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Studies on the Population Dynamics of Sugarcane Stem Borer, *Chilo infuscatellus* (Lepidoptera: Pyralidae) and its Parasitoid *Cotesia flavipes* (Hymenoptera: Braconidae) in Sugarcane in Hyderabad Region of Sindh

M. KHAN[++] R. SULTANA[++], B. A. BUGHIO*, A. ALI** B. K. SOLANGI, S. KUMAR

Department of Zoology, University of Sindh, Jamshoro, Pakistan

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Abstract: Sugarcane stem borer, *Chilo infuscatellus* Snellen is an important and destructive insect pest attacking sugarcane crop in Sindh. Wasp, *Cotesia flavipes* Cameron is effective larval parasitoid of *Chilo* species. In the present investigation, population dynamics of *C. infuscatellus* and *C. flavipes* were analyzed in Hyderabad region. The results indicated that the average percentage infestation of *C. infuscatellus* showed a significant difference among the sectors studied. The highest infestation ratio was 9.08 ± 3.97 in Chamber, followed by 8.44 ± 5.69 and 7.16 ± 3.94 in Tando Allahyar and Tando Muhammad. Khan respectively. However, in the remaining sectors infestation ratio was insignificant. Parasitism percentage of *C. flavipes* in different sectors of Faran Sugar Mills Ltd. showd that parasitism ratio was significantly higher in Khokhar i.e. 28.75% sector, followed by Digh Mori i.e. 18.75%.The overall parasitism ratio was 18.33 ± 5.57 and cocoon masses formation was 14.67 ± 4.46 out of 80 larvae of *C. infuscatellus*.

Keywords: *Chilo infuscatellus*, pest, sugarcane, population dynamics, *Cotesia flavipes*, parasitoid

1. INTRODUCTION

Sugarcane is attached by a large variety of insects including about 50 lepidopterous borers among these, seven important *Chilo* species, which damage sugarcane in Pakistan including Sugarcane stem borer, *Chilo infuscatellus* Snellen. Sugarcane stem borer is an important and destructive insect attacking sugarcane crop every year (Khanzada, 1995 and Arif *et al.*,). The attack of this pest significantly affects cane yield and reduce its sugar recovery. In India, this pest appeared in July 1933 for the first time in district Rohtak and it damaged about 80% of the crop (Qayum, 1975). It was estimated that 5.2 percent joints of sugarcane were infested by borers and sugar recovery was reduced about 0.55% (Irshad *et al.*, 1990) per unit in Pakistan. Sugarcane yield is very low as compared with other can growing countries of the world (Fasihi & Siddique, 1985). One of the major limiting factors of borers' infestation is their natural enemies. Therefore, it was considered to note the parasitism of *C. flavipes* on *C. infuscatellus* from this region.

Insect pests are the most important constraints in agriculture productivity. The amount of yield loss and decrease in quality faced by the formers depend on insect incidence. The loss in yield of crops grown by subsistence and semi-subsistence farmers usually result in food shortage for the farmers' family while losses for commercial farmers may take the form of reduced revenue. Among the number of several pests of sugarcane in Pakistan particularly in Sindh, *C. infuscatellus* plays a key role in reducing cane yield in Sindh province. *Cotesia flavipes* Cameron is a gregarious larval endoparasitoid, which attacks medium and large-sized larvae of gramineous stem borers in several countries in Asia (Overholt & Smith, 1990; Ngi-Song and Overholt 1995 and Ngi-Song *et al*., 1995). *C. flavipes* is indigenous to South and South-east Asia (Mohyuddin, 1971) became successfully established in Barbados on the American sugarcane borer, *Diatraea saccharalis* (Alam *et al*., 1971 and Rao *et al.*, 1971). In Pakistan, *C. flavipes* became established on the maize pest. *C. partellus* following its introduction from Japan in 1962 but seldom attacked *C. infuscatellus*. Therefore, the existence of strains of *C. flavipes* was proposed with different strains preference for different hosts and host plants. Shami and Mohyuddin (1992) reared *C. flavipes* on *C. infuscatellus* fed on sugarcane in the laboratory for five successive generations and recorded a significant change in preference from maize to sugarcane. Even though in Pakistan, particularly in Sindh, inadequate work has been undertaken regarding the impact of *C. flavipes* on *C. infuscatellus.* Recently, Gordh and Beardsley (2005), Irshad and Khan (2005) and Irshad (2005) carried a work on the different aspect of biological control but this subject need further and detail study from this region. Therefore, the present attempt is being made in this region.

[++] Corresponding authors: mujahidkhanawan@gmail.com, riffatumer@hotmail.com.

*Department of Agriculture, University, Mardan, Anbar Campus, Swabi, Khyber Pakhtunkhwa

**Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tandojam

2. MATERIALS AND METHODS

2.1 Study site

The following sugarcane growing areas from Hyderabad region i.e., Faran Sugar Mills Limited, Tando Mohammad Khan and Mehran Sugar Mills Ltd., Tando Allahyar were selected for the study. The selected areas of Faran Sugar Mills Ltd. were divided into eight zones/sectors i.e., Khokhar, Gate, Jhan Mori, Digh Mori, Chandia, Chamber, Daro Sendi and Tando Mohammad Khan and the selected areas of Mehran Sugar Mills Ltd. were divided into sixteen zones/sectors i.e., Gate-I, Gate-II, Kisana Mori, Bhamboro Khoh, Pak Singar, Shahpur, Hurri-I, Hurri-II, Qiaser Sehnro, Shahdadpur, Quba Stop, Tando Adam, Pyaro Lund, Nasar Pur and Kamaro Sharif.

2.2. Collection of samples of *Chilo infuscatellus*

For the stem borer incidence, 50 cane stalks were selected at random from each vehicle at the cane carrier from all the sectors of Faran Sugar Mills Limited, Tando Mohammad Khan as well as Mehran Sugar Mills Ltd, Tando Allahyar. Infested cane stalks were removed and dissected to determine percent internodes damaged **(Fig-2 a, b).** Infestation of *C. infuscatellus* was noted during the month of December 2011.

2.3 Collection of C*otesia flavipes*

To determine incidence and larval parasitism of *C. flavipes*, 25-30 larvae of *C. infuscatellus* were collected from the selected areas. The collected larvae were reared in glass jars under laboratory conditions (25^{o}-23' N, 68^{o}-24' E), where the temperature fluctuated between 28 ± 2^{o}C to 39 ± 2^{o}C with relative humidity of 26 to 61%. Sugarcane pieces were provided as food for the collected larvae and these were changed on alternate days. Larvae, which found dead, were dissected to see whether or not these were parasitized by *C. flavipes.*

2.4 Identification of specimens

Identification of specimen was carried out under the stereoscopic dissecting binocular microscope and material has been deposited in the Museum of Entomology, Department of Zoology, University of Sindh, Jamshoro

2.5 Statistical analysis:

Data was analyzed with the help of statistical software SPSS version 10.0. Obtained data from experimental groups was subjected to one-way analysis of variance (ANOVA), with repeated measures and significant means were determined using Latter significant different test (LSD).

3. RESULTS

3.1 Incidence of *Chilo infuscatellus*

During the present study, it was observed that the average percentage infestation of *C. infuscatellus* carried out in different sectors of Faran Sugar Mills Ltd, Tando Mohammad Khan, **(Table-1)** that there was a significant difference among these sectors. The higher infestation ratio was 9.08 ± 3.97 in Chamber, followed by 8.44 ± 5.69 and 7.16 ± 3.94 in TandoAllahyar and Tando Muhammad Khan respectively. However, in the remaining sectors infestation ratio was insignificant. **(Table-2)** suggested that infestation percentage in different sectors of Mehran Sugar Mills Ltd, Tando Allayar was significantly higher 25. 31 ± 11.56 in Nasar Pur, followed by 20.47 ± 15.93 and 14.78 ± 10.89 in Kamoro Sharif and Hurri, while the infestation percentage was insignificant in the other studied sectors.

3.2 Incidence of the parasitoid *Cotesia flavipes*

Parasitism percentage of *C. flavipes* in different sectors of Faran Sugar Mills Ltd. showed that parasitism ratio was significantly higher 28.75% in Khokhar sector, followed by 18.75% in Digh Mori, while the overall parasitism ratio was 18.33 ± 5.57 and the cocoon masses formation was 14.67 ± 4.46 out of 80 larvae of *C. infuscatellus* collected **(Table-3).** On contrary to this, parasitism ratio of *C. flavipes* was significantly greater as 33.75% in Nasar Pur and Gate-I of Mehran Sugar Mills, while the overall parasitism ratio was as 22.92 ± 9.28 and coccon masses formation recorded was 18.33 ± 7.42 **(Table-4).**

Table-1: Percent infestation of *C. infuscatellus* in different sectors of Faran Sugar Mills Ltd, during the month of December 2011

Sectors	Number of replications			% infestation
	1	2	3	Mean ± SD
Digh Mori	9.76	2.26	4.23	5.42 ± 3.89
Gate	6.41	3.7	3.45	4.52 ± 1.64
Daro Sendi	3.26	6.18	3.11	4.18 ± 1.73
Chamber	7.23	13.64	6.37	9.08 ± 3.97
Khokhar	6.25	8.43	5.33	6.67 ± 1.59
Jhan Mori	7.89	5.05	4.02	5.65 ± 2.00
Tando Allahyar	14.47	3.17	7.69	8.44 ± 5.69
Tando Mohammad Khan	10.84	7.63	3.01	7.16 ± 3.94
Mean ± SD				6.39 ± 1.77

Table-2: Percent infestation of *Chilo infuscatellus* in different sectors of Mehran Sugar Mills Ltd. during the month of December 2011

Sectors	Number of replications				% Infestation
	1	2	3	4	Mean ± SD
Gate 1	5.96	5.99	8.22	6.12	6.57 ± 1.10
Kisana Mori	9.66	10.99	10.16	8.22	9.76 ± 1.16
Bhambro Khoh	4	1.22	-	-	2.61 ± 1.97
Pak Singhar	-	8.52	12.18	12.52	11.07 ± 2.22
Shahpur	-	8.45	12.05	-	10.25 ± 2.55
Gate 2	2.86	9.93	3.27	4.97	5.26 ± 3.25
Hurri 2	4.01	10.09	10.51	4.58	7.30 ± 3.48
Qasir Sehnro	8.68	1.76	-	3.64	4.69 ± 3.58
Shahdadpur	0.19	6.33	8.37	2.94	4.46 ± 3.62
Quba Stop	1	0.64	7.46	-	3.03 ± 3.84
Tando Adam	7.4	13.98	6.11	16.39	10.97 ± 4.99
Piyaro Lund	6.8	18.81	14.31	11.92	12.96 ± 5.00
Hurri 1	5.95	16.99	6.88	29.3	14.78 ± 10.89
Nasar Pur	41.58	14.79	24.58	20.3	25.31 ± 11.56
Kamaro Sharif	-	5.98	37.53	17.89	20.47 ± 15.93
Mean ± SD					9.97 ± 6.44

Table–3: Percent parasitism of *Cotesia flavipes* in different sectors of Faran Sugar Mills Ltd, during the month of December 2011

Sectors	Collected Larvae of *C. infuscatellus*	Cocoon masses of *C. flavipes* produced	% Parasitism
Gate	80	12	15
Daro Sendi	80	14	17.5
Chamber	80	10	12.5
Jhan Mori	80	14	17.5
Digh Mori	80	15	18.75
Khokhar	80	23	28.75
Mean ± SD	80 ± 00	14.67 ± 4.46	18.33 ± 5.57

Table – 4:Percent parasitism of *C. flavipes* in different sectors of Mehran Sugar Mills Ltd, during the month of December 2011

Locality	Collected Larvae of *C. infuscatellus*	Cocoon masses of *C. flavipes*produced	% parasitism
Hurri-1	80	18	22.5
Hurri-2	80	17	21.25
Gate-1	80	27	33.75
Gate-2	80	10	12.5
Nasar Pur	80	27	33.75
Qaiser Sehnro	80	11	13.75
Mean ± SD	80 ± 00	18.33 ± 7.42	22.92 ± 9.28

The legs and short antennae of *C. flavipes* are red except for the spotted brownish yellow to red basal part of the hind legs. The tegulae, stigma, and costal veins of the wings are reddish brown. The first abdominal segment is widened behind and the apicolateral corners are weak and roundly constricted. The ovipositor sheath of the female adult is short (**Fig-5 c and d).**

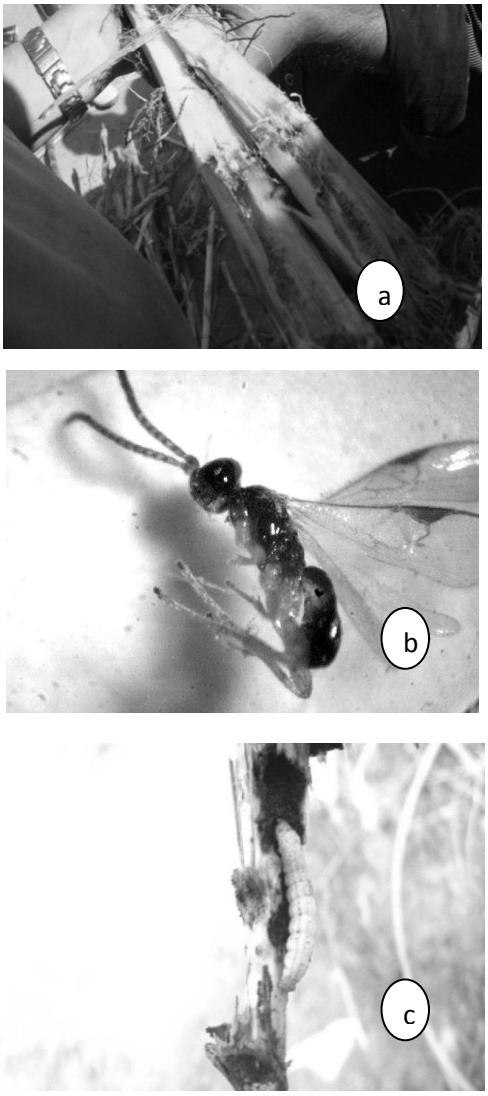

Fig.1 (a) The dead tissues inside the infested stem, (b) Larval feeding activity of *C. infuscatellus* inside the cane, (c) The adult of *C. flavipes* (x 40)

4. DISCUSSION

During present study, it was observed that larval population of *C. infuscatellus* was dependent upon the sugarcane plant phenology and pest infestation was recorded during September when plants were in full bloom. Rajabalee (1990) stated that climatic conditions had also significant impact on sugar yield and recovery. Moutia and Courtois (1952) computed a reduction of

approximately 0.5% in yield of sugarcane for each percent internodes bored. But during the present study, it was noted that the damage to cane weight varied with the level of infestation. Present study agreed on this account.

During present study, the incidence of *C. infuscatellus* was significantly higher as is also reported by Carl (1962). In the present study it was observed that the larval parasitoid *C. flavipes* gave significant result to reduce the *C. infuscatellus* population in field and the overall findings were excellent. The present study also revealed that majority of those larvae died during burning inside the cane stalks which were parasitised by *C. flavipes.* Mohyuddin and Mohammad (1986) had reported that following the releases of sugarcane adapted strains of *C. flavipes* (Indonesian and Barbados strains) in 1983 its parasitism on *Bessetia steniellus* (Hampson) and *C. infuscatellus* recorded up to 31.3 % at some locations in Khyber Pakhtunkhwa. Present study recommended that there seems to be a good scope of the biological control of sugarcane borer by *C. flavipes.*

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