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Biotic factors affecting lac insect and their management

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Abstract
The lac insect also known as *Kerria lacca* Kerr (Coccoidea- Homoptera) is very well recognized for its worthy resin. Lac insect is vulnerable to biotic factors thereby decreasing the yield of lac crop. The present study is an attempt to understand different types of biological factors that affect lac insect as well as the management of these biological factors so as to enhance the survivability of lac insect as well as boost lac production.

Keywords: Lac insect, Biotic factors, management

Introduction

Biotic factors affecting lac insect

The lac insect before settling on the host twigs spends very short period of active mobility and thereafter spends an entirely sedentary life which makes lac insect susceptible to be invaded by numerous insect parasitoids and predators, inflicting sizable harm to lac crop not only quantitatively but also qualitatively (Singh *et al*., 2011) [31]. The various biotic factors that affect lac insects include microbial fauna, invertebrates and vertebrates (Sharma *et al*., 2001, 2006) [25]. Among the vertebrates' enemies of lac insect, squirrels, rats and monkeys are the most prevalent (Thomas, a2004) [33]. Parasites and predators are the two main types of invertebrates' enemies that can cause loss to the lac insect (Sharma *et al*., 1997, 2011). A total of twenty two species of lac insect predators besides 30 species of primary parasites, 45 species of secondary parasites (Das, 1990) [6] were found to affect lac insects. In addition to the above mentioned enemies, the lac insects and their host plants are also subjected to several fungal pathogens besides numerous harmful insects leading to a rich biodiversity of the lac ecosystem (Sharma *et al*., 2006) [25].

Predators

The most prevalent predators found in the lac ecosystems which cause significant loss, particularly to the winter season *Kusmi* lac crop are the sporadic neuropteran predator *Chrysopa* species. A severe infestation through *Chrysopa* species can result in the total loss of winter season kusmi lac insect crop if not properly managed (Singh *et al*., 2011) [31]. Mehra, 1965 [16] reported that the three instars larvae (first, second and third) of *Chrysopa madestes* can eat twenty, twenty four and seventy four mature female lac insects respectively each day.

Lepidopteran predators *Pseudohypatopa pulverea* and *Eublemma ambilis* can result in thirty to forty percent loss of the lac crop (Mishra, 2002; Glover, 1937 [7] Singh *et al*., 2009; Jaiswal *et al*., 2008) [11]. *E. Amabilis* which feeds only on lac insect can cause harm to the tune of twenty to twenty-five per cent of lac crop (Narayanan, 1962). *E. Amabilis* and *P. Pulverea* which are the main pests of lac insect can cause 30 to 35 percent harm to lac crop (Malhotra and Katiyar, 1975) [15].

A new neuropteran predator *Chrysoperla zastrowi arabica* of *Kerria lacca* was reported by Singh *et al*., (2011) [30]. The *C. Zastrowi arabica*'s first instar larvae attack the newly settled *Kusmi lac* insect on tender shoots of *Kusum* host trees. About one hundred fifty to two hundred adults of *C. Zastrowi arabica* on *kusum* tree have been recorded on jethwi crop of Kusmi lac. The larva of this pest feeds on 160-195 and 425-485 lac insects during second and third instar stages respectively therby showing its highest predation capacity.

Mishra *et al*., (1930) reported that the *E. Amabilis* larvae after hatching from the eggs invade the lac colonies, lead a hidden mode of life by burrowing within the lac encrustation feeding solely on lac insects.

E. Amabilis could be extremely damaging to both the lac insect as well as lac encrustation (Rahman *et al*., 2009) [22]. This insect is normally white-pinkish in shade which lays grey-white eggs which are round in shape and depressed in the centre. The newly hatched larva of the insect enters the lac insect either via opening or by tunneling a hole throughout the lac encrustation. 42-50 mature lac cells are damaged by single larva and the level of damage is more in the Kartki than Baishakhi crop.

Parasitoids

Although Superparasitism can happen but normally one scale is parasitized by a single parasitoid larva (Narayanan, 1962). The life cycle of parasitoids is approximately one month in duration, in comparison to four-nine months, relying on *K. lacca* strain and season. *Coccophagus tschirchii Aprostocetus purpureus* and *Tachardiaephagus tachardiae* have ten to twelve generation per year on lac grown commercially as compared to nine generation for *Paraechthrodryinus clavicornis* Cameron. The most widely occuring lac associated parasitoids are *T. tachardiae* and *A. purpureus* which belong to the order hymenoptera (Chattopadhyay, 2011) [4].

The super parasitism in *K. lacca* and its effects on the productivity and resin producing ability of its two infra-subspecific forms was studied by Sharma *et al*., 2007 [27]. The parasites of lac insect can cause excessive harm to the lac crop thereby adversely affecting both the resin yield as well as the fecundity of the insects, especially during rainy

seasons. The extent of parasitisation in Kusmi and Rangeeni lac insect was found to be 18.40 percent and 26 percent respectively. The normal decrease in the production of resin by female lac insect due to parasitism varied between 17.25 to 39.80 percent and 25.24 to 37.91 percent in Rangeeni and Kusmi strain respectively. Not only this, the productiveness of lac insects has also decreased significantly ranging between 25.29 to 90.39 percent and 22.44 to 96.82 percent in *Kusmi* and *Rangeeni* strains respectively. The study further showed that the number of parasitoids was directly proportional to the fecundity of the lac insects and resin production

Varshney (1976) [34] reported 28 parasitoids from lac species from across the globe. The four species of braconid wasps were wrongly listed as lac scale parasitoids but they were actually parasitoids of a lot of predatory Lepidoptera that attack the lac scales. The remaining twenty four species are all chalcidoid wasps. The majority of these parasitoids in India were recorded from the commercial lac scale.

Three new species (*Tachardiaephagus sarawakensis*, *Ooencyrtus Paratachardinae* and O. *thaiensis*) of parasitic wasps from lac insects were collected by Hayat *et al*., 2010 [8]. Three parasitic species viz. *C. Tschirchii*, *T. Tachardia* and *A. Purpureus*, showing different peak emergence patterns on Kusmi lac were reported by Subbarayudu and Maheswer, 1998. [32]

A total of 14 parasitoids species that belong to thirteen and ten genera and families respectively were found connected to *K. lacca* (Sharma *et al*., 1997). Out of the total population of parasitoids, *T. Tachardiae* and *A. Purpureus* were the most abundant and constitute nearly 28.37 and 55.82 percent respectively. As far as the useful fauna is concerned, *B. greeni* was found to be of some significance.

Management of biotic factors affecting lac insect

Chemical management

The management of *Chrysopa* species can be done by the use of chemical insecticides like dichlorvos (Mishra *et al*., 1996) and Chlordane/ HCH (Chaudhary, 1983) [5], however after its characterization as notably risky pesticides by WHO, these pesticides are no longer advocated in India. The endosulfan known for its carcinogenic effect which is banned in most of the developed nations and some Indian states like Kerala is still widely used in lac ecosystem thereby posing a serious threat to the mankind (Arora *et al*., 2009) [1].

Gupta and Bhattacharya (2007) [2] while evaluating toxicity of naturalyte compound against *Spilarctia oblique* reported that after 48 hr of treatment, the effectiveness of spinosad was maximum. In addition to spinosad, the insecticides indoxacarb (0.02%) and fipronil (0.005 and 0.01%) are also evenly effective as they result in hundred percent mortality of larvae within 24 hr of treatment by using both topical and residual mode of insecticide application.

The evaluation of effect of ethofenprox at (0.02%) on *C. madestes* under laboratory conditions showed that ethofenprox can effectively protect the lac crop at important stage against the loss incurred by *C. madestes* under field conditions without causing any considerable loss to the lac culture (Jaiswal *et al*., 2007) [10].

The evaluation of organophosphorus insecticides by Mishra *et al*., (1996) found that dichlorvos at 0.03 percent was found most suitable for controlling the *C. madestes*. Jaiswal *et al*., (2004) [9] advocated Dichlorvos, Endosulfan, Ethofenprox and Cartap hydrochloride for the control of not only lepidopteran but also the neuropteran predators of *Kerri lacca*. Hundred percent mortality of *C. lacciperda* on lac insect was observed within 24 hour of treatment by seven safer insecticides viz ethofenprox, indoxacarb, lambdacyhalothrin, spinosad, fipronil, carbosulfan and alphamethirn (Singh *et al*., 2009, 2010) [28, 29].

Biological management

The parasite *Bracon greeni* Ashmead can be used for the biological control of *E. amabilis* (Negi *et al*., 1945) [21]. Natural enemies such as *Solebynopsis geminata* and *Componotus compressus* can also be used for the control *E. amabilis* (Rahman *et al*., 2009) [22]. The spray of the soil-dwelling bacterium *Bacillus thuringiensis* can be used effectively to control *P. pulverea* and *E. amabilis* (Malhotra and Choudhary, 1968) [13].

The successful control of both *P. pulverea* and *E. amabilis* in *Rangeeni* lac on *Zizyphus mauritiana* can be done by three sprays of *B. thuringiensis* at formulation of 0.051 percent at a gap of thirty days after brood lac inoculation (Jaiswal *et al.,* 2008). *Trichogramma pretiosum, T. achaeae, T. poliae, T. brasiliense, T. exiguum* and *T. chilonis* were found highly effective against the eggs of *P. pulverea and E amabilis* (Bhattacharya *et al.,* 2008) [3]. The number of *E. amabilis* on lac crop raised on bushes of Australian banyan tree were successfully suppressed by all the three egg parasitoids viz., *T. ostriniae*, *T. achaea*, and *T. exigum* (Bhattacharya *et al.*,2007). There was a reduction of 78.66 percent in the population of *P. Pulverea* and *E. Amabilis* by the occurrence of ant fauna on lac colony (Kumar *et al*., 2007) [12].

Cultural and physical management

The use of 60 mesh nylon net bag during brood inoculation can trap the parasitoids and predators and allow only the crawlers of lac insects to come out of the net bag for their settlement on new branches (Malhotra, 1983) [14].

Significant decrease in the population of the two Lepidopteran predators *P. pulverea* and *E. amabilis* of lac insect can be done by the plantation of medicinal plant *Cassia occidentalis* which belongs to the family Leguminosac on the sides of a field having Australian banyan tree bushes harbouring lac insects (Bhattacharaya *et al*., 2006).

Significant number of C*hrysopa* species which were found attacking *Kusmi lac* crop can be trapped by the placement of light trap in the lac field (Bhattacharya *et al.,* 2008) [3]. The essential oils extracted from lemon grass, Palmarosa grass and Citronella grass can be used as superb repellents that can prevent lac insect from the harm inflicted by *P. pulverea* and *E. amabilis* (Bhattacharya *et al.,* 2008) [3]

Conclusion

The lac insect is found to be affected by a number of parasites, predators, fungal pathogens and vertebrates' enemies. All these biotic stress factors affecting lac insect not only reduce the survivability of lac insect but also decrease the lac crop yield. Therefore there is an urgent need to manage these biotic factors affecting lac insect in order to increase the lac insect survivability as the lac yield. The cultural, chemical and biological methods should be combined for the management of biotic factors affecting lac insect.

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