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Studies on Maize Stem Borer, *Chilo partellus* in Peshawar Valley

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Abstract.- Maize stem borer damage varied from 10 to 50% in Peshawar valley during 2003. Most of the borer damage occurred when the crop was in early vegetative stage and by the time it reached tasseling, no further increase in damage was observed. The activity of adult moths started after the middle of March and continued to increase until the middle of May after which a decline in population was observed in June. This synchronizes with the infestation pattern observed for the spring maize. *Trichogramma* activity was first observed after the middle of July after which parasitism ranged from 14 to 40%. The samples collected from April to June did not indicate the presence of *Trichogramma.* Identification of *Trichogramma* species associated with maize stem borer indicated the presence of only *Trichogramma chilonis.* Preliminary studies conducted to evaluate the impact of *Trichogramma* releases showed its success in reducing the damage caused by maize stem borer.

Key words: Maize, stem borer, *Trichogramma chilonis*, biological control, population dynamics.

INTRODUCTION

Maize is an important cereal crop consumed as food, used as a fodder crop for livestock and feed for poultry, besides its use in various industrial products. It is a good source of high quality edible oil. Maize production is severely hampered by maize stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae), causing losses to the tune of 15-60% (Khan, 1983). The damaged plants remain stunted and thus yield low fodder and grain production.

The gravid female of *C. partellus* lay eggs on the leaves and the larvae after hatching enter the stem though apical portion. Having entered the stem, the borer cannot be controlled effectively through chemicals. Systemic insecticides, though used, are not cost effective and cause environmental hazards. Biological control through the use of egg parasitoid *Trichogramma* can be very effective and economical control as it can eliminate the pest in the egg stage (Bournier, 1982; Somchoudhury and Dutt, 1988).

Because of its ease of propagation and application, *Trichogramma* is an ideal choice for inundative releases against the crop borers. But since *Trichogramma* is effective only during a short temporal window when the eggs are laid, a study of biology of pest is necessary. It is important to know the natural prevalence of *Trichogramma* in maize at different times of the year. The current studies were aimed at establishing biological control of maize stem borer through *Trichogramma*. This paper presents the results of preliminary studies needed before establishing a successful biological control programme.

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MATERIALS AND METHODS

Estimating the damage extent by C. partellus

In 2003, three areas of Peshawar at least 35 km apart were selected as representative areas of Peshawar valley, where maize was being cultivated. In each area, farmer's fields having maize at different growth stages were selected and data on maize stem borer infestation were recorded. Maize crop was surveyed for maize stem borer damage based on the presence of dead hearts and shot hole symptoms. For this purpose stratified sampling scheme was used where the field was divided into four strata. Within each stratum 2-3 sites were selected randomly. At each site an area of approximately one square meter was selected where

the total number of plants and number of infested plants were counted. Thus a minimum of 10-15 samples were checked for determining the infestation caused by maize stem borer. The observations were recorded at a weekly interval starting from the first week of July and were continued until crop harvest.

During 2004, instead of taking random samples of the crop at different growth stages, five sites were selected where the maize was grown and followed it through from seedling stage to maturity so that synchronization of crop phenology with the borer damage can be established. This time, instead of using relative estimate, an absolute count of borer damage was made. At each site a field of approximately 0.3 acres was selected where the total number of plants was counted and starting from the early vegetative stage of the crop, total number of dead hearts present were counted each week thus a cumulative damage was recorded over time.

Monitoring of maize stem borer adult activity

Light traps were installed in March 2004 at NIFA, Peshawar and at Cereal Crop Research Institute, Noshehra where maize was continuously present as spring and summer crop. The light trap used consisted of a white plastic funnel (Dia.15 cm) with aluminum plate, fixed above the top of funnel. Polyethylene bag was mounted around the rim of the funnel. A 200 W incandescent lamp was suspended in the middle of aluminum plate which remained "on" from dusk to dawn. The whole trap was firmly fixed in L-shape iron stand which was inserted in the ground such that the light bulb was at a height of about 1.5 m. The traps were emptied on weekly basis by removing the polyethylene bag. The deposited samples were sorted and number of maize stem borer adults were counted.

Natural prevalence of Trichogramma *in maize fields*

Natural prevalence of *Trichogramma* in maize was determined by using egg cards of fictitious host, *Sitotroga cerealella.* An average of 100 eggs of *S. cerealella* were glued to a hard paper card of 23 x 8 cm. The cards were installed in the maize field by stapling them on the maize leaves. A total of 20-25 egg cards were installed in a quarter of an acre in maize field. The cards were removed after 24 h, brought back to laboratory and kept in individual glass vials to observe the extent of parasitism. Parasitism extent was recorded at all the three experimental locations.

Identification of Trichogramma *species*

Trichogramma adults were collected from different sites in Peshawar. Every week, fresh eggs of *S. cerealella* glued on hard paper cards (15XI0 cm) were hanged in maize field to attract the *Trichogramma* for oviposition and removed after one day from the field and brought to the laboratory for rearing until the emergence of adult *Trichogramma*. The parasitoids thus collected were preserved in 70% alcohol for identification. Before preparing permanent mounts the specimens were put for six hours in glacial acetic acid after which they were washed with water. Access water was removed with blotting paper.

For preparation of permanent mounts, a small amount of Hoyer's medium was put on glass slide and specimen was transferred from Petri dish to Hoyer’s medium on glass slide, properly positioned in the medium (dorso-ventral with wings and antennae spread) and left for 15 minutes. After 15 minutes a drop of Hoyer's medium was put on the specimen, cover slip was placed slowly on it and pressed a little to extend the appendages of the specimen. Each glass slide was properly labeled. The prepared slides were then put in an oven at 110°F for 15 days for drying. After 15 days specimens were ready for taxonomic study. The male genitalia provided a useful taxonomic character. Nagarkati and Nagaraja (1971) and Sorokina (1993) were followed for identification purpose.

Application of Trichogramma *against maize stem borer*

Preliminary studies were conducted to evaluate the success of *Trichogramma chilonis* in controlling maize stem borer damage. The experiment was planned as randomized complete block design with a total of four replications.

Each block consisted of 0.25 acres where cultivar "Azam" was sown in the first week of July, 2003. A total of four releases of *Trichogramma*

were made starting from the first week of September wherein a total of 20,000 pupae per acre were released. The releases were made at an interval of one week. The damage was recorded on the basis of dead hearts, a symptom of maize stem borer infestation.

RESULTS AND DISCUSSION

Estimating the damage extent of C. partellus

Average bore damage varied from 10 to 50% in Peshawar valley during July-Aug, 2003 (Fig. 1). An increasing trend of damage over time was observed indicating the persistent presence of maize stem borer during the season. During August, 30-50% damage was recorded which indicates the severity of borer damage. Maize stem borer leads to a severe reduction in yield. Neupane *et al*. (1985) have reported a yield reduction up to 60% in case of severe infestation. A yield reduction of 2121 Kg/ha has been reported in spring maize by Mohyuddin and Attique (1978) when 25.2% of the plants were infested while a yield reduction of 2860 kg/ha was observed in autumn when 33% plants were infested. The major loss in grain yield is due to dead-hearts and stunting of growth.

During 2004, the fields sown in April were selected and followed through for estimating the damage caused by *C. partellus* . Five location were selected where an absolute count of infestation was made based on dead hearts (Table I). Most of the borer damage occurred when the crop was in the early vegetative stage and by the time it reached tasseling no further increase in damage was observed. This indicates the importance of emphasizing the application of biological control agent when the crop is 2-3 week old and continuing it for 4-6 weeks.

Monitoring of maize stem borer adult activity

Number of *C. partellus* adults captured during 2004 at Peshawar and Noshehra are shown in Figures 2 and 3. The activity of moth adults started after the middle of March and continued to increase until the middle of May after which a decline in moth population was observed in June. This synchronizes with the infestation pattern observed for the spring maize. During the months of July and August, 3-4 population peaks of moths were observed indicating the presence of overlapping moth generations during the growth period of summer maize.

Natural prevalence of Trichogramma *in maize fields*

During 2003, as the studies were initiated in July, data on *Trichogramma* prevalence was not

Table I.- Incidence of maize stem borer damage during the whole crop season at different locations.

Location	Observation	Crop stage	% Infestation
1	14-05-04	Vegetative	9.58
	25-05-04	Vegetative	11.5
	01-06-04	Tasseling	11.8
	11-06-04	Silking	12.25
	18-06-04	Earing	12.41
	22-06-04	Earing	12.41
	27-06-04	Grain filling	12.41
	02-07-04	Grain filling	12.41
2	13-05-04	Vegetative	10.6
	25-05-04	Tasseling	15.06
	01-06-04	Tasseling	15.33
	11-06-04	Silking	15.6
	12-06-04	Earing	15.6
	20-06-04	Grain filling	15.6
	21-06-04	Grain filling	15.6
	27-06-04	Grain filling	12.41
	02-07-04	Grain filling	15.6
3	17-05-04	Vegetative	12.6
	25-05-04	Tasseling	13.13
	01-06-04	Silking	13.4
	11-06-04	Earing	13.6
	12-06-04	Earing	13.6
	30-06-04	Grain filling	13.6
	27-06-04	Grain filling	13.6
	02-07-04	Grain filling	13.6
4	19-05-04	Vegetative	20
	28-05-04	Tasseling	21.5
	02-06-04	Tasseling	21.7
	11-06-04	Silking	21.7
	12-06-04	Earing	21.7
	20-06-04	Grain filling	21.7
	27-06-04	Grain filling	21.7
	02-07-04	Grain filling	21.7
5	13-05-04	Vegetative	8.66
	18-05-04	Tasseling	9.66
	25-05-04	Tasseling	9.8
	02-06-04	Silking	9.86

12-06-04	Earing	10
12-06-04	Grain filling	10
20-06-04	Grain filling	10

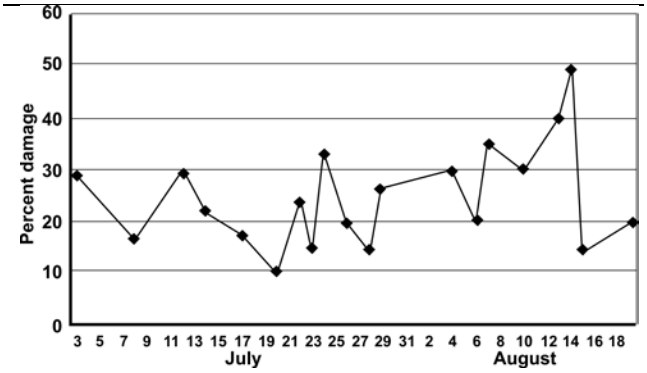

Fig. 1. Overall average damage caused by maize stem borer during July 2-31 and August 2-16, 2003.

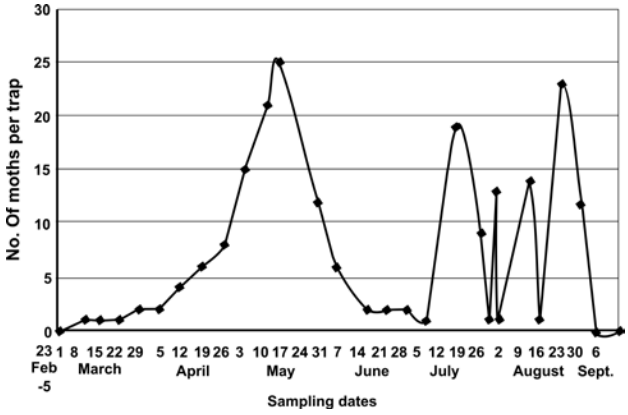

Fig. 2. Adult moths captured in light traps at NIFA, Peshawar, every week from February to September, 2004.

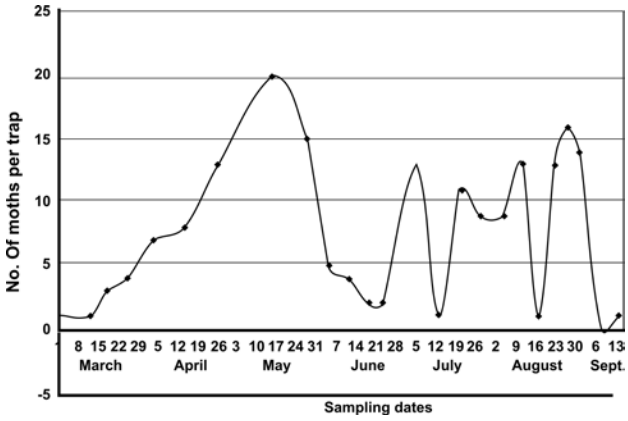

Fig. 3. Adult moths captured in light traps at CCRI, Noshehra every week during March to September, 2004.

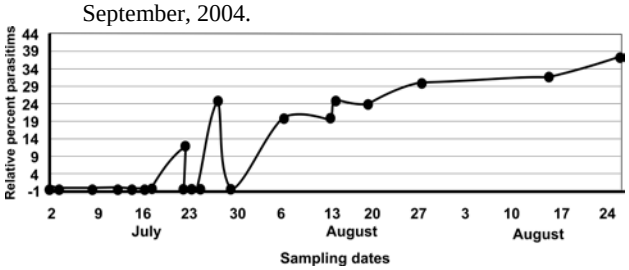

Fig. 4. Prevalence of natural population of *Trichogramma* during July to September.

present for that year before July. *Trichogramma* activity was first observed after the middle of July after which parasitism ranged from 14 to 44% (Fig. 4). During 2004, the samples collected from April to June did not indicate the presence of *Trichogramma* until June. Although a higher prevalence of *Trichogramma* was recorded late in the cropping season (late August to September), no parasitoid was observed before the middle of July. This indicates that the natural populations of *Trichogramma* are not helpful in reducing the damage as they appear late where the damage is already done by *C. partellus.* Thus there is need of augmentative release earlier during the season to check the populations build up of *C. partellus.*

Identification of Trichogramma *species*

All the specimens collected at different locations belonged to one species *i.e. Trichogramma chilonis* Ishii. Neupane *et al*. (1985) have also reported *Trichogramma chilonis* to be the most important egg parasitoid of *C. partellus*.

Application of T. chilonis *against maize stem borer*

Preliminary studies conducted to evaluate the impact of *Trichogramma* releases in reducing the damage caused by maize stem borer showed that the application of *T. chilonis* led to 68% decrease in damage over that of control indicating a success *of T. chilonis* against maize stem borer (Table II).

Table II.- Effect of *T. chilonis* application on maize stem borer damage.

Treatment	Percent borer damage

Control	29.838a
Treated	9.293b

So far use of systemic insecticides has been considered the only effective way of controlling maize stem borer infestation (Khan *et al*. 1999; Khan, 1983). Application of insecticides not only increases the cost of production but also disturbs the non target fauna *of* beneficial insects and microbes in the soil. *Trichogramma*, though an effective parasitoid, but present in small numbers in the nature. Augmentative releases of *T. chilonis* are recommended as a safer alternative to the use of insecticides for the management of maize stem borer.

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