%) were the most effective in controlling the white fly and jassid. Haq (2006) found that different neem products (botanical pesticides) proved to be effective to control Jassid under field conditions. Hassan *et al.* (2006) reported that neem based products gave significant control of jassids (*Amrasca devastans*). Khattak *et al.* (2006) used neem oil at 2% and neem seed water extract at 3% which significantly reduced the population of jassids and White fly. Dutt (2007) used neem and dhatura and the insect pests were controlled by neem and dhatura effectively. Bardin *et al.* (2008) examined the effect of biopesticides and their efficacy to control insect pests of tomato. The biopesticides appears to be a promising biological control agent against whiteflies. The use of these products in a context of integrated protection of tomato requires that their efficacy is not altered when applied together. Noonari (2008) examined the efficacy of biopesticides against jassid on brinjal having four treatments (including Control) with four replications. Neem oil, Tobacco leaves, Neem powder, Neem oil + B.M. Beneficial micro-organism were sprayed twice. The pre-treatment counts of the pest were recorded one day before spray. The post-treatment observations were taken after 24, 48, 72 hours one week two weeks. In first spray against jassid neem oil was most effective biopesticides and showed highest mortality (71.97%) followed by neem oil + B.M. Beneficial micro-organism (65.48%) neem powder (61.56%) and Tobacco leaves (54.75%). In the first spray against jassid tobacco leave has showed highest reduction percentage (85.90%) and followed by neem oil (80.00%) neem oil + B.M. Beneficial micro-organism (75.70%) and neem powder (70.70%). In second spray against jassid neem oil has showed good highest mortality (72.30%) followed by neem oil + B.M. Beneficial micro-organism (63.68%). Yadav *et al.* (2008) revealed that treatment of neem formulation with azadirachtin-endosulfan at 15 days interval brought down the jassids population up to 0.68/5 plants. Ahmed *et al.* (2009) conducted field experiment to determine the efficacy of six plant extracts (sweetsop, chilli pepper, garlic, ginger, neem and tobacco) against the insect pests of cowpea. All the plant extract treatments were significantly better than control treatments. Similarly, yield results corresponded positively with the effectiveness of the treatments. Results of the present finding therefore, suggest the use of all the tested plant extracts particularly tobacco, sweetsop and garlic as they have been found to be very promising biopesticides in the control of insect pests. Arain (2009) found that tobacco extract resulted highest mortality (98.60%) of mealy bug, neem oil was most effective after Tobacco extract causing 89.32% pest mortality, neem extract ranked third in relation to efficacy against mealy bug with insect mortality of 80.37%, while garlic extract was least effective against mealy bug with mortality of 75.82%. after 72 hours treatment. Rukhsana *et al.* (2010) reported that among the plant material, best antifungal activity was achieved by extracts of *Azadirachta indica* (Neem), and *Allium sativum* (garlic) at the concentration of 0.015%. Soto *et al.* (2010) reported that only plants sprayed with Natuneem (31.1 mg a.i./l) showed symptoms of phytotoxicity. Lime sulphur and neem based products, applied in appropriate concentrations and formulations, bear out as a viable alternative to control *T. evansi* on tomato plants. Ghananand *et al.* (2011) reported that the toxic effect of the

insecticides and bio-pesticides decreased after 7 days of treatment application. Abdalraheem and Elshafie (2013) used three biopesticides (Bt, NeemAzal and Spinosad) as alternatives to manage important tomatoes insect pests, and reported that NeemAzal was effective against all test insects pests. The chemical pesticides demonstrated the highest effects in controlling the tested insects but they reduced significantly the population of the beneficial insects. The biopesticides seem to be less hazardous to the beneficial insects.

CONCLUSIONS

The chemical control (Confidor/Nissuran) were highly effective to control whitefly, jassid and mites on brinjal; but neem extract showed parallel results for its efficacy against the target insect pests when compared with chemical control. Tobacco extract and Tooh extract also showed remarkable results for their efficacy against brinjal, whitefly,jassid and mites during both the sprays. The Akk extract was also moderately effective to suppress the insect pests and mites infestation. Although, the Dhatura extract was also effective to control the brinjal insect pests and mites but its efficacy was lowest among all the other biopesticides. By overall efficacy of biopesticides against whitefly, jassid and mites after first and second spray, the treatments ranked as: chemical control, neem extract, tobacco extract, tooh extract, akk extract and dhatura extract.

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