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Prey–predator relations with reference to tea aphid, *Toxoptera aurantii* (Boyer de Fonscolombe) and syrphid predators

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ABSTRACT: Tea aphid, *Toxoptera aurantii* (Boyer de Fonscolombe) infests the tender leaves and young shoots of the tea plant, *Camellia sinensis* and its occurrence has been observed while monitoring the pest invasion in a tea garden located at Senapati district, Manipur. Under the local climatic conditions, *T. aurantii* infests tea from April to October and its population density density varies with respect to climatic factors and abundance of syrphid predators. Random sampling of their population showed that their density varied from 12 to 175 aphids/ 5cm length of the twig, with maximum density in August and September. The syrphid species, *Episyrphus balteatus* (De Geer) and *Ischiodon scutellaris* (Fabricius) were encountered and their occurrence synchronized well with that of tea aphid. The feeding voracity of the predator was nearly 155 aphids per syrphid larva. The biology, feeding efficiency and the population status of the predatory species are discussed in the context of the abundance of tea pest.

KEY WORDS: Predator, syrphids, tea aphid, *Toxoptera aurantii*

INTRODUCTION

Tea aphid, *Toxoptera aurantii* (Boyer de Fonscolombe), is one of the sucking pests of the tea plant (*Camellia sinensis*) infesting the tender shoot and leaves. The infested seedlings and young plants invariably exhibit retarded growth and the leaves become crinkled forming a boat shaped structure. Severe attack would lead to delayed recovery of the plant resulting in poor crop productivity (Muraleedharan, 1991). Although aphid population in the mature field can be kept under check by a number of methods including manual removal especially during plucking rounds, the seedlings in the nursery and the plants that are recovering from pruning suffer to a great extent. In this context, the activities of syrphids play an important role. The larval stages of syrphids such as *Episyrphus balteatus* (De Geer) and *Ischiodon scutellaris* (Fabricius) were observed in the present study feeding on the aphids. Therefore, appreciable chances exist to use these predators as potential biocontrol agents. In view of their significance, an attempt has been made in this paper to highlight the feeding efficiency of the syrphids and the field abundance of aphid and syrphids on young tea plants in relation to abiotic factors.

MATERIALS AND METHODS

The aphid population was assessed in a young field (Assam-Cambodia hybrid), which was recovering from pruning. Of the 400 bushes marked for the study in a tea garden at Senapati district, Manipur State (latitude 23° 72 - 25° 42 N and longitude 93° 52 - 94° 52 east; altitude 1100m MSL), 10 bushes were randomly selected for sampling at every fortnight interval. Aphid and syrphid numbers were counted on 5 cm length of twig of the selected plants at the plucking level of the bush as adopted by Chitra Devi *et al.* (2002) on mustard crop. The pest and predator density was monitored consecutively for two years (2004-2005) and their

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abundance was correlated with abiotic factors. The study site was kept free from pesticide application. Feeding propensity of the syrphid predators was evaluated by rearing the syrphid larvae exclusively on aphid diet right from their early stage. The syrphid larvae were reared individually on a Petri-plate (8.5 cm diam) by providing counted number of aphid-infested twigs *ad libitum*. Daily consumption of aphid was quantified by counting the left over aphids in each culture. Totally five replications were maintained for each predator under the indoor rearing conditions (22 ±1.5°C with 72 ± 5% R.H. and 29±2°C with 60 ± 5% R.H.).

RESULTS AND DISCUSSION

Two years of field assessment on the seasonal abundance of tea aphids showed that aphids were found to occur on tea from April to October under the climatic conditions of Manipur, with maximum density during August and September (Fig. 1). The trend indicated that the infestation gradually increased from April and reached maximum during August/September. Random sampling of their population revealed that their density varied from 12 to 175 aphids per 5cm length of the twig, with the dominance of nymphs, followed by the apterous individuals. The alates were found only at the colony initiation stage. The mean percentage of nymphs, apterous and alate forms during the period of study was 78, 19 and 3 per cent, respectively. The predator density also followed the same pattern and almost every colony had a representation of either egg or larva of either of the predatory species. When the colony had sizable number of aphids, both stages of predators were encountered. But the trend noticed here is that, when the aphids initiate their colony, the hover flies lay their eggs, by the time the egg hatches out into a larva, the strength of aphid colony also increases, enabling the predatory larva to feed upon the aphids. As the predator passes through three larval stages, the colony size will also diminish, resulting in transformation into pupa. Similar trend was also noticed on the colonies of cabbage aphid (Bijaya Devi *et al.*, 1996) and mustard aphid– syrphid interactions (Chitra Devi, 1998). The mean predator – prey ratio under the field condition was 1:75. The relation between prey and predator in terms of their abundance showed a high positive correlation (r = 0.91) in the present study indicating the fact that the predator density highly depended on prey population.

On the other hand, the build up of prey population was influenced by climatic factors and the availability of young leaves besides predation by syrphids. Tea being a perennial crop, there is always a continuous growth of foliage and therefore the plucking round of two leaves and a bud is approximately 7 days. This would mean that young leaves and tender shoots are always available for colony establishment. But the climatic factors such as temperature, relative humidity and rainfall appear to influence upon the populations of the aphid, which is evident in the present study. For instance, the minimum temperature, rainfall and humidity indicated low positive correlation (r = 0.31; r = 0.34 and r = 0.55) with aphid density (Fig. 1). From these results it may be inferred here that the abiotic factors govern the pest population to some extent. As the aphid density has been found to be high during August and September, the climatic condition (temperature ranging from 20-22 °C, 29 ±2°C, 78 ±2 % RH and moderate rainfall of 15-20 cm rain spanning over a period of 15-18 days) prevailed during that period is conducive to enhance the aphid population on tea. Although during June and July the rainfall was about 15 cm each, aphid population did not show any increasing trend. This could possibly be due to little high rainfall within a short span. Presence of more aphids in April, 2004 was primarily due to delayed plucking, as the plant was recovering gradually from pruning.

Influence of predation is yet another factor that regulates field density of *T. aurantii*. This is evident from the record on the occurrence of predators (Muraleedharan and Radhakrishnan, 1986). Field observations here also revealed the presence of two species of syrphids, namely, *E. balteatus* and *I. scutellaris*, feeding on *T. aurantii* and their feeding voracity under lab condition was 136 and 155 tea aphids during their larval stage. The larvae emerged after 4 days of incubation of eggs and transformed into pupa in about 8 days after passing through 3 larval instars. The pupal period and adult longevity ranged from 7 to 9 and 2 to 5 days, respectively for both the species. The feeding efficiency of *I. scutellaris* on tea aphid was 35.5 ± 1.1, 42 ± 1.4, 80 ± 4.2 and that of *E. balteatus* being 31.5 ± 0.35, 47 ± 1.4, and 57.5 ±3.2 aphids respectively during I, II, and III instar. Their feeding rate increased with age in both species. But the total capacity of aphid consumption was numerically higher in *I. scutellaris* than *E. balteatus*, in spite of feeding them with almost uniform stage of adult aphids. While working on the syrphids of the tea ecosystem, Rhadhakrishnan and Muraleedharan (1993) reported that *E. balteatus* consumed significantly more number of tea aphids than *I. scutellaris*. Such variation in the feeding potential of the predators could also be due to the rearing conditions and the stages of the prey

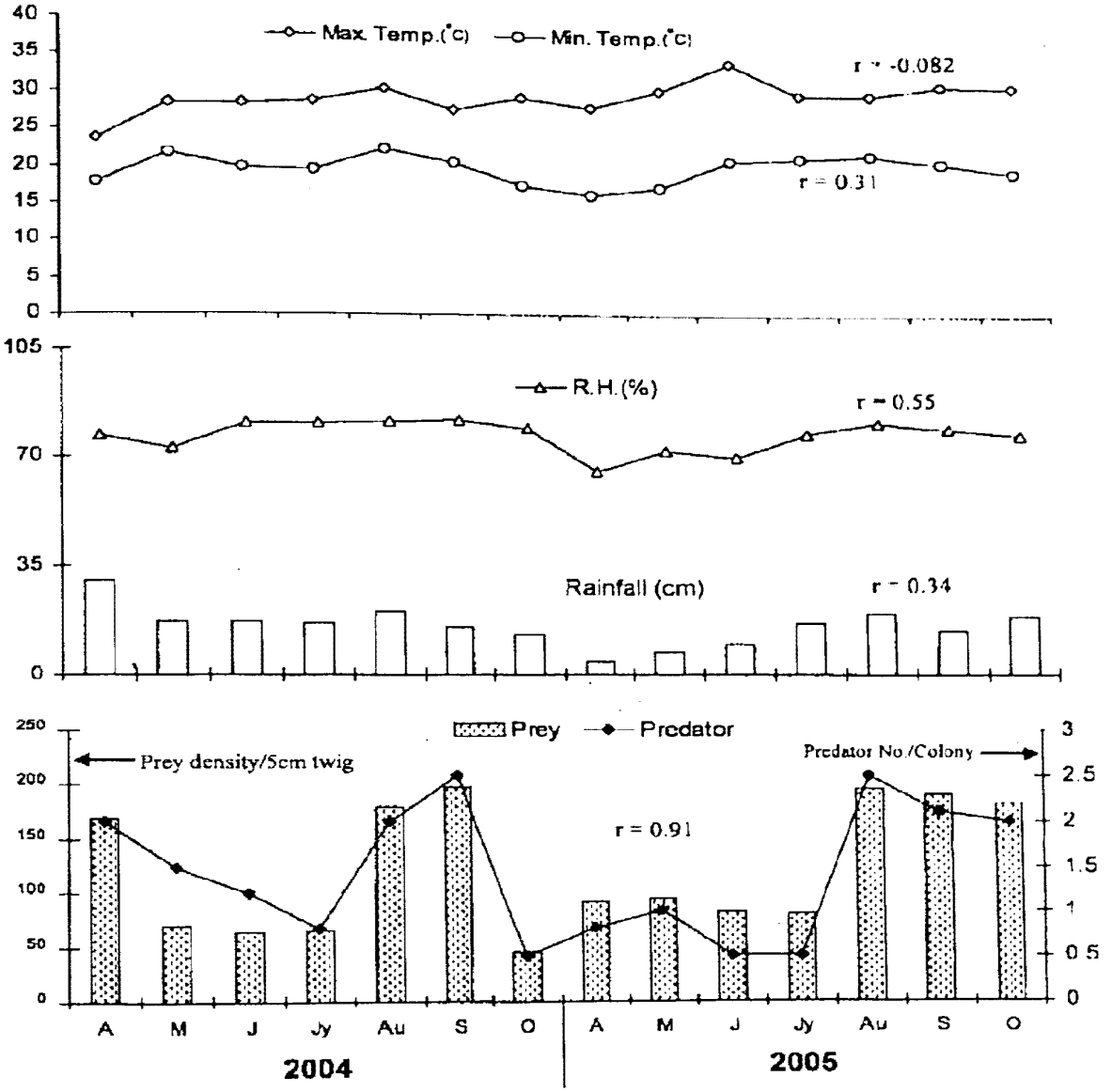

Fig. 1. Abundance of tea aphid in relation to biotic and abiotic factors.

being offered as food. Even though subtle difference occurs between the two species in terms of predatory efficiency, their presence in the field will certainly help in preventing the aphid from becoming a serious pest.

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