The Andhra Agric. J 72 (4): 473-477, 2025
doi :10.61657/aaj.2025.240

Evaluation of IPM modules against pink stem borer *sesamia inferens* in rice fallow maize

M Nagesh
Regional Research Unit (Entomology), Regional Agricultural Research Station,
Lam, Guntur, Andhra Pradesh, India

ABSTRACT

On-Farm trials on the field efficacy of egg parasitoid *Trichogramma chilonis* and Integrated Pest Management modules against pink stem borer *Sesamia inferens* were conducted in rice fallow maize fields of Guntur district during *rabi* from the year 2009 – 2013. Egg parasitoid *Trichogramma chilonis* alone could reduce the per cent dead hearts from 17.25 in control to 7.25 in the egg parasitoid release plots. As a result of adoption of IPM practices lower per cent deadhearts of 2.5 was recorded in IPM plots against 4.5 in farmers method which ultimately lead to low cost of plant protection, higher net income in IPM plots with high ICBR of 11.94 against 2.55 in farmers method was recorded

Keywords: *Dead heart, Egg parasitoid Trichogramma chilonis, Incremental cost benefit ratio ICBR and Pink stem borer Sesamia inferens*

Maize is an important cereal crop consumed as food by man and feed by poultry, livestock besides its use in various industrial products. It is cultivated on nearly 193.7 million hectares in about 170 countries(FAOSTAT 2020), It is third most important food crop after rice and wheat in India, where in over 85% maize produced in the country used to be consumed as food. But now 60% of maize produced is being used as primary food for Indias poultry industry. India cultivates maize on 8.85 million hectares with a production of 34.25 million tonnes of which 13 million tonnes are diverted for ethanol production. As the Union government is aiming to increase ethanol blending in petrol from 13% to 20%, there will be a higher demand for maize production. As per Niti Ayog and other available data, in 2025-26 domestic demand for maize in India is expected to hit 51.3 million tonnes.

Maize is being cultivated in about 0.4 million hectares under zero tillage conditions after the harvest of kharif rice by the farmers in coastal Andhra Pradesh. In united Guntur district maize area in rice fallows fluctuates from 0.7 to 1.5 lakh hectares depending on the Nagarjuna Sagar project water availability and blackgram area. Pink stem borer *Sesamia inferens* is the major insect pest attacking the rice fallow maize. It is causing deadhearts right at 16 days after sowing due to its survival and support for eggs laying from several weed hosts and paddy stubble sprouts as the crop is being sown after the harvest of paddy under zero tillage conditions. Farmers are spraying costly insecticides like flubendamide, chlorantraniliprole etc., initially and 2 or 3 whorl applications of carbofuran 3G @ 5kg per acre at 25, 35 and 45 DAS after the formation of whorl at 22 DAS. This increases cost of cultivation besides environmental pollution and elimination of natural enemies. Hence evaluation of egg parasitoid *Trichogramma chilonis* as a bioconrol method and development of ecologically, economically and socially sound location specific IPM module are very much necessary for mitigating the above problems. Similarly Prakash et al 2008 inferred that indiscriminate use of insecticides adopted for management of major insect pests viz., stem borer, *Chilo partellus* (swinhoe) , shootflies, *Atherigona naqvi* (steyskel) and *Atherigona soccata* (Rondani), Armyworm *Mythimna separate* (walker), silk cutter *Helicoverpa armigera*(Hubner), hairy caterpillar, *Spilosoma* spp. Corn leaf aphid, *Rhopalosiphum maidis* (Fitch) and thrips, *Frankliniella* sp. resulted in disturbances of the environment, pest resurgence, resistance to insecticides and effect on non target organisms.

Biological control represents an ecofriendly alternative to chemical insecticides for the management of insect pests. In many agro ecosystems, management of insect pest is carried out by different egg, larval and pupal parasitoids. Egg parasitoids *Trichogramma* spp. (Hymenoptera: Trichogrammatidae) are being widely used for biological control of lepidopteran pests (Bueno et al 2010). The studies on these parasitoids had been carried out in more than 50 countries and commercial releases had been successfully performed in about 32 million hectares of agricultural fields every year including those in India (Pizzol et al 2010). Egg parasitism by *Trichogramma chilonis* Ishii had been quite effective in the biological suppression of pink stem borer *Sesamia inferens* in upland maize (Chandrasekhar et al 2008). However studies are lacking on its effectiveness against pink stem borer *Sesamia inferens* in rice fallow maize (zero tillage condition) where in deadhearts are being observed right at 16 DAS due to the above pest incidence. In upland maize deadhearts are observed due to pink stem borer only after 25 DAS due to clean cultivation. The present study was therefore undertaken at farmers fields in rice fallow maize area of erstwhile united Guntur district in Andhra Pradesh to study the efficacy of this technology alone and in combination with other IPM methods against pink stem borer and to infer economic benefits as means of technology adoption under rice fallow maize (zero tillage) conditions. Present studies on these aspects were carried out in rice fallow maize fields of Guntur district during rabi from 2009 to 2013 crop seasons.

MATERIAL AND METHODS

For evaluating the field efficacy of egg parasitoid *Trichogramma chilonis* an On-farm trial was carried out in rice fallow maize fields of Guntur district against pink stemborer *Sesamia inferens* during rabi in December months from 2009-2013 crop seasons. Three treatments were evaluated. In the first treatment egg parasitoid *Trichogramma chilonis* was released @ 1, 50, 000 per ha for two times one at 10 DAS and another at @) 22 DAS. Second treatment is of farmers method wherein two initial insecticide treatments sprayings followed by two whorl application of carbofuran 3G @ 12.5kg/ha one at 30 DAS and another at 45 DAS was followed as practiced by the local farmers.

For the development of IPM module another On –farm trial with three treatments against the target insect pest was carried out during the above crop seasons. IPM module along with farmers method and control were tested against pink stemborer *Sesamia inferens*. Plot size of 4000 sq.m was maintained for each module. Recommended agricultural practices were carried out in the test plots. The crop hybrid 30v92 of pioneer company was used as test variety for the above experiments.

Module I

1. Monitoring of pink stem borer with Pheromone traps for adult moth activity.
2. Egg parasitoid *Trichogramma chilonis* was released @ 1, 50, 000 per ha for two times one at 10 DAS and another at 22 DAS.
3. Whorl application of neem seed kernel powder @ 75 kg/ha at 25 DAS.
4. Need based whorl application of carbofuran 3G @ 5kg/ha at 30 DAS.

Module II

In the farmers method only initial sprayings of insecticide followed by whorl application of Carbofuran 3G@ 12,5 kg/ha as practiced by local farmers was followed.

Module III

Untreated control as check in which seeds of maize were sown without any insecticide sprayings except for recommended agricultural practices.

Recording of Observations:

The per cent dead heart incidence due to pink stem borer *Sesamia inferens* was recorded for two times at 35 and 42 DAS from 25 randomly selected plants from each treatment plot of the above two field experiments and the mean of these two observations was obtained each year of experimentation. Cost of cultivation and yields were recorded for IPM evaluation plots. ICBR were evaluated based on market price. Whereas for the field evaluation of egg parasitoid yield was recorded in addition to the per cent deadhearts as indicated above. The per cent dead heart incidence due to S. *inferens* was calculated using formula as below.

Deadhearts (%) =

infested plants(no. of dead hearts) / Total number of plants X 100

Table 1. Efficacy of egg parasitoid *Trichogramma chilonis* against pink stem borer *sesamia inferens* and yield in rice fallow maize (pooled data of 2009-2013 crop seasons)

S. No	Treatment plots	Per cent deadheart incidence	Yield Q/ha
1	Egg parasitoid *Trichogramma chilonis* release plot	7.25%	78.50
2	Farmers method	1%	85.94
3	Control	17.25%	67.27

Table 2. Efficacy and economics of IPM modules against pink stem borer sesamia inferens in rice fallow maize (pooled data of 2009-2013 crop seasons)

S.no	Particulars	IPM	FM	Untreated control
	A. Pink stemborer damage			
1	Per cent dead heart incidence	2.50%	4.50%	17.25%
	B. Economics			
1	No. of insecticide sprayings	-	2	-
2	No. of whorl applications of carbofuran 3G	1	2	-
3	Cost of insecticides Rs. /ha	1250	5800	-
4	Maize grain yield q/ha	81.75	85.47	68.27
5	Gross income	98100	1,02,564	81,925
6	Incremental income	16, 175	20,639	
7	Net income (6-2)	14,925	14,839	
8	Incremental cost benefit ratio (ICBR)	11.94	2.55	

RESULTS AND DISCUSSION

Pooled data pertaining to the efficacy of egg parasitoid *Trichogramma chilonis* against pink stemborer *Sesamia inferens* for the four crop seasons from 2009-2013 are presented in Table 1. From the perusal of the table it is evident that the release of egg parasitoid *Trichogramma chilonis* at 10 DAS and 22 DAS could reduce the incidence of pink stemborer *Sesamia inferens* in terms of per cent deadheart from 17.25% in control to 7.25%. Whereas in farmers method per cent deadheart incidence was only 1% due to the adoption of insecticide sprayings and whorl application of carbofuran 3G granules.

As regards IPM modules pooled data for four crop seasons from 2009-2013 are presented in Table 2. From the perusal of the table it is evident that as a result of adoption of IPM practices in IPM module the incidence of pink stem borer *Sesamia inferens* in terms of per cent deadheart was low (2.5%) compared to farmers method (4.5%) and control (17.25%). Timely release of egg parasitoid in IPM module reduced the usage of insecticide. In IPM there was only one whorl application of carbofuran 3G granules at 30 DAS without initial insecticide sprayings against two initial insecticide sprayings and twice whorl application of carbofuraan 3G granules in the farmers method. As a result there was higher incremental cost benefit ratio of 1: 11.94 in IPM module due to low cost of plant protection compared to 1: 2.55 in farmers method.

From the present study it was conclusively proved that pink stemborer *Sesamia inferens* can be managed successfully and yield can be increased through IPM methods which includes augmentative release *of T. chilonis* @ 1, 50, 000 per ha on 10-15 days old maize crop. Though the fall armyworm *Spodiptera frugiperda* dominated in 2018-2022 in rice fallow maize, pink stem borer regained its dominant insect pest status from 2022 and hence the present studies are applicable for its management in rice fallow maize. The efforts to avoid these crop losses due to insect pests have predominantly relied on use of chemical insecticides. However, indiscriminate use of synthetic insecticides not only increases cost of production but also led to many ecological backlashes like resistance to insecticides, residues, pest resurgence, environmental toxicity, ground water and surface water contamination, food

safety hazards and human health concerns etc.,(Singh 2012). In this context, biological control practice through use of *Trichogramma* spp. not only reduced pest infestation in maize but also yielded quality produce with least use of insecticide in IPM plot. The study finds support from Chandrasekhar et al (2008) who reported field efficacy of egg parasitoid *Trichogramma chilonis* in reducing the per cent deadheart incidence due to pink stemborer in rabi upland maize.

Similarly Jalali and Singh (2003) studied the parasitisation efficiency of four Trichogramma species viz., *T. chilonis, T. japanicom, T. evanescens* and *T. dendrolimi*. Out of these *T. chilonis* (maize strain) parasitized significantly more *C. partellus* (77.9%) than other species (38.1-55.7%) when released @ 1,00,000 per ha. Agarwal and jindal (2013) validated the biological control technology for the management of maize borers at the farmers field and reported significantly lower deadheart incidence in release treatment (3.18%) than untreated control (12%). The grain yield was significantly higher in biological control treatment (46.1%) than in untreated control (37.13%). Similarly Shera et al (2017) recorded mean deadheart incidence of 4.99% in treatment plot when *T. chilonis* parasitoids were released @ 1,00,000 per ha compared to 3.66% in chemical control plot. Untreated plots recorded 11.4% mean deadheart incidence. The mean increase in yield over untreated control was 15.07% in parasitoid release plot against 16.3% in chemical control plot. However cost benefit ratio was comparatively higher in parasitoid release fields (1:41) as against chemical control (1: 30.5%).

As regards the field efficacy of IPM module Chaudhary et al (2012) reported similar observations of field efficacy of integrating release of egg parasitoid *Trichogramma chilonis* and chemical control measures against stemborer *Chilo partellus* in hoshiarpur of Punjab. The per cent infestation due to the stemborer was not more than 4% in IPM fields compared to 12% plant infestation in farmers method. Over all farmers participatory trial study revealed that IPM helped in controlling the pest population.

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Received on 17.10.2025 and Accepted on 5.12.2025