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THE LIFE HISTORY AND BIOLOGY OF *Megalocypha melongenae* POVOLNY AND BRADLEY, (LEPIDOPTERA: GELECHIIDAE), A LEAF MINER PEST OF *Solanum melongena* L.

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ABSTRACT

Megalocypha melongenae **Povolny and Bradley is a leaf miner pest of brinjal, which attacks the plant from the seedling stage to maturity. Its biology and host range have not been recorded so far. During this study, it was found to attack *Solanum indicum and Solanum xanthocarpum* besides *Solanum melongena* L. Its biology was studied using potted brinjal plants as well as field-cultivated plants. The adults copulate at dusk and oviposition takes place at night. Eggs are laid singly on the lower epidermis of the leaf close to veins. The average fecundity is 23. The incubation period at room temperature was 1-2 days. The larval period was 6-8 days and the pupal period ranged from 6-14 days. Males were shorter lived than females. Longevity of males ranged from 2-5 days while that of females ranged from 5-11 days. The adult is a brownish grey microlepidopteran measuring about 4mm in length with a wing span of 7-8mm. Two endoparasites *Hockeria* sp. (Hymenoptera: Chalcididae) and *Eupelmus* sp. (Hymenoptera: Eupelmidae) were recorded from pupae. A pathogenic fungus identified as *Aspergillus* sp. also caused mortality of pupae. Highest abundance of the pest occurred from October to December 1997, and the highest percentage parasitism of the pupae was also observed during this period.**

KEYWORDS: Biology, Life history, Brinjal Leafminer

INTRODUCTION

The brinjal leaf miner *Megalocypha melongenae* was first described by Povolny and Bradley in 1980 from specimens obtained from South India. It was first recorded in Sri Lanka by Fernando (1982), but no studies have been reported so far on the biology of this species.

The larva of *M. melongenae* mines the leaves of the host plants resulting in depletion of the photosynthetic tissue and retarding the growth of the plant. There is no record of the host range of *M. melongenae* in the literature. During the present study it was observed on three species belonging to Solanaceae namely, *Solanum melongena, S. indicum* and *S. xanthocarpum.* The present study deals with some aspects of the biology and life history of *M. melongenae* in detail.

MATERIALS AND METHODS

Brinjal plants used in this study were grown singly in 30cm tall polythene tubing of 20cm diameter, filled with a standard potting mixture. These plants were treated with NPK vegetable fertilizer mixture as recommended by the Department of Agriculture. Propineb 70% WP was used to control occasional fungal attacks. Build up of aphids on leaves was controlled by dipping the affected leaves in soap water.

Adult moths were reared from pupae collected in the field. The initial infestation of the plants were carried out by exposing the potted plants to adult moths reared from field-collected pupae. Adult moths that were used for studying the longevity and fecundity were obtained from pupae collected from potted plants. The pupae were placed in 8cm x 3cm glass vials plugged with cotton wool until adults emerged.

Two types of cages were used for studies on the life history and behavior. First type was a 60cm x 60cm x 60cm cage with a wooden frame covered over with mosquito netting and having a sleeve on one side through which plants and insects were introduced. The other was a Watkins and Doncaster cage, 36cm tall and 18cm in diameter.

Adults were fed with 1% sucrose solution dispersed from a glass vial plugged with cotton wool and hung upside down from the top of the cage with a string. Adults were sexed using the differences in shape of the abdomen of males and females. For studies on fecundity a mating pair was placed inside a Watkins and Doncaster cage provided with a potted brinjal plant about 30cm tall for egg laying. As the eggs were minute in size and liable to vanish when counting, the number of mines formed until 3 days after the death of the female was taken to be the fecundity.

Longevity of adults was studied using 15 insects (8 males and 7 females). They were fed on 1% sucrose solution and nectar of the flowers of *Ixora* sp. and *Tridax* sp. These inflorescence were placed inside the cages for them to feed on nectar. Adults emerging on the same day were reared together in the same cage. Insects in each cage were provided with an approximately 30cm tall potted brinjal plant. The death of these insects was recorded daily to determine longevity. The exact sites on the leaf surfaces where eggs were laid, the time of day when oviposition occurred and the manner in which eggs were distributed on the leaves, (*i.e.* whether singly or in clusters) were observed and recorded. The colour and

shape of eggs were observed and the length and breadth of eggs measured using a micrometer eyepiece fitted to a light microscope.

Morphological characteristics of the larvae including mouthparts, thorax and thoracic appendages and the abdomen were studied using a stereomicroscope. The lengths of the different larval instars were measured using a micrometer eyepiece fitted to a light microscope. Feeding pattern of the larvae was observed with a hand lens and the area of the mines in relation to larval size was measured using a 1mm grid on a transparent sheet. The larval period (from hatching to pupation) was recorded. The number of larval instars was determined by counting the number of shed head capsules found inside the mines and adding one to it since the fully grown larvae leave the mine to pupate and the last head capsule is shed outside the mine. Also the head capsule widths, of 207 caterpillars, of different sizes were measured using a micrometer eyepiece and a frequency distribution curve was plotted to test the Dyar's law (Chapman, 1985).

The morphology of the pupa was studied under a stereomicroscope. Body parameters were measured using a micrometer eyepiece. The pupal period was determined by observing the construction of pupal cocoons by final instar larvae and recording the dates of emergence of the adults from these cocoons; it was taken as the time taken for adult emergence from the time completion of the cocoon.

The average daily maximum and minimum temperatures and the average daily rainfall data of the study period were obtained from the Department of Meteorology in Colombo. The effect of these weather conditions on the mortality of the larvae and pupae, and on the population build up of the pest was studied. Two parasitoid species that emerged from parasitized pupae were identified at the Division of Entomology, Department of Agriculture at Gannoruwa. A pathogenic fungus isolated from the pupae was cultured in a potato dextrose agar (PDA) medium and identified using appropriate keys (Bessey, 1968; Onions *et al.*, 1981).

RESULTS AND DISCUSSION

The leaf miner larva of *Megalocypha melongenae* is a pest of *Solanum melongena,* which if not controlled, can retard the growth of the plant. Though the major host plant is *Solanum melongena,* it is found to attack some other species of Solanaceae. They are *S. indicum* and *S. xanthocarpum.* Young and mature plants are equally vulnerable to attack.

The adult *Megalocypha melongenae* (figure 1) is a small moth of 4 mm body length. The wing span is about 8mm. It is brownish gray dorsally and dark gray ventrally. The forewing has a prominent black spot in the middle. The hind wing shows the typical characteristics of the family Gelechiidae such as the lanceolate shape and the fringe on its posterior margin (figure 2). The fore legs are shorter than the middle and hind legs, and have no tibial spurs. One pair of tibial spurs is present on each of the middle legs and two pairs on each of the hind legs (figure 3). Both male and female appear 4mm in length. Males have a slender abdomen (figure 4) tapering towards the end while in females (figure 4) it is broader at its anterior end and narrows posteriorly into a slender tube at the end of which is a tuft of hairs which is thicker than in males.

The maximum life span of an adult recorded during this study was 11 days. The recorded longevity of 15 adults under laboratory conditions is given below in table 1. Males were shorter lived than females having a life span of 2 to 5 days where as females lived from 5 to 11 days.

Table 1. Longevity of adults of *Megalocypha melongenae*.

Time (Days)	*Number of deaths*	
	Male	*Female*
1	-	-
2	3	-
3	1	-
4	-	-
5	4	3
6	-	-
7	-	-
8	-	-
9	-	1
10	-	2
11	-	1

Adult emergence was observed only between 6.00 and 8.00 hours. They mate at dusk on the same day that they emerge. The number of eggs lay by a female during its lifetime ranged from 16-28 with an average of 23. Eggs are deposited singly on the lower surface of young leaves, very close to a leaf vein. Eggs (Figure 5) appear as tiny, white dots to naked eye. They are 0.26mm in length, 0.14mm in width and have an elliptical shape. When ovipositing, the females appeared to discriminate between tender leaves and mature leaves but did not avoid ovipositing on leaves on which eggs had already been laid. As a result, under crowded conditions mines coalesced, but the larvae did not attack each other.

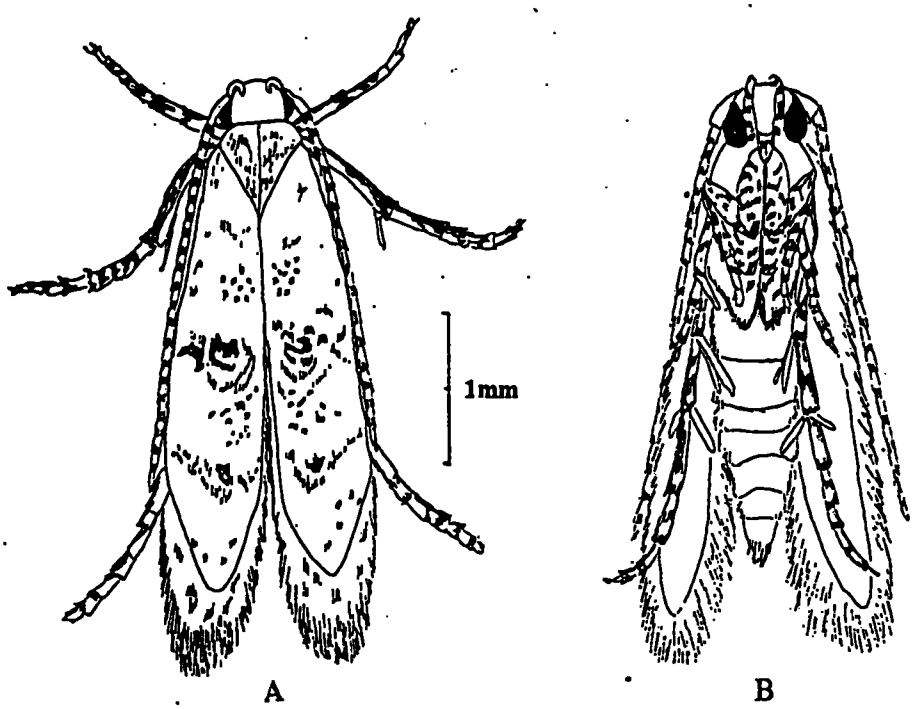

Figure 1. ***Megalocypha melongenae*** **– Adult A. Dorsal aspect B. Ventral aspect**

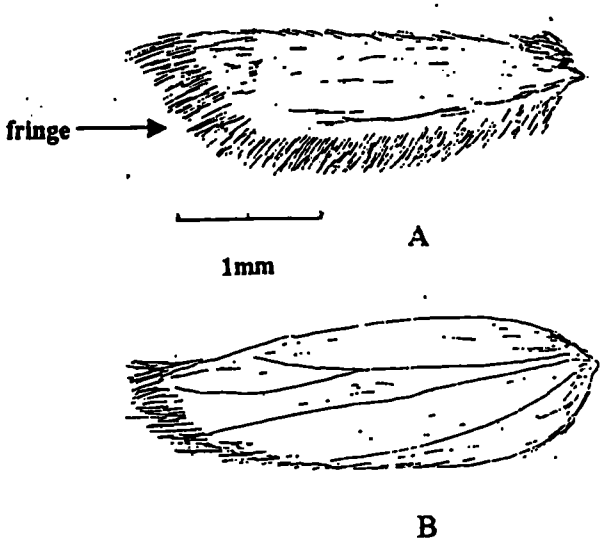

Figure 2. Shape of the wings (left) A. Hindwing B. Forewing

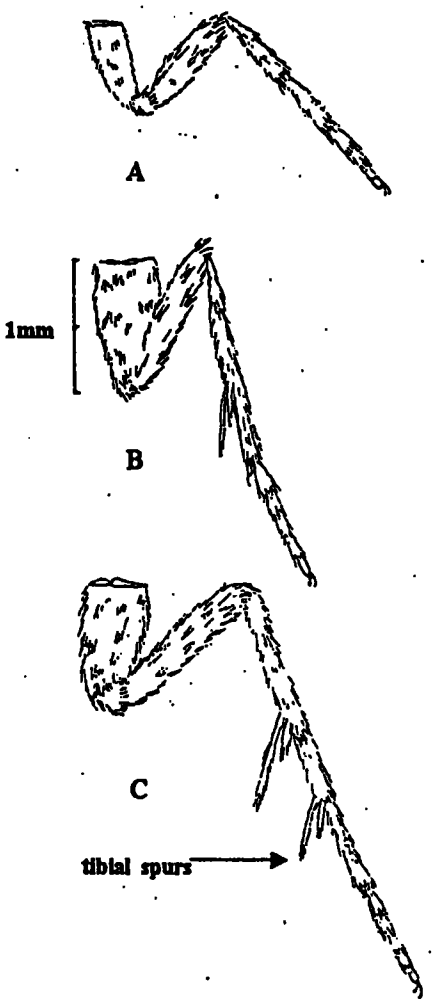

Figure 3. Legs of adult (right) A. Fore leg B. Middle leg C. Hind leg

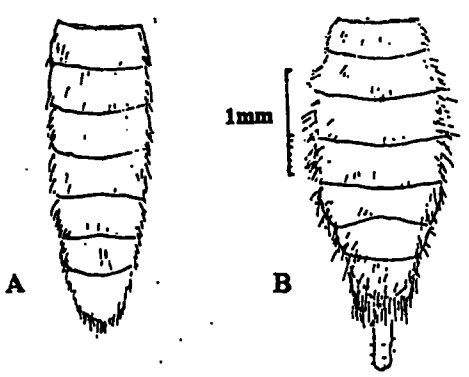

Figure 4. External features of the abdomen A. Male B. Female

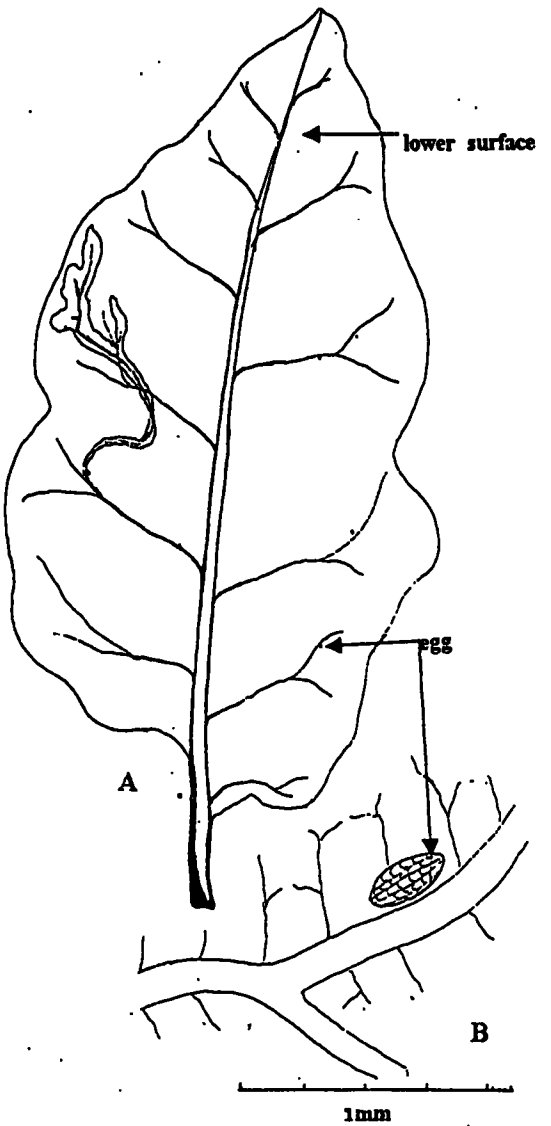

Figure 5. Egg of *M. melongeae* A. Place of deposition – as seen to the naked eye B. Egg

On hatching the larva pierces the epidermis and enters the mesophyll tissue on which it feeds. The larva (figure 6) has a cylindrical body. The length of larva ranged from 1.15mm to 7.0mm. Since the increase in body length seems to be inconsistent it cannot be used to separate them into different stages. The Dyar's law is not appropriate for this species. The larval period is 6-8 days. There are 5 larval instars. The size of the mine increases gradually with the growth of the larva (table 2, figure 7), and the speed with which the mine expands increases with larval growth. The maximum number of mines recorded on a *S. melongena* leaf was 25. Under such conditions the leaves died and the larvae were forced to leave the mines; the mature larvae pupated while the others perished. When several larvae feed on one leaf, it becomes membranous and is often attacked by pathogenic fungi. As the size of a mine is about 7.85cm^2, even a few larvae can cause severe damage to a leaf. The fifth instar larva leaves the mine and spins a silken cocoon around itself and undergoes the final moult inside it.

Table 2. Mine characteristics in relation to larval length of *Megalocypha melongenae*.

Length of larvae (mm)	*Shape of the mine*	*Mean area (mm^2) of the mine*
< 1.5	Very thin streaks	< 1.0
1.5-2.0	Small mines	6.5
2.0-4.0	Linear mines with branches	435
5.0-7.0	Interconnected blotches	785

The pupa (figure 8) is obtect and measures 3mm to 3.2mm in length and 1 mm to 1.2mm in width at the broadest place. The duration of the pupal period observed during this study ranged from 6-14 days. It was 6 to 7 days during hot weather and extended up to 2 weeks during cooler periods. The maximum and minimum temperatures and average rainfall data during the study period are given in table 3.

Table 3. Maximum and minimum temperature and rainfall data of the study period.

Month	*Temperature*		*Ave. Daily rainfall (mm)*
	Ave. Daily max. °C	*Ave. Daily min. °C*	
Sep. 1997	30.3	24.7	13.9
Oct. 1997	30.8	23.8	25.62
Nov. 1997	30.7	23.9	14.67
Dec. 1997	31.0	23.8	4.45
Jan. 1998	31.8	23.9	0.535
Feb. 1998	32.9	24.8	0.00
Mar. 1998	33.1	25.5	1.17
Apr. 1998	33.4	26.0	3.99
May 1998	32.5	27.0	6.42

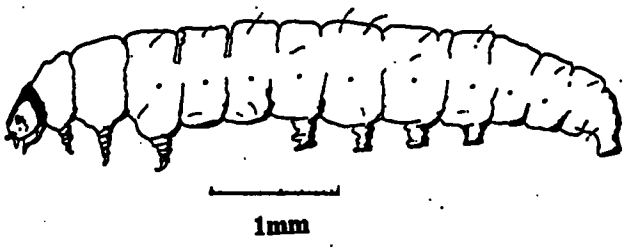

Figure 6. Larva of *M. melongenae*

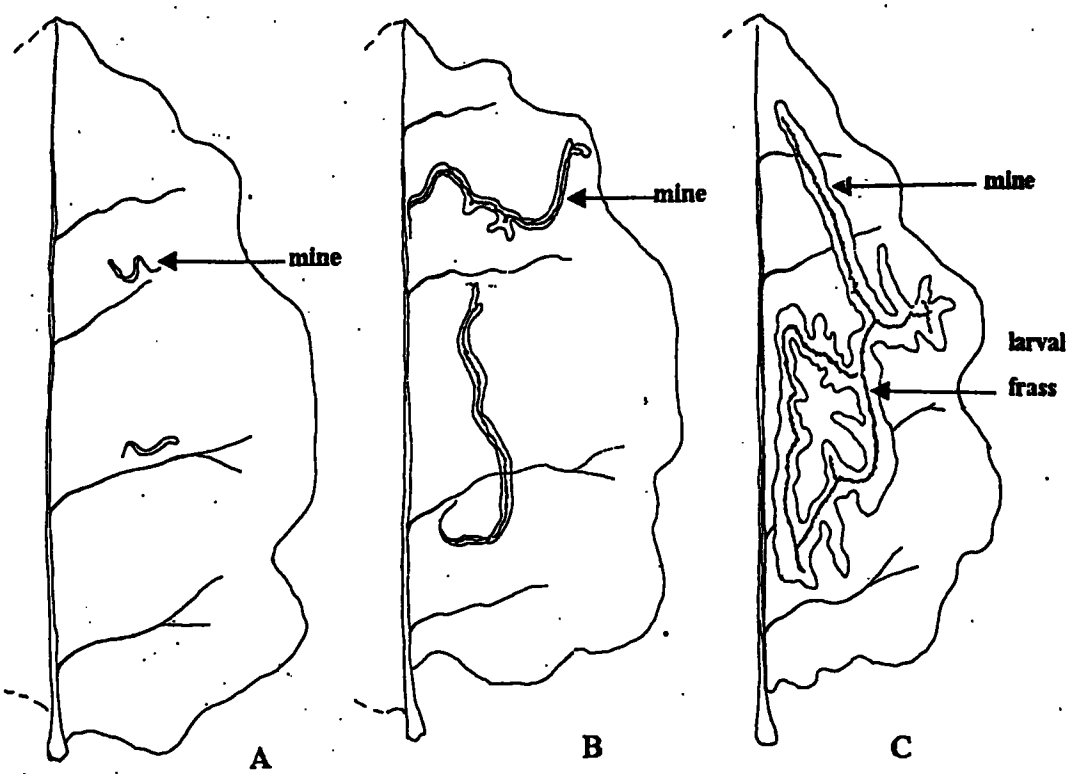

Figure 7. Progressive stages of mines A. Small mines B. Linear mines with branches C. Interconnected blotch mines

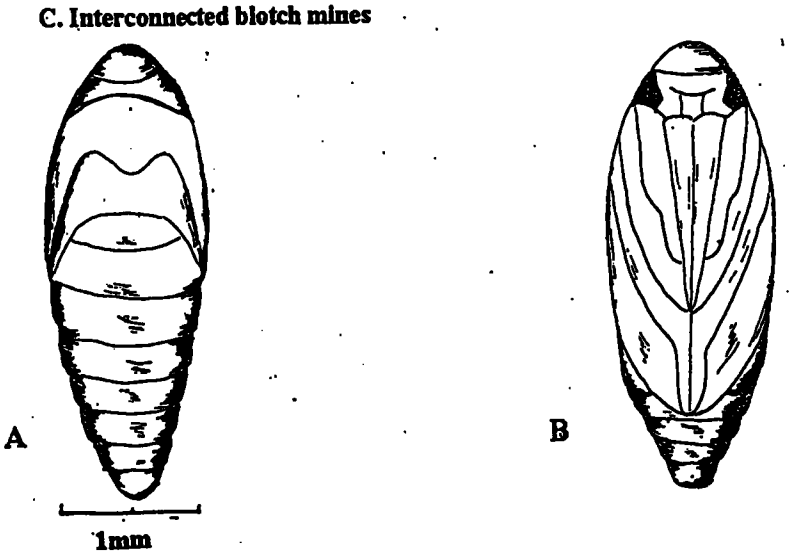

Figure 8. Pupal stage A. Dorsal view B. Ventral view

During October, November and December 1997 which were wet months with mean daily rainfalls of 25.62mm, 14.67mm and 4.45mm respectively, a large number of leaves were attacked and some mine up to 20 tunnels. A few mines were formed in the months of January and February 1998 and no new mine appeared on the plants in March 1998. These were dry months with mean daily rainfalls of 0.535mm, 0mm and 1.17mm respectively. These observations indicate that dry weather leads to population decline. However continuous heavy rain can cause some pupal mortality. The increase in population of this insect coincides with the luxuriant growth of the host plant during the rainy season.

Mortality of larvae and pupae was observed during the rainy season (October, November, December, 1997). Early instar larvae died when their mines decayed on being constantly soaked by heavy rainfall. The pupae also died after becoming deep brown and their bodies decomposed due to undetermined causes. However the true causes for the above mortalities should be studied and confirmed. Some pupae were found to dry up inside their cocoons in the months of January, February, March and April 1998. Since this type of mortality was common during dry weather conditions with maximum day temperature around 33 °C, it is possible that this mortality was the result of excessive temperature.

A pathogenic fungus found on pupa, which caused its death was identified as belonging to the genus *Aspergillus*. Two pupal parasitoids namely *Hockeria* sp. (Hymenoptera: Chalcididae) and *Eupelmus* sp. (Hymenoptera: Eupelmidae) were identified. Highest percentage of parasitism recorded during the peak period of pest incidence was 86%. Exarate pupae of a Hymenopteran parasitoid were found inside larval mines, but adults of this parasitoid could not be reared and hence could not be identified.

From this study, it was determined that the incubation period is 1 day, the maximum life span of the female is 11 days; adult emergence from pupae is accelerated by dry weather conditions; absence of tenanted mines in the field during the month of March 1998 indicates that the eggs probably undergo a period of aestivation. The leaf miner has the potential to become a serious pest of *S. melongena* but it has not reached the status of a major pest on account of the heavy use of insecticides in vegetable cultivation in Sri Lanka.

REFERENCES

Bessey, E.A. 1968. Morphology and taxonomy of fungi. Hafner Publishing Company, New York. 791 p.

Chapman, R.F. 1985. The insects- structure and function. Hodder and Stoughton, London. 819 p.

Fernando, I.V.S. 1982. An ecological study of the pests of some low-country vegetables in Kelaniya. Report of the Research grant. RGB/80/4, NSF; Colombo.

Onions, A.H.S., D. Allosopp, H.O.W. Eggings. 1981. Smith's introduction to industrial mycology. 7 th ed. Edward Arnold (Publishers) Ltd, London. 389 p.

Povolny, D., J.D. Bradley. 1980. *Megalocypha melongenae* sp. (Lepidoptera: Gelechiidae). Acta Entomologica bohemoslov. 77: 112-117.