

Concentration of Stem Injury in Maize Fields by *Chilo partellus* and Effect of *Trichogramma chilonis* on *Chilo partellus* Eggs under Laboratory Conditions

Muhammad Tayeb^{1*}, Zulfarain Sajid², Saeed Alam², Zeeshan Ahmad³, Amna Mustafa⁴, Ihsan ul-Haq¹

¹Department of Plant Protection, University of Agriculture, Peshawar, Pakistan, ²Department of Entomology, PMAS Arid Agriculture University, Rawalpindi, Pakistan, ³Department of Plant Breeding and Genetics, University of Agriculture Peshawar, Pakistan, ⁴University of Poonch Rawalakot, Pakistan

*Corresponding Author E-mail: muhammادتayeb45@gmail.com

Received: 7.12.2020 | Revised: 15.01.2021 | Accepted: 21.01.2021

ABSTRACT

Maize is an important cereal crop after wheat and rice, grown all over the world including Pakistan. Maize crop is attacked by several insects pests among them maize stem borer, *Chilo partellus* is key pest that cause huge losses. Different management tactics are adopted to control pest and minimize the yield reduction. An experimental study was conducted at Insect pest management program in National Agricultural Research Centre (NARC), Islamabad during 2017 to check the concentration of stem damage by *C. partellus* in maize field and parasitism of *Trichogramma chilonis* reared on *C. partellus* eggs under laboratory conditions. The results showed that maximum tunnels were recorded in Maize Germplasm (MBR-10) entry 1 (2.75) followed by row 4 (2.40) while minimum in the row 3 (0.42) followed by row 9 (1.00). The rates of adult emergence on the eggs of *Chilo partellus* was 83.92% followed by 78.71% and 71.21% respectively after 24, 48 and 72 hours.

Keywords: Maize, Maize Germplasm (MBR-10), Stem borer, Parasitism, *Trichogramma chilonis*.

INTRODUCTION

Maize is important cereal crop after wheat and rice. It belongs to family gramineae. It is a multipurpose crop as a source of nutrients for animals and human. It is serving as a basic raw material for the production of starch, protein, alcoholic beverages, food sweeteners and fuel (Afzal et al., 2009). During 2017-2018, maize was grown in area of 1251.4 million hectares with an annual production of 5901.6 million tonnes Pakistan (GOP, 2018).

There are many factors (biotic and abiotic) responsible for the low maize production in world including Pakistan. Abiotic include temperature, humidity and rainfall while insect pests and pathogens are biotic factors (Scholar, 2020). Insect pests are the main threat for maize production and among them, Maize stem borer, *Chilo partellus* is a most notorious and destructive pest of maize throughout the globe (Arabjafari & Jalali, 2007).

Cite this article: Tayeb, M., Sajid, Z., Alam, S., Ahmad, Z., Mustafa, A., & ul-Haq, I. (2021). Concentration of Stem Injury in Maize Fields by *Chilo Partellus* and Effect of *Trichogramma chilonis* on *Chilo Partellus* Eggs under Laboratory Conditions, *Ind. J. Pure App. Biosci.* 9(1), 18-23. doi: <http://dx.doi.org/10.18782/2582-2845.8523>

This pest can cause about 24 to 81% crop losses in Pakistan (Khan et al., 2015; Kumar, 1997; & Farid et al., 2007). The crop damage varies with respect to maize stage, variety and cultivars (Sajid, et al., 2020). Several control strategies are used against maize stem borer in the globe. Insecticides are excessively used strategy to control various crop insect pests in the world (Saleem et al., 2014) but have negative impact on biological fauna and environment. Confidor is an effective pesticide that used at national and international level against *C. partellus* (Ali et al., 2014; & Mashwani et al., 2011). Pesticides are usually not adopted by each farmer due to their high rates and insect resistance to pesticides.

Among all controlling methods, host plant resistance and biological control (*Trichogramma chilonis*) are eco-friendly and sustainable approach against pest. Many egg, larval and pupal parasitoids species (Preetha et al., 2010; Bastos et al., 2006; & Hussain et al., 2010) of various insect pests (Hassan et al., 1998; & Ahmed et al., 2003) have been reported by many researchers from various regions of Pakistan (Haffmans, 2008).

The current study was conducted to check the effect of *T. chilonis* on *C. partellus* eggs under laboratory and percentage damage of *C. partellus* on maize stem under field conditions. The purpose of study was to reduce the crop losses caused by *C. partellus* using its egg parasitoid.

MATERIALS AND METHODS

The current study was conducted in Insect pest management program at National Agricultural Research Centre (NARC), Islamabad during 2017.

2.1. Concentration of stem damage in field conditions

The concentration of stem damage of stem borer (*chilo partellus*) on maize was checked under the field conditions. For this purpose, two maize varieties Maize Germplasm (MBR-10) and Maize Germplasm (MBR-G) were sown in order to observe the resistance level against maize stem borer. The following parameters like no. of tunnels, tunnel length,

no. of holes, plant height, ear height and damage percentage were recorded.

2.2 Mass rearing of *Chilo partellus* in laboratory conditions

In second experiment, larvae were collected from different fields of fodder crops planted in Rawalpindi location. The larvae were placed into vials and brought to laboratory for rearing and mass Culturing. Twenty larvae were shifted in each jar containing small pieces of maize stem. Jars were covered with a muslin cloth and tight with a rubber band for protection of larval escape. Jars were inspected on regular basis and replaced old food with new one. The process was continued till pupation. The pupae were collected and shifted into new jars for adult emergence. The emerging adults were shifted into adult rearing cages containing maize leaves for oviposition. On daily basis, cages examined and eggs were collected from leaves by cutting them into smaller pieces. The collected eggs were kept into separate jars and used for further studies.

2.2.1 % Parasitism of *T. chilonis* reared on *Chilo partillus* eggs under control condition

The collected eggs were counted by using the binocular microscope. The counted number of eggs were glued on hard paper (8x3 cm) and placed in *T. chilonis* rearing jars (55x12 cm) and % parasitism recorded at different time interval like 24, 48 and 72 hours.

2.3 Statistical analysis:

Collected data were statistically analyzed by using computer-based software (Statistix 8.1). Duncan's Multiple Range test was used and means compared through Least Significance Difference test (LSD) at 0.05.

RESULTS

The results of first experiment as follow.

3.1 Maize Germplasm (MBR-10)

Based on the comparison of means on percent damage of stem borer on rows of MBR 10, maximum damage was recorded in row 7 (67.00%) followed by row 2 (60.42 %). Minimum damage was recorded in the row 3 (27.50%) which is statistically similar to row 9 (29.67%). Based on comparison of mean on hole number per damaged stem, maximum

holes were recorded in row 2 (9.20) followed by row 1 (5.5). Minimum holes were recorded in row 3 (1.84) followed by row 9 (2.50). Based on comparison of mean on tunnel numbers in stem per damaged plant, maximum tunnels were recorded in entry 1 (2.75) followed by row 4 (2.40). Minimum tunnels were recorded in the row 3 (0.42) followed by row 9 (1.00). Based on comparison of mean on tunnel lengths in stem per damaged plant, maximum tunnel lengths were 11.19 cm in row 1 followed by 10.03 cm (row 2). Minimum tunnel lengths were in row 3 which

is 1.20 cm followed by row 6 which is 5.43 cm. Based on comparison of mean on plant height, maximum plant height was recorded in row 4 which is 205 cm followed by row 3 which is 203 cm. Minimum plant height was recorded in row 9 which is 173 cm followed by row 7 which is 176 cm. Based on the comparison of mean regarding ear height maximum ear height was recorded in row 9 (91.0 cm) followed by row 2 (90 cm). Minimum ear height was recorded in row 7 which is 82 cm followed by row 3 which is 83 cm.

Table 1: Maize Germplasm (MBR-10) spring 2017

No of Rows	Damage (%)	Holes (No.)	Tunnel s (No.)	Tunnel Length (cm)	Plant Height (cm)	Ear Height (cm)
1	52.79 BC	5.58BC	2.75A	11.19A	186B	89ABC
2	60.42 AB	3.65CDE	2.20BC	10.03A	182B	90ABC
3	27.50 D	1.84E	0.42F	1.20D	203A	95A
4	50.00 C	7.00B	2.40AB	9.76AB	205A	98A
5	56.25 BC	9.20A	2.07BC	9.63AB	181B	83BC
6	50.00 C	4.00CD	1.58D	5.43C	181B	85BC
7	67.86 A	5.17BC	1.58D	6.29BC	176B	82C
8	53.59 BC	4.00CD	1.87CD	5.86C	180B	83BC
9	29.67 D	2.50DE	1.00E	8.02ABC	173B	91AB
CV (%)	7.47	17.82	0.11	19.05	2.87	4.10
LSD=(0.05)	8.57	1.96	0.46	3.29	12.00	8.00

3.1.1 Maize Germplasm (MBR-G)

Based on the comparison of means of the data on percent damage of stem borer on entries of MBR G, maximum damage was recorded in row 6 (35.83) followed by row 7 (33.48). Minimum damage was recorded in the row 3 (8.11) which is statistically similar to row 8 (13.45). Based on comparison of mean of the data on hole number per damaged stem, maximum holes were recorded in row 2 (6.75) followed by row 5 (5.50). Minimum holes were recorded in row 1 (2.00) followed by row 7 (2.70). Based on comparison of mean of the data on tunnel numbers in stem per damaged plant, maximum tunnels were recorded in row 8 (2.25) followed by row 6(1.54). Minimum tunnels were recorded in the row 7 (0.5) followed by row 1 (1). Based on comparison

of mean of the data on tunnel lengths in stem per damaged plant, maximum tunnel lengths were (10.57) cm in row 5 followed by 9.83 cm (row 8). Minimum tunnel lengths were in row 7 which is (1.60) cm followed by row 2 which is (207) cm. Based on comparison of mean of the data on plant height, maximum plant height was recorded in row 7 which is (185) cm followed by row 4 which is (184) cm. Minimum plant height was recorded in row 2 which is (168) cm followed by row 6 which is 180 cm. Based on the comparison of mean of the data regarding ear height maximum ear height was recorded in row 7 (91 cm) followed by row 5 (86 cm). Minimum ear height was recorded in entry 3 which is (79) cm followed by row 8 which is (82) cm.

Table 2: Maize Germplasm (MBR-G) spring 2017

Entries	Damage (%)	Holes (NO.)	Tunnel s (NO.)	Tunnel Length (cm)	Plant Height (cm)	Ear Height (cm)
1	26.66AB	2.00D	1CD	4.02DEF	183	85
2	14.83CD	6.75A	1.5BC	2.075EF	168	83
3	8.01D	2.00D	1.5BC	4.70CDE	180	79
4	18.40BCD	4.08C	2.25AB	7.40BC	184	79
5	20.007BC	5.50AB	3A	10.57A	183	86
6	35.83A	4.835BC	1.54BC	6.335CD	180	85
7	33.48A	2.700D	0.5D	1.60F	185	91
8	13.45 CD	4.33BC	2.25AB	9.83AB	183	82
CV (%)	21.14	13.79	20.06	20.08	2.83	5.60
LSD=(0.05)	10.67	1.31	0.8	2.76	NS	NS

The results of second experiment as follow

3.2 Percent Parasitism

Table 3 indicates that the maximum rate of parasitism on *Chillo partillus* was recorded 81.61%, followed by 73.09% and 61.70 % respectively.

3.2.1 Percent Adult emergence

The rates of adult emergence on the eggs of *Chillo partillus* was 83.92% followed by 78.71% and 71.21% respectively after 24, 48 and 72 hours.

3.2.2 Adult longevity

The present study table 4 indicates that *Trichogramma* reared on *Chillo partillus* was lived 5 days followed by 4.5 and 4.3 respectively after 24, 48 and 72 hours. After 24 hours of post treatment, maximum parasitism % of eggs was recorded. The adult emergence and longevity was found more after 24 followed by 48 hours.

Table 3: % Parasitism of *T.chilonis* reared on *C. partellus* eggs

Host Age Time/hours	% Parasitism	%Adult Emerges	Duration	Adult longevity
24 hours	81.61	83.92	10	5
48hours	73.01	78.71	8	4.5
72 hours	61.70	71.21	9.5	4.3

DISCUSSION

There are many factors that involved in crop yield reduction such as abiotic (temperature and humidity) and biotic (insect pests, pathogens) factors. Among biotic factors, insect pests are the main factors that directly and indirectly affect the crop production (Bergrinson et al., 2004). The various sucking and chewing insect pests are attacking on the crops especially maize crop all over the world. Maize is the cereal crop after wheat and rice,

plays key role for various countries. It is the major source of food for animals and human. The maize stem borer, *Chilo partellus* is serious and notorious pest (Mugo, 2001) of maize that causes 80-100% crop losses in various crop growing counties (Naz et al., 2003).

There are various methods such as cultural, botanicals, biological, host plant resistance and chemicals that adopted at national and international level against the

insect pests throughout the world including Pakistan (Ramzan et al., 2019). The most effective and sound approach to control insect pests and reduce insect damage is host plant resistance (Bhandari et al., 2016).

An experimental study was conducted to observe the resistance in two maize varieties like Maize Germplasm (MBR-10) and Maize Germplasm (MBR-G) against *Chilo partellus*. The results showed that in MBR 10, maximum damage was recorded in row 7 and in MBR-G, maximum damage was recorded in row 6. This observation is in agreement with others researchers (Ampofo, 1984) they reported 21-day-old plants to be more preferred by *C. partellus* for oviposition. A study was conducted in Islamabad to check the host preference of *Chilo partellus* on different maize varieties. The study concluded that dead hearts and leaf damage was recorded in 3 entries and 1 entry, respectively (Latif et al., 2019). Our study findings are also similar to earlier studies.

The insect resistance to plants can be checked by measuring the attack of insect pests like *C. partellus* at seedling stage. The current study findings are in line with other study findings (Khaliq & Mehmood, 1991). Javed et al. (2012) have reported the similar findings. Percent Parasitism of *T. chilonis* reared on *C. partillus* eggs was checked at different intervals under control conditions. In study, 81.61, 73.01 and 61.70% parasitism was observed at interval of 24, 48 and 72 hours, respectively. The maximum % parasitism was observed at 24 hours and lowest after 72 hours of post treatment. The current study findings are in line with the previous studies (Hussain et al., 2010).

Conflict of interest

Authors declare no conflict of interest.

Authors contributions

All authors have equal contribution in writing this review.

REFERENCES

- Afzal, M., Nazir, Z., Bashir, M. H., & Khan, B. S. (2009). Analysis of host plant resistance in some genotypes of maize against *Chilo partellus* (Swinhoe) (Pyralidae: Lepidoptera). *Pakistan Journal of Botany*, 41(1), 421-428.
- Ahmed, S., Khan, R. R., & Khan, M. (2003). Some studies of Varietal Resistance in Spring Maize against *Chilo partellus* (Swinhoe) with and without release of *Trichogramma chilonis*. *Int. J. Agric. Biol.* 5(4), 552-554.
- Ali, N., Singh, G., Singh, S. P., Dhaka, S. S., Ram, M., & Tawar, K. B. (2014). Efficacy of different management practices against *Chilo partellus* (Swinhoe) in Kharif maize in Western Uttar Pradesh. *Int. J. Adv. Res.* 2(11), 952-956.
- Ampofo, J. K. O. (1985). *Chilo partellus* (Swinhoe) oviposition on susceptible and resistant maize genotypes. *International Journal of Tropical Insect Science*, 6(3), 323-330.
- Arabjafari, K. H., & Jalali, S. K. (2007). Identification and analysis of host plant resistance in leading maize genotypes against spotted stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera:Pyralidae). *Pak. J. Biol. Sci.* 10(11), 1885-1895.
- Basto, C. S., Almeida, R. P., & Suinaga, F. A. (2006). Selectivity of pesticides used on Cotton, *Gossypium hirsutum* to *Trichogramma pretiosum* reared on two laboratory hosts. *J. Pest. Mgt. Sci.* 62, 91-98.
- Berginsion, D. J., Vasal, S. K., Singh, N. N., Panwarand, V. P. S., & Sekhar, J. C. (2004). Advances in conventional Breeding for Insects Resistance in Tropical Maize. In.
- Bhandari, G. S., Achhami, B. B., Neupane, S., & Sharma, S. (2016). Differential resistance reaction of maize genotypes to maize stem borer (*Chilo partellus* Swinhoe) at Chitwan, Nepal. *Journal of Maize Research and Development*, 2(1), 133-143, doi. <http://dx.doi.org/10.3126/jmrd.v2i1.16224>.
- Farid, A., Khan, M. I. N., Khan, A., Khattak, S. U. K., & Sattar, A. (2007). Study on

- maize stem borer, *Chilo partellus* (Swinhoe) in Peshawar valley: *Pak. J. Zool.* 9(2), 127-131.
- GOP. "Agricultural Statistics of Pakistan 2017-18" (2018).
- Haffmans, S. (2008). Phasing in alternatives to Endosulfan, Joint paper of the PAN (Pesticide Action Network). 12, International working group Alternatives to Synthetic Pesticides, Germany.
- Hassan, S. A., Hafes, B., Degrande, P. E., & Herai, K. (1998). The side effects of pesticides on the egg parasitoid, *Trichogramma cacoeciae* (Mar.), acute dose response and persistence tests. *J. Appl. Entomol.* 122, 569-573.
- Hussain, D., Ikram, M., Iqbal, Z., Ali, A., & Saleem, M. (2010). Effect of insecticides on *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae) on immature and adult survival. *J. Agric. Res.* 48(4), 531-537.
- Jalali, S. K., & Singh, S. P. (2003). Effect of neem product and bio-pesticides on egg parasitoid, *Trichogramma chilonis*, Ishii. *J. Appl. Zool. Res.* 14(2), 125-128.
- Javed, H. I., Saleem, A., Fateh, J., Hussain, M., & Akhtar, N. (2012). Development of resistant maize germplasm. *Pakistan Journal of Agricultural Research*, 25(2).
- Khan, I. A., Khan, M. N., Akbar, R., Saeed, M., Farid, A., Ali, I., Alam, M., Habib, K., Fayaz, W., Hussain, S., Shah, B., & Shah, S. R. A. (2015). Assessment of different control methods for the control of maize stem borer, *Chilo partellus* in maize crop at Nowshera-Pakistan. *J. Entomol. Zool. Stu.* 3(4), 327-330.
- Latif, A., Shah, J. A., Rehman, A., Khan, T., Tariq, H., Khan, S., & Akbar, A. (2019). Occurrence and influence of stem borer *Chilopartillus* (Crambidae: Lepidoptera) on maize.
- Mashwani, M. A., Ullah, F., Sattar, S., Ahmed, S., & Khan, M. A. (2011). Efficacy of different insecticides against maize stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera:Pyralidae) at Peshawar and Swat valleys of Khyber Pakhtunkhwa, Pakistan. *S. J. Agric.* 27(3), 459- 465.
- Mugo, S. (2001). IRMA Bioassay Shows But Effective Against Kenyan Borers: IRMA Updates-Insect Resistant Maize for Africa. *KARI-CIMMYT.* 2(1), 2.
- Naz, F., Hussain, M., & DIN, M. (2003). Insects pests of maize and their losses. *Asian Journal of Plant Sciences Pakistan.*
- Preetha, G., Manoharan, T., Stanley, J., Suresh, S., & Kuttalam, S. (2010). Impact of Imidacloprid on egg, egg-larval and larval parasitoid under laboratory conditions. *J. Plant Protect. Res.* 50(4), 535-540.
- Ramzan, M., Murtaza, G., Javaid, M., Iqbal, N., Raza, T., Arshad, A., & Awais, M. (2019). Comparative Efficacy of Newer Insecticides against *Plutellaxylostella* and *Spodopteralitura* on Cauliflower under Laboratory Conditions. *Indian Journal of Pure Applied Biosciences*, 7(5), 1-7.
- Saleem, Z., Iqbal, J., Khattak, S. G., Khan, M., Muhammad, N., Iqbal, Z., Khan, F. U., & Fayyaz, H. (2014). Effect of different insecticides against maize stem borer infestation at Barani Agricultural Research Station, Kohat, KPK, Pakistan During Kharif. *Int. J. Life. Sci. Res.* 2(1), 23-26.
- Scholar, A. (2020). Review of Mechanisms of Host Plant Resistance in Tropical Maize Inbred Lines to Maize Stem Borers (*Chilo partellus*).