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Bio-efficacy of novel insecticides against chilli aphid, *Aphis gossypii* Glover and thrips, *Scirtothrips dorsalis Hood* in Malwa region of Madhya Pradesh

PRINCE JAIN, S.B. SINGH, KANCHANA BORBAN AND A.K. BADAYA

Department of Agricultural Entomology, RVSKVV, College of Agriculture, Indore, Madhya Pradesh-452001

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ABSTRACT

The experiment was carried out in kharif season of 2016 at experimental farm, College of Agriculture, Indore (M.P.) in randomized block design with seven treatments and 3 replications on chilli F1 hybrid Priya (NCH-886). Four doses of chlorfenapyr 240 SC @ 144, 192, 240 and 288 g.a.i. ha^{-1},emamectin benzoate 5% SG@ 10 g.a.i ha^{-1}, imidacloprid 17.8 SL @ 50 g.a.i ha^{-1} including untreated control were sprayed at 10 days interval. After all the sprays, insect population reduction and foliage loss was recorded. Results revealed that overall highest population reduction of aphids and thrips (98.38% and 90.29%) was noted maximum in highest dose of chlorfenapyr 240 SC @ 288 g.a.i.ha^{-1} followed by second highest dose of chlorfenapyr 240 SC @ 240 g.a.i. ha^{-1} (97.21% and 89.91%). Similarly minimum foliage loss was observed in highest dose of chlorfenapyr 240 SC @ 288 g.a.i.ha^{-1} (15.83%) followed by second highest dose of chlorfenapyr 240 SC @ 240 g.a.i. ha^{-1} (18.26%). All the treatments differed significantly with untreated check in relation pest population and foliage loss. The chilli yield was also noted highest in highest dose of chlorfenapyr 240 SC @ 288 g.a.i.ha^{-1} (16.0 tonnes ha^{-1}) followed by second highest dose of chlorfenapyr 240 SC @ 240 g.a.i. ha^{-1} 15.4 tonnes ha^{-1}), however, it was recorded lowest in untreated control (8.0 tonnes ha^{-1}). The cost benefit ratio was noted higher in emamectin benzoate 5% SG@ 10 g.a.i ha^{-1} (3.20) followed by imidacloprid 17.8 SL @ 50 g.a.i ha^{-1} (2.99).

Keywords: Chilli, *Aphis gossypii* Glov, Scirtothrips *dorsalis* Hood, hybrid, assessment and Insecticidal alternation

INTRODUCTION

Chilli (*Capsicum annum* L.) is a tropical and subtropical crop grown all over the India. The crop has got great export potential besides huge domestic requirement but a number of limiting factors have been attributed for low productivity. Among them occurrence of viral diseases as well as ravages caused by insect pests are significant ones. Aphid, thrips and whitefly recongnized as a major pest of chilli crop and cause leaf curl disease (Dhanalakshmi *et al. 2016*). The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Dey *et al.* 2001). One of the practical means of increasing chilli production is to minimize losses caused by major sucking pests like aphid (*Aphis gossypii* Glover) and thrips (*Scirtothrips dorsalis* Hood) (Berke and Sheih, 2000). Economic yield loss due to these pests may be 11-75% quantitatively and 60-80% qualitatively in the event of serious infestation. The yield loss due to chilli thrips is estimated to be to the tune of 50-90 per cent (Kandasamy *et al.* 1990).Now-a-days build-up of these sucking pests in chilli are so much and for that sprays have increased over the years, but on the contrary, cost of cultivation has increased enormously and making cultivation of chilli highly risky. In addition to this, pesticidal sprays became a threat to chilli ecosystem causing problems of resistance, resurgence of pests, pesticidal residues and menace to natural enemies fauna. Pesticide residues in chilli are of great concern from the point of domestic consumption and exports as well (Awasthi *et al.* 2011). In order to impede the development of insecticide resistance efforts are always being made but due to misuse and continuous repeated use of recent and even novel in WWW insecticides, insect resistance is increased day by day. In present scenario, to increase the efficacy of insecticides highly effective and safer products are being used. Viewing the above facts the experiment was planned to test the efficacy of novel insecticides against aphid and thrips in chilli.

MATERIALS AND METHODS

The experiment was carried out in randomized block design with seven treatments and 3 replications in *kharif* season of 2016 at

experimental farm, College of Agriculture, Indore (M.P.). Chilli *F1* hybrid *Priya (NCH-886)* was transplanted on 10th November, 2016 with 45 X60 cm spacing. Insecticidal spray was started at the ETL of insects @ 500 litre water/ hectare with knapsack sprayer fitted with a flood jet nozzle. The six treatments consist of four doses of chlorfenapyr 240 SC @ 144, 192, 240 and 288 g.*a.i*. ha^{-1}, emamectin benzoate 5% SG@ 10 g.*a.i* ha^{-1}, imidacloprid 17.8 SL @ 50 g.*a.i* ha^{-1} including untreated control. Each treatment was sprayed thrice at 10 days interval. Thrips and aphid population was counted one day before and 10 days after each spray from five randomly selected plants of each plot. The aphid population was recorded from 10 cm long twig of each plant where as thrips population was counted on five leaves per plant with two top, two middle and one lower leaf using hand lens. Per cent population reduction was calculated for each spray, averaged for three sprays and finally overall population reduction was calculated based on pre treatment observation and last observation of third and last spray. Per cent leaf foliage loss was also observed visually from the same five randomly selected plants of each plot during last observation of each spray by observing the yellowing of leaves and withering and averaged. The yield of the chilli was recorded in each plot and converted into tonnes per hectare. Finally the cost benefit ratio was also calculated. The data obtained from the observations for each character were tabulated and analyzed statistically.

RESULTS AND DISCUSSION

Aphid

In pre treatment observation the aphid population ranged from 68.2 to 70.5. After first spray the least aphid count (Table 1) was observed in highest dose of chlorfenapyr 240 SC @ 288 g.*a.i*. ha^{-1} (14.10/twig) which was statistically at par with chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} (17.65) followed by emamectin benzoate5% SG@ 10 g.*a.i* ha^{-1} (21.40) and remaining treatments. Similar trend of efficacy and population reduction was noted in second and third spray.

Table 1: Effect of treatments after three sprays against chilli aphid

Treatments	Aphids population after							Average population reduction (%) of three sprays	Overall population reduction (%)
	1st spray			2nd spray		3rd spray			
	Pre-treatment	10 DAS	Population reduction (%)	10 DAS	Population reduction (%)	10 DAS	Population reduction (%)		
T_1	70.58 (8.43)	32.72 (5.76)	53.64	15.39 (3.99)	52.96	7.82 (2.88)	49.18	51.92	88.92
T_2	70.28 (8.41)	28.93 (5.42)	59.13	11.30 (3.44)	60.94	5.49 (2.45)	51.41	57.16	92.18
T_3	68.30 (8.29)	17.65 (4.26)	74.15	4.92 (2.33)	72.12	1.90 (1.55)	61.38	69.21	97.21
T_4	68.27 (8.49)	14.10 (3.82)	79.34	3.21 (1.93)	77.23	1.10 (1.26)	65.73	81.61	98.38
T_5	68.96 (8.33)	21.40 (4.68)	68.96	6.98 (2.66)	67.38	2.96 (1.86)	57.59	64.64	95.70
T_6	70.17 (8.39)	25.25 (5.01)	64.06	9.37 (3.14)	62.89	4.53 (2.21)	51.65	59.53	93.54
T_7	69.32 (8.35)	69.81 (8.39)	-	69.93 (8.39)	-	70.25 (8.41)	-	-	-
SEm±		0.22		0.17		0.10			
CD (5 %)	NS	0.68		0.51		0.30			
CV %		9.17		10.04		7.45			

The values in parentheses are square root transformed value,
DAS = Days after spray, Treatments detail: T_1- Chlorfenapyr 240 SC @ 144 g.a.i. ha^{-1} ,T_2 - Chlorfenapyr 240 SC @ 192 g.a.i ha^{-1} , T_3 - Chlorfenapyr 240 SC @ 240 g.a.i. ha^{-1} ,T_4 - Chlorfenapyr 240SC @ 288 g.a.i. ha^{-1},T_5 - Emamectin Benzoate5% SG@ 10 g.a.i ha^{-1},T_6 - Imidacloprid 17.8 SL @ 50 g.a.i.ha^{-1},T_7 - Untreated Control

Further, the average and overall insect population reduction of three sprays was noted maximum again in highest dose of chlorfenapyr 240 SC @ 288g.*a.i*. ha^{-1} (81.61% and 98.38%) and followed with chlorfenapyr 240 SC @ 240 g.*a.i* ha^{-1} (69.21% and 97.21%), emamectin benzoate5% SG @ 10 g.*a.i* ha^{-1} (64.64% and 95.70%), imidacloprid 17.8 SL @ 50 g.*a.i*.ha^{-1}(59.53% and 93.54%), chlorfenapyr 240 SC @ 192 g.*a.i* ha^{-1} (57.16% and 92.18%) and chlorfenapyr 240 SC @ 144 g.*a.i*. ha^{-1} (51.92% and 88.92%). Finally the highest dose of chlorfenapyr 240 SC @ 288g.*a.i*. ha^{-1} and even second highest dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} exhibited maximum effectiveness in reducing the pest population followed by emamectin Benzoate5% SG@ 10 g.*a.i* ha^{-1}. Ditya *et al.* (2010) reported the use of chlorfenapyr against aphid, thrips and some other insect pests as it belongs to pyrrole group of insecticides and having broad spectrum nature. Laishana *et al.* (2013**)** noticed second best control by chlorfenapyr after spinetoram. The above findings are in partial agreement with the present study but due to its translaminar movements in plants the efficacy of chlorfenapyr might be increased as it was reported by Treacy *et al.* (1994). Chlorfenapyr is newly tested against aphid on chilli hence references are not available. Further, in relation to the efficacy of emamectin benzoate against aphid Patel *et al.* (2015) reported that emamectin benzoate @ 10 g.*a.i* ha^{-1} was found to be most effective as it recorded lowest infestation, of all the recorded sucking pest of brinjal. Laishana *et al.* (2013) recorded lesser effectiveness of emamectin benzoate than spinetoram and chlorfenapyr in tomato. This might be due to regular application of emamectin benzoate. Similarly the least efficacy of imidacloprid in present study might be due to resistance of the pest as reported by Sujay *et al.* (2015) against chilli pests viz. green peach aphid (*Myzys persicae Sulzer, Aphis gossypi Glover*) while in previous years Kumar *et al.* (2011) and Das (2013) observed the best control of chilli aphid. These findings are in the line of agreement with the present study.

Thrips

The thrips population was recorded in the range of 5.9 to 6.1 in pre treatment observation. After first spray the minimum thrips number (Table 1) was noted in highest dose of chlorfenapyr 240 SC @ 288 g.*a.i*. ha^{-1} (2.75/leaf) which exhibited no significant difference with all the treatments except least dose of chlorfenapyr 240 SC @ 144 g.*a.i*. ha^{-1} (3.43).

Table 2: Effect of treatments after three sprays against chilli thrips

Treatments	Thrips population after							Avg. population reduction (%) after three sprays	Overall population reduction (%)
	1st spray			2nd spray		3rd spray			
	Pre-treatment	10 DAS	Population reduction (%)	10 DAS	Population reduction (%)	10 DAS	Population reduction (%)		
T_1	6.18 (2.58)	3.43 (1.97)	39.00	2.26 (1.66)	40.06	1.90 (1.54)	46.90	41.98	68.44
T_2	5.95 (2.54)	3.68 (2.04)	38.16	2.01 (1.58)	45.66	1.80 (1.52)	10.00	31.27	69.74
T_3	6.15 (2.58)	2.77 (1.81)	54.96	1.03 (1.23)	51.99	0.62 (1.06)	53.38	53.44	89.91
T_4	6.08 (2.56)	2.75 (1.75)	54.77	1.18 (1.27)	57.10	0.59 (1.04)	50.00	53.95	90.29
T_5	5.99 (2.55)	3.83 (2.05)	36.07	1.35 (1.36)	64.94	0.64 (1.07)	52.59	51.20	89.31
	6.16 (2.58)	3.61 (2.03)	41.40	1.62 (1.46)	56.79	1.60 (1.45)	05.91	34.70	74.02
T_7	6.00 (2.51)	6.34 (2.61)	-	7.04 (2.74)	-	8.60 (3.01)	-	-	-
S Em±		0.16		0.08		0.05			
CD (5 %)	NS	0.50		0.26		0.17			
CV %		12.00		9.20		6.25			

The values in parentheses are square root transformed values, DAS - Days after spray

Although all the treatments differed significantly with untreated control. In second spray highest efficacy against the pest population was recorded in second higher dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} (1.03) and found at par with maximum dose of chlorfenapyr 240 SC @ 288 g.*a.i*. ha^{-1} (1.18), emamectin benzoate5% SG@ 10 g.*a.i* ha^{-1} (1.35) and imidacloprid 17.8 SL @ 50 g.*a.i*.ha^{-1} (1.46). After third spray again the highest dose of chlorfenapyr 240 SC @ 288g.a.i. ha^{-1} (0.59) showed the highest effectiveness and no significant difference noticed with lower dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} (0.62) and emamectin benzoate5% SG@ 10 g.*a.i* ha^{-1} (0.64). Further, the average and overall insect population reduction of three sprays was noted maximum again in highest dose of chlorfenapyr 240 SC @ 288g.*a.i*. ha^{-1} (53.9% and 90.2%) followed by chlorfenapyr 240 SC @ 240 g.*a.i* ha^{-1} (53.4% and 89.9%) and emamectin benzoate 5% SG @ 10 g.*a.i* ha^{-1} (51.2% and 89.3%) respectively. Finally the highest dose of chlorfenapyr 240 SC @ 288g.*a.i*. ha^{-1} and even second highest dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} performed highest efficacy in reducing the pest population followed by emamectin benzoate5% SG@ 10 g.*a.i* ha^{-1}. Seal *et al.* (2006) found the highest efficacy of chlorfenapyr in reducing the densities of *S. dorsalis* adults and larvae against chilli thrips. Chakraborti *et al.* (2015) showed much better suppression of thrips population in chilli when one application of chlorfenapyr and emamectin benzoate along with neem seed kernel extract was made. These findings are in the line of agreement with present study. Further, the effectiveness of emamectin benzoate was reported by Sahu *et al.* (2015), Sarkar *et al.* (2015) and Ravikumar *et al.* (2016) against thrips *Scirtothrips dorsalis* as it was noted in present investigation.

Foliage loss

It was revealed that (Table 3) the foliage loss ranged between 33.7% and 41.6% before the spraying. The average foliage loss was recorded minimum in highest dose of chlorfenapyr 240 SC @ 288 g.*a.i*. ha^{-1} (15.8%) followed the second highest dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1} (18.2%), emamectin benzoate 5% SG @ 10 g.*a.i* ha^{-1} (21.5%) and imidacloprid 17.8 SL @ 50 g.*a.i* ha^{-1} (23.3%). Rest of the treatments exhibited comparatively higher foliage loss but better untreated control (50.7%). At of each interval both the highest doses of chlorfenapyr exhibited the best performance.

Table 3: Effect of treatments on foliage loss after three sprays against chilli aphid and thrips

Treatments	Foliage loss				Overall foliage loss	Chilli yield (t ha^{-1})	Cost benefit ratio
	Pre-treatment	After 1st Spray	After 2nd Spray	After 3rd Spray			
		10 DAS	10 DAS	10 DAS			
T_1	39.67 (39.01)	32.03 (34.17)	27.62 (31.70)	19.42 (26.15)	26.35	12.3	2.21
T_2	41.04 (39.84)	30.35 (33.43)	25.49 (30.32)	17.68 (24.86)	24.50	12.7	2.19
T_3	36.88 (37.38)	24.14 (29.39)	18.79 (25.51)	11.86 (20.03)	18.26	15.4	2.73
T_4	35.53 (36.47)	21.69 (27.63)	16.20 (23.47)	9.61 (17.57)	15.83	16.0	2.75
T_5	33.79 (39.10)	28.51 (32.57)	21.59 (27.61)	14.49 (22.34)	21.53	14.8	3.20
T_6	40.04 (39.25)	29.86 (33.12)	23.65 (29.07)	16.64 (23.99)	23.38	14.0	2.99
T_7	41.66 (40.20)	44.60 (41.90)	51.41 (45.81)	56.27 (48.60)	50.76	8.0	1.40
S Em±		1.04	1.32	1.36		0.65	
CD (5 %)	NS	3.20	4.08	4.20		2.02	
CV %		5.43	7.51	9.00		10.36	

The values in parentheses are angular transformed (arc sin) values
DAS - Days after spray

The highest efficacy of chlorfenapyr against aphid and thrips exhibits that foliage loss will be naturally least which is self explainatory and also reported by Hossain *et al.* (2016) which resulted negative correlation of thrips population with Chlorophyll Concentration Index of leaf and the lowest upward leaf curl (19.05%). The efficacy of emamectin benzoate was supported by Ravikumar *et al.* (2016) where they explained that emamectin benzoate 5 SG @ 0.4g litre^{-1} was very effective against leaf curl damage by thrips. Chakraborti *et al.* (2015) also reported that one application each emamectin benzoate and chlorfenapyr along with the plant fractions showed much better suppression of apical leaf curling intensity (0.94–1.12%) in chilli.

Economics

In present study the chilli yield (Table 3) was noted highest in highest dose of chlorfenapyr 240 SC @ 288 g.*a.i*. ha^{-1} (16.0 tonnes ha^{-1}) and found at par with second highest dose of chlorfenapyr 240 SC @ 240 g.*a.i*. ha^{-1}(15.4tonnes ha^{-1}), emamectin benzoate 5% SG @ 10 g.*a.i* ha^{-1} (14.8 tonnes ha^{-1}) and imidacloprid 17.8 SL @ 50 g.*a.i* ha^{-1} (14.0 tonnes ha^{-1}) . The cost benefit ratio was recorded highest in emamectin benzoate (3.20) followed by imidacloprid (2.99), highest dose of chlorfenapyr (2.75) and second highest dose of chlorfenapyr (2.73). The highest yield with lower cost benefit ratio of chlorfenapyr might be due to comparatively higher cost of insecticide with little higher dose. The findings of Hossain *et al.* (2016) are in partial agreement as they noted that the spraying of chlorphenapyr @ 1ml/litre of water + white sticky trap @ 40 traps ha^{-1} highest marginal benefit cost ratio (33.02) and the highest chilli yield (12.72 t ha^{-1}) against chilli pests. Similarly, Chatterjee and Mondal (2012) explained that chlorfenapyr led to increases chilli yield. Kumar and Sarada (2015) found higher cost benefit ratio of emamectin benzoate (1:3.75) followed by chlorfenapyr (1:1.53) against chickpea pests. The findings of these researchers are on other crops against thrips, hence partially supported the present investigation.

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