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Note

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Intraguild predation of green lacewing larvae (Neuroptera: Chrysopidae) on spider eggs and spiderlings

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Tea, *Camellia sinensis* L. (O. Kuntze) plantation provides habitats for thousands of insect species including pests and their natural enemies like parasitoids and predators. The immense value of predators in pest suppression has been well understood by entomologists and there is a renewed interest in biological pest suppression. Classical biological control or periodic inundative release of natural enemies has been most effective in cropping systems where large-scale use of insecticides or their ecologically disruptive practices are minimal (David & Easwaramoorthy 1988). Green lacewings are known to have tolerance to commonly used pesticides (Bigler 1984), and they are relatively easy to rear in captivity (Tulisalo et al. 1984). Laboratory culture and augmentation of *Mallada desjardinsi* (= *boninensis*) is feasible through *Corcyra cephalonica* larvae and artificial diet (Vasanthkumar et al. 2012).

Mallada desjardinsi is an important predator of pests such as mealy bugs and aphids. In tea they are important predator of Red Spider Mite *Oligonychus coffeae* (Vasanthkumar et al. 2012).

Distribution study in India showed Bengaluru, Karnataka, to have the highest density of *M. desjardinsi* population (26.6% and 5.05 ± 0.108 per plant) in the areas sampled (Boopathi et al. 2016).

The larvae of green lacewings are important predators largely used as biological agents. They feed on pest thrips, aphids, scales, caterpillars, and spider mites infesting a variety of plants (McEwen et al. 2001). Adults of green lacewing generally are not predatory and feed on nectar, pollen or honeydew while a few of them are predatory (Coppel & Mertins 1977).

Mallada desjardinsi (Navas) (= *boninensis*) (Neuroptera: Chrysopidae), is reported as an important predator of red spider mite (RSM) *Oligonychus coffeae* Nietner (Acari: Tetranychidae) (Babu et al. 2004; Vasanthkumar et al. 2012). *Mallada desjardinsi* are also considered as generalist predators and are reported as important natural enemies of a variety of pests such as mealy bugs (Mani & Krishnamoorthi 1987), white flies (Selvakumaran et al. 1996), bollworms and aphids (Kabissa et al. 1996).

Generalist predators prefer to take prey of whatever size they can handle (Dong & Polis 1992; Finke 1994). If these prey include younger conspecifics or other predators, then control of the herbivore population is not guaranteed. Intraguild predation (IGP) is a combination of the killing and eating species that use similar, often limiting, resources and are thus potential competitors (Polis & Myers 1989); however, there has been little research on the IGP of chrysopids, especially on the *M.*

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desjardinsi in tea ecosystem. Thus the seasonality, IGP on spider eggs and spiderlings and the relationship between the proportion of larvae population and spider population were studied to provide a theoretical foundation for future studies.

The current study was undertaken from December 2014 to November 2015 at UPASI Experimental Farm, Valparai (10.36666^{0}N & 76.96666^{0}E, 1,065m) in Anamallais province, Tamil Nadu, southern India. Daily field surveys were conducted randomly for a year during morning hours (08:00–10.00 hr) in tea plantations. Wild guava trees, (*Psidium guajava* L.) dispersed in tea plantations support a huge population of the predator *Mallada desjardinsi*. The identification of lacewing was done following standard reference (Babu et al. 2004). The green lacewing larvae were collected and recorded on guava trees. Recorded lacewing larvae were tabulated on monthly interval. The spider population was also assessed in the trees. *Mallada desjardinsi* larvae were found in and around spider egg sacs and spiderlings. The spiders were collected in small glass vials (5ml) with 90% alcohol, brought to the laboratory and identified using standard reference (Tikader 1987; Sebastian & Peter 2009).

Mallada desjardinsi's prey preference was derived from extensive field observations of spiderlings and egg sacs feeding and identification of prey carcasses (trash) taken from the larvae. The larvae of *M. desjardinsi* were collected in glass tubes (25×200 mm length) and brought to the laboratory and trash was examined using a stereomicroscope. Spider egg sacs were also examined in the laboratory. Egg sacs were opened and examined using a stereomicroscope to determine the number consumed by the predator. Any egg that appeared deflated was counted as consumed. The population abundance of *M. desjardinsi* and spiders (spiderlings and egg sacs) were correlated using Spearman's rank correlation (Siegel & Castellan 1988).

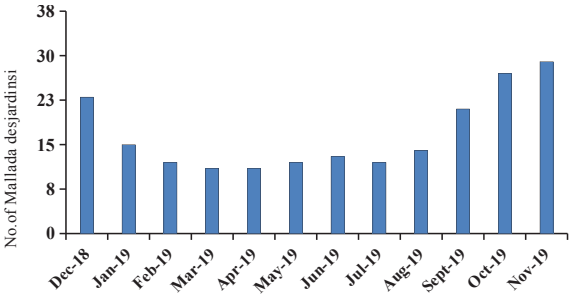

Figure 1. Population of *Mallada desjardinsi* recorded during the period of 2014–2015.

Mallada desjardinsi is a common chrysopid in tea plantations. The larvae are trash carriers and cover themselves with fluffy heaps of debris that conceal their body. The covering included remains of spider egg sacs. It is held in place by hooked spines or bristles on the larva's body. When in motion, the larva's legs and large mandibles can be seen on close inspection. The present study revealed that the fluctuation patterns of *M. desjardinsi* are more or less synchronized in different months. The population was higher during the months of September to December. A synchronized pattern of low population was observed during February to August (Fig. 1). According to regression analysis it seems that

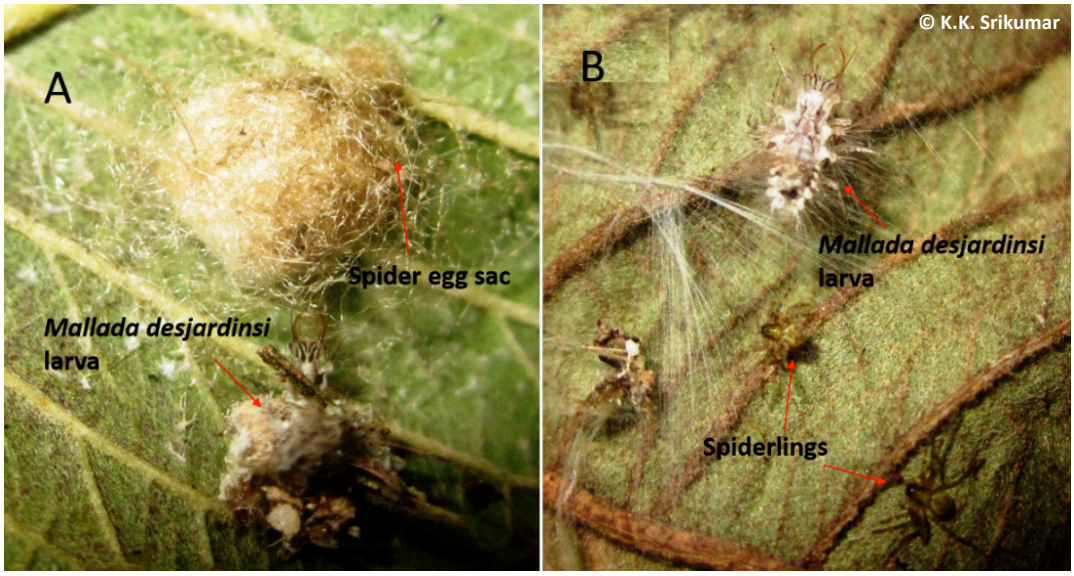

Image 1. *Mallada desjardinsi* larva predation on spider (A) egg sac and (B) spiderlings

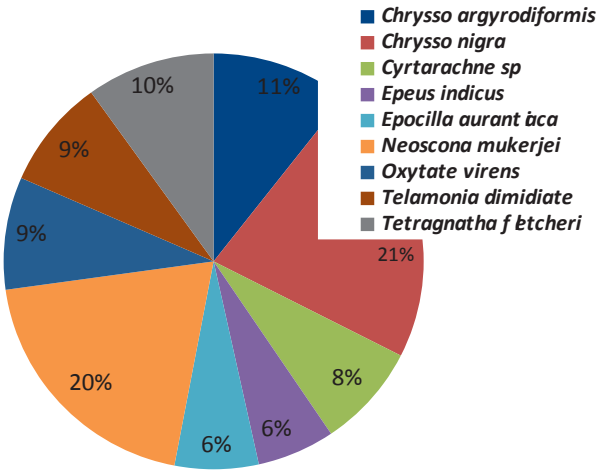

Figure 2. Spider egg sac preference by *Mallada desjardinsi*

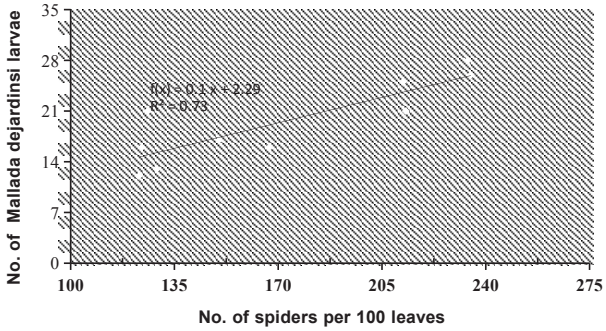

Figure 3. Relation between the population of *Mallada desjardinsi* larvae and spiders

the increase in number of species of lacewings correlates with increasing winter temperature, while they decrease with increasing summer precipitation (McEwen et al. 2001).

A total of nine species of spiders were recorded on the guava trees, viz., *Epeus indicus* Proszynski, *Epocilla aurantiaca* Simon, *Chrysso nigra* O.P. Cambridge, *Chrysso argyrodiformis* Yaginuma, *Cyrtarachne* sp., *Neoscona mukerjei* Tikader, *Oxytate virens* Thorell, *Telamonia dimidiate* Simon and *Tetragnatha fletcheri* Gravely. *Neoscona mukerjei* and *Cyrtarachne* sp. belongs to Araneidae (Orb-web spiders). *Epeus indicus, Epocilla aurantiaca* and *Telamonia dimidiate* are jumping spiders (Salticidae). *Chrysso nigra, C. argyrodiformis* and *Cyrtarachne* sp. belongs to Theridiiae (Comb-footed spiders). *Oxytate virens* commonly called as green crab spider (Thomisidae). *Tetragnatha fletcheri* Gravely (Long-jawed spiders) belongs to Tetragnathidae. These spiders construct small, irregular webs, typically on the underside of leaves and within the branches. The larvae of *M. desjardinsi* are voracious feeders on these spider egg sacs. The larvae actively seek a previously constructed spider egg sac that they enter through direct penetration (Image 1).

Preference was mostly for abandoned egg sacs and spiderlings. In the field it was observed that the fully grown larvae of *M. desjardinsi*, roamed near and consumed 22% eggs of *C. nigra*, 20% of *N. mukerjei*, 11% of *C. argyrodoformis* and 10% of *Cyrtarachne* sp. and below 10% of the other spider species (Fig. 2).

In the laboratory studies Vanitha et al. (2009) showed that when egg sacs were offered to fully grown larvae of *Chrysoperla*, they consumed eggs of *Oxyopes javanus* and *Clubiona drassodes*, whereas no consumption was observed when the mother was present. The population of *M. desjardinsi* showed a positive correlation (R = 0.7347) with spider population. Thus, the larger the population of spiderlings and egg sacs, the greater the *M. desjardinsi* population (Fig. 3). Noppe et al. (2012) reported that green lacewing, *Chrysoperla carnea* was the superior intraguild predator, winning 88.9% when the experiment was repeated in petri dishes without plant material, regardless of whether green bugs or eggs of *Ephestia kuehniella* Zeller were offered as focal prey.

Intraguild predation by *M. desjardinsi* can be regarded as a mechanism for enabling survival when the red spider mite prey is scarce. Nevertheless, the intraguild predation of *M. desjardinsi* may reduce pest suppression in tea plantations.

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