POPULATION TRENDS AND PRINCIPAL PARASITOIDS OF THE VEGETABLE LEAFMINER, *LIRIOMYZA SATIVAE*,[1] ON TOMATOES IN ALABAMA[2]

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ABSTRACT

Surveys of the populations and the parasitoids of *Liriomyza sativae* Blanchard on late-season tomatoes were conducted during two years in two locations of Alabama. Population trends and extent of parasitism were tabulated. Ten species of hymenopterous parasitoids from 4 families were reared from field-collected larvae. The three most prevalent parasitoids and their percent occurrence were: 1) *Opius dimidiatus* (Ashmead) (Braconidae), 33.3%; 2) *Chrysonotomyia* sp. (Eulophidae), 20.8%; and 3) *Halticoptera* sp. (Pteromalidae), 19.5%.

Key Words: *Liriomyza sativae*, populations, parasitism, parasitoid.

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INTRODUCTION

The vegetable leafminer, *Liriomyza sativae* Blanchard, is a polyphagous insect, having been reared from over 50 species of cultivated and wild hosts (Stegmaier 1968). In Alabama it has been found infesting many crops, but is most damaging to tomato (Chambers 1981). Injury is caused by larval feeding which reduces photosynthetic capability. More than one-third of the 3,000 ha of fresh market tomatoes grown annually in Alabama are produced in a monoculture system on Chandler Mountain in St. Clair Co. in north-central Alabama. In 1976 and 1977, premature defoliation of tomato plants caused by the vegetable leafminer at that location resulted in loss of the late-season crop. Growers sprayed at 2- to 3-day intervals with registered insecticides to control this insect (G. R. Strother, personal communication). Although parasitic hymenoptera play an important role in regulating leafminer populations (Oatman 1959; Musgrave et al. 1975), no information was available on parasitoids associated with *L. sativae* in Alabama, and no efforts were made to protect the natural populations of parasitoids.

Following the 1976-77 outbreak, the Alabama Cooperative Extension Service initiated a tomato pest management program on Chandler Mountain. To collect information needed to support this management program, field research was conducted during the 1978 - 79 growing seasons to determine population trends of the vegetable leafminer and to identify its parasitoids.

[1] Diptera: Agromyzidae
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MATERIALS AND METHODS

Population Surveys

Leafminer surveys were conducted in 1978 and 1979 at Chandler Mountain and at Auburn, Alabama. On Chandler Mountain, cv. Walter staked late-season tomatoes were grown in rows on 2.4- to 3.0-m centers. The fields sampled received a dimethoate application for seedling pests shortly after transplanting and methomyl applications every 7 - 10 days beginning at first bloom. Two 2- to 3-ha tomato fields (Field I and Field II) were monitored weekly from mid-July to mid-September. The number of active mines (those containing live larvae) observed per 30 min of searching time per field was recorded. Sampling time was equally divided among 5 stations randomly selected in each field. Mines were counted on the upper portion of 4 - 6 plants from each station. The same person made all the counts both seasons.

The survey at Auburn was conducted weekly beginning on the first week of July on a garden plot of cv. Big Boy tomatoes consisting of 3 rows, with 12 plants per row. A total of 30 minutes of search time was allocated to examination of randomly selected plants on each sample date.

Parasitization

The species of parasitoids and their incidence in *L. sativae* populations were determined by collecting infested tomato leaves at various locations throughout the growing season and allowing parasitoid larvae to mature, pupate, and emerge. Weekly samples were taken at Chandler Mountain; samples were also taken from the Auburn garden plot but at biweekly intervals. A sample consisted of all the mined leaves that could be collected in 1 man-hour of searching time. Leaves were placed in 470-ml paper containers (25 leaves per container), held at 27°C and 70% RH, and left unopened for 14 - 20 days to allow complete emergence of adult flies and parasitoids. The contents of the containers were then examined, and the number of adult leafminers and parasitoids was recorded. Parasitoid species, their relative abundance, and rates of parasitism were determined from this information. The level of parasitization was calculated using the formula:

$$\% \text{ Parasitization} = \frac{\text{no. of parasites}}{\text{no. of leafminers} + \text{parasites}} \times 100$$

RESULTS AND DISCUSSION

Population Surveys

On Chandler Mountain, leafminer larvae were first found on late-season tomatoes in early July (Fig. 1). Population levels generally increased slowly in July and early August and then increased rapidly. This rapid increase began in the second or third week of August both in 1978 and 1979. Peak population numbers were reached by mid-September. Additional observations indicated that leafminer populations began to rapidly decline by the end of September or early October during both years.

Considerable between-field variation in leafminer density occurred. In 1978, Field I had a peak population of more than 1,700 (based on active mines observed per 30 min), whereas Field II had a peak of 824 (Fig. 1, A and C). In 1979, the leafminer populations increased more slowly and did not reach the high densities that were measured in 1978 (Fig. 1, B and D).

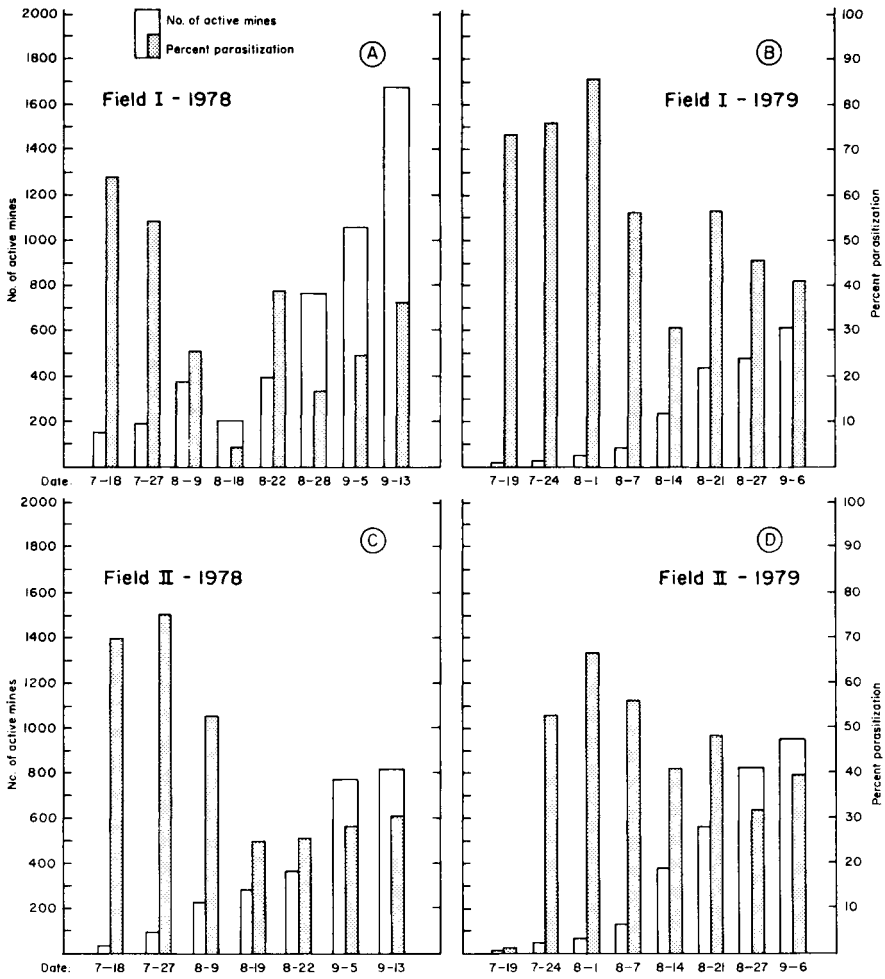

Fig. 1. Seasonal population densities and parasitization of *L. sativae* on Chandler Mountain, Alabama: A. Field I, 1978; B. Field I, 1979; C. Field II, 1978; D. Field II, 1979.

Initial infestations at Chandler Mountain in both 1978 and 1979 occurred in field border rows. In early July, weeds adjacent to fields were heavily infested with active mines while young tomato plants supported low populations of leafminers. Observations showed that insect damage remained heaviest throughout the growing season in rows bordered by weeds and trees.

Weekly observations of leafminer populations at Auburn (ca. 120 miles southeast of Chandler Mountain) showed seasonal density peaks and declines ca. 1 month earlier than at Chandler Mountain (Fig. 2). This difference possibly was due to the earlier planting by the homeowner in Auburn. The number of mines increased steadily throughout July, peaked in early to mid-August, then decreased rapidly. The 1978 population peaked ca. 2 weeks earlier than the 1979 population.

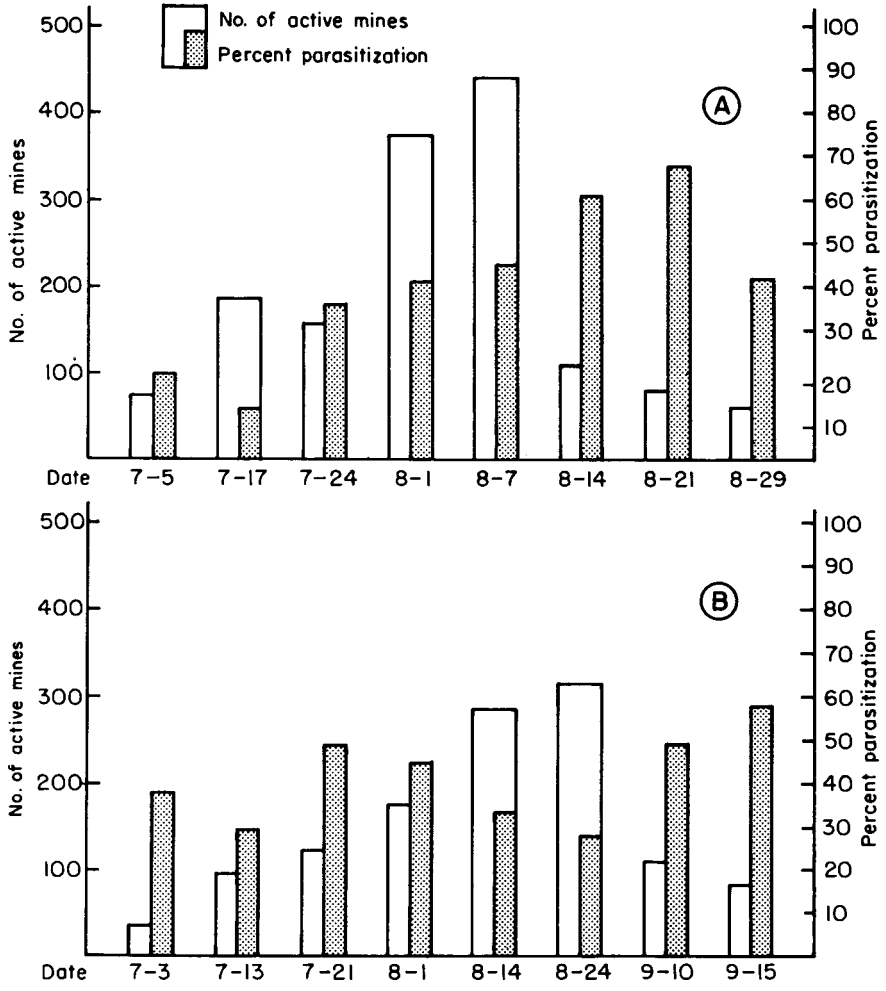

Fig. 2. Seasonal population densities and parasitization of *L. sativae* in Auburn, Alabama: A. 1978; B. 1979.

Leafminer specimens collected from the Chandler Mountain and Auburn fields were submitted for identification once and were identified as *L. sativae.* The importance of positive identification regarding *Liriomyza* leafminers was pointed out recently by Parrella and Keil (1984) with special reference to the sudden rise into prominence of *L. trifolii* (Burgess). When our research was conducted, however, the danger of serious interference by a related species was not recognized, thus repeated identifications were not attempted.

Parasitization

Ten species of hymenopterous parasitoids from 4 families were reared from *L. sativae* larvae in 1978 and 1979 (Table 1). The 3 most commonly collected

Table 1. Hymenopterous parasitoids reared from *L. sativae* larvae and their relative abundance. Alabama, 1978 - 1979.

Parasitoids	Percent of total parasitoids
Braconidae: *Opius dimidiatus*	33.3
Eulophidae: *Chrysonotomyia (Achrysocharella)* sp.	20.8
Closterocerus sp. A	6.6
Closterocerus sp. B	5.1
Closterocerus sp. C	3.3
Diglyphus intermedius	8.9
Zagrammosoma sp.	0.9
Pnigalio sp.	1.0
Pteromalidae: *Halticoptera* sp.	19.5
Alloxystidae: *Alloxysta victrix*	0.6

parasitoids were: 1) *Opius dimidiatus* (Ashmead) (Braconidae); 2) *Chrysonotomyia* sp. (Eulophidae); 3) *Halticoptera* sp. (Pteromalidae). Eulophidae was the predominant family, represented by 7 species and comprising 46% of parasites reared.

There are some strong similarities between our findings and information obtained in other areas of the continental United States. It appears that most parasitoids attacking *Liriomyza* leafminers belong to the families Braconidae, Eulophidae, and Pteromalidae. Eulophidae is the most commonly reported family, not only in Alabama but also in areas as widely separated from each other as Florida (Musgrave et al. 1975), Texas (Chandler 1984), and California (Johnson et al. 1980b; Zehnder and Trumble 1984). In most cases, 40 - 80% of the parasitoids reared are eulophids, the most common genera being *Diglyphus* and *Chrysonotomyia.* Pteromalidae also occur in all these surveys and are represented by the genus *Halticoptera.* Braconidae *(Opius* sp.) are prevalent in Florida and Alabama but represent less than 5% of total parasitoids in areas of Texas and California.

In Alabama, *L. sativae* larvae were most heavily parasitized early in the growing season, with 60 to 85% of the collected larvae being parasitized (Fig. 1, A, B, and C). Percent parasitism declined as the seasons progressed, reaching a low by mid-August. For the remainder of the tomato season the rate of parasitization fluctuated around the 40% level, staying well below the early season peak levels. Parasitization of host larvae averaged 27% higher in 1979 as compared to the same period in 1978. The average percent parasitization of *L. sativae* larvae by hymenopterous parasitoids in 1978 and 1979 combined was 46.1%.

At Auburn, *L. sativae* larvae were parasitized to a much lesser extent early in the growing season than on Chandler Mountain in both years (Fig. 2, A and B). Larval parasitism steadily increased throughout most of the 1978 growing season after a low of 12% recorded in July. The average percent parasitization of host larvae in all 1978 and 1979 collections at Auburn was 40.6%.

Data for Chandler Mountain (Fig. 1, A, B, C, and D) are consistent in that *L. sativae* larvae are most heavily parasitized at their lowest seasonal densities, or from mid-July to early August. Parasitization rates declined as the leafminer population increased. The average number of larvae observed in the first three weeks of the season (1978 and 1979) was 123 per sample. These larvae were

parasitized at a rate of 63%. By the last three weeks of the season, an average of 772 larvae was observed at each surveillance with a parasitization rate of 35.3%.

The difference between early and late season parasitization rates observed at Chandler Mountain may be, at least in part, due to the chemical control spray programs that were intensified in August. Effects of toxic sprays on parasitism have been pointed out (Oatman 1959; Musgrave et al. 1975; Schuster et al. 1979). Emphasis has been placed on the detrimental effects of methomyl on natural parasitism (Oatman and Kennedy 1976; Johnson et al. 1980a, b). Early in the season, there is little insect pressure so few or no insecticidal applications are made. In the absence of toxic spray treatments, the parasites of the leafminer are more likely to reach the upper limits of their field densities and potential as regulatory factors. But as spray programs are initiated at fruit set for control of fruit-feeding insects, the leafminer's parasite complex is reduced to levels that prevent them from being significant regulators of the *L. sativae* population densities which rapidly increase in the latter part of the season.

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