J Agric. Res., 2017, Vol. 55(2):311-321
ISSN: Online: 2076-7897, Print:0368-1157
http://www.jar.com.pk

TOXICITY OF SOME INSECTICIDES AGAINST COTTON JASSID (*AMRASCA DEVASTANS* DIST.) AND ITS PREDATOR (*CHRYSOPERLA CARNEA* STEPH.)

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ABSTRACT

A study was conducted in the lab of Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan during the year 2012-2013. To observe toxicity of insecticides against cotton jassid and its predator *Chrysoperla carnea* (Steph.) an experiment was laid out in CRD under laboratory conditions at 25±1°C temperature and 69±5% relative humidity. There were eight insecticide treatments viz., Talstar10EC (Bifenthrin), Endosulfan35EC (Thiodan), Trebon30EC (Etofenprox), Confidor200SL (Imidachloprid), Polo 500SC (Diafenthiuron), Monocrotophos 40 WSC (Monocrotophos) and two control treatments. Each pesticides was applied @ 1.4 ml with two concentrations (C1=0.025% and C2= 0.05% on third instar larvae of the predator and known number of jassids with Pottar Spray Tower in three different modes (A1- insecticides applied to the substratum, A2- insecticides applied to the substratum+prey and A3- insecticides applied to the substratum+prey+predator). Observations were recorded after 24 hours of each application. It was found that Monocrotophos was most toxic giving (95.56%) mortality of *C. carnea*, after that Talstar (79.44%), Confidor (38.33%), Endosulfan (33.33%), Polo (30.00%) and Trebon caused (27.22%) mortality of predatory larvae. Monocrotophos and Talstar proved toxic while rest of insecticides were moderately toxic and selective in their use against the predator. All the test insecticides effectively controlled the cotton jassid. Talstar was highly toxic resulting 86.81 percent mortality followed by Monocrotophos (84.24%) , Confidor (82.67%), Trebon (79.83%), Endosulfan (78.51%) and Polo (77.18%). Results of the feeding response of third instear larvae of *Chrysoperla carnea* on cotton jassid revealed that minimum consumption (2.89 pests/ larva) was on Talstar treated jassids and maximum on Polo treated *A. devastans* (6.71 pests/ larva). Larval feeding on the treated cotton jassids was Talstar 2.89, Monocrotophos 3.96, Confidor 6.33, Trebon 4.55, Endosulfan 5.84 and Polo 6.71 jassids/larva.

KEYWORDS: Toxicity; insecticides; *Amrasca devastans; Chrysoperla carnea;* cotton jassid; predation; Pakistan

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INTRODUCTION

Cotton (*Gossypium hirsutum* L.), white gold, is a major cash crop of Pakistan which provides raw material for our local cotton industry and stands at the top of our exports. It accounts for 7 percent of value added in agriculture and 1.5 percent of GDP. During 2012-13, the crop was cultivated on an area of 2879 thousand hectares, 1.6 percent more than previous year (2835 thousand hectares) (6).

Cotton crop is attacked by sucking and chewing pest complex. Bollworm attack on cotton was a serious problem during recent years but with the introduction of Bt varieties of cotton in Pakistan, this problem has been partially solved and a change in cropping scheme in the cotton growing areas has been observed (1, 2). But the problem of sucking insect pests attack remained unsolved still now. Jassid is the most destructive sucking pest among them (5). It sucks the cell sap and injects the toxic saliva inside the veins due to which leaves turned yellowish and later turned to reddish which eventually dried up affecting the photosynthesis. Reduced plant growth was observed due to heavy attack at early stage, which causes abortion of the first fruiting branch and increase shedding of squares and young bolls (21, 23).

Chrysoperla carnea (Steph.) is one of the most effective general entomophagous predators. Adults are non-predaceous, feed on honey dew and pollen, have high reproductive potential and long oviposition period (12). Its larvae are voracious predators for various soft bodied phytophagous arthropods. *Chrysoperla carnea* is important predator and has been suppressed due to pesticides use on several crops (25). Many researchers have evaluated performance of this predator against different insect pests on different crops (13, 25).

Tons of pesticides are imported every year to control crop pests and large portion of these pesticides is used against cotton pests. The indiscriminate use of insecticides can affect the success of biological control due to its direct and indirect toxic effects on natural enemies. Many methods should be considered and implemented to minimize the effects of insecticides on beneficial organisms due to this reason (11). Therefore, it is essential to understand the risks, selectivity and conditions to use these products in order to maximize compatibility between chemical and biological control. The compatibility of an insecticide with biological control agents has been determined through mortality trials on natural enemies (14), and through

selectivity tests to identify products with lower toxicity on organisms that are not the object. These selective insecticides are very effective to the pests but with minimal effects on natural enemies (8).

The hypothesis for this study was that some of the products evaluated are effective against cotton jassid and be selective for *C. carnea*. It was the object of the present investigation to compare the tolerance of *C. carnea* and cotton jassid to some insecticides under laboratory conditions and for the selection of most suitable insecticidal treatment which will favor this natural enemy in its environment.

MATERIALS AND METHODS

This study was conducted in the Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan during 2012-13 under laboratory conditions (25±1°C temperature and 69±5% relative humidity). The material used comprised sterilized petri dishes (12.5 cm), sterilized whatman filter paper (number 44), filter paper sheets, plastic jars (27×15 cm), beakers (400ml), ingredients of artificial diet viz; honey, dry brewer's yeast, casein hydrolysate and vitamin B complex, distilled water, muslin cloth, Vaseline wax, rubber band, pair of scissors, camel hair brush, cotton plants grown in earthen pots (25 cm) diameter.

Cotton jassid (*Amrasca devastans* Distant) was reared on cotton plants which were grown in the earthen pots. When the plants became 15 cm high, they were infested with nymphs of the jassid obtained from the cotton fields. Infested plants were kept in guaze cages. After about ten days, sufficient population of cotton jassid was established to test the toxicity of different insecticides to *C. carnea* and jassid. The plants in pots were checked daily for cleanliness and watering was done after every 2nd day. New stocks of plants were grown to supplement the worn out plants.

Adults and eggs *of Chrysoperla carnea* were collected from fields of cotton and maize crop planted in research area of University of Agriculture, Faisalabad. Adults were kept in plastic jars (15 per jar). A filter paper was placed at bottom to avoid possible damage to adults from bottom. Artificial diet was prepared by mixing honey, dry Brewer's yeast and distilled water in proportions of 7:4:4 (9), one part of casein hydrolysate and one part of vitamin B complex was mixed to form a paste. This diet was placed in droplets on stripes of filter paper (three stripes per jar). Mouth of each jar was covered with muslin cloth with rubber band. Small quantity of water was also sprayed on stripes and muslin cloth.

The muslin cloth and dietary stripes were changed daily. Eggs which were laid on the muslin cloth, dietary stripes along with field collected eggs were placed in petri dishes by cutting the stripes and muslin cloth according to the size of these dishes. The upper portion of the petri dishes was waxed with vaseline to prevent larval escape. All the petri dishes were placed in a growth chamber running at 25±1°C temperature and 69±5% relative humidity. After hatching these larvae were provided with fresh cotton leaves infested by the nymphs of the jassid. These leaves were replaced after two days in each jar. After pupation the leaves from the jars were placed in a rearing cage for adult emergence. After three days of adult emergence, these were shifted to the jars for egg laying.

Toxicological experiments

Six insecticides, viz. Talstar10EC (Bifenthrin), Endosulfan35EC (Thiodan), Trebon30EC (Etofenprox), Confidor 200SL (Imidachloprid), Polo 500SC (Diafenthiuron) and Monocrotophos 40 WSC (Monocrotophos) which were recommended for use in cotton were tested on 3rd instar larvae of *C. carnea.* Effectiveness of these insecticides against cotton jassids *Amrasca devastans* was also evaluated. Two insecticide concentrations, viz. C1 (0.025%) and C2 (0.05%) of active ingredient were applied. The concentrations were prepared on weight by volume basis and were kept in a deep freezer in tightly closed bottles. The experiment was laid out in completely randomized design (CRD) (31).

Non-infested cotton leaves were cut in disc shape of equal size and placed in petri dishes. A known number of cotton jassid and third instar larvae of the predator was released on each disc in petri dish. Insecticides were sprayed with equal quantity (1.4 ml) with Potter Spray Tower in three different modes to check their effectiveness on the insects.

A1. By treating the substratum: Each petri dish with cotton leaf disc was sprayed with 1.4 ml of each concentration of the insecticides. After that five, third instar larvae of the predator, alongwith the 200 jassids of all ages were released on the treated petri dish.

A2. By treating the substratum and the jassids: In second mode, 200 of jassids were released in the petri dish and sprayed with 1.4 ml of insecticide. Five, third instar larvae were released in petri dish after spray.

A3. By treating the substratum, jassids and predator's larvae: In third case, 200 of jassids and five, third instar larvae of predator were released in

petri dish and after that insecticide was sprayed with same volume and concentrations. Petri dishes were put in gentle stream of air to avoid fumigation of insecticides and then covered with muslin cloth. Control dishes with same number of jassids and predators were sprayed with same volume of water.

Each repeat had eight treatments which includes two as control. Percentage mortality of larvae and jassid and feeding response of predator on cotton jassid in each petri dish was recorded after 24 hours of applications. Results thus obtained were analyzed by using MSTATC software.

RESULTS AND DISCUSSION

Monocrotophos and Talstar had lethal affect causing 95.56 and 79.44 percent mortality of 3rd larval instar of *Chrysoperla carnea,* respectively. Both concentrations (0.05% and 0.025%) of the pesticides incur 39.84 and 46.98 percent mortality to the predatory larvae, they are not much different in their lethality (Table 1). Direct spraying of the insecticides (Mode A3 of insecticide application) on the entomophagous larvae was somewhat more lethal as to Mode A2 of insecticide application.

Table 1. Relative effectiveness (%age mortality) of six insecticides against 3rd instar larvae of *Chrysoperla carnea* (mean ± SE)

Insecticides	Mode of insecticide application			Mean
	Only leaf treated	Leaf+Jassid treated	Leaf + Jassid + predator treated	
Talstar 10 EC	66.67±4.49c	81.67±4.58b	90.00 ± 3.02 ab	79.44±2.82 B
Monocrotophos 40 WSC	90.00±3.02ab	96.67±2.25a	100.00±0.00a	95.56±.41 A
Endosulfan 35EC	15.00±4.35ghi	36.67±4.82ef	48.33±6.26de	33.33±3.74CD
Confidor 200SL	16.67±4.82gh	38.33±5.20ef	60.00±6.03cd	38.33±4.24C
Trebon 30EC	3.33±2.25ij	20.00±6.03gh	58.33±5.75cd	27.22±4.79D
Polo 500SC	8.33±3.86hij	26.67±5.12fg	55.00±4.35cd	30.00±4.10D
Control	0.00±0.00j	0.00±0.00j	0.00±0.00j	0.00±0.00E
Mean	28.57	42.86±3.85B	58.81±3.65A	
	Concentration			
	C1 (0.025 %)		C2 (0.05 %)	
Mean	39.84 ± 3.29 B		46.98 ± 3.21 A	

Means sharing similar letter in a row or in a column are statistically non-significant (P>0.05). Small letters represent comparison among interaction means and capital letters are used for overall mean.

All the test chemicals proved very effective against cotton jassid and caused more than 77.18 percent mortality (Table 2). The DMR test shows that 0.05 percent concentration of all the insecticides is more toxic to jassid than 0.025 percent concentration. Among all the insecticides Talstar is highly toxic

resulting 86.81 percent mortality then Monocrotophos 84.24 percent, Confidor 82.67 percent, Trebon 79.83 percent, Endosulfan 78.51 percent, and Polo 77.18 percent (Table 2).

Table 2. Relative effectiveness (%age mortality) of six insecticides against cotton jassid (mean ± SE).

Insecticides	Concentration		Mean
	C1 (0.025%)	C2 (0.05%)	
Talstar 10 EC	85.58 ± 0.59 b	88.03 ± 0.76 c	86.81 ± 0.59 A
Monocrotophos 40 WSC	70.94 ± 0.34 d	88.53 ± 0.38 a	84.24 ± 1.32 B
Endosulfan 35EC	76.6 ± 0.46e	80.97 ± 0.43 d	78.51 ± 0.80 E
Confidor 200SL	80.69 ± 0.42 d	84.64 ± 0.43 b	82.67 ± 0.66 C
Trebon 30EC	76.36 ± 0.25 c	83.31 ± 0.50 c	79.83 ± 1.08 D
Polo 500SC	74.72 ± 0.57 f	79.64 ± 0.49 d	77.18 ± 0.82 F
Control	2.00 ± 0.03 g	1.91 ± 0.04 g	1..95 ± 0.03 G
Mean	67.91 ± 4.24 B	72.43 ± 4.52 A	

Means sharing similar letter in a row or in a column are statistically non-significant (P>0.05). Small letters represent comparison among interaction means and capital letters are used for overall mean.

When we compare the feeding response of 3rd instar larvae on cotton jassid,consumption of jassid is 5.00 pests/ larva at 0.05% which is less than the feeding activity at 0.025% (6.70 pests/larva) (Table 3). It is obvious from the data that least feeding (2.89 pests/ larva) is on Talstar treated jassids and maximum on Polo treated *A. devastans* (6.71 pests/larva) (Table 4). Larval feeding on the treated cotton jassids is Talstar 2.89, Monocrotophos 3.96, Confidor 6.33, Trebon 4.55, Endosulfan 5.84 and Polo 6.71 jassids/larva (Table 4).

Table 3. Feeding response of third instar larvae of *Chrysoperla carnea* in different concentrations and mode of insecticide application (mean no. of jassid consumed ± SE).

Mode of insecticide application	Concentration		
	C1 (0.025%)	C2 (0.05%)	Mean
Only leaf treated	9.82 ± 0.34 a	6.90 ± 0.35 d	8.36 ± 0.29 A
Leaf+Jassid treated	5.94 ± 0.41 b	4.67 ± 0.44 c	5.30 ± 0.31 B
Leaf+Jassid+predator treated	4.35 ± 0.46 c	3.42 ± 0.50 f	3.89 ± 0.34 C
Mean	6.70 ± 0.31 A	5.00 ± 0.28 B	

Mean sharing similar letter in a row or in a column are statistically non-significant (P>0.05), Small letters represent comparison among interaction means and capital letters are used for over all mean.

Results of present findings partially agree with those of Singh and Varma (28) who stated that Monocrotophos gave 74-89 percent larval mortality over 72 h period. Ali and Khan (4) used Azodrin (Monocrotophos) in controlling infestations of *Amrasca devastans* on cotton and found that it gave 91-97.53

percent mortality of jassid. Patel and Yadev (20) studied the effect of monocrotophos on *Amrasca biguttula* and Chrysopid predator *Chrysopa scelestes* and the results suggested that although monocrotophos was effective in reducing the pest status but it had an adverse effect on *Chrysopa scelestes*.

Table 4. Feeding response of third instar larvae of *Chrysoperia carnea* in different concentrations of insecticides (mean no. of jassid consumed ± SE).

Insecticides	Concentration		Mean
	C1 (0.025%)	C2 (0.05%)	
Talstar 10 EC	3.40 ± 0.35 h	2.39 ± 0.23 i	2.89 ± 0.22 G
Monocrotophos 40 WSC	5.59 ± 1.25 de	2.32 ± 0.51 i	3.96 ± 0.72 F
Endosulfan 35EC	7.24 ± 0.52c	5.41 ± 0.43 e	6.33 ± 0.37 C
Confidor 200SL	5.29 ± 0.58 e	3.81 ± 0.43 g	4.55 ± 0.38 E
Trebon 30EC	7.16 ± 0.66 c	4.53 ± 0.47 f	5.84 ± 0.46 D
Polo 500SC	7.58 ± 0.63 b	5.84 ± 0.53 d	6.71 ± 0.43 B
Control	7.58 ± 0.63 b	1.91 ± 0.04 g	1..95 ± 0.03 G
Mean	10.67 ± 9.04 a	10.67 ± 0.04 a	10.67 ± 0.03 A

Means sharing similar letter in a row or in a column are statistically non-significant (P>0.05). Small letters represent comparison among interaction means and capital letters are used for overall mean.

Table 5. Feeding response of third instar larvae of *Chrysoperia carnea* in interaction of different insecticides, and made of insecticide application (mean no. of jassid consumed ± SE).

Insecticides	Concentration		Mean
	Only leaf treated	Leaf+Jassid treated	Leaf + Jassid + predator treated
Talstar 10 EC	4.42 ± 0.31 g	2.33 ± 0.14 j	1.93 ± 0.17 k
Monocrotophos 40 WSC	8.83 ± 1.16 c	2.77 ± 0.29 i	0.27 ± 0.12 l
Endosulfan 35EC	8.80 ± 0.39 c	5.98 ± 0.34 f	4.20 ± 0.21 g
Confidor 200SL	7.43 ± 0.38 d	3.27 ± 0.24 b	2.95 ± 0.15 hi
Trebon 30EC	8.70 ± 0.64 c	5.67 ± 0.28 f	3.17 ± 0.34 hi
Polo 500SC	9.68 ± 0.39 b	6.43 ± 0.32 e	4.02 ± 0.22 g
Control	10.67 ± 0.04 a	10.67 ± 0.04 a	10.67 ± 0.04 a

Means sharing similar letter in a row or in a column are statistically non-significant (P>0.05). Small letters represent comparison among interaction means and capital letters are used for overall mean.

Talstar with 86.81 percent mortality of jassid partially agrees with that of Ali and Khan (4) who stated that Talstar (bifenthrin) gave 91-97.53 percent mortality to jassids. Effectiveness of Talstar to the predator *Chrysoperla carnea* is also very close to the findings of above said scientists. Results of our experiment agree to those of Cerna *et al.* (10) who studied the toxicity and selectivity of bifenthrin to *C carnea* and found it selective to the predator. They also studied the toxicity and selectivity of endosulfan to *C carnea* and found that endosulfan was selective to the predator. Endosulfan was slightly persistent decreasing the survival of *C externa* upto 30 percent. Results of our investigation are close to earlier work (17) that Endosulfan was least toxic

to *Chrysoperla rufilabris* giving <50% mortality. Srinivasan and Babu (30) in their investigation showed that endosulfan and abamectin had no adverse influence on the grubs of *Chrysoperla carnea* and the grub mortality was only 3.3 and 6.7 percent. Shinde and Adlakha (27) reported that endosulfan caused only (4.75%) mortality of chrysopa larva after 24 h period. The finding of Sherma and Adhallha (26) showed that endosulfan is the safest insecticide also support present results. Results found by Soares *et al.* (29) are close to the results of present research that endosulfan was moderately persistant against predatory larvae. These results disagrees with Singh and Varma (28), who revealed that endosulfan gave 74.89% larval mortality over 72 h period. Akbar *et al.* (3) showed that endosulfan proved very effective for the control of cotton jassid and gave 66% mortality.

Confidor which shows moderate toxicity to Chrysopa is in line with that of Vivek *et al.* (32) who reported 26 percent mortality of *Chrysoperla carnea* in lab conditions at recommended field doses. In another lab study (22) imidachloprid at recommended dose caused 33.33 percent larval mortality. Rezaei *et al.* (24) tested imidachloprid against *Chrysoperla carnea* larvae and found it harmless giving 27.44 percent mortality according to IOBC system. Singh and verma (28) reported that imidachloprid caused only (0.00%) mortality at 24 h but caused (4.75%) mortality of chrysopa larva after 48 h period in thin film method. Khatak *et al.* (15) also supported our study and found that confidor significantly reduced jassid population.

Trebon proved very selective against Chrysoperla carnea but it is equally effective against the cotton jassid giving 79.83% mortality. So it can be used as safe chemical for the control of cotton jassid. In a laboratory study (22) diafenthiuron at recommended dose caused 26% larval mortality which is close to our results that Polo caused 30% larval mortality. Nasreen *et al.* (19) showed that diafenthiuron was found harmless to the larvae of *C carnea* at recommended concentration of insecticides by leaf dip bioassay method. Khatak *et al.* (15) found that Polo significantly reduced jassid population in cotton fields. Some others (7, 18) also reported that Polo is highly effective against sucking insect pests of cotton.

CONCLUSION

The results of the present research suggest that Monocrotophos and Talstar proved very toxic to the *Chrysoperla carnea* so these are not selective while rest of insecticides have shown moderate toxicity to the predator. So these chemicals can be incorporated in integrated pest management programmes.

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Received: August 20, 2015 Accepted: April 27, 2016

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Ijaz Haider	**:**	**Planned and conducted whole research**
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