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Evaluation of insecticides against insect-pests on Chillies, *Capsicum annum* L. and their management

Kamil Kabir Khanzada[1*], Bina Khanzada[2], Riaz Hussain Chandio[3], Farman Ali Sipio[4], Muhammad Irfan Jat[5]
[1-5] Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tando jam, Pakistan

Abstract
The experiment was started April 10, 2018 at the experimental field of Nasarpur in winter season. The observation were recorded 24 hours before spraying, while the post treatment observations were recorded at 3, 7 and 14 days after each spraying. Significantly higher population among all treatments was observed in Dimethoate 30EC, 2.31 respectively. Thrips population ranged between 0.72 and 1.79 among different treatments and lowest population 0.72 was observed in the treatment of Imidacloprid 17.8 SL @ 0.090 l/ha, that was at par with the population under treatment of T2, T7 T8 and T4 0.80, 0.92, 0.92, 1.04 and 1.06 respectively. Moreover, lowest population (0.20) was observed in the treatment of Imidacloprid @ 0.058 l/ha, that was at par with the population under untreated control, Dimethoate @ 0.058 l/ha and Dimethoate @ 0.875 l/ha, (0.30, 0.34 and 0.34, respectively). The infestation of thrips also started from second week of April at 7 days after transplanting with the population of 1.04 in 6 leaves, and it continued till the end of the crop season. Highest population was observed in second week of May with 3, 6 leaves at 126 days after transplanting. The pest remained active till the maturity of the crop. Thrips population show significant positive correlation with maximum temperature.

Keywords: insecticides, chilli, insect, management

1. Introduction
Chilli, *Capsicum annum* L. is one of the important Solanaceous crop, *Capsicum annum* is widely cultivated throughout the world, in tropical and subtropical regions. Chilli is one of the important cash crops of Pakistan [1]. It is grown largely for its fruits all over the plains and in hills, in some states particularly Panjab and Sindh. The area of chilli in the country is 805 thousand hectares with production of 1276 thousand million tonnes and productivity of 1.6 tonnes hectares in 2011-12. [2]. More than 39 genera and 51 species of insects and mites have been reported to cause damage to chilli crop in the field, as well as in storage. Aphid, *Aphis gossypii* (Glover), thrips, *Scirtothrips dorsalis* (Hood) and jassids, *Amrasca bigutulla* (Ishida) are some major insect pests of chilli [3]. In addition to insect pests, the crop also suffers due to the incidence of diseases, Leaf curl is one of the important causes for lower yields in chilli. Chilli leaf curl complex is caused by Gemini virus transmitted by *Bemisia tabaci* and also by thrips *S. dorsalis* and *Polyphagotarsonemus latus* [4]. Yield loss due to chilli mite may go up to 96.39 [5] leading sometimes to complete failure of the crop. Overall yield loss due to thrips and mites are estimated to the tune of 50 percent [6]. Various environmental factors like temperature, humidity, rainfall etc. have been observed to influence the population dynamics of insect pests [7]. Determining correlation of pest population with various abiotic factors of the environment prove helpful in the formulation of an appropriate pest management strategy. *Scirtothrips dorsalis* is considered as one of the most destructive pest and under severe infestation 30 to 50 % crop may be lost [8]. Till now 55 pests are reported to infest chilli crop [9] Various methods are used for controlling insect pests in chilli like chemicals, botanicals, use of resistant cultivars, use of bio-control agents, which the only practical method to control the pests is by chemical insecticides. Many conventional insecticides are being used to manage these pests. Because of development of many fold resistance to existing insecticides, it is often difficult to manage these insect pests. The application of 0.05% dimethoate was the best treatment for control of *S.dorsalis* [10]. Imidacloprid 2% SP @ 700 g/ha was most effective for suppression of thrips population and also increased the yield of green chilli [11]. Fipronil 5% SC@ 100g a.i /ha recorded lowest population of sucking pest and the highest yield [12, 13] reported that triazophos 40 EC is highly effective for higher yield of chilli crop. Hence, present study was undertaken to evaluate newer molecules of insecticides for the management of insect pests of chilli. Present investigations were conducted to record the insect pests appearing on this crop in Sindh region and to evaluate certain insecticides for their management, with the following objectives: Evaluation of insecticides for the management of insect and the incidence of chilli thrips and white fly.

2. Material and method
2.1 Location and climate
The mean annual rainfall is nearly received mostly between mid-June and mid-August. The maximum temperature during the hottest month of May and June varies from 38.5 ^{O}C to 43.4 ^{O}C were recorded respectively.

2.2 Experimental design
The experimental design was RBD and the treatments were replicated thrice. The plot size was 3x3 m. The hybrid variety was sown in nursery on February 15, 2018 and was

transplanted in experimental plots on April 10, 2018 at the experimental field of Nasarpur in winter season. Number of rows was 10, with a spacing of 1.5m between rows, 50 cm between plants and 2.0 m between replication.
Two sprays of different treatments were given to the crop at 25 days and 45 days after transplanting the crop to assess their performance in managing chilli insect pests.

2.3 Treatment details
T1 Triazophos 40EC @0.7 l
T2 Triazophos 40EC @1.050 l
T3 Dimethoate 30EC @0.580 l
T4 Dimethoate 30EC @0.875 l
T5 Imidacloprid 17.8 SL @0.058 l
T6 Imidacloprid 17.8 SL @0.090 l
T7 Fipronil 5 SC @0.350 l
T8 Fipronil 5 SC @0.525 l
T9 Untreated Control Plain water spray

2.4 Observations
Population of thrips, was counted on six leaves (i.e., 2 upper, 2 middle and 2 lower canopy leaves). Populations of whiteflies were recorded by observing leaves of 10 cm twig, on every plant using glass frame. Incidences of Mosaic virus recorded at 10 intervals throughout the crop seasons under different treatments.

3. Results
3.1 Comparative performance of insecticides against *Bemisia sp*. on chilli
Four insecticides and their different doses were evaluated against the incidence of insect pests namely thrips, *Scirtothrips dorsalis* (Hood) whiteflies, *Bemisia tabaci*. Two sprays of different treatments were given to the crop at 15 days interval. The observation were recorded 24 hours before spraying, while the post treatment observations were recorded at 3, 7 and 14 days after each spraying.

3.2 Population of, *Bemisia tabaci* after 3 days first spray
Whiteflies population ranged between 1.02 and 2.31 individuals among different treatments in Table 1. While the lowest population 1.02 was observed in the treatment of Imidacloprid 17.8 SL that was at par with the population under treatment of Fipronil 5 SC, followed by T5 and T8 (1.18, 1.29 and 1.39,). Significantly higher population among all treatments was observed in Dimethoate 30EC, 2.31 respectively. On the other hand, after 7 days spray whiteflies lowest population 2.43, was recorded in treatment of Fipronil @ 0.350 that was followed by T3, T1, T8 and T5 (2.49, 2.78, 2.78, and 2.85, respectively), whereas maximum population among all treatments was observed on Triazophos @ 1.050 (3.24). Whiteflies population did not show correlation with any abiotic factors. However, after 14 days spray whiteflies population ranged between 1.53 and 4.32, among different treatments. Whereas, lowest population (1.53 individuals per sample) was observed in the treatment of Fipronil @ 0.350, that was at par with the population under treatment of Triazophos @ 0.7, Dimethoate @ 0.580, Triazophos @ 1.050, and Fipronil @ 0.525, (2.46, 2.46, 2.62, and 2.66, respectively). Significantly higher population among all treatments was observed in untreated control (4.32).

3.3 Population of *Bemisia sp*. after 3 days 2nd spray
Whiteflies population ranged between 1.32 and 2.37 among different treatments. However, lowest population 1.32 was noted in the treatment of Imidacloprid @ 0.058 l/ha that was at par with the population under treatments of Dimethoate @ 0.580 l/ha, which followed by T2, T4, T7 and T8 (1.17, 1.44, 1.44, 1.71 and1.84, respectively). In that order, maximum population among all treatments was revealed in untreated control 2.37. In that order, after 7 days white flies population ranged between 2.10 and 3.42 among different treatments. Lowest population (2.10 individuals per sample) was observed in the treatment T8 that was at par with the population under treatment T1, T2, T3, T4, T6 and T7 2.22, 2.25, 2.40, 2.49, 2.49, and 2.49 respectively. Whereas, Fipronil 5 SC @ 0.350 l/ha treatment was observed to be the most suitable one against sucking pests on chilli *Bemisia tabaci.* Significantly higher population among all treatments was observed in untreated control (3.42).
Furthermore results discussed that after 14 days spray whiteflies ranged between 0.39 and 0.92 among different treatments. However, lowest population 0.39 was observed in the treatment of T6, T8, T3, T9, T7 and T8 0.39, 0.46, 0.46, 0.51, and 0.75. Significantly maximum population among all the treatments was observed in the treatments of Triazophos @ 0.7 l/ha 0.92 respectively.

Table 1: Mean population of *Bemisia tabaci* under different treatments on chilli

Treatments	1st Spraying			2nd Spraying			Overall Mean
	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS	
T1 Triazophos	1.98	2.78	2.46	1.93	2.22	0.92	2.03
T2 Triazophos	1.58	3.24	2.62	1.44	2.25	0.92	1.98
T3 Dimethoate	1.44	2.49	2.46	1.36	2.40	0.84	2.08
T4 Dimethoate	2.31	3.06	2.89	1.44	2.49	0.75	2.07
T5 Imidacloprid	1.29	2.85	3.06	1.32	2.75	0.46	2.20
T6 Imidacloprid	1.02	2.95	3.02	2.99	2.49	0.39	1.92
T7 Fipronil	1.18	2.43	1.53	1.71	2.49	0.51	2.05
T8 Fipronil	1.39	2.78	2.66	1.84	2.10	0.39	2.63
T9 Untreated	1.61	3.16	4.32	2.37	3.42	0.46	2.44
SEm±	0.063	0.049	0.137	0.073	0.067	0.074	0.078
CD at 5%	0.189	0.147	0.411	0.299	0.202	0.222	0.230

3.4 Population of thrips, *Scirtothrips dorsalis* 3 days after first spray
Thrips population ranged between 0.72 and 1.79 among different treatments and lowest population 0.72 was observed in the treatment of Imidacloprid 17.8 SL @ 0.090 l/ha, that was at par with the population under treatment of T2, T7 T8 and T4 0.80, 0.92, 0.92, 1.04 and 1.06 respectively in Table 2. Significantly higher population among all treatments was observed in the treatment of Triazophos 40 EC @ 0.7 l/ha 1.79. However, it was examined 7 days after first spray thrips population ranged between 1.82 and 3.96 among different treatments. Lowest population (1.82) was observed in the treatment of Imidacloprid @ 0.090 l/ha, that was at par with the population under treatment of Fipronil @ 0.350 l/ha (2.10).
Significantly higher population among all treatment was

observed in untreated control 3.96. The present findings further reported 14 days after first spray Thrips population ranged between 0.84 and 3.34 among different treatments. From the above findings it was revealed that lowest population 0.84 was recorded in the treatment of Imidacloprid @ 0.09 l/ha, that was at par with the population under treatment of Imidacloprid @ 0.058 l/ha, (1.27). Significantly higher population among all treatments was observed in untreated control 3.34.

3.5 Population of *Scirtothrips dorsalis* after 2nd spray 3 days

Thrips population ranged between 0.44 and 3.02 among different treatments. Lowest population (0.44 individuals per sample) was observed in the treatment of Dimethoate @ 0.580 l/ha, that was at par with the population under treatment of Dimethoate @ 0.875 l/ha, (0.92). Significantly higher population among all treatments was observed in untreated control 3.02. In fact, after 7days population ranged between 0.90 and 3.38 individuals /sample among different treatments. Lowest population (0.90 individual per sample) was observed in the treatment of Imidacloprid 17.8 SL @ 0.090 l/ha, that was at par with the population under T3, T6, T2 and T1, 1.23, 1.32, 1.32 and 1.96. Significantly higher population among all treatments was observed in untreated control 3.38. Although after 14 days Thrips population ranged between 0.20 and 0.81 among different treatments.

Moreover, lowest population (0.20) was observed in the treatment of Imidacloprid @ 0.058 l/ha, that was at par with the population under untreated control, Dimethoate @ 0.058 l/ha and Dimethoate @ 0.875 l/ha, (0.30, 0.34 and 0.34, respectively). Significantly higher population among all treatments was observed in Fipronil @ 0.525 l/ha 0.81. The infestation of thrips also started from second week of April at 7 days after transplanting with the population of 1.04 in 6 leaves, and it continued till the end of the crop season. Highest population was observed in second week of May with 3 6 leaves at 126 days after transplanting. The pest remained active till the maturity of the crop. Thrips population show significant positive correlation with maximum temperature.

Table 2: Mean population of *Bemisia tabaci* under different treatments on chilli

Treatments	1st Spraying			2nd Spraying			Overall Mean
	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS	
T1 Triazophos	1.79	2.49	3.24	1.36	1.23	0.67	1.51
T2 Triazophos	0.80	2.85	2.65	1.32	2.37	0.67	1.80
T3 Dimethoate	1.32	2.37	2.49	0.44	1.32	0.34	1.6
T4 Dimethoate	1.04	2.49	2.49	0.92	2.85	0.34	1.77
T5 Imidacloprid	1.06	2.37	1.27	1.12	1.32	0.20	1.5
T6 Imidacloprid	0.72	1.82	0.84	1.18	0.90	0.51	1.39
T7 Fipronil	0.92	2.10	2.37	1.18	2.34	0.53	1.34
T8 Fipronil	0.92	2.37	2.49	1.32	1.96	0.81	1.81
T9 Untreated	1.33	3.96	3.34	3.02	3.38	0.30	2.58
SEm±	0.085	0.052	0.184	0.076	0.181	0.071	0.14
CD at 5%	0.257	0.155	0.553	0.227	0.544	0.215	0.39

4. Discussion

4.1 Evaluation of comparative performance of foliar applications of insecticides against insect pests on chilli

Four insecticides namely Triazophos 40 EC, Dimethoate 30 EC, Imidacloprid 17.8 SL and Fipronil 5 SC were evaluated against *Scirtothrips dorsalis* and *Bemisia tabaci.* Based on the mean population density of pest population after treatment the performance of Fipronil 5 SC @ 0.35 l/ha was observed to be the best in controlling *Bemisia tabaci* followed by Dimethoate 30EC@ 0.058 l/ha and Triazophos 40EC @ 1.05 l/ha. Different workers evaluated insecticides against whiteflies on chilli crop and a long list of effective insecticides exists [14], reported Imidacloprid to be highly effective in the control of thrips and whiteflies on *Capsicum annum*. In present experiment the results of Imidacloprid application at 0.058 I and 0.09 l/ha were recorded to be superior but at par with the performance of Fipronil, Dimethoate and Triazophos and no significant differences existed between treatments except the untreated control that recorded significantly higher population of whiteflies [15], noted spraying of Triazophos to be effective in reducing the population of *Bemisia tabaci* and leaf curl incidence [16]. reported Triazophos @ 350 and 700 be effective against whiteflies [17]. Obtained highest average yield (19.99 q/ha) with Triazophos 40 EC application. In present experiment also the Triazophos 40 EC was effective at both the doses [18]. Conclude Fipronil 5 SC to be most effective against sucking pests on chilli [19]. Reported Fenpropathrin 30 EC @ 75 g to be effective dose in reducing sucking pests and fruit damages. In present experiment the treatment of Fipronil 5 SC @ 0.350 l/ ha registered lowest population density of *S. dorsalis* in most of the observations, followed by the treatment with Imidacloprid 17.8 SL @ 0.09 l/ha. Seasonal mean population of *Scirtothrips dorsalis* under different treatments did not give a clear picture [20] have reported the application of plant product Achook (1.5%) to be effective in controlling *S.dorsalis* in chilli crop. However, in present experiment the plant products were not evaluated [21]. found soil application of carbofuran at 0.5 kg ai/ha 15 days after transplanting followed by continous spray of Triazophos 0.04 % at 10 days interval to be effective in controlling *Scirtothrips dorsalis* in chilli crop. In present experiment also the performance of Triazophos 40 EC was observed to berelatively better in some of the observations, another researcher [22] also reported application of Triazophos to be effective in reducing thrips and leaf curl incidence in chilli. The finding of [23] are in conformity to the present findings wherein they have reported Fipronil 5 SC to be a good option for higher chilli yield. Other workers have reported different insecticides to be effective against *S.dorsalis* [24]. Reported Phosphamidon 40 % + Imidacloprid 2 SP @ 700 [25], reported Fenpropathrin 30 EC 75 g ai /ha, while [26] reported Imidacloprid to be effective in suppressing the thrips population in chilli. In present findings also the performance of Imidacloprid 17.8 SL @ 0.9 l/ha was recorded to be superior over other treatments [27, 28] have also evaluated and reported different insecticides to be effective in the management of *S. dorsalis* on chilli crop.

5. Conclusion

The population prevailed till crop maturity and peak population of *Bemisia tabaci* and *Scirtothrips dorsalis* were observed during vegetative and fruiting stage of the crop. It can be concluded from the above findings that Fipronil 5 SC @ 0.350 l/ha treatment was recorded to be the most suitable one against sucking pests on chilli.

6. Suggestions for further work

1. Similar trials may be repeated in coming years to confirm present findings.
2. Leaf curl incidence and its correlation with *Scirtothrips dorsalis* may be studied under confined cage studies.

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