

LABORATORY EVALUATION OF PREDATORY EFFICIENCY OF *GEOCORIS OCHROPTERUS* FIEBER (HEMIPTERA : LYGAEIDAE) ON SOME COMMON TEA PESTS

S. Sannigrahi and A. Mukhopadhyay¹

(Department of Zoology, School of Life Sciences, North Bengal University,
Darjeeling 734 430, (W B), India)

An attempt was made to evaluate the predatory efficiency, nymphal developmental period, percentage mortality, fresh and dry body weight gain of a polyphagous predator, *Geocoris ochropterus*, on tea thrips, mites and caterpillars from Darjeeling plains. Predation gradually increased up to IV instar on thrips prey, up to II instar on red spider mites prey, and up to adults with substantial consumption on lymantrid caterpillar prey. However, high mortality of immature stages of the predator occurred when kept on these preys.

INTRODUCTION

In the Darjeeling foothills, tea (*Camellia sinensis* (L.) O. Kuntze) is severely attacked by thrips (*Scirtothrips dorsalis* Bagnall), red spider mites (*Oligonychus coffeae* Nietner) and some other insects (Lefroy, 1909; Andrews, 1920). Among lepidopteran pests, lymantrid caterpillar (*Euproctis latifascia*) Walk. (Darjeeling) is a severe defoliator of young and mature tea plants (Watt and Mann, 1903), particularly mother leaves of cuttings in the nursery.

Information on biocontrol of insects and mites affecting tea in India is scanty except for some reports on natural enemies of tea pests (Rao, Dutta and Ramaseshiah, 1970; Das, 1974, 1979; Sharma, 1976; Muraleedharan, Selvasundaram and Radhakrishnan, 1988; Muraleedharan, 1992). The well managed ecosystem of tea plantations is highly suitable for the biological control of tea pests in view of the type of climate, duration of crop, scale of planting and agronomic practices (Greathead and Wagge, 1983). The minor status of many of the tea pests is mainly due to the influence of natural control agents (Muraleedharan *et al.*, 1988).

Polyphagous predators may often provide more effective biological control because their dynamics are not solely dependent on a target pest species but can be positively enhanced by alternate prey (Mudrock, Chesson and Cheson, 1985). Crocker and Whitcomb (1980) included small to minute arachnids, thysanopterans and noctuid larvae in the prey list of *Geocoris* sp. Several species of the polyphagous predator, *Geocoris* have been found to be associated with the natural enemy complex of a number of crop pests in India as well as abroad (Rangarajan *et al.*, 1964; Subba Rao *et al.*, 1965; Mukhopadhyay and Ghosh, 1982; Elvin, Stimac and Whitcomb, 1983), and their future use as a biocontrol agent has been envisioned by Tamaki and

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¹ Corresponding author

Weeks (1972), Suresh Kumar and Ananthkrishnan (1985) and Mukhopadhyay (1988). In certain observations (Mukhopadhyay and Sannigrahi, 1993) it was found that the polyphagous predator *Geocoris ochropterus* Fieber frequently occurs in surrounding hedges and shrubs of tea estates, and occasionally with abundance of pests, switches over to the plantation. This study was, therefore, initiated to determine the predatory efficiency and life cycle of *Geocoris ochropterus*, using thrips, red spider mites and lymantrid caterpillars as preys which incidentally were pests infesting tea plants in the Darjeeling foothills.

MATERIALS AND METHODS

a) Collection and maintenance of *Geocoris* predator

The adults as well as nymphs of *G.ochropterus* were collected by using an aspirator (April to August) or by dislodging the insects onto a sheet by beating the wild shrub, *Polygonum orientale* Wall (Polygonaceae).

The predators were reared separately in glass vials (10 cm x 2.5 cm diameter) with cotton plug and were fed with cold-preserved pupae of ants (*Oecophylla smaragdina* Fabr.) *ad libitum* supplemented with a fresh twig of *Leucus linifolia* Spreng (Labiate), a perennial weed also housing *G.ochropterus*.

b) Collection and maintenance of the 3 prey species

The thrips and red spider mites were regularly collected from a tea estate (2 km away from the laboratory), whereas the first instar larvae of the caterpillar were obtained from laying adults in the laboratory. For thrips and mites, infested leaves were brought to the laboratory with special protection for each species. The eggs and nymphs of red spider mites were eliminated so as to observe predation on adult mites only, whereas relatively advanced larvae of thrips were provided as prey.

c) Experimental details

For studying predatory efficiency on thrips, mites and caterpillars, experiments were conducted in plastic containers (5.5 x 4 cm diameter) with a piece of soaked cotton swab inside the container to meet the water requirement of the predator and to maintain the turgidity of the leaf. In each container a newly hatched instar was introduced to observe the predation rate, stadia and post-embryonic development. In each case, the prey was provided in excess of their consumption capacity and prey consumption was monitored daily. The experiments were carried out with 20 replicates and adequate controls in each case at $27 \pm 1^\circ\text{C}$, $80 \pm 10\%$ RH, and L:D of 12 hours each.

RESULTS AND DISCUSSION

The feeding behaviour of *Geocoris ochropterus* involved a series of stimulus-response events. It sucked the fluid contents of the prey, leaving behind the empty exoskeleton. Lifting and holding the prey at rostral tip by the predator immobilised the prey within a short period possibly by enzyme-rich toxic saliva (Miles, 1972).

The relationship of the prey consumed and its effects on the life cycle of *G.ochropterus* is given in Tables 1–3. The rate of consumption increased uniformly from first to successive instars on all prey species considered here. These observations were in conformity with the earlier findings (Suresh Kumar and Ananthakrishnan, 1985) where the same species was used as a predator of some castor thrips. Body weight (fresh and dry) of the predator increased gradually in successive instars.

The highest mortality took place at IV instar of predator when consistently reared on thrips or caterpillars. Mortality increased steadily with advancement of the life stages (Tables 1 and 3). Maximum casualty of the predator took place in II instar when provided with red spider mite as food (Table 2). However, in a different study, when the prey caterpillar was separately provided to the Vth instar and adult *Geocoris*, no immediate mortality could be recorded. The predation rate showed that the Vth instar on an average could consume 8.41 ± 0.80 (10.0-6.33), adult male 11.16 ± 0.21 (11.66-10.66) and adult female 11.33 ± 0.13 (11.10-11.0) preys per day.

TABLE 1 - *Predatory efficiency of Geocoris ochropterus on tea thrips (Mean \pm SE (Range); N=20)*

Life stages	Prey consumption day-1	Developmental period (days)	Percentage mortality	Body wt. (fresh) (mg)	Body wt. (dry) (mg)
I	2.62 ± 0.15 (4.0-1.6)	6.0 ± 0.30 (9-5) etc	Nil	0.12 ± 0.01 (0.12-0.11)	0.02 ± 0.01 (0.02-0.02)
II	8.18 ± 0.85 (11.85-2.16)	6.21 ± 0.39 (9-4)	30	0.27 ± 0.01 (11.85-2.16)	0.04 ± 0.01 (0.30-0.22)
III	13.01 ± 1.85 (16.77-8.0)	8.25 ± 0.41 (9-7)	28.57	0.54 ± 0.02 (0.68-0.35)	0.21 ± 0.01 (0.24-0.18)
IV	11.89 ± 3.97 (9.18 \pm 5.0)	(Lived 4.60 ± 1.78 days)	100	0.73 ± 0.14 (1.10-0.32)	0.22 ± 0.0 (0.25-0.15)

TABLE 2 - *Predatory efficiency of Geocoris ochropterus on red spider mite pests of tea (Mean \pm SE (Range); N=20)*

Life stages	Prey consumption day-1	Developmental period (days)	Percentage mortality	Body wt. (fresh) (mg)	Body wt. (dry) (mg)
I	1.78 ± 0.09 (2.20-1.57)	7.33 ± 0.65 (10-5.0)	80	0.12 ± 0.01 (0.12-0.11)	0.02 ± 0.01 (0.02-0.02)
II	3.02 ± 0.43 (3.75-2.0)	(Lived 3.50 ± 0.92 days)	100	0.26 ± 0.01 (0.31-0.22)	0.04 ± 0.01 (0.06-0.02)

TABLE 3 — *Predatory efficiency of Geocoris ochropterus on lymantrid caterpillars of tea (Mean ± SE (Range); N=20)*

Life stages	Prey consumption day-1	Developmental period (days)	Percentage mortality	Body wt. (fresh) (mg)	Body wt. (dry) (mg)
I	1.23±0.12 (1.6-1.0)	6.75±0.64 (8-5)	20	0.12±0.01 (0.13-0.12)	0.02±0.01 (0.02-0.02)
II	1.47±0.04 (1.6-1.4)	7.25±0.73 (9-5)	30	0.19±0.01 (0.20-0.18)	0.04±0.01 (0.04-0.03)
III	2.14±0.13 (2.25-2.0)	6.75±0.85 (9-5)	66	0.34±0.01 (0.39-0.32)	0.15±0.01 (0.18-0.14)
IV	7.99±0.75 (9.66-6.0)	(Lived for 5.4±0.11 days)	100	1.26±0.02 (1.58-0.95)	0.56±0.02 (0.66-0.4)

The delayed development period, high mortality and comparatively low predation rate by IV instar nymph of predator on thrips may be due to inadequate nutrients available from the prey to support metabolic demands of advanced instars. Small body size and swift running is the main prey defence for thrips (Lawrence and Watson, 1979; Crocker and Whitcomb, 1980) rendering the prey unacceptable to advanced stages of *Geocoris*. The successful development and survival of first instar *Geocoris* on red spider mites may be due to more dependence on supplemental phytophagy (Naranjo and Stimac, 1985) than entomophagy. As the host plant influences the prey suitability of predators (Flanders, 1930; Hagen, Bombosch and McMurtry, 1976), the possible accumulation of defensive chemicals from tea by the mites may be a factor for mass mortality of the predator in early instars. High mortality in IV instar of *Geocoris* when reared solely on thrips and caterpillars may be due to their inability to gain higher body weight needed by the V instar for entering adulthood, as evident from the successful rearing of *G.ochropterus* on ant pupae (Mukhopadhyay and Sannigrahi, 1993). This may also be due to the accumulation of toxic defence chemicals in the predator from tea by way of tritrophic chain (Vinson and Barbosa, 1987). Though specific studies on prey preference by the predator was not carried out, current data may indicate a preference for, and acceptability of, lymantrid caterpillars by advanced instars and adults.

Survival and reproduction of polyphagous predators on enforced narrow diet may set a limit on natural environmental clues or behavioural options of prey and predator (Crocker and Whitcomb, 1980). Since prey defence and predators' age affect the functional response of predators (Morris, 1963; Mukherjee and Leroux, 1969), a knowledge of existing predators to kill the prey of various stages and information on efficiency of native predators appear to be basic for taking decisions on use of pesticides, particularly in tea nursery and young plantations.

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