
ORIGINAL ARTICLE

Evaluation of six different groups of insecticides for the control of citrus psylla *Diaphorina citri* (Hemiptera: Psyllidae)

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Abstract

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Songklanakarin J. Sci. Technol., 2005, 27(1) : 17-23

Studies on the efficacy of different insecticides against citrus psylla, *Diaphorina citri* (Hemiptera: Psyllidae) were carried out at Agricultural Research Institute, Tarnab, Peshawar, Pakistan. Six insecticides viz. Actara 25 WG, (thiamethoxam) Cascade 10 DC (Flufenoxuron), Match 050 EC (lufenuron), Thiodan 35 EC (endosulfan), Karate 2.5 EC (α -cyhalothrin), and Supracide 40 EC (methidathion), were tested for their effectiveness against *D. citri*. After first spray overall mean population of *D. citri* was 3.63, 4.75, 5.59, 6.66, 7.47, 8.11 per six inches tender shoot on Actara 25 WG, Cascade 10 DC, Match 050 EC, Thiodan 35 EC, Karate 2.5 EC and Supracide 40 EC treated plants respectively, while on control plants the population was 12.39. Similarly, after the second spray of each of the same insecticides the population of *D. citri* was 2.65, 4.23, 5.61, 6.41, 7.35 and 8.73 respectively. Where in controls there were 15.18 psyllids. Percent decrease of *D. citri* population in comparison to control after the first spray was highest in Actara 25 WG (72.20) followed by Cascade 10 DC (62.91), Match 050 EC (54.07), Thiodan 35 EC (47.61), Karate 2.5 EC (38.94) and Supracide 40 EC (35.74). After the second spray percent decrease over control recorded was highest in Actara 25 WG (83.54), followed by Cascade 10 DC (71.08), Match 050 EC (63.94), Thiodan 35 EC (60.79), Karate 2.5 EC (52.52) and Supracide 40 EC (45.62).

Key words : citrus psylla, citrus, insecticides

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Received, 19 June 2004 Accepted, 26 July 2004

Several species of insect attack citrus all over the world. The major insect pest of citrus are Citrus leaf miner *Phyllocnistis citrella* Stainton, citrus psylla *Diaphorina citri* Kuwayama, citrus caterpillar *Papilio demoleus* Linnaeus, fruit piercing moth *Ophideres* spp, citrus white fly (*Dialeurodes citri* Ashmead), citrus red scale *Aonidiella aurantii* Maskell citrus mealybug *Pseudococcus filamentosus* Cockerell, citrus mite (*Paratetranychus citri* Mc Gregor), citrus nematode *Tylenchulus semipenetrans* Cobb and lance nematode *Hoplolaimus indicus* Sher. Among these, citrus psylla is the major insect pest of citrus in North West Frontier Province (NWFP)- Pakistan (Anonymous, 2001).

Citrus psylla (*D. citri*) is the most destructive and consequently the most important of all the insect pests of citrus. Buds and soft young shoots are attacked by the pest, leaves become distorted and curled; honeydew production leads to sooty mould infestation. Badly damaged leaves die and fall and defoliation of branches can occur. It is thought that the saliva of the pest is probably toxic to produce such distortion (Dennis, 1983).

Although there is a visible difference in the rise and fall of citrus psylla population in various seasons, yet the ill effects of its damage are so long-lasting that the trees may look sickly even when the pest population is not high. Thus sooty and sickly plants seen in the winter are the victims of this insect, which had caused damage during the previous summer (Atwal, 1976).

As far as chemical control of citrus psylla is concerned, Boulahia *et al.* (1996) found that Confidor (imidacloprid), Evisect (thiocyclam) and the mineral oil oleostec significantly reduced the pest population as compared to untreated plants.

Mixtures of various insecticides have also been evaluated and found effective against citrus psylla. Rezk *et al.* (1996) concluded that a mixture of vertimec (abamectin) and mineral oil was the most effective combination for the control of citrus psylla followed by a mixture of methomyl (Lannate) + dimethoate, methomyl alone and dimethoate.

Keeping in view the great commercial importance of citrus fruit, and for importance of

this pest in Pakistan, particularly in North West Frontier Province (NWFP), the present study was conducted with the view to determine the efficacy of various insecticides against citrus psylla.

Materials and Methods

1. Selection of Experimental Plants

For this purpose 33 citrus plants *Citrus aurantium* L. were selected at citrus orchard of Agricultural Research Institute (ARI) Tarnab, Peshawar, Pakistan. This experiment comprised seven treatments including control. Each treatment had three replications. Between the treatments two plants were kept untreated and considered as a buffer between the two treatments. Randomized complete block design (RCBD) was used to carryout the application of the various treatments. Data were analyzed using F-test and Duncan's multiple rouge test (DMRT) for means separation.

2. Population Density/Infestation

For the citrus psylla population density on each plant, five-reference points were randomly selected and tagged. In each of these reference points, fresh growth of the shoot from top, middle and bottom portions were selected and the populations of citrus psylla on both sides of the leaves were recorded.

Percent decrease over control for citrus psylla was calculated by the following formula: (Khattak *et al.*, 1987).

$$C = \frac{A}{B} \times 100, \text{ Where}$$

A = population infestation in treated plants

B = population infestation in control

C = decrease over control

Percent decrease = 100-C

3. Chemical Control

The following six insecticides were applied along with one control to study their effectiveness on this pest populations. Insecticides were applied when the pest was observed on both sides of the leaves.

S.No.	Common Name	Trade Name	Chemical Group	Dose
1.	Thiamethoxam	Actara 25 WG	Neonicotinoid	10 gm/HLW
2.	Lufenuron	Match 050 EC	I. G. R	60 ml/HLW
3.	Methidathion	Supracide 40 EC	Organophosphate	150 ml/HLW
4.	Endosulfan	Thiodan 35 EC	Organochlorine	200 ml/HLW
5.	α -Cyhalothrin	Karate 2.5 EC	Pyrethroid	50 ml/HLW
6.	Flufenoxuron	Cascade 10 DC	I. G. R	150 ml/HLW

Results and Discussions

The efficacy of six insecticides, Actara 25 WG; Cascade 10 DC; Match 050 EC; Thiodan 35 EC; Karate 2.5 EC and Supracide 40 EC were tested at recommended doses for the control of citrus psylla. The insecticides were applied two times. The first application was made on April 6, and the second was on May 4, 2002. The post spray data, first recorded 24 hours after 1st spray and then on a weekly basis.

First spray

The data in Table 1 and Figure 1 reveal that all the insecticides were significantly effective in reducing the citrus psylla population as compared to control.

The citrus psylla population density after 24 hours was 0.26, 1.60, 2.40, 3.2, 3.93 and 4.13 citrus psylla/6" tender shoot in Actara, Cascade, Match, Thiodan, Karate and Supracide treated plants, respectively, as compared to control where it was 11.13 citrus psylla /6" tender shoot.

The statistical analysis showed that after 1st week of spray, Actara ranked first in reducing the population density followed by Cascade, Match, Thiodan, Karate and Supracide with population densities of 2.0, 3.26, 4.13, 4.40, 5.80 and 6.53 citrus psylla/6" branch respectively. The highest population density of citrus psylla was recorded in check plots where it was 11.53 citrus psylla/6" branch.

The data recorded two weeks after the spray revealed that Actara proved to be the best treatment followed by Cascade, Match, Thiodan, Karate and Supracide with a population of 3.13, 4.33, 5.06, 6.60, 7.13 and 8.30 citrus psylla /6" branch respectively.

The observation made on the 3rd week of the 1st spray for treatments revealed the lowest population of 5.33/6" tender shoot, with Actara followed by Cascade, Match, Thiodan, Karate and Supracide with a population of 6.33, 7.66, 8.33, 9.53 and 10.3 citrus psylla/6" branch, respectively, as compared to control where it was 13.47 citrus psylla/6" branch. The result revealed that all the

Table 1. Mean number of citrus psylla per 6" tender shoot after the first spray of 6 different insecticides.

S. No	Insecticides		Citrus psylla /6" tender shoot after first sprayed					
	Common Name	Trade name	24 hrs	1 st week	2 nd week	3 rd week	4 th week	Mean
1	Thiamethoxam	Actara 25 WG	0.26 F	2.0 E	3.13 E	5.33 F	7.43 D	3.63 E
2	Flufenoxuron	Cascade 10 DC	1.60 E	3.26 DE	4.33 DE	6.33 EF	8.26 CD	4.75 D
3	Lufenuron	Match 050 EC	2.40 E	4.13 CD	5.06 D	7.66 DE	8.73 C	5.59 D
4	Endosulfan	Thiodan 35 EC	3.2 C	4.40 CD	6.60 C	8.33 CD	10.8 B	6.66 C
5	α - Cyhalothrin	Karate 2.5 EC	3.93 B	5.80 BC	7.13 C	9.53 BC	10.97 B	7.47 BC
6	Methidathion	Supracide 40 EC	4.13 B	6.53 B	8.30 B	10.33 B	11.27 B	8.11 B
7	Control		11.13 A	11.53 A	11.87 A	13.47 A	13.93 A	12.39 A

Means followed by the same letter in a column are not significantly different from each other (P>0.05), using DMR test.

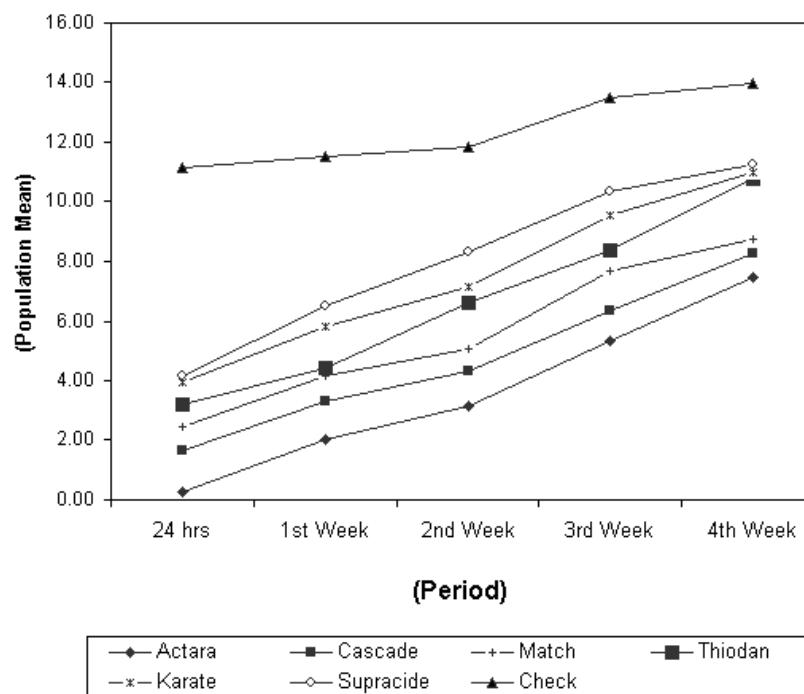


Figure 1. Change in number of citrus psylla per 6" tender shoot after first sprayed of 6 different insecticides.

insecticides were significantly better than control. Actara proved to be the best of all the treatments.

The data recorded on 4th week of spray revealed that all the insecticides were significantly different from the check plots. Actara proved to be the best treatment by reducing citrus psylla population to 7.43/6" tender shoot followed by Cascade, Match, Thiodan, Karate and Supracide with a population of 8.26, 8.73, 10.8, 10.97 and 11.27 citrus psylla /6" branch, respectively, as compared to control where it was 14.0 citrus psylla/6" branch. The results of Thiodan, Karate and Supracide were non-significant to each other.

After application of the 1st spray mean data showed that Actara (3.63 citrus psylla/6" branch) was significantly better than all other treatments.

Second spray

The post spray data are presented in Table 2 and Figure 2. The data recorded after 24 hours showed that all insecticides gave significant control of citrus psylla better than check. However, Actara

ranked first by reducing pest population to zero followed by Cascade (0.73 citrus psylla/6" branch). Results of Match (2.33), Thiodan (2.46), Karate (2.73) and Supracide (3.60) were not significantly different from each other. Whereas in check the population was maximum (14.0 citrus psylla/6" tender shoot).

The data recorded after one week of the second spray revealed that all insecticides gave significant control of citrus psylla. Actara proved to be the best of all insecticides reducing the population to 0.93 citrus psylla/6" tender shoot. Cascade was 2nd by reducing the population to 2.46 citrus psylla/6" shoot followed by Match, Thiodan, Karate and Supracide with a population of 4.0, 4.6, 5.53, and 6.53 citrus psylla/6" branch. The maximum numbers recorded from check (14.6 citrus psylla/6" tender shoot).

Results obtained after 2nd week of spray showed that all insecticides proved better than check. Actara proved to be the best of all insecticides in reducing citrus psylla population to 2.13

Table 2. Mean number of citrus psylla per 6" tender shoot after the second spray of 6 different insecticides.

S.No	Insecticides		Citrus psylla/6" tender shoot after second sprayed							
	Common Name	Trade name	24 hrs	1 st week	2 nd week	3 rd week	4 th week	5 th week	6 th week	Mean
1	Thiamethoxam	Actara 25 WG	0 C	0.93 F	2.13 G	4.26 E	5.93 G	7.20 D	8.93 D	2.65 F
2	Flufenoxuron	Cascade 10 DC	0.73 C	2.46 E	4.33 F	6.0 DE	7.66 F	8.26 D	10.07 C	4.23 E
3	Lufenuron	Match 050 EC	2.33 B	4.0 D	5.46 E	7.66 CD	8.60 E	10.13 C	13.33 B	5.61 D
4	Endosulfan	Thiodan 35 EC	2.46 B	4.6 CD	6.40 D	9.0 C	9.60 D	10.93 C	13.47 B	6.41 CD
5	α -Cyhalothrin	Karate 2.5 EC	2.73 B	5.53 BC	8.36 C	9.6 BC	10.53 C	11.13 C	13.60 B	7.35 C
6	Methidathion	Supracide 40 EC	3.60 B	6.53 B	9.40 B	11.20 B	12.93 B	13.27 B	14.0 B	8.73 B
7	Control		14.0 A	14.6 A	14.8 A	17.27 A	16.67 A	16.40 A	15.60 A	15.18 A

Means followed by the same letter in a column are not significantly different from each other (P>0.05), using DMR test.

citrus psylla/6" tender shoot. Cascade ranked 2nd followed by Match, Thiodan, Karate and Supracide with a population of 4.33, 5.46, 6.40, 8.36 and 9.40 citrus psylla/6" branch, respectively. The population density recorded in check was 14.8 citrus psylla/6" shoot.

Results obtained after 3rd week of spray revealed that all the insecticides provided good

control of the pest as compared to check. Actara ranked first by reducing the citrus psylla population to 4.26/6" tender shoot followed by Cascade (6.0), Match (7.66), Thiodan (9.0), Karate (9.6) and Supracide (11.20) citrus psylla/6" branch, respectively. The highest population of the citrus psylla was recorded in check plots where it was 17.27/6" shoot.

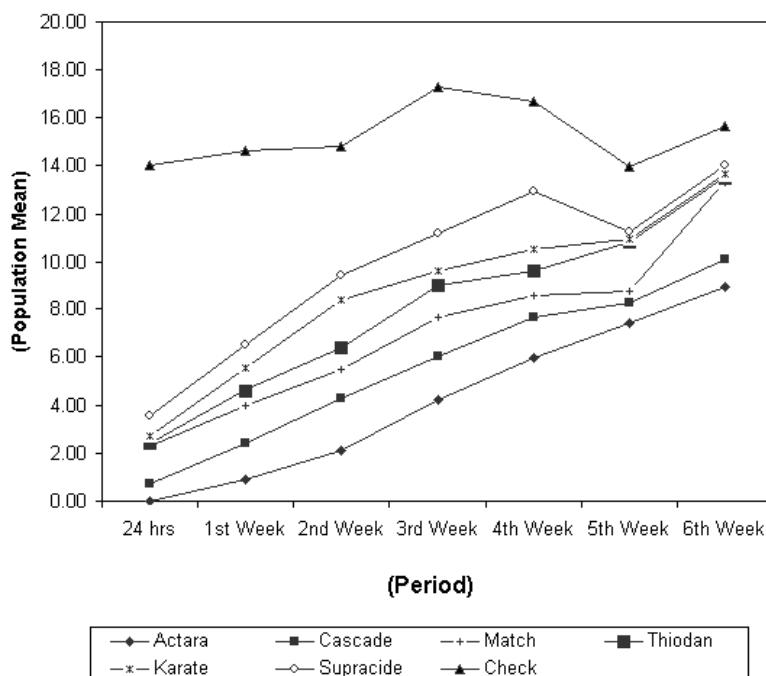


Figure 2. Change in number of citrus psylla per 6" tender shoot after 2nd spray

Post spray data recorded on 4th week indicated that all insecticides were effective to suppress the pest population as compared to check. Minimum pest population was recorded in Actara (5.93) treated plots followed by Cascade (7.66), Match (8.60), Thiodan (9.60), Karate (10.53) and Supracide (12.93) citrus psylla/6" branch, respectively. The maximum pest population was recorded in check plots where it was 16.67 citrus psylla/6" shoot.

For the residual effect post spray, data were also recorded after 5th and 6th week. Results obtained after 5th week indicated that all the insecticides were effective to suppress pest population. Results of the Actara and Cascade were non-significant, however, Actara was still ranked 1st having minimum pest population (7.20 citrus psylla/6" branch) followed by Cascade (8.26 citrus psylla/6" branch). Similarly Match, Thiodan and Karate were statistically the same 10.13, 10.93 and 11.13 citrus psylla/6" branch, respectively. The results of Supracide (13.27 citrus psylla/6" shoot) were significantly greater from the above 5 insecticides but significantly lower than from the check plots where it was 16.40 citrus psylla/6" shoot.

Data collected after 6th week showed that all the insecticides were effective in comparison to control. Actara (8.93 citrus psylla/6" shoot) was ranked first followed by Cascade (10.07 citrus psylla/6" shoot). The remaining four insecticides; Match, Thiodan, Karate and Supracide were in the 3rd category and statistically similar to each other

13.33, 13.47, 13.60 and 14.0 citrus psylla/6" shoot, respectively. The highest population of citrus psylla was recorded in the check plot where it was 15.60/6" branch.

Overall 2nd spray results revealed that all insecticides were effective as compared to control. Means indicated that Actara ranked first throughout the spray followed by Cascade. Both were persistent for six weeks. The remaining four insecticides; Match, Thiodan, Karate and Supracide were found superior to control and less persistent than Actara and Cascade.

Percent decrease of citrus psylla population over time in comparison to control.

The result of the first spray (overall means) Table 1, revealed that Actara (70.71) showed best performance followed by Cascade (61.69), Match (54.91), Thiodan (46.2), Karate (39.72), and Supracide (34.59). After first spray, the maximum percent decrease of citrus psylla population over time in comparison to control was recorded in Actara 25 WG and the minimum in Supracide 40 EC.

The result of the 2nd spray (overall means) Table 3 indicated that Actara (83.54) showed best performance followed by Cascade (71.08), Match (63.94), Thiodan (60.79), Karate (52.527), and Supracide (45.62). After 2nd spray, the maximum percent decrease of citrus psylla population over time in comparison to control was recorded in Actara and minimum in Supracide. Overall, a

Table 3. Percent decrease of Citrus psylla population per 6" tender shoot over time in comparison to control after both sprays.

S. No	Insecticides Trade name	Common Name	1 st Spray	2 nd Spray
1	Actara 25 WG	Thiamethoxam	72.20 A	83.54 A
2	Cascade 10 DC	Flufenoxuron	62.91 B	71.08 B
3	Match 050 EC	Lufenuron	54.07 C	63.94 C
4	Thiodan 35 EC	Endosulfan	47.61 D	60.79 C
5	Karate 2.5 EC	α -Cyhalothrin	38.94 E	52.52 D
6	Supracide 40 EC	Methidathion	35.74 E	45.62 D

Means followed by the same letters in a column are not significantly different from each other (P>0.05), using DMR test.

greater percent decrease was observed in the 2nd spray as compared to the 1st spray.

As evident from the results, all insecticides significantly controlled the *D. citri* upto four weeks after first spray application. Actara 25 WG (thiamethoxam) remained highly effective against *D. citri* during two sprays, followed by Cascade 10 DC, Match 050 EC, Thiodan 35 EC, Karate 2.5 EC and Supracide 40 EC.

Similarly, percent decrease of citrus psylla over time in comparison to control was high in Actara 25 WG followed by Cascade 10 DC, Match 050 EC, Thiodan 35 EC, Karate 2.5 EC and Supracide 40 EC both in the first and second spray. Overall, the performance of Actara 25 WG with its knockdown effect proved best of all treatments where minimum of citrus psylla population and maximum percent decrease over control was recorded.

The active ingredient of Actara is Thiamethoxam which acts as contact and stomach poison. It possesses high systemic activity and is rapidly taken up by the shoots, leaves and roots of the plant (Anonymous, 2000). This insecticide is quite new in this area and has not been used by the farmers of the area. This might be one of the reasons for its high efficacy against the citrus psylla.

The present study confirmed the efficacy of these insecticides against citrus psylla *Diaphorina citri* of citrus in Peshawar valley. As the time passes more and more new products are being introduced to the market which need close monitoring and evaluation. The present study was such an effort in

which various insecticides were tested for their efficacy. The present studies also revealed that all the insecticides were effective in controlling the pest. Based on the present finding it could be suggested that Actara 25 WG should be listed in the spray schedule for the control of citrus psylla.

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