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# Predators and parasitoids of sugarcane crop in ecological zone of Rahim Yar |Khan

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## Abstract

This study summarizes the natural enemies of major sugarcane pests and their roles in natural control in sugarcane growing regions in Rahim Yar Khan Zone. In general, these natural enemies can be divided into two groups: parasites and predators. The dominant species include *Apanteles flavipes* (Cameron), *Sturmiopsis inferens* Townsend and *Trichogramma* sp., which parasitize the sugarcane borer; *Synonycha grandis* (Thunberg), *Lemnia biplagiata* (Swartz), *Cheilomenes sexmaculata* (Fabricius) and *Thiallela* sp., which prey on *Ceratova cunalanigera* Zehntner; and *Euborellia pallipes* Shiraki, *Orius* (*Heterorius*) *minutes* (Linnaeus) and *Scymnus* (*Neopullus*) *hoffmanni* Weise which preys on *Saccharicoccus sacchari* (Cocherell), *Baliothrips serratus* Kobus and *Trochorhopalus humeralis* Chevrolat. Results of the field studies revealed that under unreleased area of *Trichogramma chilonis*, the infestation of borers was 10.85% and in the released area it was 1.59 %, while in case of Chrysoperla the infestation of borers was 11.7% and in the released area it was 2.0 %. Protecting these natural enemies will encourage natural control of pest species while protecting the environment and maintaining ecological balance. Moreover, through enhanced pest control, sustainable development of the sugar industry will be promoted. Efficiency of biocontrol of the insect pest can be improved only with integrated management practices of the crop identified, these are resistant varieties, alternate planting dates, trash blanketing of ratoon crop, early harvesting, balanced fertigation, pest-free seed cane and field monitoring.

**Keywords:** sugarcane pests, parasites and predators, infestation of borers, biocontrol.

## Introduction

Sugarcane is an important industrial and cash crop in Pakistan and in many countries of the world. It grows about 1 million hectares of sugarcane, more than all other cane producing countries except Brazil, China, Cuba, India and Thailand. Average production of sugar cane in Pakistan is 450 - 500 mounds per acre. Pakistan is world's 5th largest producer of sugarcane in terms of area under sugarcane cultivation, 11th by production and 60th in the yield (Shahid *et al*., 2007). It contributes about 0.6 percent to GDP and 2.9 percent addition in agriculture with production 66.880 million tonnes (Anonymous, 2019-20). Sugar cane production of Pakistan increased from 26.4 million tonnes in 1970 to 66.9 million tonnes in 2019 growing at an average annual rate of 2.89%. Sugarcane is grown on an area of more or less one million hectares in Pakistan. The Punjab shares 62 %, Sindh 26 % and N.W.F.P. shares 16 % of the total area. Pakistan occupies an important position in cane producing countries of the world. It ranks at the fifth position in cane acreage and production and almost 15th position in sugar production. Punjab province is the 1st largest sugarcane growing area in Pakistan as well as the main area of distribution and the most potential development area of future production. As a result, sugarcane is a major economic crop, and the

sugar industry the main source of regional economic development and farmers' income in frontier minority areas in Punjab. However, the long-term control and treatment of sugarcane pests currently relies on highly toxic chemicals and broad-spectrum pesticides such as methamidophos, omethoate and terbufos. As a result, many natural enemy species are also targeted, with some having experienced a rapid decline, therefore, the pest resistance to insecticide is higher than before, upsetting the dynamic relationship between pests and their natural enemies. Moreover, this has a direct effect on pest control, further encouraging successive long-term application of pesticides, and thereby increasing residual toxicity and pollution, which poses a threat to human health (Huang and Li, 2011, 1995b, 1997; Liang *et al*., 2010). In Pakistan it has been recorded from *Chilo infuscatellus* Snellen, *Chilo partellus* Swinhoe, *Helicoverpa armigera* Hübner, *Agrotis ipsilon* Hufnagel, *Spodoptera litura* Fabricius and *Bissetia steniellus* Hampson. In many cases successful bio-control applications have been done to control borers. Crop plants treated with *T. chilonis* has wide chance to spread its generation on sugarcane, which play a vital role to suppress the population of borers (Smith, 1996; Soula *et al*., 2003). Sugarcane stem borer, *Chilo infuscatellus* (Lepidoptera: Pyralidae) is the most notorious, predominant and destructive pest of sugarcane and causes major damage to crop which is up to 36.51% (Ashraf *et al*., 1993; Aheer *et al*., 1994). The stem borer is active from March to November and passes the winter as full grown larvae in the stubble, while parasitoids and predators are present in cane fields (William, 1983; White and Regan, 1999). Management (IPM) strategies *i.e.*, cultural, mechanical, biological, chemical and physical control methods individually and in combination. *Trichogramma chilonis* (Ishii) (Hymeoptera: Trichogrammatidae) is the typical gregarious egg parasitoid and is widely distributed throughout the world. These wasps are tiny (0.5 mm long) parasitoids which attack eggs of more than 200 species of lepidopterous pests (Farmanullah *et al*., 2011). Parasitoids complete their life cycle in borer's egg and after 7-8 days a tiny wasp emerges out and again starts searching for borer eggs for oviposition. The life cycle starts in cane field, where parasitoids multiply in field and control the pest population. In favourable conditions 70-80% parasitism was recorded on borer's egg, which break down the pest population to less than 5%. This moth-egg parasitoid *Trichogramma* species is reared in laboratories and released in the field as a bio-control agent against lepidopterous pests (Hussain *et al*., 2007). To avoid the negative effects of pesticide application, several avenues of research and novel control strategies have demonstrated potential in controlling insect pests. For example, the use of silicon based fertilizers can enhance sugarcane resistance to pests (Frew *et al*., 2016), light-trapping is widely used for trapping a variety of insect pests (Wu *et al*., 2009) and biological control agents such as *Beauveria bassiana* and *Metarhizium anisopliae* have good effect to control sugarcane borers (Ashok and Tandan, 1996). Biological prevention has recently become a comprehensive method of pest control in Pakistan, achieving wide-spread attention due to the social and ecological benefits. Research on the use of natural enemies in sugarcane growing areas will therefore help effective control of the damage caused by pests, thereby increasing raw cane production, reducing environment pollution, maintaining ecological balance and reducing production costs. Moreover, since entering the World Trade Organization (WTO), which demands strict regulation of agricultural products, the protection and utilization of natural enemies rather than pesticides has become of even greater importance. Recent research reported that nectar-producing plants grown around rice fields could attract natural enemies, significantly reduced populations of two key pests, reduced insecticide applications by 70%, increased grain yields by 5% and delivered an economic advantage of 7.5% (Gur *et al*., 2016). Besides using pesticides/insecticides, insects could also be controlled by biological measures. *Cotesia flavips* is an important larval parasitoid of sugarcane bores. Its female lays eggs inside the borer larva and after hatching; its larvae feed inside the borer larva. Adult parasitoid attack more borer larvae in the field. *Trichogramma chilonis* destroys the eggs of sugarcane borers. Its female lays eggs inside the eggs of borers. Parasitoid larvae feed in the host eggs, destroying them. *Epi-pyropes* destroy sugarcane Pyrilla. These parasitoids are mass multiplied in the laboratory and then released in the cane fields.

Rahim Yar Khan District lies between 27°40'-29°16' north latitudes and 60°45'-70°01' east longitudes main distribution area and most potential development area of sugarcane production in Pakistan. The riverain area of the district lies close to eastern bank of the river Indus and Panjnad. The Rahim Yar Khan District is bounded on the north by Muzaffargarh District, on the east by Bahawalpur District, on the south by Jaisalmer district (India) and Ghotki District of Sindh province, and on the west

by Rajanpur District. The area under cultivation of sugar cane increased to 430,000 acres in 2020 from 310,000 acres in 2014-15. Six sugar mills are located in the district. While pests are numerous, natural enemy resources are also very rich. Around more than 1500 species of insects feed on sugarcane plant recorded throughout the world (Box, 1953). A total of 283 natural enemies exist in province alone. Sugarcane is specially grown in tropical and sub-tropical regions of the world in a range of climates from hot dry environment near sea level to cool and moist environment at higher elevations irrigated with moderate temperature frost free zone between 26° N latitude to 30°N latitude, Irrigated arid sub-tropical zone between 240° N latitude to 260° N latitude, Temperate zone of northern Punjab and K.P.K. between 32° N latitude to34° N latitude. A comprehensive list of about 800 records of parasitoids, predators and pathogens of the 24 key moth borers in Asia and the Indian Ocean islands was complied, with enormous information on the host stage they attack, host plant or crop and country of record (Sallam, 2006). A report documented 48 species from Indo-Pakistan subcontinent feed on crop (Rehman, 1942). Many important insect's pests have been stated even from Pakistan (Naqvi, 1975). Dominant species with conservation use value and research significance include *Apanteles flavipes* (Cameron), *Sturmiopsis inferens* Townsend and *Trichogramma* sp., which parasitize sugarcane borer; *Synonycha grandis* (Thunberg), *Lemnia biplagiata* (Swartz), *Chilomenes sexmaculata* (Fabricius) and *Thiallela* sp., which prey on *Ceratovacuna lanigera* Zehntner; and *Euborellia pallipes* Shiraki, which preys on *Saccharicocus sacchari* (Cocherell) and *Trochorhopalus humeralis* Chevrolat (Huang and Li, 1995a).

## Materials and Methods

The experiment was conducted at farmer's field from Adaptive Research Farm Rahim Yar Khan during 2018 and 2019 to determine the impact of predators and parasitoids on sugarcane crop. Assessment was started from June 2018 to February 2019 and HSF 242 variety of sugarcane predominantly cultivated in this district. Pest species complex and their relative richness were assessed by plant sampling**.** The district Rahim Yar Khan was selected for this study with four tehsils comprising of Sadiqabad, Rahim Yar Khan, Khan Pur and Liaquat Pur. This study was conducted in a randomly selected Tehsil Khan Pur. Khan Pur is much renowned for sugarcane cultivations. 28 of the 10 villages along with union councils randomly selected for study. All these sites were personally visited for the infestation of sugarcane crop and collection of pests were made possible direct from the field (Figure 1).

Diverse pests were collected from the tehsil Kanpur from different sites/locations of sugarcane crops. This survey is in progress with the onset of different seasons. The collection was made possible right from the seasoning time till maturity of the crop and providing a comprehensive data collection to assess their damage in a real way.


Figure.1

To determine insect pests composition in Sugarcane pests hence collected with a wide range of insects including major groups like, Leaf feeders (Lepidoptera, *Noctuidae*) and grasshoppers/locusts *(Orthoptera)*, sap feeders, stalk feeders and root feeders. Subsequently different pests hence collected from the sugarcane crop identified using different keys and other entomological sources from the literature. Also specimens were sent to Jhang entomological Sugar mill for the exact identification. Sugarcane insect pest on the basis of infestation observed in field are listed in table.1.

**Table-1 Primary and secondary insect pests of sugarcane crop**

| Sr. No. | Common name | Technical name |
|---|---|---|
| **Primary** | | |
| 1 | Sugarcane top borer | *Scirpophaga excerptalis* Wlk. S. *Nivella* Fab. |
| 2 | Sugarcane stem borer | *Chilo infuscatellus* Snell. |
| 3 | Sugarcane root borer | *Emmalocera depressella* Swin. |
| 4 | Sugarcane leaf hopper | *Pyrilla perpusilla* Wlk. |
| 5 | Sugarcane white fly | *Aleurolobus barodensis* Mak. |
| **Secondary** | | |
| 6 | Sugarcane stem borer | (*Sesamia inferens* Wlk. (*Chilo partellus* Swinh). |
| 7 | Sugarcane black bug | *Cavelerius excavatus* Dist. |
| 8 | Sugarcane mealy bug | *Ripersia sacchari* G. |
| 9 | Sugarcane thrips | *Fulmekiola serrata* Kobus. *Haplothrips* sp. |
| 10 | Sugarcane (White ants) | *Microtermes obesi* Holmgren |
| 11 | Sugarcane mites | *Oligonychus* sp. *Schizotetranychus* sp. |

(Khanzada, 1993)

Parasites and predators that could be used successfully against the insect pests of sugarcane crop are given in table-2.

**Table-2 Parasites and predators of insect pests of sugarcane crop**

| Sr. No. | Name of parasite/predator | Name of pest – host | Nature of parasitism |
|---|---|---|---|
| 1 | *Trichogramma chilonis* | Stem borer | Egg |
| | *Trichogramma chilonis* | Root borer | Egg |
| 2 | *Apantle*s (Cotesia) flavipes | Top, stem & root borers | Larvae |
| 3 | *Elasmus zehntneri* | Top borer | Larvae |
| 4 | *Telenomus dignus* | Top borer | Larvae |
| 5 | *Coccinella septempunctera* | All borers | Eggs |
| 6 | *Epiricania melanoleuca* | Pyrilla | Nymph and adults |
| 7 | *Pyrilloxenos compactus* | Pyrilla | Nymph and adults |
| 8 | *Tetrastichus pyrillae* | Pyrilla | Eggs |
| 9 | Spiders | Pyrilla | All stages |
| 10 | *Chrysopa* sp. | | Egg and nymph predator |
| 11 | *Coccinella septempunctera* | | Egg predators |
| 12 | *Azotus* sp. | White fly | Nymph and pupae |
| 13 | *Encarsia* | | Pupae |
| 14 | *Chrysopa* and *Coccinella* species | | Predator |

(Khanzada, 1993)

Infestation % of borers in both released and unreleased plots with *Trichogramma chilonis* was taken by sampling from June to February each year. Nymph of *Pyrilla perpusilla* per stalk and larvae of borers on internode basis were counted in a randomly selected block of 20 x 20 m. Quality analysis for sugar recovery % cane of healthy and infested samples of borers was done from October-April. Trichogramma has proved most effective egg parasite against root, shoot and stem borers. Millions of parasitised eggs were released at different interval in the field. A store grains pest *Sitotroga cerealella* is a good alternate host of Trichogramma and has a capacity to breed a large population in shortest possible time in the laboratory. Sitotroga is reared of the laboratory, under controlled environment. Its eggs are collected and pasted on cards. Sitotroga eggs, act as host of Trichogramma. Cards are placed in plastic jars and eggs of Sitotroga are parasitized by Trichogramma. As and when required, cards are taken to the field and punched on the under surface of leaves to avoid direct exposure to sunlight. In 2-3 days Trichogramma in infested eggs complete their life cycle and adults come out of eggs. Trichogramma search out the eggs of borers and lays their own eggs through ovipositor. Trichograma has wide chance to spread its generation on sugarcane, maize and rice borer. The eggs of borers are parasitized, and Trichograma complete its life cycle in borer eggs. Parasite has start life cycle of 7-8 days, thus releases must coincide with the presence of host (insect) eggs in the field. A cyclic chain of Trichograma parasitism is developed in cane fields. In favorable environments, 70-80% borer's eggs parasitism is noticed which bring down the pest population to less than 5%. In unfavorable conditions more frequent releases are required to establish parasitism in the cane fields. This is the cheapest, efficient and environmental friendly method of borer control. *Chrysoperla carnea* commonly known, as Chrysopa is the most effective predator. It is utilized for the control of borers complex and *Pyrilla perpusilla* of sugarcane crop. It has the same host (Sitotroga) as *Trichogramma chilonis*. *Chrysoperla carnea* has the peculiarity of eating eggs, larvae and nymphs of all types of borers, Pyrilla, white fly, bugs and mites. It can be reared and released in all seasons. Rearing of Chrysopa is more technical, expensive and time consuming. Lab. studies conducted at SSRI, has shown that Chrysoperla larvae of 7-8 days life period has given 80 % predation to the eggs population of Pyrilla. In another study at the lab of the institute indicated that through release of Chrysoperla larvae, 65 % mortality of nymph of *Pyrilla perpusilla* was recorded.

Data collected on different parameters were analyzed statistically by using M STAT-C Programme (Anonymous,1986) for analysis of variance and means were separated using Fisher's protected least significant difference (LSD) test at 5% probability level (steel et al., 1997).

## Results and Discussion

Highly significant control of borers infestation was established through periodic release of *Trichogramma chilonis* and *Chrysoperla Carnea* in cane growing areas of District Rahim Yar Khan. The results have indicated that the infestation of borers was 12.77 % during 2018 in unreleased area and 1.76 % in released area while in 2019 10.67% area unreleased and 2.25% area under released for chrysoperla spp controlling acrages. The results of Trichogramma have indicated that the infestation of borers was 12.78 % during 2018 in unreleased area and 1.40% in released area while in 2019 8.92% area unreleased and 1.78% area under released for Trichogramma spp controlling acrages. Periodic increase in acreage of *Trichogramma chilonis* applications was done in the area 500. The results have indicated that application of Trichogramma is useful, efficient and environment friendly. Detail of acreage covered through release of Trichogramma and Chrysoperla for control of borers infestation is given in table-3.

Table-3 Acreage covered and impact of Trichogramma chilonis and *Chrysoperla carnea* on infestation of borers complex in released and unreleased areas of Khan Pur Tehsil District Rahim Yar khan

| Year | Acrage | Infestation % of *Trichogramma chilonis* | | Infestation % of *Chrysoperla carnea* | |
|---|---|---|---|---|---|
| | | Released area | Unreleased area | Released area | Unreleased area |
| 2018 | 300 | 1.40 | 12.78 | 1.76 | 12.77 |
| 2019 | 200 | 1.78 | 8.92 | 2.25 | 10.67 |

- Field applications of *T. chilonis* cards and *C. carnea* sheets should be pest scouting based
- Efficiency of biocontrol could be increased with trash blanketing, balanced fertigation, pest-free seed and appropriate field monitoring
- Efforts are now required to develop transgenic plants of sugarcane for resistance against major infesting insect pests like borers and *Pyrilla perpusilla*
- All the sugar mills should immediately establish *T. chilonis* and *C. carnea* rearing labs.
- *T. chilonis* cards and *C. carnea* sheets produced should be given on highly subsidized price to cane growers.

## References


1. Aheer, G.M., Ahmad, H., Ashfaq, M. and Jalali, M., 1994. Weather effect on population dynamics of top borer, *Scirpophaga nivella* and stem borer *Chilo infuscatellus* on sugarcane crop. *J. agric. Res*., 32: 411-420.
2. Anonymous, (2019-20). "Economic survey of Pakistan", Ministry of Food and Agriculture, Islamabad. pp.26.
3. Anonymous. 1986, MSTATC Microcomputer Statistical Programme.Michigan State University Michigan, Lansing,USA.
4. Ashraf, M., Fatima, B. and Ahmad, N., 1993. Control ofsugarcane by inundative releases of *Trichogramma chilonis* (Ishii). *Pakistan J. Zool*., 25: 23-25.
5. Ashok, V. and Tandan, B.K., 1996. Pathogenicity of three entomogenous fungi against insect pests of sugarcane. *J. biol. Contr*., 10: 87-91.
6. Box H.E (1953). The control of sugarcane moth borer in Venezuela. A preliminary account. Trop Agric 30(4-6): 97-113.
7. Farmanullah, M., Shakur, H., Badshah and Zada, H., 2011. Comparative field effectiveness of different released levels of *Trichogramma chilonis* (Ishii) (Trichogrammatidae: Hymenoptera) against sugarcane stem borer (*Chilo infuscatellus*) in district Bhalwal. *Pakistan Entomol*., 33: 26-29.
8. Frew, A., Allsopp, P.G., Gherlenda, A.N. and Johnson, S.N., 2016. Increased root herbivory under elevated atmospheric carbon dioxide concentrations is reversed by silicon-based plant defences. *J. appl. Ecol.*, https: //doi.org/ 10.1111/1365-2664.12822
9. Gur, R. C., Richard, J., Calkins, M. E., Chiavacci, R., Hansen, J. A., Bilker, W. B., et al. (2016). Age group and sex differences in performance on a computerized neurocognitive battery in children age 8-21. *Neuropsychology* 26, 251–265. doi: 10.1037/a0026712
10. Hussnain, Z., Naheed, A. and Rizwana, S., 2007. Bio-control of insect pest of sugarcane (*Saccharum* spp). Shakarganj Mills Ltd. Toba Tek Singh. *Pak. Sugar J*., 22: 14-23.
11. Huang YK, Li WF (2011) Colored atlas of main diseases, insect pests and weeds of modern sugarcane. China Agriculture Press, Beijing.
12. Huang, Y.K. and Li, W.F., 1995a. Insect pests and their natural enemies resources for sugarcane in Yunnan province. *Sugarcane Canesugar*, **5**: 15-17.
13. Huang, Y.K. and Li, W.F., 1995b. Insecticidal effects of isocarbophos on *Ceratovacuna lanigera* Zehntner. *Agrochemicals*, 34: 39
14. Huang, Y.K. and Li, W.F., 1997. The effect test of 5 insecticides to control *Ceratovacuna lanigera* Zehntner. *Agrochemicals*, 36: 37-38.
15. Khanzada, A. G. (1993). Pest management in sugarcane: an un-abridged review. Pakistan Sugar Journal. 7(2): 11-18.
16. Liang, J.H., Li, K.H., Qin, Z.Y., Wei, J.S., Mao, Y.L., Li, Z.Y., Tang, F.H. and Wei, J.M., 2010. Field efficacy of 5% new pesticide type "kekewusun" on insect pests of sugarcane. *Guangxi agric. Sci.*, 41: 441-443.
17. Naqvi KM (1975) Important Insect Pests of Sugar Cane Crop in Sindh. Sugarcane Crop Seminar. Representation and Recommendations, Ciba Geigy: 67-70.
18. Rehman KA (1942) Parasites of Insect Pests of Sugar Cane in the Punjab. Ind J Agric Sci II 1: 119-128.
19. Sallam MN (2006) A review of sugarcane stem borers and their natural enemies in Asia and Indian Ocean Islands: an Australian perspective. Ann Soc Ent France 42: 263-283.
20. Shahid, M.R., Suhail, A., Arif, M.J., Gogi, M`.D., Shahzad, M.A. and Hussain, S., 2007. Effectiveness of *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammatidae) against sugarcane stem borer (*Chilo infuscatellus* Snellen) (Lepidoptera: Pyrallidae). *Pakistan Entomology*, 29: 141-146.

21. Smith, S.M., 1996. Biological control with *Trichogramma*: Advances, successes, and potential for their use. *Annu. Rev. Ent.*, 41: 375-406.
22. Soula, B., Goebel, R., Caplong, P., Karimjee, H., Tibere, R. and Tabone, E., 2003. *Trichogramma chilonis* (Hymenoptera: Trichogrammatidae) as a biological control agent of *Chilo sacchariphagus* (Lepidoptera: Cramidae) in Reunion Island. *Proc. South African Sugar Technol. Assoc.*, **77**: 278-283.
23. Steel, R.G.D., Torrie, J.H. and Dickey, D.A., 1997. Principles and procedures of statistics. A biometrical approach, 3rd ed. McGraw Hill Inc., New York.
24. White, W.H. and Regan, T.E., 1999. Biological control of the sugarcane borer with introduced parasites in Louisiana. *Sugar J.*, 9: 13-17.
25. Williams, J.R., 1983. The sugar cane stem borer (*Chilo sacchariphagus*) in Mauritius. *Rev. Agric. Sucr. Maur.*, 62: 5-23.
26. Wu, Y.Q., Duan, Y. and Jiang, Y.L. 2009. Reviews on Lighting for Insect-pests Control. *Henan agric. Sci.*, **9**: 127-130.



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