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Effect of border crop on the population of *Chilominus sexmaculatus* and *Coccinella septumpunctata* in chilli (*Capsicum annuum* L.)

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ABSTRACT : Field experiments were carried out at Agricultural Research Station, Devihosur, Haveri during kharif 2006 and 2007 to find out the effect of border crop of maize on the coccinellid population in chilli variety Byadagi dabbi. Results revealed that chilli plots surrounded by two rows of maize all along the border (untreated) recorded significantly more number of coccinellids (2.56 /p) at 15 weeks after transplanting(WAT) compared to chilli crop bordered by maize (treated-1.18/p). Whereas, standard check recorded least number of coccinellid population(0.49/p) which received chemical spray periodically and was found that these chemicals were found to be detrimental to natural enemy population. The present studies indicated that maize grown all along the border of chilli crop contributed significantly in conserving natural enemy population.

Keywords : Border crop, coccinellids and chilli

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the key commercial spice crops grown in India, earning valuable foreign exchange. India produces about 10.70 lakh tones of chilli from an area of 9.08 lakh hectares (Singhal, 2003). Among the plethora of production constraints, the infestation of a multitude of insect pests at different crop stages is of utmost concern. Aphids, thrips, mites and fruit borer are the major insect pests of chilli in Karnataka and elsewhere in the country, often resulting in significant crop losses (Ahmed *et al.*, 1987; Kandasamy *et al.*, 1990). In order to save the crop from the pest ravages, farmers resort to as many as 20 rounds of chemical sprays (Lingappa *et al.*, 2002; Anon., 2004 and Anon., 2006) leading to pest resurgence, destruction of natural enemies and pesticide residues in fruits (David, 1991; Joia *et al.*, 2001 and Smitha and Giraddi, 2006). As pesticide residues in chilli are of great concern from the point of exports and domestic consumption as well, non-chemical pest management strategies such as growing border crop of maize for the management of chilli pests is entirely new approach. Keeping this in view, investigations were conducted to study how border crop affects the activity of natural enemies that have impact on the population of insect pests of chilli.

MATERIALS AND METHODS

Field experiments were conducted during *kharif* 2006 and 2007 at Agricultural Research Station, Devihosur, Haveri, Karnataka, India to find out the effect of border crop of maize on coccinellid population. Treated plots received two interventions of spray, first spray with neem based molecule and second spray with ecofriendly new insecticide molecule. The experiment consisted of eight treatments with five blocks.

Raised nursery seed beds were prepared. Seeds of popular local growing variety Byadagi dabbi were sown in nursery beds and as per package of practices farmyard manure and chemical fertilizers were applied to nursery beds. Before transplanting chilli seedlings, seeds of maize hybrid (All Rounder) were sown in two rows all along the border of each treatment, fifteen days earlier to chilli planting and later thirty five days old chilli seedlings were transplanted to main field in the third week of July during 2006 and 2007 with a spacing of 0.6m x 0.6m.

All the agronomic practices were followed except the plant protection measures. The spray operation was done with knapsack sprayer. To compare the effect of border crop of maize on incidence of thrips and mites in chilli crop both recommended plant protection measures (RPP) and as well as untreated check (sole crop of chilli) were maintained in the experiment.

Observations on number of grubs and adults per plant were counted on ten tagged plants at weekly interval starting from 3 WAT upto 15 WAT. And the number of

coccinellids per plant were converted to $\sqrt{x + 1}$ transformation and later the data was subjected to analysis of variance.

RESULTS AND DISCUSSION

Observations recorded and presented in Table 1 indicated that at 3 WAT, there was no significant difference in mean number of coccinellids per plant among different treatments and it ranged from 0.03 to 0.09 per plant. At 4 and 5 WAT, it was found that, there was significant differences in population of coccinellids per plant among different treatments. Among various treatments, it was found that the treatments *viz.*, T_1, T_2, T_3, T_4, T_5, T_6 and untreated check recorded slightly higher population of coccinellids per plant and found statistically superior to standard check. At 6 WAT, it was found that among various treatments chilli crop bordered with two rows of maize both treated and untreated plots *viz.*, T_1 (0.58/plant), T_2 (0.64/plant), T_3 (0.55/plant), T_4 (0.52/plant), T_5 (0.49/plant) and T_6 (0.51/plant) recorded higher population of coccinellids per plant as compared to recommended plant protection measures (0.07/plant). This clearly revealed that in standard check (RPP) spraying taken at the beginning had determined effect on natural enemy population and hence recorded least number of coccinellids per plant. However, in all other treatments except untreated check without the border crop of maize revealed that maize as a border crop contributed significantly in conserving and enhancing natural enemy population.

Similar trend was observed at 7 WAT and it was found that among all the treatments T_1 (1.05 No./plant), T_2 (0.98 No./plant), T_3 (0.90 No./plant), T_4 (0.85 No./plant), T_5 (0.67 No./plant) and T_6 (0.64 No./plant) were found significantly superior to standard check (0.14 No./plant) and recorded higher population of coccinellids per plant. Observations recorded at subsequent weeks 8 and 9 WAT also indicated the similar trend as that of previous week and it was found that the treatments bordered with maize crop recorded higher population of coccinellids per plant and found superior to standard check.

Although in T_2, T_4 and T_6 received one spray with Neemazal (1%) at the rate of 2 ml per l at 7 WAT but this botanical spray was not determintal to natural enemy population and hence recorded higher population of coccinellids. But at 10 WAT the trend was little different and it was found that T_2 (0.32 No./plant), T_4 (0.48 No./plant) and T_6 (0.35 No./plant) were statistically inferior to T_1 (1.90 No./plant), T_3 (1.46 No./plant) and T_5 (1.20 No./plant) and recorded least number of coccinellids per plant. This could be due to the fact that T_2, T_4 and T_6 received spray with Difenthiuron 50 WP at the rate of 0.75 g per l at 9 WAT was determintal to natural enemy population and hence recorded least number of coccinellid population. But at subsequent weeks at 11 WAT, 12 WAT, 13 WAT and 14 WAT, it was found that the treatments bordered with maize crop recorded significantly higher population of coccinellids per plant were statistically superior to standard check. From these results, it can be concluded that maize grown all along the border of chilli crop helps in conservation of coccinellid population, thereby reducing pest load on chilli crop.

Dry chilli yield (q/ha)

Observations recorded on dry chilli yield and presented in Table-3 indicated that during 2006-07 among various treatments, highest dry chilli yield recorded in T_4 (7.86 q/ha), which was found significantly superior to standard check (7.12 q/ha), T_2 (6.48 q/ha) and T_6 (5.18 q/ha), T_1 (5.84 q/ha), T_3 (6.28 q/ha), T_5 (5.18 q/ha).

During 2007, it was found that the trend was little different than previous years. The yield levels were comparatively low in all the treatments due to continuous and heavy rainfall during 2007-08. However, it was observed that among different treatments, T_4 (5.92 q/ha) recorded better yield (5.92 q/ha) followed by standard check (5.14 q/ha) and found significantly superior to T_1 (4.42 q/ha), T_2 (5.10 q/ha), T_3 (4.02 q/ha), T_3 (4.10 q/ha) and T_6 (5.02 q/ha).

The trend was different in pooled analysis and found that yield was significantly higher in T_4 (6.90 q/ha) and was significantly superior to standard check (6.13 q/ha), followed by T_1 (5.23 q/ha), T_2 (5.01 q/ha), T_3 (5.45 q/ha) and T_5 (5.74 q/ha).

Pooled mean of the percent increase in yield indicated that, among various treatments, T_4 recorded highest per cent increase in yield (44.05%), followed by standard check (27.97%) and T_5 (18.57%). However, all other treatments *viz.*, T_1, T_2, T_3 and T_5 recorded lowest per cent increase in yield.

These results are in line with the findings obtained by Srinivas and Lawande (2002) and reported that maize was a good barrier in conservation of coccinellid population. Results of Ferers (2000), Hooks and Ferers (2006), Kibaru (2000), Wang *et al.* (1998), Idris *et al.* (1999), Mohammed Roff and Ho (1991) and Hussain *et al.* (1992) also revealed that effectiveness of maize barrier crop in conserving the population of coccinellids.

Table 1. Effect of border crop on the population of natural enemy, coccinellids at different intervals

Treatments	Number per plant											
	3 WAT			4 WAT			5 WAT			6 WAT		
	2006	2007	Mean	2006	2007	Mean	2006	2007	Mean	2006	2007	Mean
T_1 - Chilli with two rows of maize all along the border (untreated)	0.04 (1.01)	0.06 (1.02)	0.05 (1.02)	0.08a (1.03)	0.06ab (1.02)	0.07ab (1.02)	0.26a (1.12)	0.12a (1.05)	0.19a (1.08)	0.62b (1.27)	0.54a (1.22)	0.58a (1.25)
T_2 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.04 (1.01)	0.08 (1.03)	0.06 (1.02)	0.12ab (1.05)	0.10a (1.04)	0.11a (2.04)	0.28a (1.12)	0.14a (1.06)	0.21a (1.10)	0.80a (1.34)	0.48a (1.20)	0.64a (1.20)
T_3 - Chilli with two rows of maize all along the border (untreated)	0.04 (1.01)	0.06 (1.02)	0.05 (1.02)	0.10ab (1.04)	0.08a (1.03)	0.09a (1.03)	0.20a (1.10)	0.12a (1.05)	0.16a (1.07)	0.70a (1.30)	0.40ab (1.18)	0.55a (1.04)
T_4 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.02 (1.00)	0.06 (1.00)	0.03 (1.01)	0.08a (1.03)	0.08a (1.03)	0.08a (1.03)	0.24a (1.11)	0.14a (1.06)	0.19a (1.08)	0.68a (1.29)	0.36ab (1.16)	0.52a (1.22)
T_5 - Chilli with two rows of maize all along the border (untreated)	0.08 (1.03)	0.08 (1.03)	0.08 (1.03)	0.10a (1.04)	0.12a (1.06)	0.11a (1.05)	0.24a (1.11)	0.16a (1.06)	0.20a (1.09)	0.60b (1.26)	0.38ab (1.16)	0.49ab (1.22)
T_6 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.08 (1.03)	0.10 (1.10)	0.09 (1.06)	0.10a (1.04)	0.14a (1.06)	0.12a (1.05)	0.14ab (1.06)	0.18a (1.08)	0.16a (1.06)	0.62b (1.26)	0.40ab (1.18)	0.51c (1.20)
T_7 - Recommended plant protection measure (RPP) – Dimethoate 30 EC @ 1.70 ml/l at 2 and 5 WAT, Dicofol 18.5 EC @ 2.5 ml/l at 7 and 11 WAT and Carbaryl 50 WP @ 4 g/l at 11 WAT	0.06 (1.02)	0.04 (1.01)	0.05 (1.02)	0.02b (1.02)	0.04b (1.01)	0.03b (1.01)	0.12ab (1.04)	0.08ab (1.03)	0.10b (1.04)	0.08d (1.02)	0.06d (1.02)	0.07d (1.02)
T_8 - Untreated check	0.04 (1.01)	0.08 (1.03)	0.06 (1.02)	0.10ab (1.04)	0.12a (1.06)	0.11a (1.05)	0.18ab (1.08)	0.16a (1.06)	0.17a (1.07)	0.42c (1.20)	0.20c (1.09)	0.31a (1.14)
CD at 5%	NS	NS	NS	0.03	0.02	0.02	0.03	0.02	0.03	0.04	0.03	0.04
				0.07	0.06	0.06	0.08	0.06	0.07	0.12	0.10	0.14

Figures in parentheses are transformed values of √x+1; Means followed by the same letter does not differ significantly

Table 1 Contd.....

Treatments	Number per plant											
	7 WAT			8 WAT			9 WAT			10 WAT		
	2006	2007	Mean	2006	2007	Mean	2006	2007	Mean	2006	2007	Mean
T_1 - Chilli with two rows of maize all along the border (untreated)	1.48a (1.56)	0.62a (1.27)	1.05a (1.41)	1.66a (1.63)	0.84a (1.34)	1.25a (1.48)	1.78a (1.64)	1.20a (1.48)	1.49a (1.56)	2.12a (1.74)	1.68a (1.62)	1.90a (1.68)
T_2 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	1.40a (1.54)	0.56a (1.24)	0.98a (1.39)	1.10b (1.42)	0.40c (1.18)	0.75c (1.30)	1.24ab (1.48)	0.82b (1.34)	1.03ab (1.41)	0.48d (0.56)	0.16b (1.42)	0.32ef (1.49)
T_3 - Chilli with two rows of maize all along the border (untreated)	1.32a (1.52)	0.48a (1.20)	0.90a (1.36)	1.46a (1.58)	0.72a (1.30)	1.09c (1.44)	1.60a (1.60)	0.94b (1.38)	1.27a (1.48)	1.82b (1.66)	1.10b (1.44)	1.46c (1.55)
T_4 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	1.30a (1.50)	0.40ab (1.18)	0.85ab (0.54)	1.02b (1.42)	0.22c (1.10)	0.62c (1.26)	1.24ab (1.48)	0.38c (1.16)	0.81bc (1.32)	0.40d (1.50)	0.56c (1.22)	0.48e (1.37)
T_5 - Chilli with two rows of maize all along the border (untreated)	0.94b (1.38)	0.40ab (1.15)	0.67c (1.28)	1.12b (1.46)	0.68a (1.28)	0.90b (1.37)	1.46ab (1.54)	0.76b (1.32)	1.11ab (0.43)	1.30c (1.60)	1.11de (1.32)	1.20d (1.46)
T_6 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthiuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.82b (1.40)	0.46a (1.20)	0.64c (1.27)	0.60c (1.26)	0.22c (1.10)	0.41d (1.18)	0.84d (1.35)	0.46c (1.20)	0.65bc (1.27)	0.34de (1.38)	0.28cd (1.28)	0.31ef (1.33)
T_7 - Recommended plant protection measure (RPP) – Dimethoate 30 EC @ 1.70 ml/l at 2 and 5 WAT, Dicofol 18.5 EC @ 2.5 ml/l at 7 and 11 WAT and Carbaryl 50 WP @ 4 g/l at 11 WAT	0.16c (1.06)	0.12c (1.06)	0.14d (1.06)	0.10d (1.04)	0.06d (1.04)	0.08e (1.04)	0.28e (1.12)	0.20c (1.08)	0.24d (1.60)	0.60d (0.26)	0.46c (1.16)	0.53e (1.21)
T_8 - Untreated check	0.68b (1.28)	0.46a (1.20)	0.57c (1.24)	0.74c (1.32)	0.66c (1.24)	0.67c (1.28)	1.10bc (1.40)	0.82b (1.32)	0.96ab (1.36)	1.74b (0.52)	1.62b (1.38)	1.68b (1.45)
SEm±	0.08	0.06	0.06	0.07	0.06	0.05	0.09	0.08	0.07	0.07	0.08	0.06
CD at 5%	0.22	0.17	0.18	0.24	0.18	0.16	0.28	0.22	0.24	0.18	0.22	0.20

Figures in parentheses are transformed values of √x+1; Means followed by the same letter does not differ significantly

Table 2. Dry chilli yield (q/ha)

Treatments	Area	Yield (q/ha)			Per cent increase over UTC		
		2006	2007	Mean	2006	2007	Mean
T_1 - Chilli with two rows of maize all along the border (untreated)	0.25 acre	5.84	4.56	5.20	13.18	3.07	8.12
T_2 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.25 acre	6.48	5.10	5.61	25.58	15.38	17.12
T_3 - Chilli with two rows of maize all along the border (untreated)	0.5 acre	6.28	4.62	5.45	21.71	4.52	13.78
T_4 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthuron 50 WP @ 0.75 g/l at 9 WAT (treated)	0.5 acre	7.86	5.92	6.90	52.33	33.94	44.05
T_5 - Chilli with two rows of maize all along the border (untreated)	1.0 acre	5.18	4.48	4.83	0.39	1.33	0.86
T_6 - Chilli with two rows of maize all along the border – Neemazal 1% (10,000 ppm) @ 2 ml /l at 7 WAT followed by Difenthuron 50 WP @ 0.75 g/l at 9 WAT (treated)	1.0 acre	6.46	5.02	5.74	25.19	11.96	18.57
T_7 - Recommended plant protection measure (RPP) – Dimethoate 30 EC @ 1.70 ml/l at 2 and 5 WAT, Dicofol 18.5 EC @ 2.5 ml/l at 7 and 11 WAT and Carbaryl 50 WP @ 4 g/l at 11 WAT		7.12	5.14	6.13	37.98	16.29	27.97
T_8 - Untreated check		5.16	4.42	4.79	0.00	0.00	0.00
CV (%)		12.10	9.54	10.26			
SEm+		0.22	0.14	0.19			
CD at 5%		0.64	0.40	0.56			

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