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Integrated pest management of maize stem borer, *Chilo partellus* (Swinhoe) in maize crop and its impact on yield

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Abstract

Two years studies on integrated pest management of maize stem borer, *Chilo partellus* in maize and its impact on yield were conducted during the crop seasons 2008 and 2009 at the Cereal Crops Research Institute, Pirsabak, Nowshera. In these trials, different control methods viz. cultural, mechanical, biological and chemical alone and in combination of all as IPM (Integrated Pest Management) as compared to control conditions were applied for the control of maize stem borer. The results showed that all the control methods were found significantly effective in reducing maize stem borer infestation in maize crop. Maize stem borer infestation was significantly lower in IPM treatment with 2.32% and 2.77% followed by chemical 3.68% and 3.47% as compared to control 12.92% and 7.70% during 2008 and 2009, respectively. The highest grain yield was obtained from plots treated with IPM 8.64 ton/ha and 5.81 ton/ha as compared to control 6.23 ton/ha and 3.63 ton/ha during 2008 and 2009 respectively. It is concluded that IPM is one of the best method for control of maize stem borer and obtaining the highest yield.

Keywords: Maize, IPM, stem Borer, *Chilo partellus*, yield.

1. Introduction

Maize (*Zea mays* L.) is the third major cereal crop grown throughout the world. It is extensively grown in temperate, subtropical and tropical regions of the world [9]. Maize is grown on 43% cropped area in Pakistan and 37% in Khyber Pakhtunkhwa. The total area under maize cultivation in Khyber Pakhtunkhwa during 2009 was 509.0 thousand hectares with total production of 903.9 thousand tones with an average yield of 1776 kg/ha [6]. Maize plays an important role in the economy and food security of many countries. It is second most important kharif crop in Pakistan, grown mainly in the Punjab and Khyber Pakhtunkhwa provinces [5]. In Khyber Pakhtunkhwa maize crop is grown in Peshawar, Mardan, Charsadda, Swabi, Malakand, Haripur, D.I. Khan, Bannu and Kohat districts [8]. Maize is utilized as human food (25%) as well as in different industries (29%). Its higher protein content results in improvement of animal and human health [4]. Among the many limiting factors, insect pests, e.g., maize stem borers, aphids, grasshopper, flea beetle and shoot fly have significant role in losses of maize yield in Pakistan [2]. Maize stem borer *Chilo partellus* is the most destructive pest of maize and responsible for low yield of maize crop [7].

Pesticides have been frequently used to control insect pests of maize. However, these pesticides may also kill their natural enemies. Thus, population of insect pests increase and 43.3% yield loss occur due to killing of natural enemies [3]. IPM is good alternative to control insect pests of maize as they have little side effect on their natural enemies of insect pests [1]. Keeping in view, the importance of maize crop in the economy of Khyber Pakhtunkhwa and the economic losses caused by the maize stem borer, the present study was conducted with the aim to develop and standardize IPM Technology for the control of maize stem borer in maize crop to minimize misuse of hazardous pesticides and to reduce killing of different natural enemies and its impact on yield.

2. Materials and Methods

Two years field experiments were conducted to evaluate different control methods for the control of maize stem borer in maize and their impact on yield of the crop at the Cereal Crop Research Institute, Pirsabak Nowshera during the crop seasons 2008 and 2009. Azam, a variety of maize was sown in 1st week of July. The experiments were conducted in

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Randomized Complete Block Design having six treatments including check replicated three times. A plot size of 5 x 4.5 m² having six rows 75 cm apart. All the agronomic practices were applied uniformly throughout the season. Data on maize stem borer infested plants was recorded at fortnights (15 days intervals). Details of the treatments are given below.

T1: Cultural control

- (i) Removal of crop residues
- (ii) Irrigation with 20 days interval

T2: Mechanical control

- (i) Destruction of crop residues/stubbles before planting
- (ii) Removal of infested plants in early stage of the crop.

T3: Biological control

(Release of the *Trichogramma* @ 20,000 parasitoids/acre)

T4: Chemical control

- (i) Confidor 70 WP @ 250 gm/acre at sowing time
- (ii) Furadon 3G @ 2 gm/plant at 6-8 leaf stage (funnel application)

T5: IPM control (T1+T2+T3+T4)

Combination of T1, T2, T3, T4 at proper time

T6: Control (No treatment)

Maize stem borer infestation data were recorded by counting the number of infested plants (shot holes and dead hearts) on randomly selected ten plants in each plot. For yield assessment, the treated plants were individually harvested,

threshed and grain yield was taken with the help of electronic digital balance and converted to ton/ha. The data recorded for each parameter were statistically analyzed by using MSTATC computer software and significant means were separated by using Fisher protected LSD^[12].

3. Results and Discussion

Data recorded on maize borer, *Chilo partellus* percent infested plants and yield in different control methods applied alone and in combination with IPM practices during 2008 are presented in Table 1. Statistical analysis of data showed that all treatments were significantly different as compared to control. During 1st fortnight of April, lowest percent infestation of maize stem borers (2.45%) was found in plots treated with IPM (combination of cultural, mechanical, biological and chemical control methods) followed by chemical method (5.72%) which was at par with all other control methods as compared to control (21.92%). During 2nd fortnight of April, maize stem borer percent infested plants were the lowest in IPM (2.54%) and chemical treatments (3.28%) as compared to control (11.11%).

The lowest maize stem borer percent infested plants were observed in IPM treatment (3.66%) which was at par with all other control methods as compared to control (11.62%) during the 1st fortnight of May. During 2nd fortnight of May, the lowest maize stem borer percent infested plants were found in IPM treatment (0.603%) as compared to control (7.77%) which was significantly higher than the all other treatments. Average data of all fortnight indicated that IPM (2.32%) had the lowest maize stem borer percent infested plants among all treatments.

Table 1: Percent infested plants by maize stem borer, *Chilo partellus* in maize crop and yield during 2008.

Treatments	April		May		Average	Yield (ton/ha)
	1 st fortnight	2 nd fortnight	1 st fortnight	2 nd fortnight		
Cultural	6.00 b	6.37 ab	6.27 b	3.94 ab	5.65b	7.35 c
Mechanical	7.96 b	9.89 a	5.03 b	2.63 b	6.38b	7.15 c
Biological	7.84 b	6.75 ab	6.32 b	3.33 ab	6.06b	7.62 bc
Chemical	5.72 b	3.28 b	3.97 b	1.75 b	3.68c	8.05 b
IPM	2.45 c	2.54 b	3.66 b	0.63 b	2.32c	8.64 a
check	21.16 a	11.11 a	11.62 a	7.77 a	12.92a	6.23 d
LSD value	3.08	4.28	3.21	4.68	3.13	0.38

Means in the same columns followed by different letters are significantly different at 5% level of probability

The yield obtained from different treatments showed that highest yield (8.64 ton/ha) was obtained from IPM followed by chemical method (8.05 ton/ha). All the treated plots gave better grain yield as compared to control from where lowest yield (6.23 ton/ha) was obtained.

The data of second year 2009 is given in Table 2. It is evident from mean values of data that all treatments gave significant reduction in maize stem borer infestation as compared to check. During the 1st fortnight of April, the lowest maize stem borer percent infested plants (3.20%) were found in plots treated with IPM as compared to control (8.05%). The data of 2nd fortnight of April showed that maize stem borer percent infested plants was the lowest in IPM (3.04%) followed by chemical method (3.84%) as compared to control where borer infested plants were significantly higher in (8.30%) among all treatments. The data recorded during the 1st fortnight of May showed that the IPM was the best one among all treatments having lowest borer infested plants of (2.34%) as compared to control (5.90%). During 2nd fortnight of May, the lowest

percent infested plants were found in IPM treatment (2.51%) followed by chemical method (2.63%) as compared to (6.03%) control.

The yield obtained from different treatments show that highest yield (5.81 ton/ha) was obtained from IPM treatment followed by chemical method (5.56 ton ha⁻¹) as compared to control (3.63 ton/ha). However, all the treated plots gave better grain yield as compared to control. The average data of all fortnights showed that IPM was most effective control method among all treatments having the lowest maize stem borer infestation (2.77%) and highest yield (5.81 ton/ha) because in IPM all control methods were applied at proper stage and time of crop and insects. The present study is in agreement with Shelton and Badenes^[11] who studied the effectiveness of different methods for control of maize stem borer and proved that IPM was most effective in controlling the maize stem borer. The present achievements are in accordance with the finding of Samantha *et al.*^[10] who observed that the infestation of maize stem borer greatly decreased by IPM control method.

Table 2: Percent infested plants by maize stem borer, *Chilo partellus* in maize crop and yield during 2009.

Treatments	April		May		Average	Yield (ton/ha)
	1 st fortnight	2 nd fortnight	1 st fortnight	2 nd fortnight		
Cultural	6.28ab	5.20b	4.8b	3.98b	5.07	4.61b
Mechanical	5.40abc	4.67bc	4.14b	3.54b	4.44	4.68b
Biological	5.05bc	4.18bc	3.67bc	3.26b	4.04	5.09ab
Chemical	4.24bc	3.84bc	3.20bc	2.63b	3.47	5.56a
IPM	3.20c	3.04c	2.34c	2.51b	2.77	5.81a
check	8.05a	8.303a	5.90a	6.03a	7.07	3.63c
LSD value	2.85	3.42	2.93	1.95	1.57	1.04

Means in the same columns followed by different letters are significantly different at 5% level of probability

4. Conclusion and Recommendations

In the present study, it is evident that all the treatments were significantly effective in reducing the maize stem borer infestation as compared to check. IPM was the most effective control method for controlling maize stem borer and obtaining higher yield of maize grain. So IPM technology should be applied for controlling insect pests and obtaining maximum yield of maize.

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