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Population dynamics and emergence profile of the key parasitoids and the common predators associated with *rangeeni* lac insect

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Abstract : Relative abundance and emergence profile of the key parasitoids and predators associated with lac insect were recorded at two climatically distinct locations *viz*., Institute Research Farm (Namkum, Ranchi, Jharkhand) and Putidih (Jhalda, West Bengal). Caging of lac samples and microscopic examination revealed three parasitoids (*Aprostocetus purpureus*, *Tachardiaephagus tachardiae* and *Parechthrodryinus clavicornis*) and two predators (*Eublemma amabilis* and *Pseudohypatopa pulverea*) were in abundance during summer season (*baisakhi*) crop of *rangeeni* strain. *A. purpureus* and *P. clavicornis* emerged in large numbers during March-April, whereas *T. tachardiae* was more during June –July in summer (*baisakhi* 2012-13) crop. During rainy season (*katki* 2013) crop, emergence of *A. purpureus* and *P. clavicornis* was more during September-October, whereas *T. tachardiae* was more in October-November. Predators' populations *viz*., *E. amabilis* and *P. pulverea* were more during crop maturity period in both the crops. Variations in populations were observed among the location, host and crop season. Summer crop was more vulnerable to *A. purpureus* and most of the parasitization took place on or before sexual maturity stage leading to sever mortality of *rangeeni* lac insect as compared to the rainy crop where parasitization occurred at crop maturity stage with considerable survival of lac insects.

Keywords: Lac insect, parasitoids, population dynamics, emergence profile

INTRODUCTION

National lac production trends in India have shown inconsistence and fluctuating production trend over the past years. India is the largest producer of lac in the world. Three commercially potential products are obtained from lac *viz*., resin, dye and wax which find application in diverse areas such as food, pharmaceuticals, cosmetics, paints and varnishes. In view of bio-safety and stress on natural products the demand potential of lac is upbeat. Besides, it is a source of livelihood to millions of economically backward population especially tribals in Jharkhand, Madhya Pradesh, Chhattisgarh, Maharashtra and West Bengal etc. Lac is the only natural resin of insect origin derived mostly from a few species of *Kerria* (Coccoidea: Tachardiidae) belonging to a specialized group of scale insects that are phytosuccivorous and thrive well only on specific plants called lac-hosts. In India lac is mainly derived from the Indian lac insect, *Kerria lacca* represented by two forms *rangeeni* and *kusmi*. Both the strains complete two cycles in a year producing two crops. The lac production of the country can be viewed as the summation of the contribution of four crops, contributed by two crops each of these strains. But these two forms differ in life cycle patterns due to their genetic differences in their developmental response to temperature. Thus, these two forms exhibit differences in their vulnerability to deviations from the normal climatic conditions.

Since the lac insect spends only few hours of active mobility and thereafter, spends a complete sedentary life,

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they are prone to be attacked by many insect pests causing considerable loss to the lac crop. The average loss by the insect pests in lac culture is known to be far greater than what is usually witnessed in other agricultural crops. The loss caused to lac crops by the insect predators amounts to about 35-45% annually. *K. lacca* is associated with a large pest complex comprising mainly of predatory and parasitic insects. Ninety-seven species of lac insect-pests have been reported, which includes 22 species of lac predators, 30 species of primary and 45 species of secondary parasitoids in lac insect ecosystem (Varshney, 1976; Sharma *et al*., 2006). But only a few of them are economically important from lac production standpoint causing significant damage to the lac crop. Large deviations in the relative contribution of *kusmi* and *rangeeni* crops have been seen in recent years, compared to long-term averages. The relative contribution of *kusmi* crop has increased to over half of country's lac production compared to about 20% earlier. This change had been due to (i) intervention of Indian Institute of Natural Resins and Gums (IINRG), Ranchi for promoting *kusmi* lac production, especially on *ber* during winter crop season and (ii) drastic decline in the production of summer *rangeeni* lac crop, which used to be the major crop. This declining trend is attributed to unusual pre summer mortality of *rangeeni* lac insects (Ramani, 2010; Sharma *et al*, 2010; Ramani et al 2011; Monobrullah *et al*, 2013). Recently, it has been observed that those species which were not recognized as economically injurious have now become serious and many new insect species which have not been reported earlier are found to be associated with lac culture fauna. Keeping in view the severity of damage caused, the present study was undertaken to assess the population dynamics and emergence profile of lac associated biotic fauna to generate information to device suitable management strategies for enhanced lac production.

MATERIAL AND METHODS

The study was conducted on *rangeeni* strain of lac insect raised on *ber*, *Ziziphus mauritiana* and *palas*, *Butea monosperma* at two climatically distinct locations *viz*., Institute Research Farm (Namkum, Ranchi, Jharkhand) and Putidih (Jhalda, West Bengal) for both summer (*baisakhi*) and rainy (*katki*) season crops. Samples were collected at fortnightly interval and were caged for one month for emergence of parasitoids and predators. Caging was done in especially designed wooden cage for emergence of parasitoids and predators (Fig. 1). The collection of parasitoids and predators was initiated soon after commencement of first emergence of parasitoids and predators and continued for one month. Samples were collected on daily basis and sorting of different species was done simultaneously for further analysis of data. Before caging of samples, length of lac encrustation was measured and at a time samples were caged in 10 cages and were replicated thrice, thus in total 30 cages were used for one time caging.

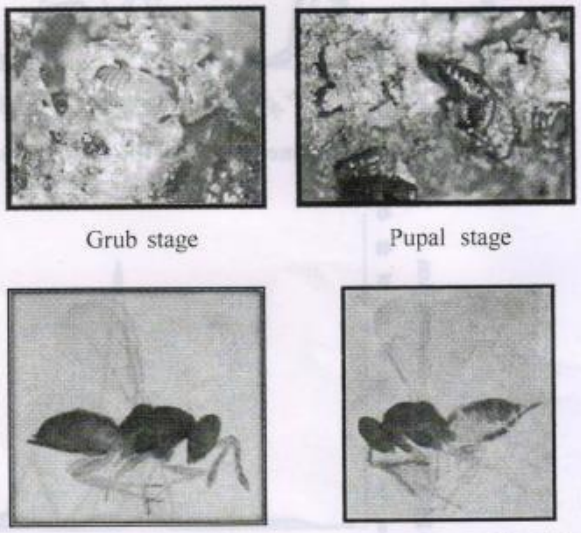
RESULTS AND DISCUSSION

Relative abundance and emergence profile of parasitoids and predators associated with *rangeeni* lac insect revealed that three parasitoids (*Aprostocetus purpureus*, *Tachardiaephagus tachardiae* and *Parechthrodryinus clavicornis*) and two predators (*Eublemma amabilis* and *Pseudohypatopa pulverea*) were associated in varying numbers. Among them, *Aprostocetus purpureus*, an endoparasitoid (Fig. 2) was found as the most abundant. During *baisakhi* (2011-12) *A. purpureus* population was more during March at both the locations and on both the hosts which coincided with the sexual maturity period resulting in complete mortality of lac insect whereas, during *baisakhi* (2012-13) the maximum emergence of *A. purpureus* was in April on both hosts in Ranchi samples (Fig. 3). Microscopic examination of lac cells during *baisakhi* (2011-12) revealed 80-90 per cent parasitization with *A. purpureus*. Sharma *et al* (2010) also reported up to 57.6% parasitization of lac insects with *A. purpureus* whereas only 20 per cent parasitization was reported about two decades back. The populations of *T. tachardiae* and *P. clavicornis* were negligible during *baisakhi* (2011-12) but the population of *T. tachardiae* was more in the month of July -August during 2012 which coincided with early rainy (*katki*) season crop, clearly indicating more vulnerability during rainy season crop (Fig. 4 & 5). Similarly, during *baisakhi* (2012-13), the maximum population of *T. tachardiae* was at crop maturity stage *i.e*., during June-July, indicating it as the major problem during rainy season crop. In *katki* 2013, *A. purpureus* and *P. clavicornis* populations were more in the month of September-October, whereas *T. tachardiae* was more in October-November (Figs. 3, 4 & 5). Populations of

predators *viz.*, *E. amabilis* and *P. pulverea* were more during crop maturity period in both crops (Fig. 6, 7).

Population variation was observed between the location, the host and the crop season. Caging of lac samples for recording population and emergence profile of parasitoids and predators revealed that summer crop were more vulnerable to *A. purpureus* and most of the parasitization took place on or before sexual maturity stage thus, killing lac insect invariably as compared to rainy crop (parasitization at crop maturity stage). Microscopic examination of dead lac insects and caging experiments with sexually mature lac crop conducted by Sharma *et al.* (2013) also reported *A. purpureus* as the major cause of lac mortality. PCR study conducted by Sharma *et al.* (2013) with *A. purpureus* specific primers also confirmed parasitization as the major cause of early mortality.

Fig. 1. Wooden cage for emergence of parasitoids and predators



Grub stage | Pupal stage

A. purpureus adult female | *A. purpureus* adult male

Fig. 2. Different stages of *A. purpureus*

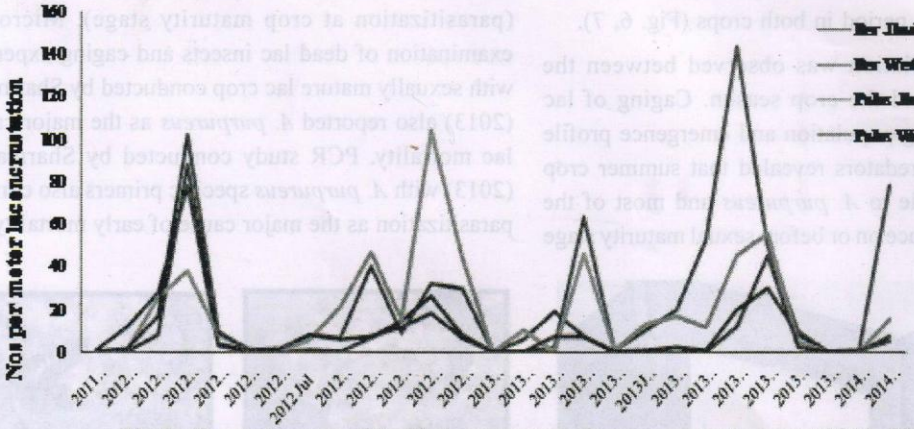


Fig 3: Emergence profile of *A. purpureus* from rangeeni crops (2011- 2014)

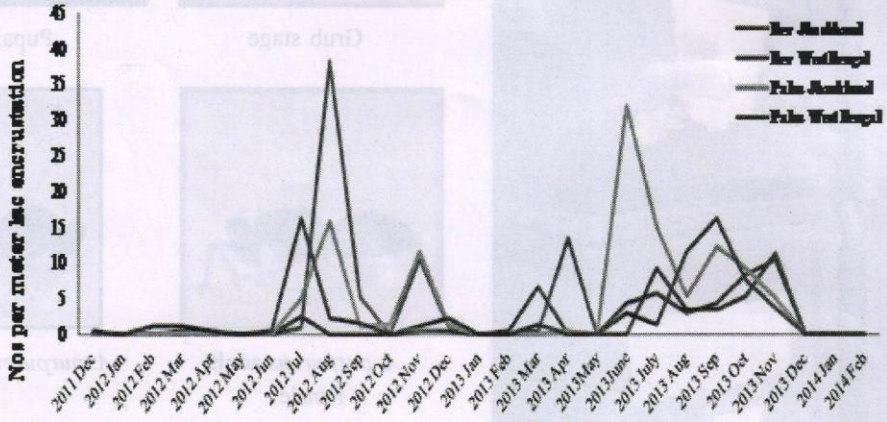


Fig 3: Emergence profile of *A. purpureus* from rangeeni crops (2011- 2014)

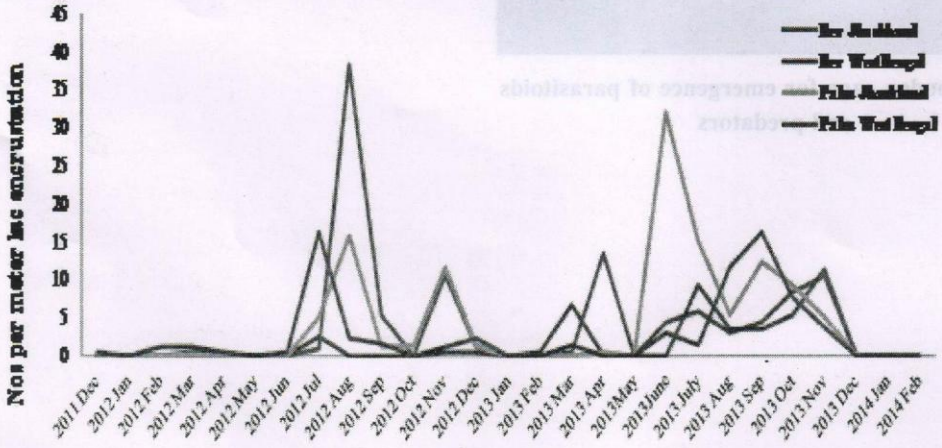


Fig 4: Emergence profile of *T. tachardiae* from *rangeeni* crops (2011- 2014)

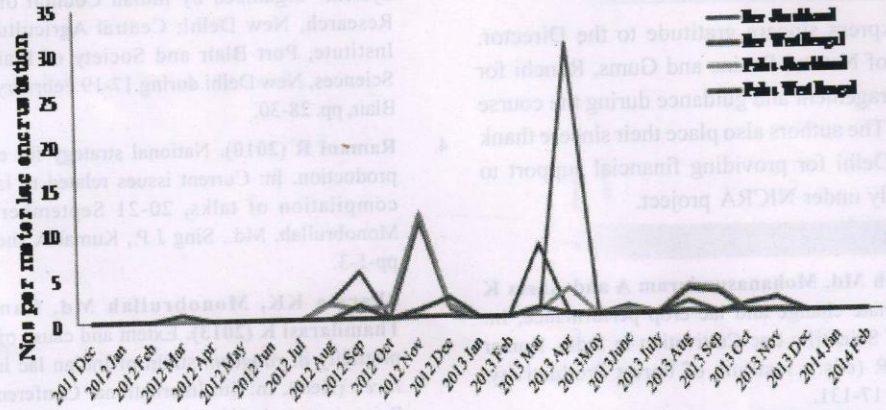


Fig 5: Emergence profile of *P. clavicornis* from *rangeeni* crops (2011- 2014)

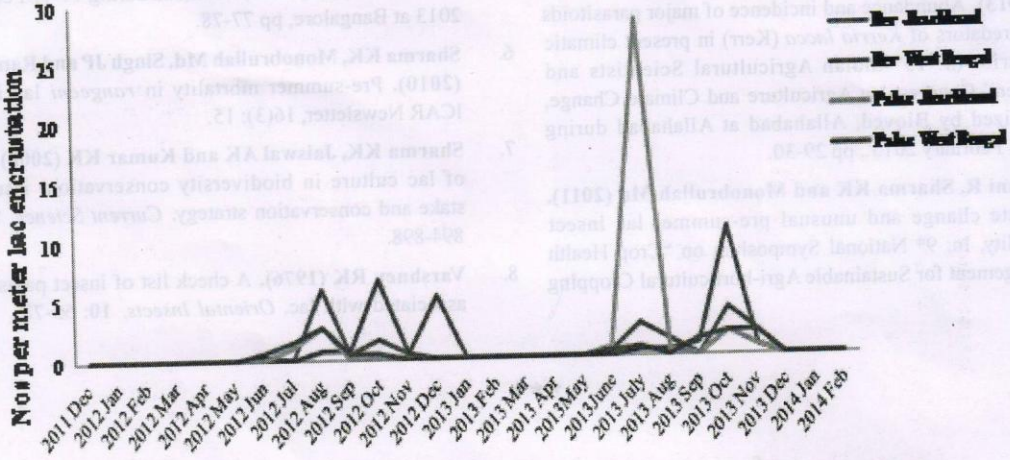


Fig 6: Emergence profile of *E. amabilis* from *rangeeni* crops (2011- 2014)

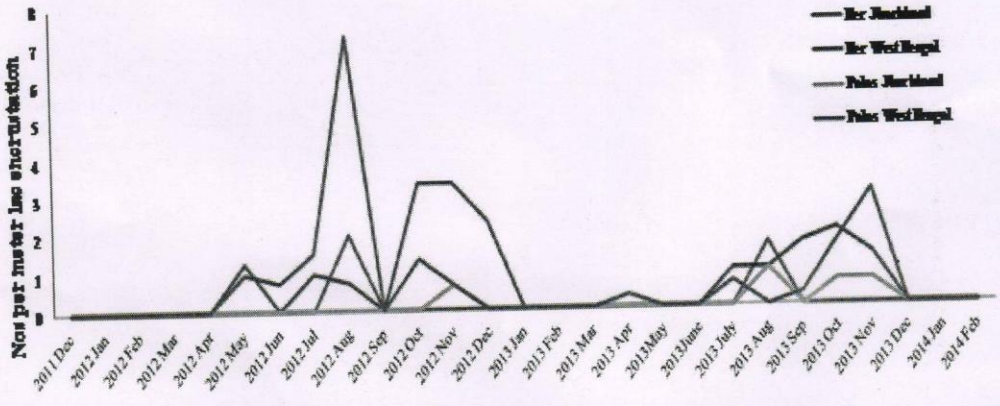


Fig 7: Emergence profile of *P. pulverea* from *rangeeni* crops (2011- 2014)

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