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RESEARCH ARTICLE

Efficacy of different management practices against *Chilo partellus* (Swinhoe) in Kharif maize in Western Uttar Pradesh

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Abstract

The field experiments were conducted to determine the comparative efficacy of different management practices against *Chilo partellus* (Swinhoe) in *Kharif* maize in western Uttar Pradesh. All the treatments were found significantly effective in reducing the infestation of stem borer and increasing the yield compared with control. Treatment indoxacarb 14.5 SC @ 500 ml/ha was found best with minimum per cent infestation and leaf injury followed by endosulfan 35 EC @ 1.5 lit/ha. The minimum number of dead hearts was also recorded with treatment indoxacarb 14.5 SC @ 500 ml/ha and next effective treatments were maize+cowpea (intercropping) and imidacloprid 17.8 SL @ 7 ml/kg. Treatment indoxacarb 14.5 SC @ 500 ml/ha proved highly toxic to coccinellids and spiders population while the treatment *Trichogramma chilonis* proved highly safe to coccinellids population. In case of spider population, the maximum population was recorded with treatment maize+cowpea (intercropping) followed by *T. chilonis*. The maximum grain yield obtained from the indoxacarb14.5 SC @ 500 ml/ha followed by endosulfan 35 EC @ 1.5 lit/ha and imidacloprid 17.8 SL @ 7 ml/kg.

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops in the world agriculture economy both as food for man and feed for animals and also known as "Queen of Cereals" because of high yield potential. Over 85% of maize produced in the country is consumed as human food. The maize contributes 36% (712 m ton) of the global grain production. In India, maize is the third most important cereal crop after rice and wheat. The area, production and productivity of maize in India during 2007-08 was 8.26 m ha, 19.31 m ton and 2337 kg/ha, respectively (Anonymous, 2008). In Uttar Pradesh, it is grown in an area 8.47 lac hectare with a production of 11.17 lac tons and the productivity was 1326 kg/ha in 2006-07 (Anonymous, 2008). Insect- pests are the major factors responsible for low productivity of maize in India. Out of them, *Chilo partellus* (Swinhoe) is a serious pest of maize throughout India during *kharif* season causing grain yield loss of 24.3 to 36.3 per cent (Chatterji *et al.*, 1969). A number of practices have been used to manage *C. partellus*. Hence, efforts were made to utilize different practices i.e. bio-pesticide, bio-agent and neem based insecticide and chemical insecticide to manage this pests.

Material and Methods

The field experiments were conducted for two consecutive years during *Kharif* seasons of 2008 and 2009 at crop research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut in a randomized block design having seven treatments with three replications. Each plot was having 10 rows of 5 meter and row to row and plant to plant spacing being 60 cm and 25 cm, respectively. The healthy seeds of maize variety 'Hishell Non YG' was sown manually 5-7 cm deep on June 26, 2008 for the first year experiment and on June 25, 2009 for the

second year experiment. The major components of Integrated Pest Management technology i.e. cultural, biological, botanical and chemical insecticides and different application methods of them were taken to check out their efficacy against *C. partellus*. In different treatments three chemical insecticides *viz.*, indoxacarb 14.5 SC @ 500 ml/ha, imidacloprid 17.8% SL @ 7 ml/kg seed, endosulfan 35 EC @ 1.5 lit/ha, one neem based insecticide viz. neemarin 1500 ppm @ 3 lit/ha, one Bio-agent *viz., Trichogramma chilonis* @ 1 lac eggs/ha, and cowpea as intercropping 1 line after two maize lines were applied with untreated plot as control. First spray was done at 15 DAS and second spray at 35 DAS. The treatment with bio-agent *T. chilonis* was done by releasing it two times (in the form of Tricho-card) at 15 and 26 DAS @ 1 lac eggs/ha.

For recording the observation on stem borer infestations per cent, leaf injury and number of dead hearts six inner rows were selected and other four rows were left to avoid border effect. All the plants showing infestation symptoms of stem borer damage or shoot holes in the six inner rows were counted first time at 25 DAS and second time at 40 DAS and their percentages were calculated on the basis of total plants observed. Leaf injury rating from ten selected plants in each plot was scored twice at 25 and 40 DAS based on 1-9 scale given by Sarup *et al.*, (1978)**.** Ten plants were uprooted at random from each plot at harvesting time and dissected and tunnel length was measured with the help of scale in centimeter. Per cent stem tunneling was calculated on the bases of total tunneled length divided by plant height of affected plant. Grain yield kg per plots at 15 per cent moisture was converted into q/ha by adjustment based on plots area and was calculated with the help of given formula.

$$\text{Grain yield (q/ha)} = \frac{\text{Grain Yield (Kg/ plot)} \times 10000}{\text{Plot size } (m^2) \times 100}$$

Cost benefit ratio, net return per rupees invested, was calculated by using the following formula.

$$\text{Cost benefit ratio} = \frac{\text{Cost of increased yield}}{\text{Cost of treatment (Rs/ha)}}$$

Result and Discussion

Effect of different treatments on stem borer damage

On the basis of pooled data presented in table1 revealed that all the treatments were found significantly superior over the untreated control in reducing the infestation of *C. partellus* during *Kharif*, 2008 and 2009. Among all the treatments, indoxacarb was performed best with minimum infestation of 9.99 per cent and 11.75 per cent at 25 and 40 DAS, respectively. The second best treatment was found endosulfan with infestation of 13.03 and 14.99 per cent at 25 and 40 DAS, respectively. The maximum infestation of 36.23 per cent (25 DAS) and 38.29 per cent (40 DAS) was recorded with untreated control. The minimum number of dead hearts (2.69 per cent) at 20 DAS and (4.00 per cent) at 40 DAS were found with the treatment of indoxacarb. This was followed by the treatment maize+cowpea (intercropping) with 4.13 and 5.12 per cent dead heart at 25 and 40 DAS, respectively. The maximum number of dead hearts 14.37 (25 DAS) and 14.37 (40 DAS) was recorded with untreated control. Minimum leaf injury rating of 1.15 (25 DAS) and 1.30 (40 DAS) were recorded in plot treated with indoxacarb and then followed by endosulfan and imidacloprid with 2.26 (25 DAS), 2.52 (40 DAS) and 3.21 (25 DAS), 3.51 (40 DAS). The highest leaf injury rating of 7.30 (25 DAS) and 7.34 (40 DAS) was recorded in untreated control. The result obtained by Rehsburg *et al*. (1992**)** support the present findings as they reported that application of endosulfan 35 EC @ 1.5 lit/ha and imidacloprid @ 200 ml/ha are effective to check the infestation of *C. partellus* in maize. These findings are also in close conformity with the finding of Ganguli *et al.* (1997), Jalali and Singh (2004). They observed neem based bio-pesticide very effective in controlling infestation of *C. parlellus* in maize. The related observations also recorded by Katti and Verma (1988), Kishore and Barman (2003), Khan *et al* (2004), Bhanukiran *et al.* (2005) and Teli *et al*. (2007). The present findings are also in accordance with Pal *et al.* (2009) as they reported the minimum leaf injury rating 2.09 (20 DAS) and 2.41 (40 DAS) with imidacloprid and leaf injury rating 3.10 (20 DAS) and 3.29 (40 DAS) with endosulfan. The results by Idraw and Jouri (2007) are in agreement with the present findings. They reported that dead heart formation by European corn borer was 3.68 in treatment with Avaunt (indoxacarb). Radha *et al.* (2006) found that the numbers of dead hearts were 11.68, 16.7 and 40.0 with the treatment of endosulfan 35 EC 0.07%, imidacloprid 17.8 SL 0.0045% and neem based product at 20 DAS, respectively.

Effect of different treatments on natural enemies populations

On the basis of pooled data presented in table 2 revealed that the ranged of coccinellids populations were from 3.03 to 11.00 (30 DAS), 2.33 to 14.28 (45 DAS) and 2.71 to 16.05 (60 DAS) per five plants. The highest population 11.00, 14.28 and 16.05 coccinellids/5 plants was recorded in untreated control at 30, 45 and 60 DAS, respectively. It was followed by maize+cowpea (intercropping) and *T. chilonis* with population of 9.77, 13.13, 15.00

and 8.38, 9.33, 10.03 coccinellids/5 plants at 30, 45, and 60 DAS, respectively. Those were at par with untreated control. The lowest population 3.03, 20.33, and 2.71 coccinellids/5 plants were recorded with indoxacarb at 30, 45, and 60 DAS, respectively. Like coccinellids population, the spider highest population 5.21, 7.46 and 9.66 spider/5plants were found in untreated control at 30, 45, and 60 DAS, respectively. The treatments, maize+cowpea (intercropping) and *T. chilonis* were next best treatments to safe the spider population with 4.81, 6.89, 9.42 and 3.58, 5.78, 6.91 spider/5plants at 30, 45, and 60 DAS, respectively. The lowest spider population 1.14, 1.50 and 2.85 spider/5plants were also recorded with the treatment indoxacarb at 30 45 and 60 DAS, respectively. On the basis of pooled mean it is clear that the maize+cowpea (intercropping) and *T. chilonis* treatments were safe to the natural enemies population. The relative performance of different treatments with regards to the natural enemies population in all the observations was as:-

Maize+cowpea (intercropping) > *T. chilonis* > Neemarin > Imidacloprid > Endosulfan >Indoxacarb.

The data pertaining to grain yield revealed that increased yield varied from 6.07 to 27.05 q/ha in different treatments when compared with untreated control (Table 3). Maximum grain yield of 27.05 q/ha was recorded with the treatment of indoxacarb and followed by endosulfan, imidacloprid, maize+cowpea (intercropping) and neemarin with grain yield of 19.23, 16.92, 14.43 and 13.09 q/ha, respectively. However, minimum grain yield of 6.07 q/ha was recorded in plots treated with *T. chilonis*. While it showed minimum cost (Rs. 945.00/ha) and followed by maize+cowpea (intercropping), neemarin, imidacloprid and endosulfan with the cost of 1250.00, 1290.00, 1336.00 and 1392.00 Rupees, respectively while the maximum cost of treatment (Rs. 1950.00/ha) was recorded with indoxacarb due to per unit high price rate of it. The highest net profit (Rs. 21038.25/ha) was obtained from the plots treated with indoxacarb followed by endosulfan 1.50 lit/ha, imidacloprid, maize+cowpea (intercropping) and neemarin with the net profit of 14953.50, 13041.75, 11011.25 and 9836.50 rupees/ha, respectively. The lowest net profit (Rs. 4214.50.00/ha) was estimated from the treatment of *T. chilonis*. By working out the cost benefit ratio, it was revealed that indoxacarb ranked 1st with highest cost benefit ratio of 10.79 and was followed by endosulfan, imidacloprid, maize+cowpea (intercropping) and neemarin and *T. chilonis* with 10.74, 9.76, 8.81, 7.63 and 4.43 C: B ratio, respectively. The findings of Yadav (2007) are in agreement with the present findings as he reported 50.43 per cent reduction in population of coccinellids with endosulfan and found more toxic to the beetle population than neemarin with 23.58 per cent reduction. Barwal and Rao (1988) reported that endosulfan was most toxic to *Mylabris phalerata* and *Epicautes* during 16 hr application of treatment.

Table 1. Effect of different treatments on infestation of *Chilo partellus* (Swinhoe) in maize during *Kharif*, 2008 and 2009

Treatments	Dose	Mean per cent infestation		Average no. of DH		% DH at 40 DAS	Average stem tunnel (cm)	LIR	
		25 DAS	40 DAS	25 DAS	40 DAS			25 DAS	40 DAS
Indoxacarb 14.5 SC	500 ml/ha	9.99 (18.14)	11.75 (20.04)	2.69	4.00	6.65	1.37	1.15	1.30
Imidacloprid 17.8 SL	7 ml/kg seed	13.86 (21.78)	16.74 (24.12)	6.13	7.04	11.87	5.84	3.21	3.51
Endosulfan 35 EC	1.5 lit/ha	13.03 (21.08)	14.99 (22.77)	5.53	5.60	9.36	3.53	2.26	2.52
Neemarin 1500 ppm	3 lit/ha	15.67 (23.27)	19.89 (26.48)	7.40	8.27	13.78	7.43	4.58	4.98
Trichogramma chilonis	1 lac eggs/ha	18.96 (25.73)	23.01 (28.61)	8.12	9.27	15.40	9.28	5.27	5.80
Maize+Cowpea (Intercropping)	2:1	15.00 (22.77)	18.19 (25.20)	4.13	5.12	8.50	6.85	4.31	4.75
Control	---	36.23 (36.38)	38.29 (38.46)	14.37	13.67	22.78	16.84	7.30	7.34
	SEM±	**1.49**	**0.91**	**1.26**	**1.18**	**1.30**	**0.26**	**-**	**-**
	CD at 5%	**4.64**	**2.84**	**3.19**	**3.67**	**4.05**	**0.82**	**-**	**-**

*Figures in parentheses are angular transformed values

DAS- Day after spraying

Table 2. Effect of different treatments on natural enemies population in maize during *Kharif*, 2008 and 2009

Treatment	Dose	Population of coccinellids/ 5 plant at different intervals			Population of spider/ 5 plant at different intervals		
		30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
Indoxacarb 14.5 SC	500 ml/ha	3.03 (2.00)	2.33 (1.82)	2.71 (1.92)	1.14 (1.46)	1.50 (1.58)	2.85 (1.96)
Imidacloprid 17.8% SL	7 ml/kg seed	6.71 (2.78)	7.89 (2.98)	8.53 (3.08)	3.00 (1.99)	3.39 (2.09)	4.95 (2.43)
Endosulfan 35 EC	1.5 lit/ha	4.05 (2.25)	3.53 (2.13)	3.83 (2.20)	1.52 (1.57)	1.99 (1.73)	3.16 (2.04)
Neemarin 1500 ppm	3 lit/ha	5.03 (2.47)	5.39 (2.53)	5.50 (2.55)	2.12 (1.76)	2.83 (1.94)	4.32 (2.30)
Trichogramma chilonis	1 lac eggs/ha	8.38 (3.06)	9.33 (3.21)	10.03 (3.32)	3.58 (2.13)	5.78 (2.59)	6.91 (2.81)
Maize+Cowpea (Intercropping)	2:1	9.77 (3.28)	13.13 (3.75)	15.00 (3.99)	4.81 (2.41)	6.89 (2.80)	9.42 (3.22)
Control	----	11.00 (3.46)	14.28 (3.91)	16.05 (4.13)	5.21 (2.49)	7.46 (2.91)	9.66 (3.26)
SEM±		**0.04**	**0.08**	**0.08**	**0.05**	**0.11**	**0.11**
CD at 5 %		**0.11**	**0.26**	**0.25**	**0.17**	**0.34**	**0.34**

Figures in parentheses are Square root transformed values
DAS- Day after spraying

Table 3. Economic of different treatments against *Chilo partellus* in maize on pooled yield of *Kharif*, 2008 and 2009

Name of treatment	Dose	Yield qt/ha	Increase in yield over control qt/ha	Value of increase yield (Rs./ha)	Cost of treatmen t/ha	Net profit (Rs./ha)	Cost benefit ratio
Indoxacarb 14.5 SC	500 ml/ha	48.21	27.05	22988.25	1950.00	21038.25	10.79
Imidacloprid 17.8% SL	7 ml/kg seed	38.08	16.92	14377.75	1336.00	13041.75	9.76
Endosulfan 35 EC	1.5 lit/ha	40.39	19.23	16345.50	1392.00	14953.50	10.74
Neemarin 1500 ppm	3 lit/ha	34.25	13.09	11126.50	1290.00	9836.50	7.63
Trichogramma chilonis	1 lac eggs/ha	27.23	6.07	5159.50	945.00	4214.50	4.46
Maize+Cowpea (Intercropping)	2:1	35.59	14.43	12261.25	1250.00	11011.25	8.81
Control	---	21.16	---	---	---	---	---

* Labour charges - @ Rs. 100.00/day/labour.
* Rental value of sprayer - @ Rs. 25.00/day.
* Market price of maize grain - @ Rs. 850.00/qt.

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