



NATIVE PARASITOIDS OF FALL ARMY WORM *SPODOPTERA FRUGIPERDA* (J E SMITH) IN MAIZE

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Fall Army worm *Spodoptera frugiperda* (J E Smith) is a devastating, polyphagous pest which entered India during 2018, starting from Karnataka and spreading to other states. This study on its native parasitoids and their parasitisation efficiency in maize crop under Punjab conditions. The *S. frugiperda* larvae were collected during kharif 2019 and 2020, and it was found that no parasitoids could be observed in 2019, as the pest recently invaded the crop in late season. But, during kharif 2020, two types of parasitoids were observed- *Campoletis* sp. (Hymenoptera: Ichneumonidae) and *Chelonus formosanus* Sonan (Hymenoptera: Braconidae); these which existed as natural enemies of *Chilo partellus* were found to adapt effectively with the new invasive pest. The parasitism rate of 21.92 and 16.33% was observed for the *Campoletis* sp. and *Chelonus formosanus*, respectively.

Key words: *Spodoptera frugiperda*, maize, invasive pest, Punjab, kharif, *Campoletis* sp., *Chelonus formosanus*, parasitoids, parasitisation, rate, *Chilo partellus*, adaptability

Fall army worm (FAW) is a key pest of maize crop, and it is a native of Americas with damage potential of 21% to 53% in annual maize production in 12 maize-producing African countries (Abrahams et al., 2017). In Africa during 2017 after its invasion, the maize losses were estimated at US \$2.5 to 6 million (Day et al., 2017). This pest became invasive in India during 2018 in Karnataka (Ganiger et al., 2018) and then spread to all maize growing states Naggana et al., 2020). In Punjab, maize is cultivated in spring and kharif seasons for various purposes. Accordingly, an IPM package for FAW was recommended to the farmers (Anonymous, 2021). Additionally, native natural enemies can provide defense against this invasive pest (Firake and Behere, 2020). The native parasitoids available in north India may also adapt on to FAW larvae and thereby help in reducing its further spread. Parasitoids can be highly effective as these are ecofriendly (Wilson and Huffaker, 1976; Stary and Pike, 1999). Keeping these in view, the present study assessed the prevalence of native parasitoids and their parasitism efficacy in maize fields under Punjab conditions.

MATERIALS AND METHODS

The weekly field collection of FAW larvae was carried out from the experimental area of Punjab Agricultural University, Ludhiana (from September 2019- January 2020 and from end June, 2020 onwards). The collected larvae were transferred to individual plastic vials (3x 4.5cm) separately with small holes in

the lid to allow ventilation. Fresh maize leaf whorls were used to feed larvae and were replaced every 3rd day as per need. The vials containing larvae were kept at 25±2°C and 70% RH, in the Maize Entomology Laboratory, Punjab Agricultural University (PAU), Ludhiana. These were observed for the emergence of parasitoids, and the emerged parasitoids (larval and pupal) were preserved in 70% ethanol and kept separately. The parasitized larvae were identified morphologically using their coloration, reduced activity, shrinkage and were confirmed at emergence of parasitoid. The parasitism parameters such as parasitism rate, relative abundance and the survival rate were observed according to Canico et al. (2020).

RESULTS AND DISCUSSION

During 2019, no parasitoids were observed as the pest invaded the crop late in kharif season; during kharif 2020, the pest reappeared in June and its larval parasitoids were observed in the cropping season from 4th week of October, 2020 to 1st week of January, 2021. Degree of parasitization depends on the prevailing weather factors, and growth and development of the host (Pillai et al., 2016). The present study observed the native parasitoids' adaptability to parasitize FAW from Punjab. Two major types of parasitoids were observed- *Campoletis* sp. (Hymenoptera: Ichneumonidae) and *Chelonus formosanus* Sonan (Hymenoptera: Braconidae). Of these *Campoletis* sp. was predominant with weekly parasitism rate ranging from 2.50- 46.67%,

maximum being in the 4th week of November (46.67%) with parasitism rate of 21.92%. The parasitism by *Campoletis chlorideae* (2-3%) was also reported by Sharanabasappa et al. (2019) in maize fields of Shivamogga and Devanagere districts of Karnataka. *Chelonus* is among the established FAW parasitoids, initially reported from America and Africa (Rao et al., 1993); in the present study, parasitism rate of 6.67- 32% by *C. formosanus* was observed with maximum being in 2nd and 3rd week of November, 2020; with overall mean parasitism rate of 16.33%. The total parasitism rate ranged from 10.00- 60.00% with overall of 38.26%. The maximum total parasitism (60%) was during 2nd week of December, 2020. The relative abundance (82.35%) of *Campoletis* sp. and *C. formosanus* was maximum at 4th week of November and 3rd week of December, 2020, respectively. Relative abundance of both parasitoids ranged from 17.65- 82.35%. The overall relative abundance for *Campoletis* sp. and *C. formosanus* was 59.86% and 40.14%, respectively; reaching the maximum survival rate of 100% in 2nd week of November, 2020 and 80% in 4th week of December, 2020, respectively (Table 1).

Chelonus has good species diversity- up to 45 species are from Caribbean nation of Trinidad and Tobago as well as Queensland and Western Australia

(Kittel et al., 2016). Because of adaptability, *Chelonus* occurs in wide geographical areas, and might prove to be effective biocontrol agent against FAW. *Campoletis* sp. is oligophagous attacking many hosts falling under several genera in Noctuidae (Murua et al., 2006). As per the inventory of parasitoids and parasites of FAW in America and Caribbean basin, a number of parasitoids are known (Molina- Ochoa et al., 2003). Among these, about a dozen species attack immature stages of key pest of maize, *Chilo partellus* in different maize growing parts of the country. Among larval parasitoids *Apanteles*, *Bracon*, *Chelonus*, *Iphiaulax*, *Campoletis*, *Stenobracon*, *Goniozus* and *Sturmiopsis* sp are predominant. These belongs to Ichneumonidae, Braconidae, Eulophidae, and Tachinidae families of larval parasitoids (Panwar, 2005). The adaptability of native parasitoid of *C. partellus* to *S. frugiperda* observed in the present study will lead to findings on more parasitoids (Meagher et al., 2016; Hay-Roe et al., 2016). Sharanabasappa et al. (2019) observed larval parasitoids including *Coccygidium melleum*, *Campoletis chlorideae*, *Eriborus* sp, *Odenteypris* sp and tachinid, *Exorista sorbillans* (Wiedemann) (Diptera: Tachinidae) in Karnataka maize fields wherein *Coccygidium melleum* which is a parasitoid of *S. exigua* was first time reported as parasitizing the larvae. Also, *Odenteypris* sp., ectoparasitoids of lepidopteran larvae

Table 1. Parasitism and survival rates, and relative abundance of parasitoids on *S. frugiperda* (PAU, Ludhiana; 2020-21)

Week	Week of collection	Parasitism rates (%)			Relative abundance (%)		Survival rate of parasitoids (%)		
		<i>Campoletis</i> sp.	<i>Chelonus formosanus</i>	Total parasitism (%)	<i>Campoletis</i> sp.	<i>Chelonus formosanus</i>	<i>Campoletis</i> sp.	<i>Chelonus formosanus</i>	Total survival (%)
44	4 th week of October, 2020	39.35	14.19	53.55	73.49	26.51	42.62	36.36	40.96
45	1 st week of November, 2020	28.13	15.63	43.75	64.29	35.71	46.67	28.00	40.00
46	2 nd week of November, 2020	8.00	32.00	40.00	20.00	80.00	100.00	0.00	20.00
47	3 rd week of November, 2020	18.00	32.00	50.00	36.00	64.00	55.56	37.50	44.00
48	4 th week of November, 2020	46.67	10.00	56.67	82.35	17.65	64.29	0.00	52.94
49	1 st week of December, 2020	45.45	10.91	56.36	80.65	19.35	64.00	0.00	51.61
50	2 nd week of December, 2020	45.00	15.00	60.00	75.00	25.00	66.67	0.00	50.00
51	3 rd week of December, 2020	3.00	14.00	17.00	17.65	82.35	33.33	21.43	23.53
52	4 th week of December, 2020	6.67	6.67	13.33	50.00	50.00	60.00	80.00	70.00
1	1 st week of January, 2021	2.50	7.50	10.00	25.00	75.00	0.00	66.67	50.00
	Overall	21.92	16.33	38.26	59.86	40.14	53.87	21.92	41.08

are known to be the parasitoid of *S. frugiperda*. Thus, it can be concluded that native parasitoids and their adaptability is crucial for biological control of FAW in maize. Conservation and relocation of these will be required.

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