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Evaluation of bioagents against mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Homoptera: Aphididae), under net covered condition in field

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ABSTRACT: Three bio-agents *viz.*, *Coccinella septempunctata* (Linnaeus), *Chrysoperla carnea* (Stephens) and *Verticillium lecanii* (Zimmerman) were evaluated against mustard aphid *Lipaphis erysimi* (Kaltenbach) under net covered condition in the field at National Research Centre on Rapeseed-Mustard, Sewar, Bharatpur (Rajasthan), during 2005-06 and 2006-07. *C. septempunctata* @ 5,000 beetles/ha was found to be most effective by reducing 88.17 percent aphid population after 10 days of release, followed by *V. lecanii* @ 10^8 spores/ml (75.79 percent) and *C. septempunctata* @ 3,000 beetles/ha (65.46 percent). Maximum yield was recorded with the release of *C. septempunctata* @ 5,000 beetles/ha followed by *V. lecanii* @ 10^8 spores/ml and *C. septempunctata* @ 3,000 beetles/ha.

KEY WORDS: *Coccinella septempunctata*, *Chrysoperla carnea*, *Verticillium lecanii*, *Lipaphis erysimi*, mustard aphid, *Brassica juncea*, Mustard

INTRODUCTION

Rapeseed-Mustard crops are attacked by more than 40 insect pests, among which mustard aphid, *Lipaphis erysimi* (Kaltenbach), is considered as the key pest in almost all parts of India (Bakhetia and Sekhon, 1989). Mustard aphid causes 26-96% loss in seed yield (Phadke, 1980) and 15% in oil content (Verma and Singh, 1987). A large number of insecticides have been recommended by many workers (Misra, 1993; Kumar *et al.*, 1996) for the management of mustard aphid. These insecticides cause serious problems such as environmental pollution, insect resistance and pest resurgence besides adversely affecting beneficial organisms. Singh (2001) emphasized the use of natural enemies for the management of aphids. *Coccinella septempunctata* (Linnaeus), *Chrysoperla carnea* (Stephens) and *Verticillium lecanii* (Zimmerman) have been reported for their potentiality against different aphid species (Honek, 1985; Singh and Singh, 1993; Singh *et al.* 2003; Purwar and Sachan, 2004). Work on the field evaluation of these bioagents is lacking and hence, it was felt essential to evaluate these three bioagents for their efficacy against mustard aphid under net cover in field conditions.

MATERIALS AND METHODS

A field experiment was conducted at the experimental farm of National Research Centre on

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Rapeseed-Mustard, Sewar, Bharatpur (Rajasthan) during Rabi season of 2005-06 and 2006-07 in randomized block design (RBD) using *Brassica juncea* (variety PCR-7) with 30 cm row-to-row and 10 cm plant-to-plant distance in plot size of 2 X 2 m. These treatments were replicated thrice. The crop was sown late to receive high aphid population. The plots were covered with a net to avoid the interference of other natural enemies. Three bioagents, *i.e.*, *C. septempunctata* @ 3,000 and 5,000 beetles/ha, *C. carnea* @ 40,000 and 50,000 larvae/ha and *V. lecanii* @ 10^7 and 10^8 spores/ml, were evaluated for their efficacy against mustard aphid. *C. carnea* was released at 2nd instar stage and *C. septempunctata* at adult stage while *V. lecanii* was sprayed. Uniform infestation of mustard aphid was maintained by keeping infested twigs collected from general crop fields. Ten plants in each plot were selected and tagged for observations. The population of mustard aphid was counted when the aphids settled properly before release/spray of the bioagents and population was recorded 3, 7 & 10 days after release/spray. The second release application was done 15 days after the first yield data were also recorded and subjected to the statistical analysis.

RESULTS AND DISCUSSION

Coccinella septempunctata

The mean reduction in aphid population due to the release of *C. septempunctata* @ 3,000 beetles/ha was 30.50, 45.68 and 64.03 per cent after 3, 7 and 10 days of 1st release, 28.55, 41.72 and 59.25 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 29.53, 43.70 and 61.64 percent, respectively. However, @ 5,000 beetles/ha reduced the aphid population to the tune of 40.33, 67.45 and 85.08 per cent after 3, 7 and 10 days of 1st release, 36.75, 62.58 and 85.09 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 38.54, 65.02 and 85.09 per cent, respectively, during 2005-06. During 2006-07, *C. septempunctata* @ 3,000 beetles/ha reduced the aphid population to the tune of 29.84, 39.08 and 64.58 per cent after 3, 7 and 10 days of 1st release, 31.67, 46.33 and 66.33 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 30.76, 42.71 and 65.46 per cent, respectively. With the release of 5,000 beetles/ha, the reduction on aphid population was 42.45, 68.50 and 87.08 per cent after 3, 7 and 10 days of 1st release, 42.07, 69.08 and 89.25 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 42.26, 68.79 and 88.17 percent, respectively.

Chrysoperla carnea

Release of 40,000 larvae/ha reduced the aphid population to the tune of 20.30, 50.70 and 39.30 per cent after 3, 7 and 10 days of 1st release, 17.95, 46.95 and 36.73 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 19.13, 48.83 and 38.02 per cent, respectively, during 2005-06. However, release of 50,000 larvae/ha reduced 26.90, 61.19 and 45.75 per cent aphid population after 3, 7 and 10 days of 1st release, 21.35, 58.89 and 42.67 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 24.13, 60.04 and 44.21 per cent, respectively. During 2006-07, the mean reduction in aphid population due to release of 40,000 larvae/ha was 18.56, 45.40 and 37.67 per cent after 3, 7 and 10 days of 1st release, 17.15, 42.67 and 35.65 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 17.86, 44.04 and 36.66 per cent, respectively. However, release of 50,000 larvae/ha reduced 20.30, 58.02 and 45.30 per cent after 3, 7 and 10 days of 1st release, 20.08, 56.85 and 44.03 per cent after 3, 7 and 10 days of 2nd release and pooled mean after 3, 7 and 10 days was 20.19, 57.44 and 44.67 per cent, respectively.

Verticillium lecanii

Application of *V. lecanii* @ 10^7 spores/ml reduced 17.65, 28.43 and 40.00 per cent aphid population after 3, 7 and 10 days of 1st spray, 15.78, 26.33 and 37.05 per cent after 3, 7 and 10 days of 2nd spray and the pooled mean after 3, 7 and 10 days was 16.71, 27.38 and 38.53 per cent, respectively. Sprays @ 10^8 spores/ml reduced the aphid population by 34.75, 57.85 and 70.00 per cent after 3, 7 and 10 days of 1st spray, 35.67, 59.25 and 75.96

Table 1. Evaluation of bioagents in plots covered with net during 2005-06

S. No.	Treatments	Reduction in aphid population (%)						Mean reduction in aphid population (%)			Yield (kg/ha)
		1st Release/spray			2nd Release/spray						
		3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
1	*C. septempunctata* @ 3,000 beetles/ha	30.50 (33.52)	45.68 (42.51)	64.03 (53.19)	28.55 (32.31)	41.72 (40.24)	59.25 (50.35)	29.53 (32.92)	43.70 (41.38)	61.64 (51.77)	1342
2	*C. septempunctata* @ 5,000 beetles/ha	40.33 (39.43)	67.45 (55.23)	85.08 (67.28)	36.75 (37.33)	62.58 (52.30)	85.09 (67.28)	38.54 (38.38)	65.02 (53.77)	85.09 (67.28)	1456
3	*C. carnea* @ 40,000 larvae/ha	20.30 (26.78)	50.70 (45.40)	39.30 (38.82)	17.95 (25.06)	46.95 (43.26)	36.73 (37.31)	19.13 (25.92)	48.83 (44.33)	38.02 (38.06)	1158
4	*C. carnea* @ 50,000 larvae/ha	26.90 (31.24)	61.19 (51.47)	45.75 (42.57)	21.35 (27.53)	58.89 (50.13)	42.67 (40.78)	24.13 (29.39)	60.04 (50.80)	44.21 (41.68)	1219
5	*V. lecanii* @ 10^7 Spores/ml	17.65 (24.85)	28.43 (32.22)	40.00 (39.23)	15.78 (23.41)	26.33 (30.88)	37.05 (37.50)	16.71 (24.13)	27.38 (31.55)	38.53 (38.37)	1138
6	*V. lecanii* @ 10^8 Spores/ml	34.75 (36.11)	57.85 (49.53)	70.00 (57.13)	35.67 (36.67)	59.25 (50.35)	75.96 (60.65)	35.21 (36.39)	58.55 (49.99)	72.98 (58.89)	1358
7	Control	0.00* (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1083
SEM ±		0.39	0.73	0.70	0.68	0.94	0.88	-	-	-	32.39
CD (P=0.05)		1.17	2.18	2.11	2.05	2.83	2.63	-	-	-	97.16

DAS= Days After Spray/releas; * The population of mustard aphid increased in control, and hence for the sake of analysis reduction was taken 0.00; Figures in parentheses are angular transformed values

Table 1. Evaluation of bioagents in plots covered with net during 2006-07

S. No.	Treatments	Reduction in aphid population (%)						Mean reduction in aphid population (%)			Yield (kg/ha)
		1st Release/spray			2nd Release/spray						
		3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
1	*C. septempunctata* @ 3,000 beetles/ha	29.84 (33.52)	39.08 (38.68)	64.58 (53.49)	31.67 (34.26)	46.33 (42.90)	66.33 (54.54)	30.76 (33.68)	42.71 (40.79)	65.46 (54.02)	1295.00
2	*C. septempunctata* @ 5,000 beetles/ha	42.45 (40.67)	68.50 (55.87)	87.08 (68.95)	42.07 (40.43)	69.08 (56.21)	89.25 (70.97)	42.26 (40.55)	68.79 (56.04)	88.17 (69.96)	2043.30
3	*C. carnea* @ 40,000 larvae/ha	18.56 (25.52)	45.40 (42.36)	37.67 (37.88)	17.15 (24.47)	42.67 (40.78)	35.65 (36.67)	17.86 (25.00)	44.04 (41.57)	36.66 (37.28)	1755.80
4	*C. carnea* @ 50,000 larvae/ha	20.30 (26.76)	58.02 (49.62)	45.30 (42.32)	20.08 (26.61)	56.85 (48.95)	44.03 (41.57)	20.19 (26.69)	57.44 (49.29)	44.67 (41.95)	1819.17
5	*V. lecanii* @ 10^7 Spores/ml	19.70 (26.35)	30.57 (33.56)	45.63 (42.49)	18.65 (25.60)	28.03 (31.96)	44.05 (41.59)	19.18 (25.97)	29.30 (32.76)	44.84 (42.04)	1805.85
6	*V. lecanii* @ 10^8 Spores/ml	37.67 (37.88)	61.55 (51.69)	78.13 (62.13)	34.03 (35.69)	58.23 (49.74)	73.45 (58.99)	35.85 (36.79)	59.89 (50.72)	75.79 (60.56)	1955.40
7	Control	0.00* (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1590.35
SEM ±		0.92	0.62	0.62	0.49	0.78	0.95	-	-	-	68.97
CD (P=0.05)		2.77	1.85	1.87	1.48	2.34	2.84	-	-	-	206.92

DAS= Days After Spray/release; * The population of mustard aphid increased in control, and hence for the sake of analysis reduction was taken 0.00; Figures in parentheses are angular transformed values

per cent after 3, 7 and 10 days of 2nd spray and the pooled mean after 3, 7 and 10 days was 35.21, 58.55 and 72.98 per cent, respectively, during 2005-06. During 2006-07, *V. lecanii* @ 10^7 spores/ml reduced the aphid population by 19.70, 30.57 and 45.63 per cent after 3, 7 and 10 days of 1st spray, 18.65, 28.03 and 44.05 per cent after 3, 7 and 10 days of 2nd spray and the pooled mean after 3, 7 and 10 days was 19.18, 29.30 and 44.84 percent, respectively. *V. lecanii* spray @ 10^8 spores/ml reduced the aphid population by 37.67, 61.55 and 78.13 per cent after 3, 7 and 10 days of 1st spray, 34.03, 58.23 and 73.45 per cent after 3, 7 and 10 days of 2nd spray and the pooled mean after 3, 7 and 10 days was 35.85, 59.89 and 75.79 per cent, respectively.

Yield

All the treatments provided significantly higher seed yield of mustard except *C. carnea* @ 40,000 larvae/ha in both the years of study and *V. lecanii* @ 10^7 spores/ml during 2005-06. Maximum seed yield of mustard was recorded with the release of *C. septempunctata* @ 5,000 beetles/ha (1456 kg/ha), followed by *V. lecanii* @ 10^8 CS/ml (1358 kg/ha) and *C. septempunctata* @ 3,000 beetles/ha (1342 kg/ha) during 2005-06. During 2006-07, the same trend was found with higher yield in *C. septempunctata* @ 5,000 beetles/ha (2043.30 kg/ha), followed by *V. lecanii* @ 10^8 spores/ml (1955.40 kg/ha) and *C. septempunctata* @ 3,000 beetles/ha (1925.00 kg/ha).

On the basis of above observations, *C. septempunctata* @ 5,000 beetles/ha was found to be most effective with 88.17 percent reduction in aphid population after 10 days of release followed by *V. lecanii* @ 10^8 spores/ml (75.79 percent), *C. septempunctata* @ 3,000 beetles/ha (65.46 percent) and *C. carnea* @ 50,000 larvae/ha (60.04 percent after 7 days of release). All the bioagents provided maximum reduction in aphid population after 10 days of release/spray except *C. carnea* where the maximum reduction was found after 7 days of release that may be due to pupation of larvae after 7 days. Sharma *et al.* (1997) reported the feeding capacity of *C. septempunctata* (adult) as 51.5-75.9 aphid/day while Behera *et al.* (1999) recorded a consumption of 55.27 aphid/day by adults of *C. septempunctata*. Singh *et al.* (2003) observed that 1st, 2nd and 3rd instar larvae of *C. carnea* consumed 4, 19 and 28 aphid/day, respectively, in the laboratory, as on our study. Purwar and Sachan (2004) reported the reduction in aphid population to the tune of 42.46-76.58 per cent after 10 days of application of *V. lecanii* @ $5x10^8$ spores/ml in the field which is in conformity with the present study though the minor variations may be due to climatic conditions. In view of their effectiveness in field conditions *C. septempunctata* and *V. lecanii* may be useful in the management of mustard aphid.

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