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Field efficacy of insecticides against chaffer beetle, *Popillia lucida* Newman infesting rice

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ABSTRACT

Field experiments were conducted at Amatrahar, Ansui and Ladoh in Kangra district of Himachal Pradesh to evaluate efficacy of insecticides viz., bifenthrin (Talstar 10 EC), imidacloprid (Confidor 17.8 SL), thiamethoxam (Suckgan 25 WG), indoxacarb (Aalwant 14.5 SC), cypermethrin (Cypermil 10 EC) and biopesticide azadirachtin (Neem Baan 1500 ppm) against chaffer beetle Popillia lucida Newman. Order of efficacy of insecticides was cypermethrin > imidacloprid > thiamethoxam > bifenthrin > indoxacarb > azadirachtin. Cypermethrin @ 62.5 g.a.i ha^{-1} was found to be the most effective insecticide against chaffer beetle. The treatments imidacloprid @ 25 g.a.i ha^{-1} and thiamethoxam @ 25 g. a.i ha^{-1} were at par with cypermethrin for the control of chaffer beetle. The treatments also resulted in significant reduction in infested panicles and damaged florets leading to higher yields in different treatments. In all the three experiments on evaluation of efficacy of insecticides similar trends in grain yield and additional return were observed with cypermethrin treated plots resulting in highest grain yield and benefit of additional return followed by imidacloprid, thiamethoxam, bifenthrin, indoxacarb and azadirachtin.

Key words: *rice, chaffer beetle, insecticides, field efficacy*

Among the rice growing countries, India has the largest area under rice in the world and ranks second in production with 120.6 million tonnes (Anonymous 2012). Major rice growing states of India are West Bengal, Uttar Pradesh, Punjab, Bihar, Tamil Nadu and Madhya Pradesh. In India, rice is attacked by number of insect-pests that cause serious loss to the crop. In Himachal Pradesh, rice occupies third position in acreage after wheat and maize with 75.20 thousand hectares and total production of 128.92 thousand metric tonnes (Anonymous 2011). The most common insect-pests of rice prevalent in the state are *Scirpophaga innotata* (Walker), *Cnaphalocrocis medinalis* (Guenee), *Nymphula depunctalis* (Guenee), *Dicladispa armigera* (Oliver), *Hydrellia philippina* (Ferino) and *Heteronychus liloderes* (Redt.) *etc.* (Srivastava *et al.* 2009). In addition to these, another insect-pest, the chaffer beetle, *Popillia lucida* Newman reported recently was found to feed on the spikelets at the flowering stage of the crop. The beetles open the spikelets and feed on the grains at milky stage leading to chaffiness. This beetle has been reported to infest rice at panicle initiation and panicle emergence stage in Kangra, Mandi, Una and Sirmour districts of Himachal Pradesh (Sharma *et al.* 2012). The pest was recorded to inflict yield losses to the extent of 24.84 - 28.95 per cent during 2007 and 2008 in Himachal Pradesh (Srivastava *et al.* 2009). Since information on the control measures of the pest are scanty, the present investigation was undertaken to study the efficacy of insecticides and biopesticides under field condition.

MATERIALS AND METHODS

Field experiments at three locations *viz*., Ansui, Amatrahar and Ladoh of district Kangra in Himachal Pradesh were conducted on the farmers' fields during wet season 2011-12. The experiments were laid out in randomized block design with seven treatments including untreated control and three replications. The recommended rice variety HPR 1068 was transplanted in a plot size of 4m × 4m. At all the three locations ten hills plot^{-1} were randomly selected and tagged one day prior to application of insecticides. Pre treatment data on number of beetles on tagged plants were recorded on the day of insecticidal application before starting the application of insecticides without disturbing the beetles feeding on the plants. Similarly, the number of beetles on 10 hills^{-1} replication^{-1} were recorded at 1, 3, 5, 7, 10 and 15 days after treatment (DAT). The data on number of infested panicles hill^{-1} and number of damaged florets panicle^{-1} on tagged plants were also recorded. The per cent reduction in population under different treatments over untreated control was calculated based on formula elaborated by Fleming and Retnakaran (1985). The data so obtained were statistically analyzed as per the procedure elaborated by Gomez and Gomez (1984). Cost-benefit ratio was also worked out.

RESULTS AND DISCUSSION

The pooled data of three locations revealed that cypermethrin resulted in highest reduction in the population of chaffer beetle with 58.56, 69.29, 78.33, 83.60, 85.69 and 68.16 per cent after 1, 3, 5, 7, 10 and 15 days of insecticidal application, respectively (Table 1). One day after treatment (DAT), the reduction in pest population was maximum in cypermethrin being significantly at par with other treatments except azadirachtin, which recorded significantly less reduction in chaffer beetle population. Three DAT, cypermethrin imidacloprid, thiamethoxam and bifenthrin provided significant reduction in pest population ranging between 57.51-69.29 per cent. However, indoxacarb with 53.73 per cent reduction in the chaffer beetle population was also at par with imidacloprid, thiamethoxam and bifenthrin but significantly superior to azadirachtin. The per cent reduction was maximum (78.33%) five days after treatment in cypermethrin treatment followed by imidacloprid and thiamethoxam, being at par with each other. Bifenthrin and indoxacarb recorded 64.87 and 63.60 per cent reduction, respectively, and were at par with imidacloprid and thiamethoxam. All the treatments resulted in significantly higher percentage of reduction in pest population as compared to azadirachtin. Seven days after treatment, cypermethrin and imidacloprid resulted in maximum reduction of pest and remained statistically at par with each other. Ten DAT, the cypermethrin, imidacloprid, and thiamethoxam resulted in 85.69, 82.53 and 79.33 per cent reduction in pest population, respectively and remained statistically at par with each other followed by bifenthrin. Fifteen DAT, all the treatment gave better control of the pest by registering the pest reduction ranging between 53.69-68.16 per cent as compared to azadirachtin, which in turn was statistically at par with indoxacarb.

The per cent reduction data observed at 1 DAT (Table 2) revealed that cypermethrin (35.19%) being at par with thiamethoxam, imidacloprid and bifenthrin recorded 31.70, 28.99 and 21.49 per cent reduction in infested panicles, respectively. Treatment with thiamethoxam, imidacloprid and bifenthrin were at par with indoxacarb, which in turn was at par with azadirachtin. The reduction in number of infested panicles was found to be highest (46.08%) in cypermethrin treated plots at 3 DAT, being at par with imidacloprid and thiamethoxam. The per cent reduction

Table 1. Per cent reduction in population of chaffer beetle at different locations during wet season 2011-12

Treatments	Dosage	Per cent reduction over control*					
	(g.a.i. ha^{-1})	1 DAT	3 DAT	5 DAT	7 DAT	10 DAT	15 DAT
Bifenthrin	50	45.22 (42.07)	57.51 (49.34)	64.87 (53.69)	72.93 (58.84)	75.63 (60.90)	64.42 (53.46)
Imidacloprid	25	52.73 (46.58)	64.16 (53.46)	73.58 (59.43)	79.17 (63.08)	82.53 (65.46)	63.91 (53.39)
Thiamethoxam	25	50.07 (45.03)	60.24 (50.99)	69.10 (56.34)	71.41 (57.89)	79.33 (63.10)	61.03 (51.56)
Indoxacarb	30	48.30 (43.98)	53.73 (47.07)	63.60 (52.91)	67.22 (55.16)	70.00 (57.16)	53.69 (47.26)
Cypermethrin	62.5	58.56 (49.95)	69.29 (56.72)	78.33 (62.40)	83.60 (66.22)	85.69 (67.91)	68.16 (55.75)
Azadirachtin	375	37.23 (37.45)	38.93 (38.20)	48.93 (44.36)	62.10 (52.06)	63.64 (52.99)	40.81 (39.43)
CD (P <0.05)		12.30	8.54	7.77	5.94	6.96	11.31

Figures in parentheses are the arc sine transformed values

* Pooled data of three locations, DAT: Days after treatment

Table 2. Per cent reduction in infested panicles and damaged florets over control by *P. lucida* at different locations during wet season 2011-12

Treatment	Dosage (g.a.i h^{-1})	Per cent reduction in infested panicles and damaged florets over control*											
		1 DAT		3 DAT		5 DAT		7 DAT		10 DAT		15 DAT	
		Per cent reduction in infested panicles	Per cent reduction in damaged florets	Per cent reduction in infested panicles	Per cent reduction in damaged florets	Per cent reduction in infested panicles	Per cent reduction in damaged florets	Per cent reduction in infested panicles	Per cent reduction in damaged florets	Per cent reduction in infested panicles	Per cent reduction in damaged florets	Per cent reduction in infested panicles	Per cent reduction in damaged florets
Bifenthrin	50	21.49 (27.17)	16.91 (23.61)	32.44 (34.47)	20.99 (27.05)	32.18 (34.11)	25.35 (30.04)	36.00 (36.73)	30.01 (33.11)	39.52 (38.85)	31.83 (34.25)	40.86 (39.65)	33.77 (35.46)
Imidacloprid	25	28.99 (32.24)	26.92 (31.13)	42.52 (40.59)	31.67 (34.14)	42.00 (40.31)	35.03 (36.10)	43.66 (41.27)	38.33 (38.15)	45.20 (42.21)	40.11 (39.23)	47.53 (43.59)	41.86 (40.26)
Thiamethoxam	25	31.70 (33.96)	26.03 (30.39)	38.14 (37.95)	27.74 (31.65)	38.78 (38.37)	29.25 (32.60)	40.46 (39.41)	32.93 (34.91)	41.51 (40.04)	34.39 (35.83)	43.86 (41.43)	36.51 (37.11)
Indoxacarb	30	18.11 (24.61)	10.70 (18.58)	26.99 (30.78)	14.49 (21.95)	26.42 (30.78)	18.87 (25.22)	29.21 (32.37)	21.96 (27.65)	31.64 (34.00)	24.77 (29.65)	32.85 (34.87)	27.37 (31.40)
Cypermethrin	62.5	35.19 (36.17)	30.10 (33.12)	46.08 (42.65)	33.76 (35.44)	47.04 (43.22)	37.11 (37.46)	50.18 (45.09)	39.65 (38.94)	51.26 (45.72)	42.03 (40.34)	52.62 (46.51)	44.32 (41.69)
Azadirachtin	375	10.67 (16.76)	9.06 (16.07)	22.61 (27.84)	12.43 (19.93)	20.12 (26.22)	14.81 (20.43)	21.75 (27.40)	17.87 (24.37)	23.91 (28.86)	19.91 (26.10)	23.52 (28.83)	21.34 (27.16)
CD (P< 0.05)		10.24	8.27	6.7	6.03	7.12	8.06	7.13	6.07	6.7	5.6	5.11	5.21

Figures in parentheses are the arc sine transformed values, * Pooled data of three locations, DAT: Days after treatment

in infested panicles on 5 DAT in cypermethrin was 47.04 per cent being at par with imidacloprid and thiamethoxam, which in turn were at par with bifenthrin. The treatment cypermethrin showed highest per cent reduction in infested panicles i.e. 50.18 per cent at 7 DAT, being at par with imidacloprid and thiamethoxam. Almost similar trend was followed after 10 days of treatments with cypermethrin, imidacloprid and thiamethoxam being significantly better and at par in reducing panicle infestation from other treatments. The per cent reduction in infested panicles at 15 DAT revealed that cypermethrin, imidacloprid and thiamethoxam (52.62, 47.53 and 43.86%, respectively) were significantly better and at par in reducing panicle infestation. However, the treatments imidacloprid and thiamethoxam were also at par with bifenthrin (40.86%), also whereas, the azadirachtin treated plots proved inferior to all these treatments and showed 23.52 per cent infested panicles.

The reduction in damaged florets one day after treatment was maximum in cypermethrin treated plots (30.10%), being at par with imidacloprid and thiamethoxam, which in turn were also at par with bifenthrin. At 3 DAT, the highest per cent reduction in damaged florets was brought by treatment of cypermethrin (33.76%) being at par with imidacloprid and also at par with thiamethoxam. The data recorded at 5 DAT recorded that treatments *viz.* cypermethrin and imidacloprid were at par in reducing florets damage The per cent reduction in damaged florets at 7 DAT, revealed that cypermethrin, imidacloprid and thiamethoxam were at par with each other. At 10 DAT, the higher per cent reduction was found in cypermethrin treated plots (42.03%) and lowest reduction in azadirachtin (19.91%). The treatment of cypermethrin, imidacloprid and thiamethoxam, proved significantly better and at par in reducing florets damage. Almost similar trend was followed after 15 days of treatment with cypermethrin, imidacloprid, thiamethoxam, bifenthrin, indoxacarb and azadirachtin in reducing damaged florets.

Cypermethrin was the most effective insecticide for the control of chaffer beetle followed by imidacloprid and thiamethoxam. It proved superior to all the insecticides and biopesticide based on the per cent reduction in chaffer beetle population. The per cent reduction in chaffer beetle population was highest in cypermethrin plots and was followed by imidacloprid, thiamethoxam, bifenthrin, indoxacarb and azadirachtin.

The per cent reduction in infested panicles was also observed to be maximum in cypermethrin treated plots followed by imidacloprid and thiamethoxam. Similarly, the highest per cent reduction in damaged florets was recorded in cypermethrin followed by imidacloprid and thiamethoxam (Table 2) contributing to higher yields in these treatments as compared to other treatments and untreated control. The data on per cent reduction in adult population of chaffer beetle, per cent reduction in infested panicles and per cent reduction in damaged florets revealed that cypermethrin was the most efficacious insecticide for the control of chaffer beetle followed by imidacloprid, thiamethoxam, bifenthrin, indoxacarb and azadirachtin.

The results are supported by the findings of Srivastava and Sharma (2010), who reported cypermethrin @ 62.5 g a.i ha^{-1} and chlorpyriphos @ 250 g a.i ha^{-1} to be the most effective insecticides for the control of chaffer beetle, *P. lucida*. They evaluated chlorpyriphos 20 EC @ 250 and 500 g a.i. ha^{-1}, endosulfan 35 EC @ 525 g a.i. ha^{-1}, profenophos + cypermethrin 44 EC @ 550 g a.i. ha^{-1}, cypermethrin 10 EC @ 62.5 g a.i. ha^{-1} and cartap hydrochloride 50 SP @ 62.5 g a.i. ha^{-1} along with untreated control.

The present finding are also in agreement with the observations of Pettis *et al*. (2005) who reported that bifenthrin, imidacloprid and thiamethoxam were the most effective among the eleven insecticides tested in the field trials for suppression of concurrent populations of beetles on nursery of *Lagerstroemia*. Mannion *et al.* (2001) also showed the superiority of imidacloprid for the control of *P. japonica* in nurseries.

The mean yield of all the three locations was taken for calculating the additional return and the maximum additional return of ₹ 5742.40 was recorded in cypermethrin treated plots followed by imidacloprid and thiamethoxam (Table 3). The results are in conformity with the findings of Srivastava and Sharma (2010) who reported the highest return from cypermethrin treated plots. The results indicated that application of cypermethrin 62.5g a.i. ha^{-1} is very effective in reducing chaffer beetle population and damage of grains.

Table 3. Grain yield and benefit cost ratio as obtained in different treatments

Treatments	Grain yield (t ha^{-1})			Mean grain yield (t ha^{-1})	Value of additional grain yield over control (₹)	Cost of spray (₹)	Additional return (₹)
	Ansui	Amatrahar	Ladoh				
Bifenthrin	2.38	2.23	2.35	2.32	4438.80	1106.00	3322.80
Imidacloprid	2.49	2.35	2.47	2.43	5680.80	874.2.00	4806.60
Thiamethoxam	2.40	2.24	2.37	2.34	4622.40	1020.00	3602.40
Indoxacarb	2.29	2.18	2.27	2.24	3639.60	1292.50	2347.10
Cypermethrin	2.58	2.41	2.55	2.51	6512.40	770.00	5742.40
Azadirachtin	2.19	2.08	2.17	2.14	2552.40	1520.00	1032.40
Untreated control	1.97	1.84	1.92	1.91	-	-	-
CD (P<0.05)	0.11	0.12	0.11	0.13	-	-	-

Value of grain ₹. 1080 $quintal^{-1}$

REFERENCES

Anonymous 2011. Economic survey of Himachal Pradesh. Economics and Statistical Department. Government of Himachal Pradesh, India. p 46-47

Anonymous 2012. F.A.O. Statistical Yearbook. p 222

Fleming R and Retnakaran A 1985. Evaluating single treatment data using Abbott's formula with reference to insecticides. Journal of Economic Entomology 78(6): 1179-1181

Gomez KA and Gomez AA 1984. Statistical Procedures for Agriculture Research. John Wiley and Sons, Inc. p 680

Mannion CM, McLane W, Klein MG, Moyseenko J, Oliver JB and Cowan D 2001. Management of early-instar Japanese beetle (Coleoptera: Scarabaeidae) in field-grown nursery crops. Journal of Economic Entomology 94(5): 1151-1161

Pettis GV, Braman SK, Guillebeau LP and Sparks B 2005. Evaluation of insecticides for suppression of Japanese beetle, *Popillia japonica* Newman and crapemyrtle aphid, Tinocallis kahawaluokalani kirkaldy. Journal of Environmental horticulture 23(3): 145-148

Srivastava A, Rana S, Prashar A, Sood A, Kaushik RP and Sharma PK 2009. Paddy insect-pests and diseases management in Himachal Pradesh. Indian Farming 59 (6): 24-29

Srivastava A and Sharma PK 2010. Efficacy of insecticides against newly emerged *Popillia lucida* Newman on paddy in Himachal Pradesh. Journal of Insect Science 23 (2): 213-216

Sharma PK, Upmanyu S, Srivastava A and Rana SK 2012. Scenario of insect-pest and diseases of paddy in Himachal Pradesh. Agricultural Science Digest 32(1): 71-74 .