Research Article

Impact of Egg Parasitoid of Trichogramma Cards on Growth Yield and Quality of Sugarcane at Different Intervals

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Abstract | Sugarcane is an important crop in Pakistan and this crop usually affected by insect pest. Among these insect pests in sugarcane, borers are very dangerous, (Lepidoptera: Pyralidae) whereas Trichogramma chilonis Ishii. (Hymenoptera: Trichogrammatidae) is prominent egg parasitoid utilized for the purpose of borers attack in IPM. This research was carried-out for the purpose of success various issuance of T.chilions in case of sugarcane insect attacks and observe the decay rate of sugarcane borers and such as control issuance by T. chilonis egg cards. The borers' generation emerges out after 27 days, trichogramma cards T. chillions were installed with the duration after 10, 15, 20, days interval repeated and to check out infestation of sugar cane borers. The research shows that results of installed crop was excellent minimum borer attack as compared to less installed trichogramma card. More treated with trichogramma card about 60000 parasitoids eggs /acre at interval after 20 days repeat from May to August. While borers complete their life cycle 30-35 days. This study shows that treated with biological control plot significantly decrease borers infestation as contrast to the less tricho gramma card used. It is very cheap and fully control as well as co-friendly, no effect on the crop stress as compared to the pesticides application. To increase the quality about 0.2-0.5 in sugarcane recovery and more than 150 -200 mound per acre increases due to application of trichogramma cards. Whole minimum to high amount of trichogramma cards T3 600000 parasitoids eggs/acre growth was 42.07 note max high yield 35.51 ton/ha and more brix 20.1 were seen. The results showed that T. chilonis eggs card is successful and inexpensive and environmental safe recruitment for complete dominating over sugarcane borers.

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Introduction

Borers growth period is different From April to October four to five generation appeared Thus hot season need 25 days from larvae to adult (Fucus and Hardings, 1979). Eggs size is 1.16 mm length and 0.75mm width. Mass of eggs were 2 to 50 present under the lower side of sugar cane leaf. Prolongation of eggs is 4-6 days approximately 700 eggs reproduce offspring of borers (Basin and Reagan, 1990). Instar is different about 3-10 yet 5-6 is usual. (Holloway *et al.*, 1928) observed that instar range approximately 3-6,4-

8, 6-9, 4-9 days for instar 1 to 5, as fallows, Larvae eat sugar cane (Roe *et al*., 1982) head size approximately 0.29, 0.40, 0.62, 0.93, and 1.32 mm for instar 1-5 larvae. larvae completes its life cycle 25 -30 days in hot season, in cool season 30-35 days and get body size in approximately two –four, six – nine, ten -fifteen, fifteen – twenty, twenty - thirty mm from 1-5 instar physiology of sugarcane borer is narrated by Holloway *et al*. (1928) and classified by (Roe, 1981). Other crops are rarely at risk. Sugarcane borer is a little irritant of sweet corn also occur in flower species. Temperature support its life cycle and sugarcane is more affected (Kelsheimer *et al*., 1950). Injury of sugarcane borers to corn is explained by (Flynn *et al*., 1984). Biological control have significant effect against bores attack about 90% (Bessin and Reagan,1990) larvae division is is founded by (Hall, 1986) which indicated that sugar cane normally have five tiller from five plants at a distance for about 5 m to determine borers population.

Sugarcane (*Sacchiarum officinerum* L) is existence main crop in Pakistan and have a great importance in agriculture economics. Pakistan is a big creator of sugar cane crop in crop wise 5th in the world growing,11th manufacturer in sugar, 60th in the yield (Shahid *et al*., 2007). About 1500 type of insect that attack on sugar cane in all over the world (Box,1953). About 800 parasitoid victim and harmful 24 borers adult in Asia and in Bharat damage the sugar cane crop (Sallaman and Allosopp, 2005). Both biotic and abiotic connect with the yield as well as from cultivation of sugar till maturity. High temperature consequently decrease yield and recovery (Rafique *et al*., 2007). In cold region sugar cane cannot be sown as well as above 40˚C and moisture below 40% immediate attack of major insect pest on sugar cane (Talpur *et al*., 2002). Getting more yield and better growing of sugar crop need good soil, normal rain, moisture and high temperature (Smith, 1996). High temperature immediate cause of severe strike of various borers increase quickly (Kumar *et al*., 2007). Sugarcane stem borer, Chilo infuscatellus Snellen, 1890 (Lepidoptera: Pyralidae) is highly prominent, chief sporting of borer and source of greater attack of sugarcane about 36.51% (Ashraf *et al*., 1993; Aheer *et al*., 1994). Borers affected by various spray (Qayyum, 1975; Dent, 1991). Borers made gallery under stalks in the internodes and where reaching of various chemical is impossible and approximately 80-85% reduction in the yield (Sharma *et al*., 1997). Destruction of to 3rd and 4th young of cane by sugarcane borers Cause in about 25% less in production (Gupta and Singh, 1997). The borers is Energetic from March to November and remain in cool season under the straws in the crops and prey eater are also occur in sugarcane crops (William, 1983; White and Regan, 1999). Borers like to choice cool season, more moisture and also search out the small prey yet no of in the Pakistan (Ashraf *et al*., 1999). Approximately 48 types of borers in Indian and Subcontinent attack on sugarcane (Rehman, 1942). Therefore, 12 types of borers note in Pakistan (Chaudhry and Ansari, 1988; Naqvi, 1975) borers damage the crop and results decrease the recovery as well as production of sugarcane crop.

To control the hesitance for manufacturer the standard sugar and to compete requirement of international business must be used integrated pest management (IPM) facts i.e., cultural, mechanical, biological, chemical and physical techniques separately and in mixing. Trichogramma chilonis (Ishii) (Hymeoptera: Trichogrammatidae) is the model organized eggs parasitoid and vastly divided in all over the world. Insets are very small (0.5 mm long) parasitoids that is damage the eggs of above about 200 type of lepidopterous pests (Farmanullah *et al*., 2011). Parasitoid eggs finish their activity in the insect eggs and between 7-8 days small trichogramma come up and further look after insets eggs for laying eggs in side host eggs. Whole process begins in sugar cane crop trichogramma generation increasing to reducing insect adult. Suitable situation 70-80% parasitism was seen on insets egg that is reducing the insect family upto a 5%. This citotroga-egg parasitoid by Trichogramma insect bring up in the biological lab and distributed in the crop as bio pesticides for strike of the lepidopterous insects (Hussain *et al*., 2007).

In Various demonstrations good utilization of bio pesticides against borers sugarcane crop cure by *T. chilonis* has a vast choice to increase its offspring on sugarcane that is important to damage adult of insect (Smith, 1996; Soula *et al*., 2003) this study shows that the importance of split rate and duration of trichogramma cards for control of borers' eggs.

Materials and Methods

A field area of 1.944 hectare, in which sugarcane variety cp77400 cultivate twenty seven plot each have same size 0.036 hectares) in Complete Randomize

Block Design (CRBD) implement in this experiment. Three treatments were taken one plot was control (T1), 30000 parasitized eggs /acre (T2), 40000 parasitized eggs /acre (T3), 60000 parasitoid eggs / acre. The experiment was repeated three times. The data was noted on basis of of infestation of sugar cane borers after ten days of the installation of trichogaramma card in the field by evaluating the control plot from month May to August 2023, therefore sugar cane production was noted at the time of cutting. All the agronomic approaches recommended dose of fertilizer and water were given according to the need of crop. Insecticides were not used in the crop. The infestation level of borers were measure the borers affected cane unsystematically from the month May to August after interval of 10,15 20 days that is A B and C block separately. Select five different places from each plot. In every plot within 10 square meters note the affected plants and evaluate the percentage of borers infestation in every plot. To reduce the borers attack of sugarcane Trichogramma chilions (ishii) (Hymeoptera: trichogrammatidae was raise on created host on wheat seed pest, a small tinned moth citotroga cerealella (Olivier) (Lepidoptera: Trichogramatidae in the laboratory of hamza sugar mills jetha bhutta khan pur below temperature 25±2˚C and relative humidity 60-70% and available for farmer use in the sugar cane crop as bio control agent. Installation of million T. chilonis at various duration in the crop must raise their generation to egg parasite in huge amount.

Rearing of host Sitotroga cerealella

Wheat seeds wash in the open container and boil with hot water, seeds were desiccate in presence of sunshine for three to four days increase or decrease according to the temperature and measure wheat and about 6.66 kg and put it into the tray and treated with 2.5 gram eggs of cititroga in every tray. Insect larvae emerge out from the Eggs within four to five days and larva pass through a pupal stage after 22-28 days. Young citotroga emerge out catch with help of baloor machine or in the plastic bag and put into plastic jar for parturition cut the plastic jar at the base put 24 mesh net in the lower side of the plastic jar net heat on oven and attach at the basal side of plastic jar. Egg laying period is 3-5 hours and eggs are sived from 70 and 80 mesh on every days for tricho grama cards and to make for next culture as well as stack eggs for host culture.

Preparation of eggs cards

For making cards pure eggs of fictitious host S. cerealella splash on perforated paper cards size 3*2 inches sticky with the mixture of liquid (gum) with the help of 3 inches width small brush (elastic yarn made from nylon fiber (9 inch length and 2 inch width), every card is consist more than 500 eggs of S. cerealella treated with trichogramma culture parasitoids cards were stock in the lower portion of refrigerator for 10-15 days at the temperature of 6-7˚C probably release out from the lab.

Rearing of Trichogramma chilonis

Well parasitoid cards of trichogramma culture were place in the 5 kg glass jar mouth covered with white muslin cloth stretch with rubber curved. After 6-8 days female wasp emerge out. Card length modify shade from orangish brown to brown and convert dark brown to blackish brown. When *T. chillion* start emerge out from fertile eggs. Therefore within one hour females were able to mate and looking for feed the S.cerealella eggs and lay their eggs inside the. S. cerealalla eggs. Each individual female gave 3-4 eggs in every eggs of S. cerealalla Put the eggs inside S. cerealalla and hatched about 24-48 hours. Emerged larvae finish their whole period were continued insides eggs of S. creaelalla and finally adult emerge out after 5-7 days. Therefore, fertile eggs modify shade from golden brown to orange than dark orange to brown and finally dark brown.

Field application of T.Chilon is cards

All parasitoid eggs card covered in party tissues and put into ice container. Eggs card were attach with staple at lower side of the sugar cane leaf. Each cards consist of 500 eggs per perforated paper cards S. cerealla parasitoid eggs and create 1500 1800 trichogramma cards young into various hours well prepared S. cerelellia eggs card were place in jar for 4-5 days in laboratory temperature 25 ±2°C till fully grown. Parasitoid eggs changed from golden brown to orange than dark orange to brown and finally dark brown.

Preservation of parasitoid cards

Parasitoid egg cards collected from glass jars were kept in plastic envelops and placed in the refrigerator vegetable box at 6-7˚C. These egg cards were stored up to 15-30 days. As the duration was long the emergence percent was low as compare to starting days. On demand of the farmer or at the time of application, these mature egg cards can be taken out of refrigerator for 2-4 hour before use.

Results and Discussion

In sugar cane total expenses are more by the farmer on single highest cost unit in the whole process. The adaptation of biological process is a cheap and 90% save cast in trichogramma cards not a labors, 100% control to reduce the borers infestation.The farmers of Pakistan are using conventional method to control borers attack and research indicates that for getting high quantity and recovery modern technique method must be applied (Radadia *et al*., 2013). However, treatment with trchogramma cards control all the borers attack (Sallaman and Allosopp, 2005). This research was organized to describe the impact of trichogramma cards on growth, yield and quality of sugar cane at different intervals 10, 15, 20 times. There was very important and most effective control of borers.

Decrease infestation of bores was installed rate of tricho grama cards. It is very suitable and successful bio control against sugar cane borers. The highest and lowest installation was recorded in the minimum and maximum emerge out of trichogramma cards with 10 and 20 days duration as mentioned. This is a great difference were seen in borers attack as comparing to control and installed block. The decrease of borers attack was due to emerge out of trichograma chilonis cards. There was a great dissimilarity of lower and more trichograma cards, the highest cards were installed dose of 60000 parasitoids eggs /acre cards.

There was a significant consequence of biological control agent against borer attack during whole study. The maximum and minimum release of trichogramma cards after 10, 20days interval respectively. There was a significance difference was seen between lowest and highest trichogramma card treated.

The lowest borer attack was determined based on the amount of trichogramma cards eggs at maximum 40000, 60000 parasitoids eggs/acre. Table 1 shows that more significantly ($p<0.01$) of borers damage. In the month of May data was collected in treatment T1 growth was 20.97 and yield was 17.754 ton / acre brix was minimum 12.3. Due to minimum repeated and three times completed in the month of May very less growth result in low production and borers attack appears ultimately effect on the quality of sugarcane. (Gupta and Singh, 1997) described that gurdospur borer attack r educe due to 3rd and 4th generation of sugar cane borer approximately 25% less in yield crop getting final height and sudden plant start falling upper side,spiral shape cut in side cane due to three times application of biological agent after 10 days interval in the month of May gurdospur borers infestation start from May to Sept. (Jalali and Singh, 2006b) reported that biological agent has great character to hunt and search out the borers eggs easily approach able at less temperature eat the bores eggs and gave their eggs inside the host eggs. During the early days in the month of May, temperature is normal biological agent perform better at normal temperature (Anonymousy, 2005) noted that emerge out of biological agent and installed after 10 days 50000/ha that reduce the infestation of top borers in the Punjab therefore the fourth generation come out in the month of July and in this experiment biological cards were installed three times after 10 days till at end of May asshon in Figure 1**.** While, top borers eggs were not damage by biological control so reduce the growth, yield and quality of sugarcane gurdospur borer Reduce due to 3rd and 4th generation of sugar cane borers approximately 25% less in yield (Gupta and Singh, 1997).

Table 1: *Analysis of sugarcane MEAN and SE as influenced by different trichograma eggs after 10days interval for damaging borers eggs in different treatment after release of T. chilions different intervals in May to August in sugarcane crop.*

Treatments (Tricho gramma eggs Amounts	Growth	Yield	Brix
T1	MEAN 20.97 SE 0.3128	MEAN 15.76 SE 0.5367	MEAN 8.7 SE 3.5757
T2	MEAN 27.20 SE2.0.5816	MEAN 16.25 SE1.2315	MEAN 11.5 SE 3.6310
T3	MEAN 27.95 SE 0.7583	MEAN 17.75 SE 1.0535	MEAN12.3 SE 5 2.3184

Similarly, in the treatment T2, growth was observed, 29.8 after harvesting noted that yield was 32.4 and brix was seen 13.91 as shown in Figure 1.

Installed biological card four times after intervals of 15 days completed in the month of June all the bores infestation start from march to October (Radadia *et al*.,2013) who reported that many borers of sugar cane such as shoot borer, top borer, stalk borer are damage the crop and decrease the production as well as recovery of sugar cane. Top borers infestation was seen

in June, early shoot bores was seen about 60 days in May and stalk was seen after 100 at harvesting time (Jalili *et al*., 2006c) who reported that at more temperature (32 - 40°C) gave their eggs inside host eggs and produce more generation for control long period of borers attack. Parasitism sugarcane stem borer 993 million hectare every years all over the world (Saroj and Jaipal, 2000). Table 2 shows that less application of trichogramma card results in less in yield as well as brix as shown in Figure 2.

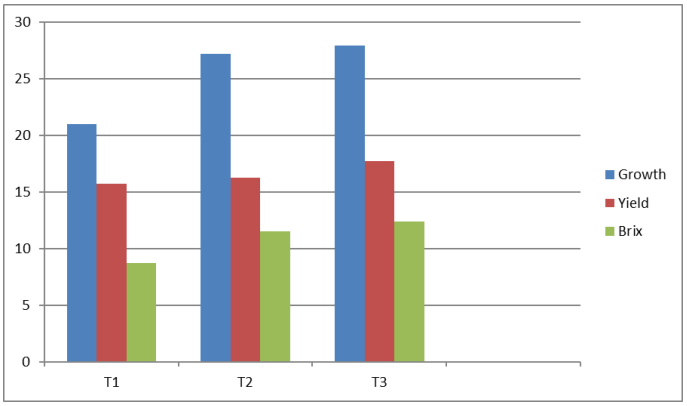

Figure 1: *Analysis of sugar cane as influenced on growth, yield and brix by different trichogramma eggs after 10 days interval for damaging borers eggs in different treatment after release of T. chilonis in May sugarcane crop.*

Table 2: *Analysis of sugarcane MEAN and SE as influenced by different trichograma eggs after 15 days interval for damaging borers eggs in different treatment after release of T. chilions different intervals in May to august in sugar cane crop.*

Treatments (Tricho gramma eggs Amounts	Growth	Yield	Brix
T1	MEAN 24 SE 2.7382	MEAN 15 SE	MEAN 9.5 SE 2.4677
T2	MEAN 25.74 SE 3.9392	MEAN 23.27 SE1.7066	MEAN 10.5 SE 1.4161
T3	MEAN 33.14 SE 1.7260	MEAN 25.29 SE 6.1561	MEAN 12.2 SE 1.5791
T4	MEAN 34.40 SE 1.9126	MEAN 32.85 SE 6.1561	MEAN 13.2 SE 1.4294

Therefore, in the treatment T3 growth was seen 42.07% and yield was noted 35.51 t/acre, brix was 20.1 was recorded at the highest biological card were used after 20 days intervals six times repeat in the same filed as shown in Table 3. Maximum repeat gave mare growth due to free from the borers eggs in the crop, no sign of attack were seen fresh crop get more growth as well as increase the yield and recovery. Note the b biological control agent was seen get protein and gave their eggs insides internode bores in the sugarcane crop seen about 7-55% (Vengopal *et al*., 1968).

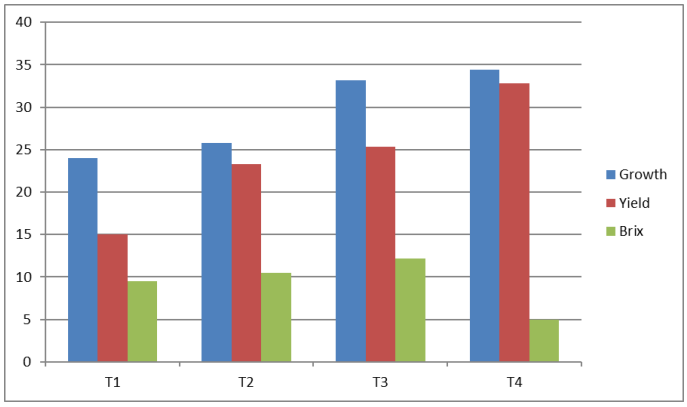

Figure 2: *Analysis of sugarcane as influenced on growth, yield and brix by different trichogramma eggs after 15 days interval for damaging borers eggs in different treatment after release of T. chilonis at different intervals in May to June in sugar cane crop.*

Table 3: *Analysis of sugarcane as influenced on growth, yield and brix by different trichograma eggs after 20 days interval for damaging borers eggs in different treatment after release of T. chilions different intervals in May to August in sugarcane crop.*

Treatments (Tricho gramma eggs Amounts	Growth	Yield	Brix
T1	MEAN 36.04 SE 1.6563	MEAN 26.05 SE 2.9529	MEAN 15.2 SE 1.1829
T2	MEAN 36.58 SE 0.7991	MEAN 30.33 SE 1.0780	MEAN 15.4 SE 1.3567
T3	MEAN 38.60 SE 1.6563	MEAN 30.87 SE 0.6659	MEAN 16.2 SE 1.6731
T4	MEAN 39.67 SE1.8522	MEAN 31.82 SE2.5712	MEAN 17.7 SE 0.5854
T5	MEAN 41.91 SE 0.3995	MEAN 31.97 SE 1.4475	MEAN 18.36 SE 0.9276
T6	MEAN 42.07 SE 0.9647	MEAN 35.51 SE1.8181	MEAN 20.1 SE 0.9485

Mahela (2002) observed that Gurdaspur borer is a very destructive borer infestation spread when crop getting max growth takes place July to Sept. The female lay eggs 90-300 eggs in mass farm attack in gathering thus bio control is best technique to control gurdaspur borer eggs no further generation spread. In addition, Gull *et al*. (2010) reported that larvae emerge out after 21-27 days and become pupae all development inside the cane become adult after 35-

40 days in July to Sept. In a ballot farm withered on the top of sugarcane. More trichogramma cards were used more growth and highest yield as well as more brix as shown in Figure 3.

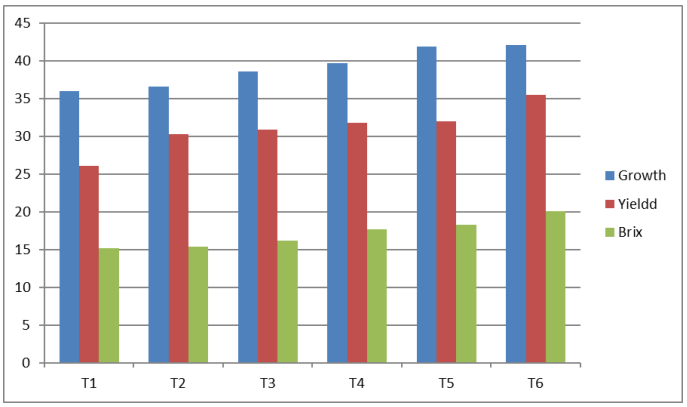

Figure 3: *Analysis of sugarcane as influenced by different trichogramma eggs after 20 days interval for damaging borers eggs in different treatment after release of T. chilions different intervals in May to August in sugarcane crop.*

Temperature resistant biological agent at the rate of 100000/ha emerge out after 7 days duration that reduced infestation top shoot borer of sugar cane and control the 3rd generation of top borers infestation. Biological agent has a great character to hunt at less temperature (Jalali and Singh, 2006b). Therefore, at more temperature (32 - 40°C) gave their eggs inside host eggs and produce more generation and young for control long period of borers attack (Jalili *et al*., 2006c).

Gurdospur borer is destructive borer spread when crop getting max growth takes place July to Sept. (Mahela, 2002) female lay eggs 90-300 eggs in mass farm attack in gathering. Larvae emerge out after 21-27 days and become pupae all development stages complete inside the cane become adult after 35-40 days in July to Sept. In a ballot farm wither on the top of sugarcane (Gull *et al*., 2010) stem borer attack is more on sugar cane about 66-73% it created 3-4 offspring emerge out annually (Rehman and walayati, 2023). Many borers of sugar cane such as shoot borer, top borer, stalk borer are damage the crop and decrease the production as well as recovery of sugarcane. Top borers infestation was seen in June, early shoot bores was seen about 60 days in May and stalk was seen after 100 at harvesting time (Radadia *et al*., 2013).

Conclusions and Recommendations

Application of *T. chilonis* eggs cards decrease infestation level of borers attack. This technological research is very successful and climate friendly which restrict recovery and production and deprived of sugarcane in case of borers. It is recommended that more application of trichogramma cards will increase production as well recovery of sugarcane.

Novelty Statement

This research had observed around 2.5 million acreage of sugarcane and 60% bores damage of sugarcane in the field in terms of yield and quality.

Author's Contribution

Abdul Mannan: Conducted the Research, analysis and draft of the paper
Naveed Iqbal: Helped and analysis
Randhawa: Helped in field experiment
Abdul Hanan: Helped in relevant literature
Abdul Qadeer: Editing and proofreading

Conflict of interest
The authors have declared no conflict of interest.

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