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Management of Stem Borer, *Chilo Partellus* (Swinhoe) in Maize Through Inundative Release of *Trichogramma Chilonis* Ishii

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ABSTRACT

Inundative release of *Trichogramma chilonis* @ 1, 00,000/ha at weekly interval starting from 20 DAE in maize (hybrid - 30V92) was evaluated in a farmers' fields during *rabi* seasons of 2009-10 and 2010-11. Parasitoid released plots and chemical control plots were at par in recording shot hole damage (9.3 and 7.7 %), dead hearts (3.2 and 2.5%), *C. partellus* larvae (1.8 and 1.2/ plant) at 50 DAE and stem tunneling at harvest (22.3 and 18.4%) and were significantly superior than untreated control (19.6% shot hole, 10.8% dead hearts, 31.1% stem tunneling) and larval population (4.5 / plant). Similar trend in stem borer incidence was continued during *rabi* 2010-11. Two year mean grain yield in parasitoid release treatment (66.0 q/ha) and chemical control (73.5 q/ha) fields were at par, whereas, it was significantly lower in untreated control (43.7 q/ha). The net profit over control during *rabi* 2009-10 and 2010-11 in biocontrol package was Rs. 22125/- and Rs. 23780/- per ha as compared to Rs. 27745/- and 30095/- per ha in farmers' practice with cost benefit ratio of 1: 20.5, 1: 22.0, 1:8.9 and 1: 9.6, respectively

Key words: *Biocontrol, Inundative release, Chilo partellus, Maize, Trichogramma chilonis.*

In India, maize is the third most important crop after rice and wheat and is used as the staple food. It is a multipurpose crop that provides the most important ingredient of cattle fodder and poultry feed (Chaudhary, 1983). In India, it is grown in an area of 94.26 million hectares with an annual production of about 24.35 million tones thus giving an average productivity of 2583 kg ha^{-1}. In Andhra Pradesh it is cultivated in an area of 1063 thousand hectares with a production of 4968 thousand tones and 4673 kg ha^{-1} productivity (Yadav, 2015). One of the major obstacles in the enhancement of maize yields has been the attack of various insect pests, of which maize stem borer, *Chilo partellus* (Swinhoe) is the most destructive one. The maize stem borer appears from second week after crop emergence till harvest of the crop. Infestation of *C. partellus* can cause crop damage up to 81% (Moyal, 1998) and grain yield losses to the extent of 35.4% (Panwar *et al*., 2001). Since maize is a highly remunerative crop, plant protection with number of insecticides either by spraying or through granular application is a common practice. However, application after certain stage is very difficult due to plant height. Further, the concern over indiscriminate use of chemical pesticides and the adverse effect of pesticides on the environment warrant eco-friendly approaches in pest management programs (Ramesh *et al*., 2012).

Biocontrol agents such as parasitoids, predators and pathogens though reported to have suppressed the population outgrowth of *C. partellus* (Bonhof, 2000) their activity in the field situation was not enough to reduce the pest populations below the economic damage level. The parasitic effects of larval parasitoid, *Cotesia flavipes* on larvae of *C. partellus* was reported by several authors (Divya *et al*., 2009; Jalali and Singh, 2002; Prasada Rao *et al.,* 2001). Similarly, parasitization of *Trichogramma chilonis* Ishii on eggs of *C. partellus* in spring maize ranged from 14 to 40 per cent (Abid-Farid *et al.,* 2007). Biocontrol strategies employing the inundative release of parasitoids are gaining significance as possible alternative for the sustainable management of stem borer in maize. Owing to the devastating capacity of stem borer in maize ecosystem, large scale demonstration of biocontrol practice i.e., inundative release of *T. chilonis* in maize was carried out in the farmers'fields.

MATERIAL AND METHODS

Large scale demonstration of inundative release of *T. chilonis* in maize for the management of maize stem borer, *C. partellus* was carried out in 7.2 hectare area (1.2 hectare in each village) with farmers participatory approach during *rabi* seasons of 2009-10 and 2010-11 at Krishi Vigyan Kendra, Undi adopted villages *viz.*, Adavikolanu, Kalla, Korukollu, Pedaamiram, Tadepalligudem and Dwaraka Tirumala of West Godavari district of Andhra Pradesh. Maize hybrid, 30V92 was grown in all the locations following standard agronomic practices recommended in the region. The demonstration area was divided into three equal identical blocks representing three treatments, *viz.*, six releases of *T. chilonis* @ 1,00,000 parasitoids / ha, chemical control (farmers' practice) and untreated control. Tricho-cards each having approximately 20,000 parasitized eggs were cut into 10 strips and were stapled uniformly to the underside of the central whorl leaves on 20 days old crop in biocontrol treatment and subsequent releases were made at weekly interval. In farmers' practice (farmers own way of managing the stem borer by chemical control), endosulfan 35 EC @ 1000 ml/ ha was sprayed at 15-20 Days after crop Emergence (DAE) followed by whorl application of carbofuran 3G @ 10 Kg /ha at 30-35 DAE.

The observations on shot hole damage, dead hearts and number of larvae were recorded on 10 randomly selected plants in 10 sampling units in each plot at 30 and 50 DAE and presented as percent incidence. The length of larval tunneling before harvest was also observed by destructive sampling of twenty randomly selected plants in each plot. Grain yield was recorded at harvest on whole plot basis. The data on pest incidence and grain yield in different treatments was analyzed statistically following ANOVA. The benefit cost ratio was also worked out based on increased yield over untreated control and cost of treatment.

RESULTS AND DISCUSSION

The data recorded on the stem borer incidence and various economic parameters in biocontrol, chemical control and untreated control fields are presented in Tables 1 and 2. The results of 2009-10 trials indicated that mean shot hole damage at 30 and 50 DAE in fields with six releases of *T. chilonis* (6.7 and 9.3 %) was at par with chemical control (5.1 and 7.7 %). However, both the treatments were significantly better than untreated control (13.8 and 19.6 %). Based on the mean of all locations, dead heart incidence in biocontrol fields was 1.9 and 3.2 per cent at 30 and 50 DAE, respectively. The corresponding figure in the fields where farmers took pesticide application was 1.1 and 2.5 per cent. Both the treatments were significantly superior to untreated control both at 30 DAE (6.3 %) and 50 DAE (10.8 %). The larval incidence of *C. partellus* in biocontrol plots at 30 DAE was 2.6 larvae / plant while it was 1.4 larvae / plant in chemical control plots and was significantly superior to untreated control (4.3 larvae / plant). At 50 DAE the pest incidence was significantly least in the fields where no parasitoid has been released (1.2 larvae / plant) as compared to parasitoid treatment (1.8 larvae / plant) and untreated control (4.5 larvae / plant). The mean stem tunneling damage was significantly better in farmer's practice (18.4 %) and biocontrol field (22.3 %) as against 31.1 % in untreated control. Similar trend in stem borer incidence was observed during *rabi* 2010-11 except that higher per cent dead heart damage at 50 DAE and higher no. of *C. partellus* larvae / plant at 30 and 50 DAE in parasitoid released plots compared to farmers practice of pesticide application. However, both treatments were significantly better than untreated control in registering the stem borer damage and harboring stem borer larval population (Table 1). Six releases of egg parasitoid, *T. chilonis* @ 1,00,000/ha at weekly interval starting from 20 DAG could bring down stem borer incidence to levels at par with chemical control which contained two rounds of pesticide application for the target pest. This is an indication of increase in biodiversity in the absence of chemical pesticides which must have helped in lowering the incidence of *C. partellus* in biocontrol fields. The scope of natural control of stem borer has also been stressed upon so that the safety of management practices to the natural enemies would be considered while imposing them.

The grain yield in untreated control during *rabi* 2009-10 and 2010-11 (42.7 and 44.6 q/ha) was significantly lower than parasitoid release fields (64.8 and 67.2 q/ha) and chemical control (72.1 and 74.8 q/ha) and the latter two were at par with each other (Table 2). Two year mean grain yield in parasitoid release treatment (66.0 q/ha) and chemical control (73.5 q/ha) fields were at par,

Table1. Incidence of *C. partellus* and grain yield in maize under different methods of management during *rabi* 2009-10 and 2010-11.

Treatments	Rabi 2009-10							
	% Shot hole damage		% Dead heart damage		No. of *C. partellus* larvae/ plant		% Stem tunneling	Grain yield (Q / ha)
	30 DAE	50 DAE	30 DAE	50 DAE	30 DAE	50 DAE		
T.chilonis @1,00,000 per ha*	6.7 [b]	9.3 [b]	1.9 [b]	3.2 [b]	2.6 [b]	1.8 [c]	22.3 [b]	64.8 [a]
Farmers' practice**	5.1 [b]	7.7 [b]	1.1 [b]	2.5 [b]	1.4 [b]	1.2 [b]	18.4 [b]	72.1 [a]
Untreated control	13.8 [a]	19.6 [a]	6.3 [a]	10.8 [a]	4.3 [a]	4.5 [a]	31.1 [a]	42.7 [b]
CV (%)	22.4	13.9	24.4	16.9	37.7	12.0	16.6	10.3
CD (P=0.05)	2.8	2.8	1.1	1.4	1.5	0.4	5.8	9.0

Treatments	Rabi 2010-11								
	% Shot hole damage		% Dead heart damage		No. of *C. partellus* larvae/ plant		% Stem tunneling	Grain yield (Q / ha)	M ean Grain yield (Q / ha)
	30 DAE	50 DAE	30 DAE	50 DAE	30 DAE	50 DAE			
T.chilonis @1,00,000 per ha*	3.1 [b]	5.9 [b]	2.3 [b]	2.8 [c]	2.2 [c]	1.7 [c]	21.4 [b]	67.2 [a]	66.0 [a]
Farmers' practice**	2.3 [b]	4.5 [b]	1.6 [b]	1.8 [b]	1.6 [b]	1.0 [b]	17.0 [b]	74.8 [a]	73.5 [a]
Untreated control	12.1 [a]	13.6 [a]	5.7 [a]	9.9 [a]	3.7 [a]	4.9 [a]	33.4 [a]	44.6 [b]	43.7 [b]
CV (%)	11.5	30.4	30.6	13.2	9.9	12.5	16.2	9.7	8.9
CD (P=0.05)	1.0	3.5	1.4	0.9	0.4	0.5	5.7	8.8	7.9

DAE – Days After crop Emergence;
* 6 releases of *T. chilonis* @ 1, 00,000/ha at weekly interval starting from 20 DAG;
** Spraying of endosulfan @ 2ml/lt at 15-20 DAG followed by whorl application of carbofuran 3G @ 10 Kg /ha at 30-35 DAE

whereas, it was significantly lower in untreated control (43.7 q/ha). The net profit over control during *rabi* 2009-10 and 2010-11 in biocontrol package was Rs. 22125/- and Rs. 23780/- per ha as compared to Rs. 27745/- and 30095/- per ha in farmers' practice with cost benefit ratio of 1: 20.5, 1: 22.0, 1:8.9 and 1: 9.6, respectively (Table 2). Similar results were earlier reported by Ramanujam *et al.* (2015) on large scale demonstration of proven biocontrol technologies against maize stem borer, C. *partellus* using *T. chilonis.*

It can be concluded that biological control using *T. chilonis* @1, 00,000/- per ha rendered effective control of maize stem borer, *C. partellus* as against untreated control and was comparable to chemical control (farmers' practice). Moreover,

Table 2. Cost benefit analysis of different methods of stem borer management during *rabi* 2009-10 and 2010-11.

Particulars	*Rabi* 2009-10			*Rabi* 2010-11		
	T.chilonis @1,00,000 per ha	Farmers' practice	Untreated control	*T.chilonis* @1,00,000 per ha	Farmers' practice	Untreated control
Grain Yield (q/ha)	64.8	72.1	42.7	67.2	74.8	44.6
Additional yield over control (q/ha)	22.1	29.4	-	22.6	30.2	-
Gross return from increased yield (Rs/ha)	23205	30870	-	24860	33220	-
Cost of treatment* (Rs/ha)	1080	3125	-	1080	3125	-
Net profit over control (Rs/ha)	22125	27745	-	23780	30095	-
Cost: benefit ratio	1 : 20.5	1 : 8.9	-	1 : 22.0	1 : 9.6	

Price of maize grain Rs. 1050 per quintal during 2009-10 and Rs. 1100 per quintal during 2010-11
* include trichocard / insecticide + labour cost

the cost benefit ratio was higher in biocontrol treatment as against farmers practice. Adoption of biocontrol in maize helps in maintaining the ecological balance in nature besides being cost effective to the farmer in the long run.

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