

PREDATORY ROLE OF LAMPYRID LARVAE (*Lamprigera tenebrosa*); LABORATORY EXPERIMENTS TO CONTROL AGRICULTURAL MOLLUSCAN PESTS, *Achatina fulica* & *Laevicaulis alatae*

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Abstract: Lampyrid larvae (Coleoptera; Lampyridae) are voracious feeders on molluscan pests. Their role as biological control agent for agricultural molluscan pests has never been studied experimentally. The aim of study was to investigate the predatory role of lampyrid larvae (*L. tenebrosa*) using two selected molluscan pest species by comparing the damage of selected vegetable nurseries. Results indicated that the feeding efficiency of *L. tenebrosa* : *A. fulica* / *L. alatae* was 1:2 under laboratory conditions during 12 hrs period. The damage comparison revealed that in the absence of *L. tenebrosa* larvae, *A. fulica* caused about 90% average damage to cabbage and bean saplings and, *L. alatae* caused 55% to cabbage and 36% to bean saplings during 12 hrs feeding period. Presence of higher number of *L. tenebrosa* larvae had significantly reduced the percentage damage of cabbage saplings ($r^2 = 0.800$, $P < 0.05$) and of bean saplings ($r^2 = 0.938$, $P < 0.05$) by *A. fulica*, and similarly for cabbage saplings ($r^2 = 0.767$, $P < 0.05$) and bean saplings ($r^2 = 0.829$, $P < 0.05$) by *L. alatae*. The present study emphasized the importance of *L. tenebrosa* larvae as biological controlling agent to manage agricultural molluscan pests of *A. fulica* and *L. alatae* in Sri Lanka.

Keywords: Larvae of *L. tenebrosa*, Molluscan agricultural pests, Predatory role.

INTRODUCTION

Fireflies are important as general predators. The larvae of fireflies are carnivorous, feeding on arthropods, snails, slugs and other invertebrates (Lloyd, 1973). Since fireflies spend most of their lives in larval stage of development, understanding the larvae's eating habits is helpful to discover their relationship to the environment. According to the Harvey, (1952) fireflies' larvae feed in one of two ways-by eating decomposing bodies or by hunting live prey. *Luciola cerata* Olivier for example, consume the carcasses of arthropods and mollusks. Species such as *L. yunnana* (Fairmaire), for example, attack ants, earth worms, shellfish, snails and other small arthropods by injecting them with a sort of digestive liquid that anesthetizes victims. Once the prey is immobile the firefly larvae go to work with their

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jawbones until the carcass is consumed (Hess, 1920). John, (1981) the gregarious feeding has been observed in several Lampyrid species and *L. tenebrosa* (Walker, 1858) was one of major feeder of the group.

Lamprigera tenebrosa (Walker, 1858) is widely distributed in Sri Lanka and throughout the Oriental realm. Their female is true larviform and apterous (Jeng, *et al.*, 2000). Larvae of these species are common in the environment at dark and Sri Lankans well known as “Rebadulla”. Bess, (1956) realized that the firefly, *L. tenebrosus* was a voracious feeder on the giant African snail, *A. fulica* (Bowdich) and that during 1954 & 1955 several hundred larvae were collected from Sri Lanka, and shipped to Hawaii, Indonesia & Guam and Philippines for control of the *A. fulica*. *L. tenebrosa* consider as endemic to India, Malaysia and Sri Lanka (Mead, 1961). *A. fulica* and *L. alatae* are serious pests in seedling stages of vegetable cultivars in Sri Lanka (Priyadarshana, 1998).

The present objective was to study the predatory role of lampyrid larvae (*L. tenebrosa*) using two laboratory experiments- to investigate the feeding efficiency of lampyrid larvae on selected exotic snail species (*A. fulica*) and slug species (*L. alatae*), and to compare the damage of selected vegetable nurseries caused by molluscan pests (*A. fulica* & *L. alatae*).

MATERIALS AND METHODS

Experiment was carried out from June to December in 2012.

Test 01- Experiment was carried out under (Tem: 27-30°C, RH: 48-72%) inside the laboratory. Range of 40 – 60 mm sized larvae of *L. tenebrosa* was selected for the study. 147 × 100 × 75 mm sized 10 transparent boxes were used and each was closed in top side by fine meshed net. Bottom of each box was covered by 10mm height normal soil substrate. Soil substrate was continuously wetted by spraying water during the experiment. 5 individuals of larvae (*L. tenebrosa*) were placed in each box at 18.00 hour. Half an hour later, selected 30 – 40 mm sized *A. fulica* individuals were inserted to the each box as regularly increase their numbers starting from 5 individuals up to 14. 12 hours later, numbers of *A. fulica* fed by *L. tenebrosa* larvae were counted. Experiment was repeated for 5 times. Same procedure was carried out applying *L. alatae* (20 – 30 mm sized) instead of *A. fulica* under same laboratory conditions.

Test 2- Experiment was conducted under laboratory conditions of Tem: 27-30 °C, RH: 48-72%. Larvae of *L. tenebrosa* (40 – 60 mm) and seedlings of cabbage and bean were used. Eleven plastic containers (370× 240 × 240 mm) (1for control and 10 for test) were used for each seedling type. Each container were filled with 100mm height soil mixture (Compost:

Silt: Coir dust- 1: 1: 1). When each container had 20 saplings, selected 30 – 40 mm sized *A. fulica* were placed into the middle point of that container. 5 individuals of *A. fulica* were put at once for each container at 18.00 hour of the day. After one hour later, the larvae of *L. tenebrosa* were inserted as increasing their numbers from 1 individual up to 10 for each container except the control one. These larvae were put into the middle of container at crawling stage of their body. Then each container was covered at top side by fine meshed net. 12 hours later numbers of damaged saplings were counted in each container. Experiment was repeated for 5 times. Water was sprayed daily for all containers. Same experiment was carried out using bean seeds instead of cabbage. Same procedures were followed similarly applying 20 – 30 mm sized *L. alatae* instead of *A. fulica*.

Data was analyzed using SPSS software 13.0 version.

RESULTS AND DISCUSSION

Test 1- Results of the feeding efficiency of *L. tenebrosa* on *A. fulica* revealed that five *L. tenebrosa* would be able to feed ten *A. fulica* during 12 hour feeding period (Figure 01). The feeding efficiency of *L. tenebrosa* (40 – 60 mm): *A. fulica* (30 – 40 mm) was 1: 2 under laboratory conditions during 12 hrs experimental period. In addition this study shows that prey catching behavior of *L. tenebrosa* does not depend on the number of prey items.

The feeding efficiency of *L. tenebrosa* (40 – 60 mm) on *L. alatae* (20 – 30 mm) was similar as its feeding on *A. fulica* (Figure 02). According to these findings it could be assumed that one *L. tenebrosa* normally feed on 2 *L. alatae*, however when more prey available they tend to kill more than they feed. That might be due to the absence of protective shell in *L. alatae* make them more vulnerable to their predator. Hence external shell of *A. fulica* reduce the feeding activity of *L. tenebrosa* larvae because lampyrid larvae spend inside a single prey item until it finished (Ormaily, 2010). However, the feeding activity of *L. tenebrosa* larvae does not depend on the size of the prey because glow worms did not show any tendency to select a particular size prey (Ronnie, 2005).

Test 2- Results indicated that in the absence of *L. tenebrosa* larvae, *A. fulica* (30 – 40 mm) can cause about 90% average damage to the cabbage seedlings during the 12 hrs feeding period under the laboratory conditions. In the presence of one *L. tenebrosa* larvae, average damage reduced about 80% and with the increase of number of *L. tenebrosa* larvae, average damage reduced about 15% (Figure 03). As such, when the presence of higher number of *L. tenebrosa* larvae, the damage of cabbage saplings done by *A. fulica* was significantly reduced ($r^2 = 0.800$, $P < 0.05$).

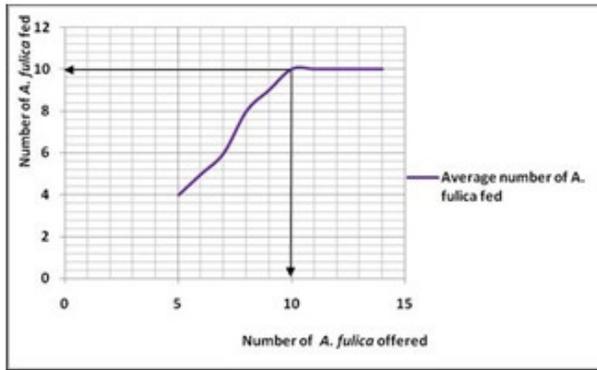


Figure 01: Feeding efficiency of *L. tenebrosa* larvae on *A. fulica* under laboratory conditions during 12 hrs period

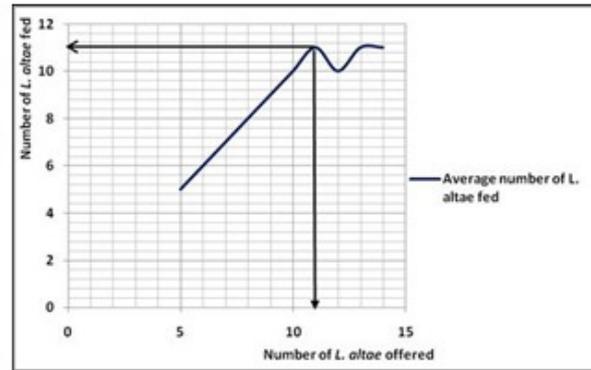


Figure 02: Feeding efficiency of *L. tenebrosa* larvae on *L. altae* under laboratory conditions during 12 hrs period

In the absence of *L. tenebrosa* larvae, the percentage damage of *A. fulica* on bean seedlings was about 90%. The damage had reduced to 10% after the introduction of 10 *L. tenebrosa* larvae into the arena (Figure 04). Hence, presence of higher number of *L. tenebrosa* larvae had significantly reduced the percentage damage of bean seedlings by *A. fulica* ($r^2 = 0.938$, $P < 0.05$).

L. altae cause less damage to cabbage seedlings than that of *A. fulica* under similar laboratory conditions. Damage of *L. altae* in the absence of *L. tenebrosa* larvae was about 55%. In the presence of *L. tenebrosa* larvae, damage was reduced to 3% (Figure 05). As such, Presence of higher number of *L. tenebrosa* larvae had significantly reduced the percentage damage of cabbage seedlings by *L. altae* ($r^2 = 0.767$, $P < 0.05$).

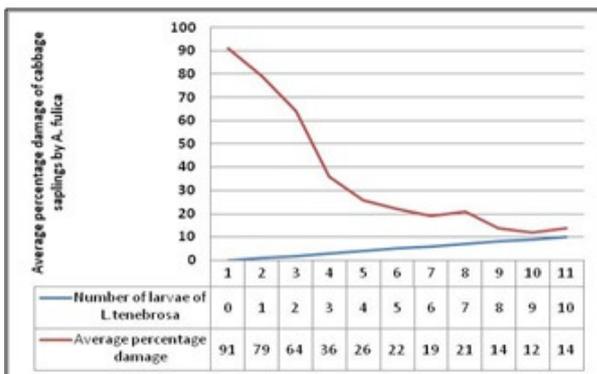


Figure 03: Percentage damage of cabbage saplings done by *A. fulica*, with different number of *L. tenebrosa* larvae inserted.

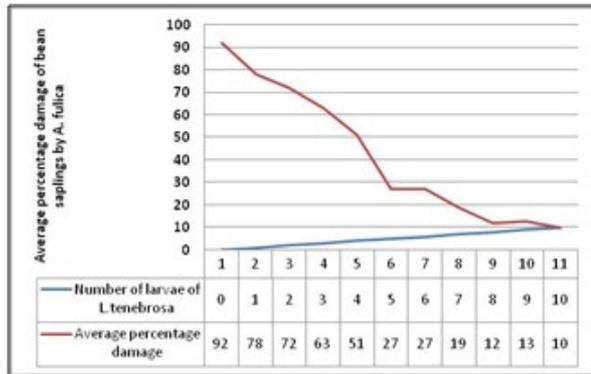


Figure 04: Percentage damage of bean saplings done by *A. fulica*, with different number of *L. tenebrosa* larvae inserted.

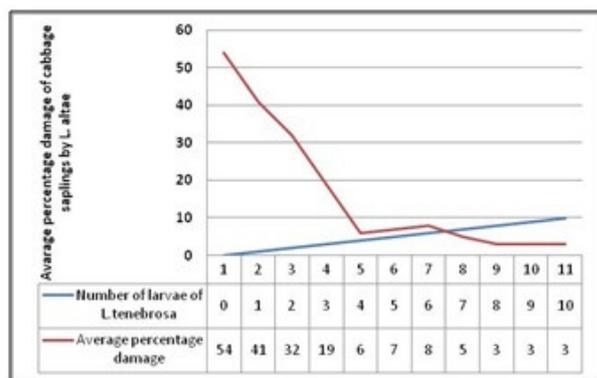


Figure 05: Percentage damage of cabbage saplings done by *L. altae*, with different number of *L. tenebrosa* larvae inserted.

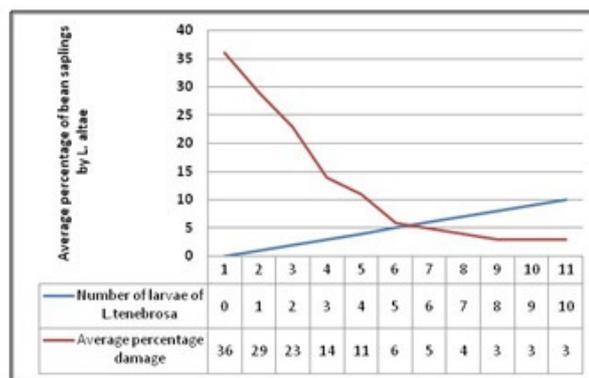


Figure 06: Percentage damage of bean saplings done by *L. altae*, with different number of *L. tenebrosa* larvae inserted.

Similarly, damage caused by *L. altae* on bean seedlings was relatively lower than that of the damage on cabbage seedlings. The percentage damage was 36% by *L. altae* on bean when the absence of *L. tenebrosa* larvae and damage was significantly reduced to 3% after the introduction of *L. tenebrosa* larvae into containers ($r^2 = 0.829$, $P < 0.05$) (Figure 06).

The overall results of this laboratory experiment indicated that *L. tenebrosa* larvae could be useful as a biological control agent for nocturnal molluscan pest species such as *A. fulica* and *L. altae*. In addition, it shows that the percentage damage caused by above molluscan pests on seedling stages of cabbage and bean cultivars could be significantly reduced after introducing *L. tenebrosa* as the predator. Although study has conducted under laboratory conditions, the situation might not vary in the natural field. Hence study results provide the outline on applying of *L. tenebrosa* larvae in Integrated Pest Management Practices (IPM) of agriculture field in future.

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