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DIVERSITY OF NATURAL ENEMIES ASSOCIATED WITH LAC INSECT *KERRIA LACCA* (KERR) IN PUNJAB

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ABSTRACT

A survey was conducted to record the diversity of lac insect *Kerria lacca* (Kerr) associated natural enemies (predators/ parasitoids) during 2019-2020. In katki crop, the abundance of natural enemies ranged from 1.08 to 44.09%. There were three parasitoids viz, *Parechthrodryinus clavicornis* (Cameron) (1.08%), *Aprostocteus purpureus* (Cameron) (26.88%), *Tachardiaephagus tachardiae somervilli* (2.15%); and two predators; *Chrysoperla zastrowi sillemi* (5.38%), *Eublemma amabilis* (44.09%) and only one hyperparasitoid viz; *Bracon greeni* (Ashm.) (20.43%). Shannon-Weiner diversity index, evenness index and dominance index for natural enemies was found to be 0.67, 0.80 and 0.20. In baisakhi crop, the abundance ranged from 6.56 to 45.90% with maximum abundance of predator *E. amabilis* (45.90%) and the least of parasitoid *T. tachardiae* How. (6.56%); and the Shannon-Weiner diversity index, evenness index and dominance index was 0.65, 0.77 and 0.23, respectively.

Key words: *Kerria lacca*, baisakhi, katki, parasitoids, predators, diversity, abundance, evenness, dominance, species diversity, parasitism

Kerria lacca (Kerr) is a beneficial soft-bodied lac insect, known to produce lac of recoverable and commercial value (Kumar and Bhatnagar, 2013), and India is the largest producer with 21,008 tons of annual production Yogi et al., 2015). It is exported earning annually $ 16 to 22 million as foreign exchange (Prasad et al., 2004; Shah et al., 2015). Lac cultivation plays a major role in the up-liftment of economic status of tribal people (Kumar, 2002), giving employment to marginal, small as well as big farmers (Pal, 2009). Lac insect is prone to natural enemies (insect parasitoids and predators), causing considerable loss to the lac yield (Singh et al., 2011a); and 22 species of lac insect predators, 30 species of primary parasitoids, 45 species of secondary parasitoids are known (Das, 1990) and several fungal pathogens of lac insects as well as lac hosts (Sharma et al., 2006). Among predators, *Chrysopa* spp. from order Neuroptera (Singh et al., 2011b), and *Eublemma amabilis* (Moore) and *Pseudohypatopa pulverea* (Meyr) from order Lepidoptera (Jaiswal et al., 2008 and Singh et al., 2009) are the most potential. Parasitoids belonging to family Braconidae, Aphelinidae, Encyrtidae, Eulophidae, Eupelmidae and Pteromalidae parasitise lac insects (Sharma et al., 1997); and parasitization varies between 15.5% in summer (baisakhi crop) to 18.6% in rainy season crop (katki crop) of rangeeni strain; it is 19.04% for kusumi strain in winter crop (aghani crop) and 22.8% in summer crop (jethwi crop) (Kumari et al., 2012). Earlier, Punjab contributed significantly in lac cultivation, but later it was abandoned (Sharma et al., 2006); and scope of lac cultivation in Punjab has been indicated by Sangha et al. (2019). However, information on the diversity of lac insect associated parasitoids and predators from the state is lacking. Therefore, the present study to collect the information regarding lac insects and diversity of its natural enemies from different agroclimatic zones of Punjab.

MATERIALS AND METHODS

Studies on the insect fauna associated with lac insect were carried out during katki and baisakhi crop during 2019 and 2020. The samples (brood sticks and lac sticks) were collected from the three agroclimatic zones: 1) Central zone: Amritsar, Taran Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Patiala and Moga; 2) Submontaneous zone: Roop Nagar, Hoshiarpur, Pathankot, Shaheed Bhagat Singh Nagar, Gurdaspur, SAS Nagar and Chandigarh; 3) Arid Irrigated zone: Bathinda, Mansa, Sri Muktsar Sahib, Faridkot, Ferozepur and Sangrur. These regions were surveyed to record the population status of lac insect and their host plants. GPS coordinates of each location were also recorded and data on insect predators on insect infested plants by traditional methods viz., hand net, hand picking, stem beating etc.

The lac insect infested branches (brood sticks) of the plants were collected randomly, in five replications, and these samples were kept in specially designed bioagent collection cages (20x 20x 30 cm) fitted with glass tubes (ICAR- IINRG). These cages were monitored twice a week to record the emergence of parasitoids and predators from broodlac sticks. The samples of parasitoids and predators were preserved in ethyl alcohol, before getting identified from ICAR- IINRG, Ranchi, India. The lac encrusted sticks were observed visually for the presence of predators and numbers recorded. To check the diversity or dominance of individual parasitoids and predators collected, the data on number of individuals were subjected to computation of Shannon and Weiner diversity index (1963), Pielou evenness index (1966) and Southwood dominance index (1978).

RESULTS AND DISCUSSION

Number of insect parasitoids and predators belonging to order Hymenoptera, Lepidoptera and Neuroptera were observed during the study. The numerical abundance of parasitoids and predators belonging to these was: Hymenoptera (50.54%)> Lepidoptera (44.09%) > Neuroptera (5.38%). In katki crop, the abundance of three parasitoids namely *Aprostocteus purpureus* (Cam.) (Hymenoptera: Eulophidae) (26.88%), *Tachardiaephagus tachardiae somervilli* (Mahd) (Hymenoptera: Encyrtidae) (2.15%), and *Parechthrodryinus clavicornis* (Cam.) (Hymenoptera: Encyrtidae) (1.08%) was observed. One species of hyperparasitoid, namely *Bracon greeni* (Ashm.) (Hymenoptera: Braconidae) (20.43%) was also seen. Among the predators, two species, namely *Eublemma amabilis* Moore (44.09%), *Chrysoperla zastrowi sillemi* (5.38%) belonging to order Lepidoptera (Family: Noctuidae) and Neuroptera (Family: Chrysopidae), respectively was recorded. The abundance of these ranged from 1.08 to 44.09%, of which the maximum abundance was of *E. amabilis* (44.09%) and the least of *P. clavicornis* (1.08%) (Table 1). In baisakhi crop, maximum number of natural enemies belonged to Hymenoptera (54.10%), followed by Lepidoptera (45.90%); there were three parasitoids- *T. tachardiae* How. (Hymenoptera: Encyrtidae) (6.56%), *P. clavicornis* Alam. (8.20%) and *Aprostocetus tachardiae* Cam. (8.20%); one species of hyperparasitoid *B. greeni* (Hymenoptera: Braconidae) (31.15%); one species of predator *E. amabilis* (Lepidoptera: Noctuidae) (45.90%) were also observed. The abundance of these ranged from 3.08 to 43.08%, with maximum being of *E. amabilis* (45.90%) and the least of *T. tachardiae* (6.56%) (Table 1).

The data related to diversity indices shown in Table 1 revealed even distribution of all species of natural enemies. The distribution and dominance observed with Shannon Weiners index (H'), evenness index (J) and dominance index (D) with katki (0.58, 0.74, and 0.26, respectively) and baisakhi crops (0.65, 0.77 and 0.23) confirmed these. Lac insect is immobile and after settlement it becomes

Table 1. Natural enemies associated with lac insect and their diversity in Punjab

S. No.	Name	Predator/ parasitoid	Family	Order	% abundance
		Katki (2019)			
1.	*Eublemma amabilis* (Moore)	Predator	Noctuidae	Lepidoptera	44.09
2.	*Aprostocteus purpureus* (Cam.)	Parasitoid	Eulophidae	Hymenoptera	26.88
3.	*Bracon greeni* (Ashm.)	Hyper parasitoid	Braconidae	Hymenoptera	20.43
4.	*Chrysopa zastrowi sillemi* (Esben-peterson)	Predator	Chrysopidae	Neuropteran	5.38
5.	*Tachardiaephagus tachardiae somervilli* (How.)	Parasitoid	Encyrtidae	Hymenoptera	2.15
6.	*Parechthrodryinus clavicornis* (Cam.)	Parasitoid	Encyrtidae	Hymenoptera	1.08
		Baisakhi (2019-20)			
7.	*Eublemma amabilis* (Moore)	Predator	Noctuidae	Lepidoptera	45.90
8.	*Bracon greeni* (Ashm.)	Hyper parasitoid	Braconidae	Hymenoptera	31.15
9.	*Tyndarichus clavicornis* (Alam)	Parasitoid	Encyrtidae	Hymenoptera	8.20
10.	*Aprostocetus tachardiae* (Cam.)	Parasitoid	Eulophidae	Hymenoptera	8.20
11.	*Tachardiaephagus tachardiae somervilli* (How.)	Parasitoid	Encyrtidae	Hymenoptera	6.56

Diversity indices

Crop	Shannon Weiners index (H')	Pielou evenness index (J)	Southwood dominance index (D)
Katki	0.58	0.74	0.26
Baisakhi	0.65	0.77	0.23
Overall	0.60	0.77	0.23

susceptible to many natural enemies, and about 35-40% damage is usually caused. Many reports document the natural enemies observed now. Sharma et al. (1997) reported 14 species of parasitoids, out of which *A. purpureus* (55.82%) and *T. tachardiae* (28.37%) are the most abundant. Among beneficial fauna, 5.37% relative abundance of *B. greeni* as hyperparasitoid had been reported. Jaiswal and Saha (1995) documented predator- *E. amabilis*; parasitoid- *T. tachardiae*, *Eoccophagus tschirchii* Mahd. and *P. clavicornis* and hyperparasitoid- *B. greeni* and *Elasmus claripennis* Cam. as being dominant in harvested lac. Bhattacharya and Yogi (2015) reviewed 72 insect parasitoids and predators, and according to them, *E. amabilis*, *T. tachardiae* and *A. purpureus* are the most abundant.

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AUTHOR CONTRIBUTION STATEMENT

Conceptualization and designing of the research work by R Kaur, Shera P S and S Sharma, Execution of field/lab experiments and data collection, analysis of data and preparation of manuscript carried out by A Singh, A Thakur and H K Mangat. The identification of natural enemies had been carried out by A Mohansundaram. All authors read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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