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Infestation of maize stem borer, *Chilo Partellus* (Swinhoe) in maize stubbles and stalks

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Abstract

The research was conducted to record the infestation of maize stem borer in maize stubbles and stalks in two maize cultivars *i.e.* local white and hybrid in three different locations of Mardan, Divison during 2012. Results showed highest maize stem borer infestation of 26.7% in stubbles at Palo and lowest of 15.0% recorded at Badder. Highest (24.4%) maize stem borer larval infestation was recorded on hybrid as compared to local white where the percent infestation was recorded lowest (17.2%). Results further revealed maximum mean percent (8.2) of maize stem borer hibernating larvae in Hybrid and minimum (3.2) in local white where as the mean percent of hibernating larvae was recorded maximum (11.8) at Palo and lowest (1.0%) at Badder. In stalks highest infestation occurred at Ghowndo ranged (3-10%), (2-9%) at Palo and (1-9%) at Badder, respectively. The study concluded that percent infestation of maize stem borer in stubbles and the mean percent of hibernating larvae was highest at hybrid variety at Palo which means that the hybrid is more susceptible to maize stem borer infestation. In stalks the maize stem borer infestation was also recorded highest at Palo. For farmers it is recommended to organize the dry stalks before the next cropping season to minimize the emergence of the adults that can assault the new crop.

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Introduction

Maize (*Zea mays* L.) is the most completely domesticated crop among the cereals. Mexico or Central America is most likely being the origin of corn (Martin *et al.*, 2002). In Pakistan maize is the most important cereal after wheat and rice. Maize is multipurpose crop, providing food and fuel for human, feed for poultry and livestock and have a great nutritional value. Maize is used as raw product for manufacturing many industrial products (Afzal *et al.*, 2009).

During 2008-2009 maize was sown on 1052.1 thousand ha in Pakistan with an average production of 3415 kg ha^{-1} with a total production of 3593 thousand tons (MINFA, 2008-09).

Maize is most vulnerable to *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) which causes severe losses to maize crop. It is an important pest in Asian and African countries (Arabjafari and Jalali, 2007).

Maize production is severely affected by maize stem borer to the extent of 15 -60%. A loss of 24-75% has been reported by the attack of this pest alone (Kumar, 2002). Farid *et al.*, (2007) reported 10–50% damage by maize stem borer in Peshawar valley. Yield losses caused by stem borers in Africa could as high as 80% for maize alone while in Kenya, 18% yield losses was attributed to *C. partellus* and *C. orichalocociliellus* in maize and as much as 88% in sorghum by *C. partellus*. Maximum stalk damage in maize and up to 80% grain yield loss in sorghum by *Chilo partellus* was reported in 20 days old crops, where as similar infestations induced no significant loss when plants were infested soon (6 days) after emergence (Van den berg, 2009).

Various approaches have been made to control maize stem borer including cultural, physical, biological and chemical in an uncoordinated manner throughout the country. Not much attempts have been made to look into the level of infestation in the stubble and particularly in the stalks.

Keeping in view the importance of the crop as well as importance of the maize stem borer, the present research work was initiated to investigate the level of infestation of the maize stem borer (MSB) in the stubbles and stalks at farmer's fields in the main maize growing area of Mardan division of Khyber Pakhtunkhwa, Pakistan.

Materials and methods

To investigate the level of maize stem borer infestation in the stubbles and stalks two trials were carried out in Mardan during 2012.

Experiment No. 1

In this experiment two Maize varieties (Local white and Hybrid, Pioneer-3025-W) were sown at farmer's fields at three different locations; Ghowndo, Palo and Baddar at Katlang (Mardan). Farmers were given all the required inputs as well as the produce. After the crop harvesting in October, five samples (considered as replication) each of 50 stubbles in each locality at the selected field were randomly dug out with the help of "Kudal" from both the local white and hybrid maize fields during mid November. The stubbles were cut open with the help of field knife and examined for stem borer infestation. Presence of larvae, pupae and puparium were considered for infestation.

Experiment No. 2

The second trial was carried out to know the extent of hibernating larvae and pupae in the stalks (dried stalks stored as a heap for fodder purposes) at farmer's fields in three different locations, village Ghowndo, Palo and Baddar. During the month of December and January, five samples (considered as replications) each of 50 stalks in each location were randomly selected from the heaps and cut open with the help of field knife for examination. Presence of larvae, pupae and puparium were considered for infestation.

Data analysis

The data were analyzed statistically and means were separated using LSD test at $P<0.005$. Mean

percentages and standard deviations (SD) was also calculated for all means. T-test was used to compare the mean percent infestation of MSB in stubbles (STATISTIX 8.1®, 2005).

Results and discussion

Results of percent damage by stem borer in stubbles of maize are reported in Table1.The data show significant difference at P<0.05 of the main effects of locations and varieties. Highest mean percent infestation of 20.0 in stubbles of MSB was recorded in V_1 at L_2 where as the lowest (15.0) mean percent infestation was recorded at L_1. Mean percent infestation of 16.7 recorded at L_3 on par with L_1. In V_2 highest (33.3) mean percent infestation was recorded at L_2 as compared to L_3 where the mean percent infestation was recorded lowest *i.e.* 15.0%. Mean percent infestation of MSB recorded in V_2 at L_1 was 25.0% which was significantly different from L_2 and L_3.

Table 1. Percent infestation of MSB, *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) in stubbles of two maize cultivars at three locations in Mardan, during 2012.

Location	V_1 (Local white)	V_2 (Hybrid)	Mean
Ghwondo (L_1)	15.0 b	25.0 b	20.0 b
Palo (L_2)	20.0 a	33.3 a	26.7 a
Badder (L_3)	16.7 b	15.0 c	15.8 c
Mean	17.2	24.4	-

Treatments means with common letters are non-significant by LSD test at P<0.05.
MSB maize stem borer.

Overall mean percent infestation of MSB in stubbles show highest infestation of 26.7 at L_2 followed by 20.0% and 15.8% at L_1 and L_3, respectively. Statistical analysis of the data showed that all the three locations were significantly different at P<0.005 from each other in percent infestation. Significant difference between the two cultivars *i.e.* V_1 and V_2 was recorded as P<0.01 (T-test). The data revealed highest MSB infestation (24.4%) in V_2 where as the lowest (17.2%) mean percent infestation was recorded in V_1. The maize stem borer infestation was recorded highest in V_2 as compared to V_2 where the infestation was recorded lowest and was significantly different from variety V_1.

Table 2. Mean Percent of MSB *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) hibernating larvae in stubbles of two maize cultivars at three locations in Mardan, during 2012.

Location	V_1 (Local white)	V_2 (Hybrid)	Mean
Ghwondo (L_1)	2.7 b	6.0 b	4.3 b
Palo (L_2)	6.0 a	17.7 a	11.8 a
Badder (L_3)	1.0 b	1.0 c	1.0 c
Mean	3.2	8.2	-

Treatments means with common letters are non-significant by LSD test at P<0.05.
MSB maize stem borer.

Data in Table2 indicated significant difference between the locations at the mean percent of maize stem borer larvae at P<0.05. In variety V_1 the maximum mean percent (6.0%) of hibernating larvae was recorded in L_2 where as the minimum mean percent of 1.0% was recorded in L_3. The mean percent of hibernation larvae recorded at L_1 was 2.7% which was on par with L_3. In V_2 the maximum mean percent of hibernating larvae recorded at L_2 *i.e.* 17.7% which was followed by 6.0 and 1.0% at L_1 and L_3,

respectively. The treatments L_1, L_2 and L_3 were significantly different from each other in the mean percent of maize stem borer hibernating larvae.

Overall mean percent of hibernating larvae of maize stem borer in stubbles showed significant difference among the treatments. The maximum mean percent of 11.8% was recorded at L_2 followed by L_1 and L_3 *i.e.* recorded 4.3 and 1.0% respectively. The T-test indicated significant difference between V_1 and V_2 at $P<0.01$. The data showed maximum mean percent (8.2) of maize stem borer hibernating larvae at V_2 where as the minimum mean percent was recorded at V_1 i.e. 3.2%. The data indicated maximum mean percent of hibernating larvae in stubbles at variety V_2 as compared to V_1 where the mean percent of hibernating larvae was recorded minimum.

Descriptive statistics of the data on MSB damage in stalk of maize at three locations are presented in Table3. The average infestation show significant differences among the localities, the highest damage occurred at L_1 and lowest in L_2, the stem borer infestation in maize stalks ranged from 3-10 % at location L_1, while the damaged ranged from 2-9 % at location L_2 and from 1-9 at location L_3.

Table 3. Descriptive statistics of *C. partellus* (Swinhoe) (Lepidoptera: Pyralidae) infestation in stalks of maize at three localities in Mardan during 2012.

Locality	Total	Average	Minimum	Maximum	Lower Limit	Upper Limit	SD	SE
Ghwondo (L_1)	29	7.25	3	10	5.70	8.80	3.10	1.55
Palo (L_2)	23	5.75	2	9	4.31	7.19	2.87	1.44
Badder (L_3)	26	6.5	1	9	4.65	8.35	3.70	1.85

Mean percent infestation of MSB in stubbles was recorded highest at L_2 (Palo) followed by L_1 (Ghwondo) and L_3 (Badder), respectively. Significant difference between the two cultivars *i.e.* V_1 (Local white) and V_2 (Hybrid) was also recorded as $P<0.01$ (T-test). The maize stem borer infestation was recorded highest in V_2 as compared to V_1 where the infestation was recorded lowest and was significantly different from variety V_1. Mean percent of hibernating larvae of maize stem borer in stubbles was recorded maximum at L_2 followed by L_1 and L_3, respectively. The data indicated maximum mean percent of hibernating larvae in stubbles at variety V_2 as compared to V_1 where the mean percent of hibernating larvae was recorded minimum. Similar results of differences in hibernating larvae in stubbles of the different varieties were also reported by Ali *et al.*, (2002) in Peshawar valley. An effective control would be to destroy old stalks and stubbles to reduce the first generation of adult's population. Similar results of observations of MSB in stalks after harvest have been reported by Seshu (1985) and Warui and Kuria (1983) in Africa. Kfir (1990) reported that 90,000 to 226,000 larvae over winter ha^{-1} in South Africa. Slashing maize stubbles destroy 70% of maize borer population and additional plowing and disking destroy additional 19% of the pest population in maize (Kfir, 1990).

Crop residues are crucial for carrying over stem borer larval populations from one growing season to the next. In Kenya, *C. partellus* was reported from stalks after the crop harvest (Warui and Kuria, 1983; Seshu, 1985). Tillage may reduce borer populations through mechanical damage either by burying them deeply into the soil or by breaking the stems and exposing the larvae to adverse weather conditions (Ajayi, 1998), as well as birds, rodents, ants, spiders, and other natural enemies (Seshu, 1988). Control measures have to be applied to manage the pest harmoniously, moths emerging from untreated fields can infest adjacent crops. Currently this system is not widely adapted in South Africa because of the minimum tillage practices and the need for winter grazing beef farmers on maize (Kfir, 2000).

In rural Africa, maize, sorghum, and millet's dry stems are used in houses construction as a fencing material, as fuel, bedding for livestock, boundaries of terraces on slopes, and as stakes (Sagnia, 1983). Farmers normally stack dry stalks in the field where they are kept until commencement of rains before being taken to villages, thus creating a reservoir for infestation in the following season. To solve this problem, early cutting of stalks and horizontal position on the soil surface has been recommended. This was observed to cause mortality of 97% of stem borers in maize and 100% in sorghum in Ethiopia and to reduce the residual population of borers in millet from 16% in uncut stems to 3% (Youm *et al.*, 1993). The high level of mortalities of *C. partellus*, *C. orichalcociliellus*, and *S. calamistis* in horizontally placed stalks was attributed to the effects of sun and heat, more specifically, the reaching of the thermal threshold for survival (Päts, 1996). Control of *B. fusca and C. partellus* by burning old stalks and other crop residues immediately after harvest has been recommended. Almost complete inhibition of *C. partellus* on maize and sorghum was achieved in Tanzania by burning stalks (Duerden, 1953). In Nigeria about 95 percent of farmers kept sorghum stalks and did not follow the practice of burning them after harvest as per recommendation. As conciliation, fractional burning was recommended while the leaves are dry but the stems are not (Adesiyun and Ajayi, 1980). Burning leaves generate heat which kills up to 95 percent of larvae and the stalks are cured at the same time, making the stalks stronger as construction materials and more resistant to termite attack (Ajayi, 1998). Kfir (1988) observed 45 percent larvae hibernating inside the dry stalk in the lower 3rd and 50 percent in the middle 3rd position of sorghum grown for grain. Crop residues are the only source of natural substance added into soils in many small-holding of farms in African countries but burning crop residues can cause troubles in farms where the natural content of soils is low. Burning of crop residues are also creating problems where soil is eroded by wind and rain is harsh. The base line is to organize the dry stalks before the next cropping to minimize the emergence of the adults that can assault the new crop. In our condition the right that would be end of February as the adults emerges in early to 15th of March (Afzal *et al.*, 2009).

Conclusion

In conclusion of the present research work the percent infestation of maize stem borer in stubbles and the mean percent of hibernating larvae was highest at Hybrid variety at location Palo. In stalks the maize stem borer infestation was also recorded highest at Palo. In field conditions it is necessary to organize the dry stalks before the next cropping season to minimize the emergence of the adults that can assault the new crop. In the present conditions the right that would be the end of February as the adults emerges in early to 15th of March.

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