


**DEVELOPMENT OF LIRIOMYZA TRIFOLII (DIPTERA: AGROMYZIDAE) LARVAE ON TOMATO AT CONSTANT TEMPERATURES**

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**ABSTRACT**

The development of *Liriomyza trifolii* (Burgess) larvae was studied at 15.6, 21.1, 26.7, and 32.2°C constant temperatures in excised leaflets of tomato *Lycopersicon esculentum* Mill. cv. ‘Walter’. The relationship between the developmental rate (Y) (as measured by the reciprocal of days required to complete development) and the temperature (X) in Celsius is given by the equation \( Y = -0.0926 + 0.0118X \). The threshold for larval development was predicted by the equation to be 7.8°C. Using this threshold, larval development was predicted to require 85.0°C-days. Under fluctuating greenhouse temperatures, development required 80.7°C-days based upon the 7.8°C threshold.

**RESUMEN**

Se estudió el desarrollo larvario de *Liriomyza trifolii* (Burgess) en hojas de tomate *Lycopersicon esculentum* Mill. variedad ‘Walter’, cortadas individualmente, a temperaturas constantes de 15.6, 21.1, 26.7, y 32.2°C. La relación entre la tasa de desarrollo (Y) (medida por el recíproco de los días requeridos para completar el desarrollo) y la temperatura (X), en grados Celsius, está dada por la ecuación \( Y = -0.0926 + 0.0118X \). En base a esta ecuación, la predicción de la temperatura umbral de desarrollo larvario es de 7.8°C. El desarrollo larvario requeriría 85.0°C-días utilizando el umbral antes mencionado. Bajo temperaturas fluctuantes en un invernadero, el desarrollo larvario fue de 80.7°C-días en base al umbral de 7.8°C.

*Liriomyza* spp. are pests of tomato, celery, and chrysanthemum in Florida. The timing of insecticide applications based upon the results of periodic scouting would be desirable since outbreaks may be induced by the frequent applications of broad spectrum insecticides (Oatman and Kennedy
Such management programs have been demonstrated economically and biologically feasible for tomatoes (Pohronezny et al. 1978, Schuster et al. 1980). A quantitative description of the impact of temperature on the development of leafminers would be one component of a mathematical model which could be useful in the prediction of the dynamics of leafminer populations. Such a predictive model would be valuable in management programs.

Little information is available regarding the influence of temperature on the development of *Liriomyza* spp. Genung and Harris (1961) exposed snap bean plants to *Liriomyza* spp. in the field and followed the development of the egg, larval and pupal stages in an air conditioned greenhouse where the temperature ranged from 22.0°C to 25.5°C and averaged 23°C. Under these conditions, larval developmental times ranged from ca. 4 to 6 days and averaged 4.9 days. Oatman and Michelbacher (1959) studied the impact of temperature on development of *L. pietella* (Thomson), although the species with which they worked was probably *L. sativae* Blanchard (Spencer 1973). They demonstrated in growth chamber studies that the larval developmental time in bean leaves ranged from ca. 3.5 days at 32.2°C to ca. 10.4 days at 15.6°C.

The purpose of the present study was to study and mathematically describe the impact of temperature on the development of *Liriomyza trifolii* (Burgess) larvae on tomato. This leafminer is the predominant species in tomato on the west coast of Florida at the present time.

**Materials and Methods**

Leaflets were cut from 8- to 12-week-old greenhouse grown tomato plants cv. ‘Walter.’ Their petioles were immersed in tap water contained in 4 dram glass vials. Ten to 18 vials were held in plastic shell racks. Four racks were placed in 61 x 61 x 61 cm cages covered with organdy cloth. The leaflets were exposed for 12 h to >100 adult *L. trifolii* that were reared from field-collected excised foliage. A single rack of vials with leaflets containing eggs was placed in each of 4 incubators set at either 15.5, 21.1, 26.7 or 32.2°C constant temperatures. Fluorescent lighting was provided at a 12 h photoperiod. Three replicates were completed and no incubator was used at the same temperature more than once. Flies for infesting tomato foliage for each replicate were obtained from foliage collected from different host plants during the spring of 1980. The foliage for one replicate was collected from chrysanthemum from the Bradenton, FL area and the foliage for two replicates was collected from celery from the Belle Glade, FL area. All leafminers reared from foliage of these host plants during this period have been identified as *L. trifolii* (G. L. Leibee and J. F. Price, personal communications).

Larval development was observed daily. All larvae in excess of 2 per leaflet were killed with a dissecting needle to prevent overcrowding. Water was added to the vials as needed. The base of each petiole was pruned regularly to reduce the clogging of the vascular tissues by microbial organisms. Developmental rates (the reciprocal of days) were calculated, averaged for each temperature for each replicate and regressed on temperature. A regression equation was derived utilizing the general linear model of the Statistical Analysis System computer program (Ray 1982). The equation was then used to calculate the lower developmental temperature threshold and the C°-days required to complete larval development.
To test the validity of the predicted lower temperature threshold and the $C^\circ$-day requirement under fluctuating temperatures, adult *L. trifolii* were confined from 2-3 h on tomato leaflets in the greenhouse using the clip cage of Zoebisch et al. (1983). The adults utilized had been reared for at least 10 generations on tomato foliage in the laboratory using techniques similar to those of Ketzler and Price (1982). The adults were removed at about 1200 h and development observed daily at 0800, 1200 and 1700 h. Temperature and RH were recorded with a hygrothermograph and average temperatures computed for each day using the modified sine wave technique of Allen (1976). These values were then utilized to calculate the predicted $C^\circ$-days and development time. The experiment was repeated 3 times.

RESULTS AND DISCUSSION

Developmental times decreased with increasing temperature, averaging 10.1 days at 15.6°C ($n=61$), 7.1 days at 21.1°C ($n=50$), 4.4 days at 26.7°C ($n=45$) and 3.5 days at 32.2°C ($n=34$). A linear regression equation provided a good mathematical description of the effect of temperature on development of *L. trifolii* larvae in tomato foliage (Fig. 1). The regression coefficient ($r=0.97$) was significant at the $P = 0.01$ level.

At 12.8°C, the 17.1 days estimated for larval development in our study compares quite closely to the 16.9 days observed in bean foliage by Oatman

![Graph](image-url)

Fig. 1. Influence of temperature on developmental rate of *Liriomyza trifolii* larvae in tomato foliage.
and Michelbacher (1959) for L. sativae. The 3.5 days for larval development at 32.2°C in our study approximated the 3.3 days in the study of Oatman and Michelbacher (1959) for L. sativae. The estimated larval developmental time at 23°C in our study (5.6 days) was greater than that observed by Genung and Harris (1961), 4.9 days.

The degree-day concept can be used within the 15.5 to 32.2°C temperature range for predicting the days required to complete development. The larval stage would be predicted to require 85.0 C°-days, with a lower threshold of 7.8°C.

In the greenhouse, where the RH averaged 80% and the temperature averaged 27.6°C and fluctuated from a mean high of 31.9°C to a mean low of 22.7°C, 158 larvae required an average 80.6 ± 4.6 (SD) C°-days to complete development. The time required for development was 4.1 days and compares favorably with the 4.3 days predicted by the laboratory study.

The equation presented here for describing the impact of temperature on development of L. trifolii larvae should be an important component of a mathematical model for describing and predicting the dynamics of L. trifolii populations.

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REFERENCES CITED


