
STUDIES ON THE BIONOMICS OF DIFFERENT SPECIES IN THE GENUS *LIRIOMYZA* IN THE BATTICALOA DISTRICT

R. F. NIRANJANA¹, H.N.P.WIJEYAGUNESSEKARA² AND S.RAVEENDRANATH³

¹ DEPARTMENT OF AGRONOMY,
EASTERN UNIVERSITY, SRI LANKA

² DEPARTMENT OF AGRIC. BIOLOGY,
UNIVERSITY OF PERADENIYA

³ VICE CHANCELLOR, EASTERN UNIVERSITY, SRI LANKA

INTRODUCTION

Genus *Liriomyza* was not reported as pests of crops in Sri Lanka until 1980. The first incidence was recorded in mid country and this pest was identified as *Liriomyza trifolii* in 1993. Another new species was reported in upcountry in 1997, and this species was identified as *Liriomyza huidobrensis*. Both species were reported to be introduced to Sri Lanka from another country.

However, some species of *Liriomyza* may have been existed in this country as non-pest. In some of these non-pests species may have develop to the status of pests due to various reasons. This may due to overuse and misuse of pesticides and the development of new biotypes. Other possibility is newly introduced species either from mid country or up country may have migrated to other districts such as Batticaloa.

MATERIALS AND METHODS

Preliminary data on leafminers were collected by farmer field surveys and observation of selected farmer fields and some laboratory studies. Farmers from nine Agricultural Instructor (AI) divisions were selected for this survey, from among the 17 Agricultural Instructor divisions in the Batticaloa district. The selected Agricultural Instructor divisions are; Kaluwanchikudy, Karadiyan Aru, Mandur, Palugamam, Ayithiyamalai, Mandapathady, Vantharumoolai, Kiran and Arayampathy

Five Grama Niladhari (GN) Divisions were randomly selected from each selected AI division. From each GN division, ten farmer fields were selected for this study. All selected farmers were interviewed with the help of a questionnaire.

From the commencement of cultivation field visiting and observations were carried out in each farmer field to observe the host range of *Liriomyza* leafminers, collect samples of leaf mining insects for the identification of species and to study their bionomics.

COLLECTION OF SAMPLES

One square meter of field was selected from each selected farmer field for this study. Within that area, all infected leaves with larval instars of leafminers were picked. Samples were collected by weekly interval for one month and replicated four times.

The collected samples of different vegetable crops and infested wild plants by above-mentioned method were taken to laboratory. Samples from each farmer field were collected separately and kept on sand tray providing humid conditions (80-90% RH). After the development up to pupal stage they were kept in an insect proof cage until the emergence of adult. Then these samples were preserved for further studies.

IDENTIFICATION OF LEAFMINER SPECIES

The collected samples using above-mentioned method were taken for identification. The insect belonging to Family: Agromyzidae were separated from the collection. Then the specimens belonging to genus *Liriomyza* were identified and separated from the Agromyzidae insects. Morphological and morphometric characterization were carried out to specimens belonging to genus *Liriomyza* leafminers among separated Agromyzidae insects.

The number of *Liriomyza* species was confirmed by this grouping. *Liriomyza* species in Batticaloa district were confirmed by using reference collections, catalogues and taxonomic keys on *Liriomyza* species. In addition, the population dynamics of leaf miners in the Batticaloa district were assessed by monitoring and counting the insects in the field.

DETECTION OF LIFE CYCLE OF EACH LEAFMINER SPECIES

After the detection of adult *Liriomyza* in each field, the leaves of each vegetable crop were carefully observed by using hand-lens to find out the egg deposition. Twenty leaves with eggs were collected separately in twenty polyethylene bags with labels. They were cultured in laboratory providing suitable environmental conditions.

Each egg deposited leaf was observed under microscope. Without damaging them the colour, shape and diameter of the eggs were noted. By daily observation, the incubation period of egg were also recorded. After hatching out the larvae, they were observed daily under the microscope to study their characteristics, such as colour and length. These features were recorded until pupation. Larval period and the number of instars were also evaluated using 1300 leafminer larvae in different stages, which were collected from farmer fields. Their body length and width were measured and recorded to determine the number of larval instars.

The characteristics of pupa, such as place of pupation, colour, and type and pupation period were recorded by making daily observations. After emergence of adult from each sample, their external morphological parts were sketched carefully and the species of each adult were identified with the help of reference materials. Morphometric studies were also carried out for each species.

Just after the emergence of adults, they were introduced to an insect proof cage containing tomato crop to study the pre-oviposition period of the leafminer.

RESULTS AND DISCUSSION

Identification of *Liriomyza* sp. in the Batticaloa District

The dipteran insects were separated from the preserved samples with the help of the specific character of order Diptera that is one pair of wing. Among them insects with black and yellow colour were grouped into the family Agromyzidae. In general, any agromyzid with a bright yellow central area of the scutellum and bright yellow areas of the head and pleura belongs to the genus *Liriomyza*. With the help of these characters the insects belong to the genus *Liriomyza* were separated from the Agromyzids.

Likewise, six thousand four hundred and sixty *Liriomyza* adults were separated from the preserved sample. Morphological and morphometric studies showed that the characteristics of an adult were similar to each other. Therefore it could be concluded that only one species of *Liriomyza* is found in the Batticaloa district. Morphological and morphometric features of *Liriomyza* species are listed below.

Colour of the body of *Liriomyza* species was black and yellow. Length of body ranged between 1.5mm to 1.8mm. Pre-oviposition period of *Liriomyza* is 2 days.

Head: Most of part of head was occupied by compound eyes. Three ocelli were arranged in a triangular shape between the compound eyes. Face and frons were bright yellow in colour. The hind margin of the eye was black. The inner vertical setae (vti) arose from yellow area and outer vertical setae (vte) from black area of the head.

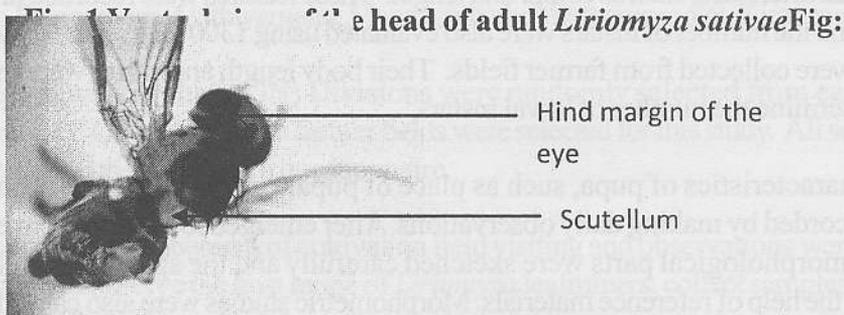
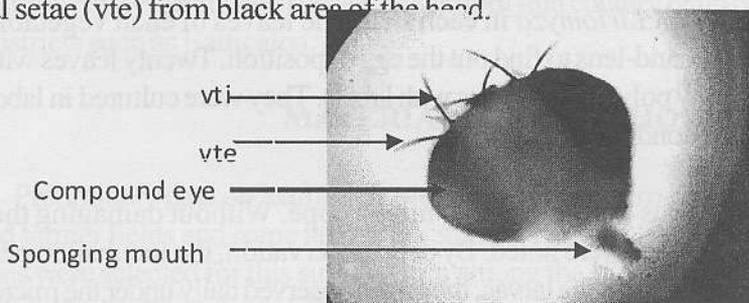


Fig: 2. Dorsal view of the adult *Liriomyza sativae*

Antennae had three segments; the scape, pedicel and meriston. Scape was yellow, round and larger than the other two segments. Black coloured terminal arista was attached to distal end of the meriston. *Liriomyza* had typical sponging type mouthparts.

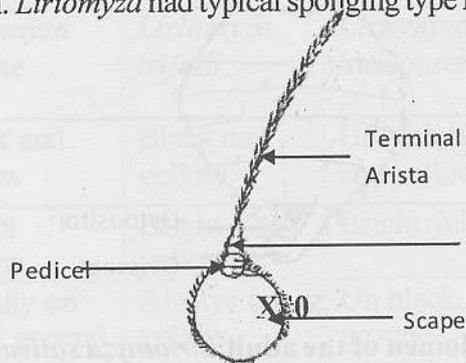


Fig: 3 Aristate type of antennae of adult *Liriomyza sativae*

Thorax: It consisted of three segments. Among them mesothorax was larger and well developed than pro and metathorax so as to carry the functional fore wings. The mesonotum was shiny black to the edge of a bright yellow scutellum. The mesopleura was predominantly yellow with a variable dark area. Length of fore wings ranged between 1.4mm to 1.6mm. Venation of fore wing is shown in Figure 4. A free alula was found near the base of the forewing. Subcostal vein (Sc) was vestigial.

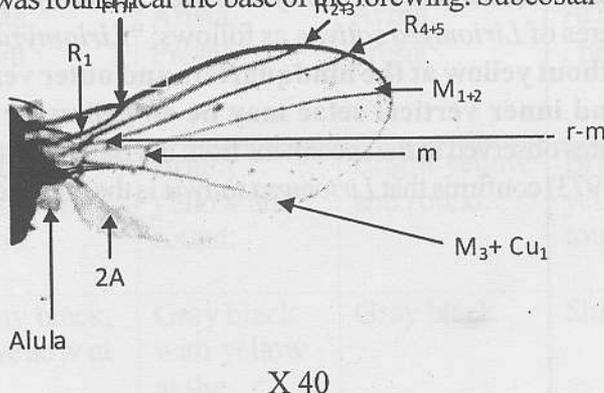


Fig: 4 Forewing of the adult *Liriomyza sativae*

All three pairs of legs were similar in size and shape. Tarsal formula was 5-5-5. First tarsomer of the tarsus was larger than the other tarsomers. Pre-tarsus consisted of a pair of claws.

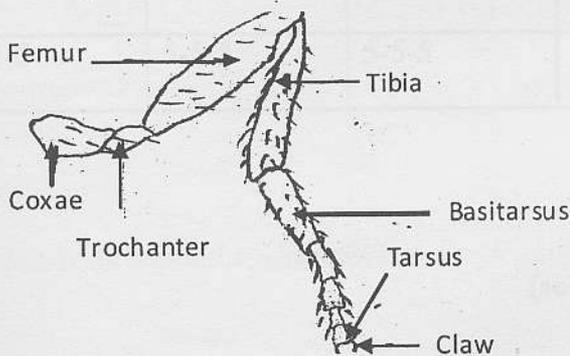


Fig: 5 Fore leg of the adult *Liriomyza* sp.

Abdomen: It consisted of six segments. Sixth abdominal segment of the female was modified as oviscapt, which encloses the ovipositor. There were many bristles on abdomen. Bristles of the dorsal surface were arranged in rows.

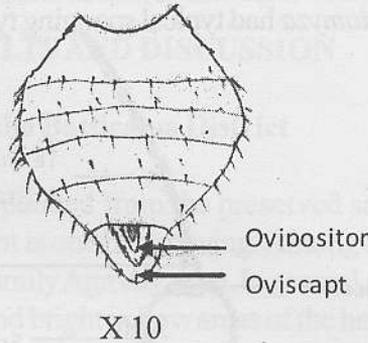


Fig: 6 Abdomen of the adult *Liriomyza sativae*

Table 1 shows the summary of key characters of four species of *Liriomyza* sp., those were reported to be found in Sri Lanka (Wijesekara, 1997) and comparison of the features of *Liriomyza* sp. collected from Batticaloa district.

The characteristics of *Liriomyza* species that was collected from Batticaloa district were very closer to the characteristics features of *Liriomyza sativae* (Table 1). Spencer in 1973 recorded the characteristic features of *Liriomyza sativae* as follows: "***Liriomyza sativae* has shining black mesonotum without yellow at the hindquarters and outer vertical setae always on black background and inner vertical setae may be on yellow or black background**". Comparison of the features observed in the specimens from the Batticaloa district with the features described by Spencer (1973) confirms that *Liriomyza sativae* is the only leafminer species existing in this district.

Table: 1 Summary of key characteristic features of four species of *Liriomyza* species reported to be present in Sri Lanka and comparison of the features of *Liriomyza* species collected from Batticaloa district (Species X)

Characters	<i>Liriomyza sativae</i>	<i>Liriomyza trifolii</i>	<i>Liriomyza huidobrensis</i>	<i>Liriomyza brassicae</i>	Species X
Colour	Black and yellow	Black and yellow	Grayish black and yellow	Black and yellow	Black and yellow
Head	Bright yellow	Bright yellow	Bright yellow	Bright yellow	Bright yellow
Vte	Usually on black ground	Always on yellow ground	On black ground	On yellow ground	On black ground
Vti	On yellow ground	On yellow ground.	On black ground	On yellow ground	On yellow ground
Hind margin of the compound eye	Black	Yellow	Black	Yellow	Black
Antennae: Third antennal segment	Arista, presnt	Arista, Presnt	Arista, presnt	Arista, . presnt	Arista, presnt
Antennae: Basal antennal segment	Bright yellow and round.	Bright yellow and round.	Bright yellow and round.	Bright yellow and round	Bright yellow and round.
Mesonotum	Shiny black, no yellow at the hindquarters	Gray black with yellow at the hindquarters	Gray black	Shiny black	Shiny black
Scutellum	Bright yellow	Bright yellow	Bright yellow	Bright yellow	Bright yellow
Wing length	1.3 – 1.7 mm	1.3 – 1.7 mm	.3 – 2.3 mm.	1.2 – 1.6 mm	1.4 - 1.6 mm.
Tarsal formula	5-5-5	5-5-5	5-5-5	5-5-5	5-5-5

(source: Spencer, 1973)

Characteristics of immature stages of *Liriomyza sativae***Egg**

Eggs are white in colour, translucent and elliptical in shape. The length of an egg ranges between 0.2 – 0.3 mm and width ranges from 0.1 mm to 0.2 mm. Incubation period is 2 – 4 days.

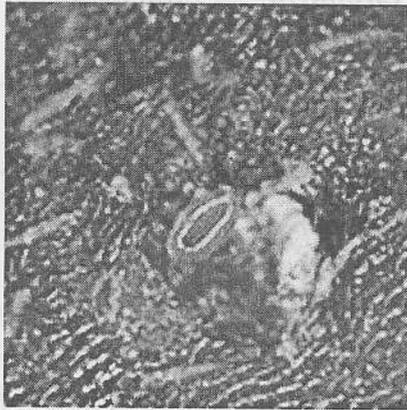


Fig: 8 Egg of *Liriomyza sativae*

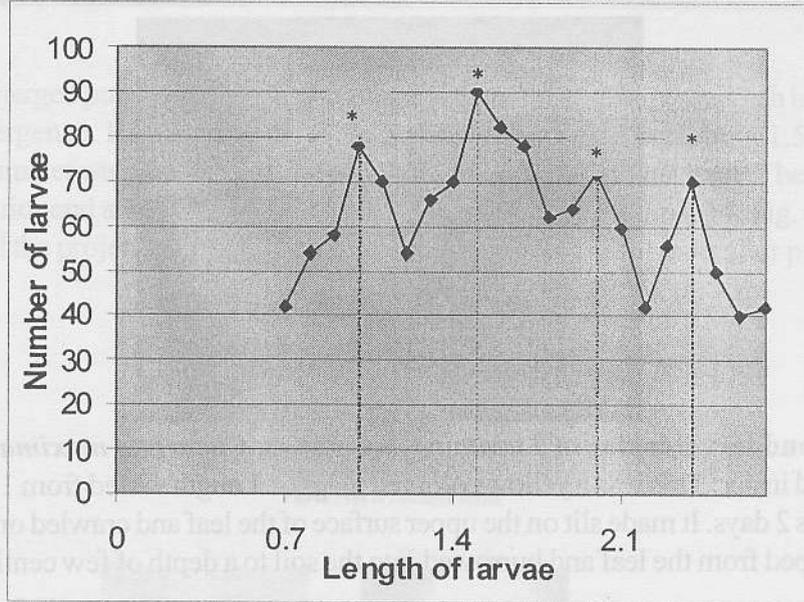
Larva

Larvae of *Liriomyza sativae* are legless maggots with no separate head capsule. Four larval instars were detected by the measurements of larval length. The table 2 shows the length of 1300 larvae of *Liriomyza sativae*.

Table: 2 Length of 1300 larvae of *Liriomyza sativae*

Length of Larvae (cm)	Number of Larvae
0.7	42
0.8	54
0.9	58
01	78
1.1	70
1.2	54
1.3	66
1.4	70
1.5	90
1.6	82
1.7	78
1.8	62
1.9	64
02	72
2.1	60
2.2	42
2.3	56
2.4	70
2.5	50
2.6	40
2.7	42

Graph 1: Frequency distribution of length of 1300 larvae of *Liriomyza sativae*



The above graph clearly shows that there is four larval instars in the life cycle of *Liriomyza sativae*. Pettitt in 1990 also recorded four larval instars of *Liriomyza sativae*. All these maggots had black coloured mouthhook.

First instar: This was a colourless and transparent maggot. The length of this maggot ranged from 0.7 mm to 1.2 mm. Duration of first instar was 2 days.

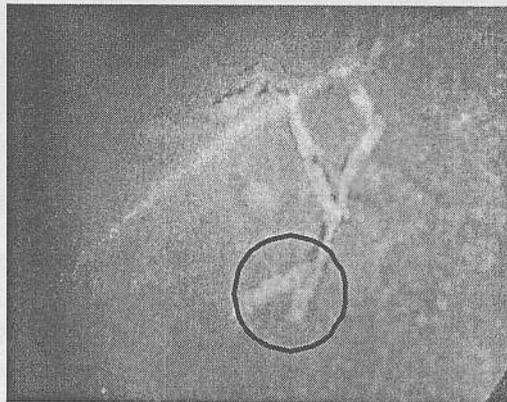


Fig: 9 First larval instar of *Liriomyza sativae* in a *Cucurbita maxima* leaf mine

Second instar: Greenish yellow in colour maggot ranged from 1.3mm to 1.8mm in length. Duration of this maggot was 2 days.

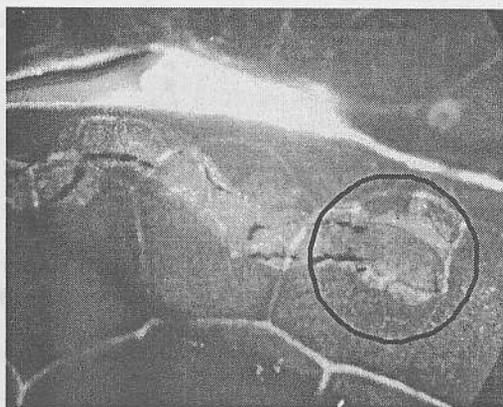


Fig: 10 Second larval instar of *Liriomyza sativae* in a *Cucurbita maxima* leaf mine

Third instar: This was a yellow coloured maggot. Length varied from 1.9mm to 2.3mm. Duration was 2 days. It made slit on the upper surface of the leaf and crawled on the leaf surface. Then it dropped from the leaf and burrowed into the soil to a depth of few centimetres to form a pupanum.

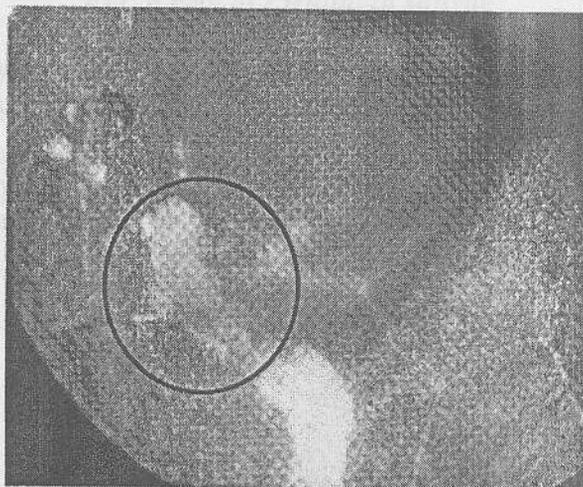


Fig: 11 Third larval instar of *Liriomyza sativae* in a *Cucurbita maxima* leaf mine

Forth instar: It occurs between puparium formation and pupation. Yellow coloured maggot varies from 2.3mm to 2.7mm in length. Highest width of this instar ranges from 0.6mm to 0.7mm. This is a non-feeding stage and lives only for 3 - 6 hours.



Fig: 12 Forth larval instar of *Liriomyza sativae*

Pupa

Newly emerged pupa was yellow in colour and then it changed into reddish brown colour onl day after emergence. Rectangular, oval shaped puparium measured about 1.5 - 1.7mm in length Highest diameter was 0.6 - 0.7mm. Ten segments were visible in this stage. There were threl bulbs at the posterior end and two bulbs at the anterior end of pupae (Fig. 4.14, Fig. 4.13). Thesl bulbs represented the projected spiracles. Adults were emerged 6 to 12 days after pupation.



Fig: 13 Pupa of *Liriomyza sativae*



Fig: 14 Anterior end of pupa

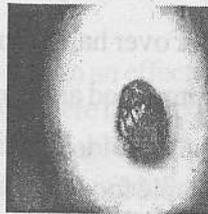


Fig: 15 Posterior end of pupa

Table 3 shows the duration of immature stages of *Liriomyza sativae* and their statistical arameters.

Table: 3 Duration of different stages of *Liriomyza sativae* and their statistical parameters

Immature stage	Duration	Mean	Mode	SE
Eggs	2-4 days	2.95	3	±0.17
First larval instar	2 days	2	2	± 0.397
Second larval instar	2 days	2	2	± 0.397
Third larval instar	2 days	2	2	± 0.397
Forth larval instar	3 – 6 hrs	4.65	5	± 0.221
Pupal stage	6 – 12 days	8.95	9	± 0.37

CONCLUSION

The study showed that *Liriomyza sativae* is the only Agromizidae leafminer species, which is inhabiting and damaging almost all the vegetable crops grown in the Baticaloa district.

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