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The Vegetable Leafminer *Liriomyza sativae* Blanchard (Diptera: Agromyzidae) and its Parasitoids on Cucumber in the Hochiminh Region of Vietnam

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The vegetable leafminer *Liriomyza sativae* has been well established on many vegetable crops in Vietnam, but have never been investigated the leafminer relative abundance and its associated parasitoids. A survey was conducted in three locations of the Hochiminh region of Vietnam during the rainy and dry season (July 2003–January 2004) with arm at recording associated parasitoid species complex and relative abundance of the leafminer and its parasitoids on the cucumber fields. Infestations of *L. sativae* occurred in the field during the rainy season with low densities and became more serious in the dry season. Sampling of leafminer-infested leaves from cucumber plants yielded 7 species of hymenopteran parasitoids. The most abundant species were *Neochrysocharis* sp. and *Asecodes delucchii*, accounting for 43.7–69.6% and 18.5–46% parasitism, respectively. The pest population was low when parasitism was high in all fields sampled. The results suggest that these parasitoids play a very important role in *L. sativae* suppression in the cultivated cucumber fields.

INTRODUCTION

Among the polyphagous *Liriomyza* species, *Liriomyza sativae* (Blanchard), *Liriomyza trifolii* (Burgess) and *Liriomyza huidobrensis* (Blanchard) are economically important pests of a wide variety of vegetable and ornamental crops worldwide (Murphy and LaShalle, 1999). Native to the North America, *L. sativae* is widespread over many countries in the world (Spencer, 1973; Murphy and LaShalle, 1999). *L. sativae* was also dominant *Liriomyza* species found on various vegetables including tomato, watermelon, white gourd, Chinese mustard, French bean, yard-long bean and cucumber throughout most of Vietnam (Thang, 1999; Andersen *et al.*, 2002).

Currently, conventional control of leafminers has been dependent on synthetic chemical insecticides, including chlorfenapyr, chlorfluazuron, chlorpyriphos-etyl, deltamethrin, diazinon, edosulfan, malathion, abamectin and cyromazine (Sivapragasam

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and Syed, 1999; Thang, 1999; Civelek and Weintraub, 2003). However, applications of broad spectrum insecticides have resulted in a decline in parasitism and the development of resistance within fly population followed by an increase in leafminer density (Oatman and Kennedy, 1976; Murphy and LaSalle, 1999; Thang, 1999; Tran *et al.*, 2004).

Agromyzid leafminers are known to have rich natural enemy communities. Over 40 species of parasitoids have been recovered from *Liriomyza* spp. leafminers in the world (Waterhouse and Norris, 1987). In Japan, *Neochrysocharis formosa* (Westwood), *Hemiptarsenus varicornis* (Girault), *Neochrysocharis okazakii* Kamijo and *Chrysochasis pentheus* (Walker) (Eulophidae) are numerically dominant species (Arakaki and Kinjo, 1998). Eleven species of parasitoids such as *Chrysochasis pentheus* (Walker), *N. formosa*, *N. okazakii*, *Neochrysocharis* sp., *H. varicornis*, *Cirrospilus ambiguus* Hansson & LaSalle, *Asecodes* sp., *Closterocerus* sp., *Quadrastichus* sp. (Eulophidae), *Ooencyrtris* sp. (Eucyrtidae) and *Gronotoma* sp. (Eucolidae) have been reported in Vietnam (Thang, 1999). They have played a very important role in leafminer suppression in natural ecosystems or cultivated areas with reduced insecticide use (Johnson *et al.*, 1980a).

The objectives of this study were to survey damage caused by *L. sativae* in three large cucumber-growing areas of the Hochiminh region of Vietnam; to determine associated parasitoid complex and relative abundance of the leafminer and its parasitoids.

MATERIALS AND METHODS

Surveys were carried out from July 2003 until January 2004 in the cultivated cucumber fields of three districts named Thuduc, Hocmon and Cuchi. In generally, the local cucumber varieties of Dualeotrang and Dualeoxanh were planted from July 2003, the middle of the rainy season, to January 2004, the middle of the dry season, using standard local practices, except that no pesticides were applied. Each district, five fields were monitored 1–3 times per month through the growing season by collecting 25 infested leaves at random. Leaves were placed in plastic bags labeled with the name of location and date. Samples were placed in an ice chest and brought into the laboratory and held in plastic containers (15 cm×25 cm) with (8 cm×12 cm) rectangular holes covering with fine mesh screen for air ventilation for emergence of leafminer and parasitoids. Numbers of *L. sativae* and parasitoids that emerged were counted and recorded daily. All flies and wasps were separately kept in small vials with 70% ethanol. Identification of parasitoids was done by the third author with help of Dr. Kazuaki Kamijo (Bibai, Hokkaido, Japan).

RESULTS

Parasitoid species composition

A total of 4,122 parasitoid individuals emerged from leafminer-infested cucumber leaves collected and 7 parasitoid species of 3 families (Braconidae, Eucoilidae and Eulophidae) were identified (Table 1). Among them, *Neochrysocharis* sp. was the most abundant species in both of rainy and dry seasons, accounting for 53.1–59.4% and 43.7–69.6%, respectively. *Asecodes delucchii* was the second most abundant species in both of the rainy and dry seasons, accounting for 31.1–40.5% and 18.5–46%, respectively

Table 1. Species composition of parasitoids of *L. sativae* on cucumber in Hochiminh, Vietnam.

Family	Species
Braconidae	1. *Opius* sp.
Eucoilidae	2. *Gromotoma* sp.
Eulophidae	3. *Cirrospilus ambiguus* Hansson & LaSalle
	4. *Neochrysocharis* sp.
	5. *Asecodes delucchii* (Boucek)
	6. *Diglyphus isaea* (Walker)
	7. *Hemiptarsenus varicornis* (Giraut)

Table 2. Number (emerged adult) and relative abundance (%) of *L. sativae* parasitoids reared from cucumber leaves collected in the rainy and dry seasons in different districts of Hochiminh, Vietnam.

Season and district	Neo*chrysocharis* sp.	*Asecodes delucchii*	Others
Rainy season (from July 2003 to October 2003)			
Thuduc	451 (59.4)	236 (31.1)	72 (9.5)
Hocmon	665 (56.7)	475 (40.5)	33 (2.8)
Cuchi	750 (53.1)	492 (34.8)	171 (12.1)
Dry season (from November 2003 to January 2004)			
Thuduc	173 (43.9)	106 (33.9)	69 (22.1)
Hocmon	296 (69.6)	79 (18.5)	50 (11.8)
Cuchi*	–	–	–

* Crop finished

(Table 2).

Seasonal occurrence of leafminer and parasitoids

In three districts (Thuduc, Hocmon, Cuchi) of Hociminh city, densities of *L. sativae* were low during the rainy season. During this period, parasitism was very high and reached a peak of nearly 97, 95 and 80% in Thuduc, Hocmon and Cuchi, respectively. Infestations of *L. sativae* became more serious in the dry season. The most severe was in the end of November 2003 when the densities reached a peak of nearly 38 larvae/ leaf in Thuduc and Hocmon. Parasitism in the dry season was declined and the pest completely destroyed the crop by the end of November 2003 in Hocmon, the beginning of January 2004 in Thuduc (Fig. 1).

DISCUSSION

Liriomyza sativae have been accidentally introduced into Vietnam. Currently, this has been well established in Vietnam on many vegetable crops (Andersen *et al.*, 2002) and become one of the most important pests on cucumber (Rauf and Shepard, 1999). The occurrence and relative abundance of leafminers associated with season and host plants may reflect the impact of climate and their distinct preferences for host plants

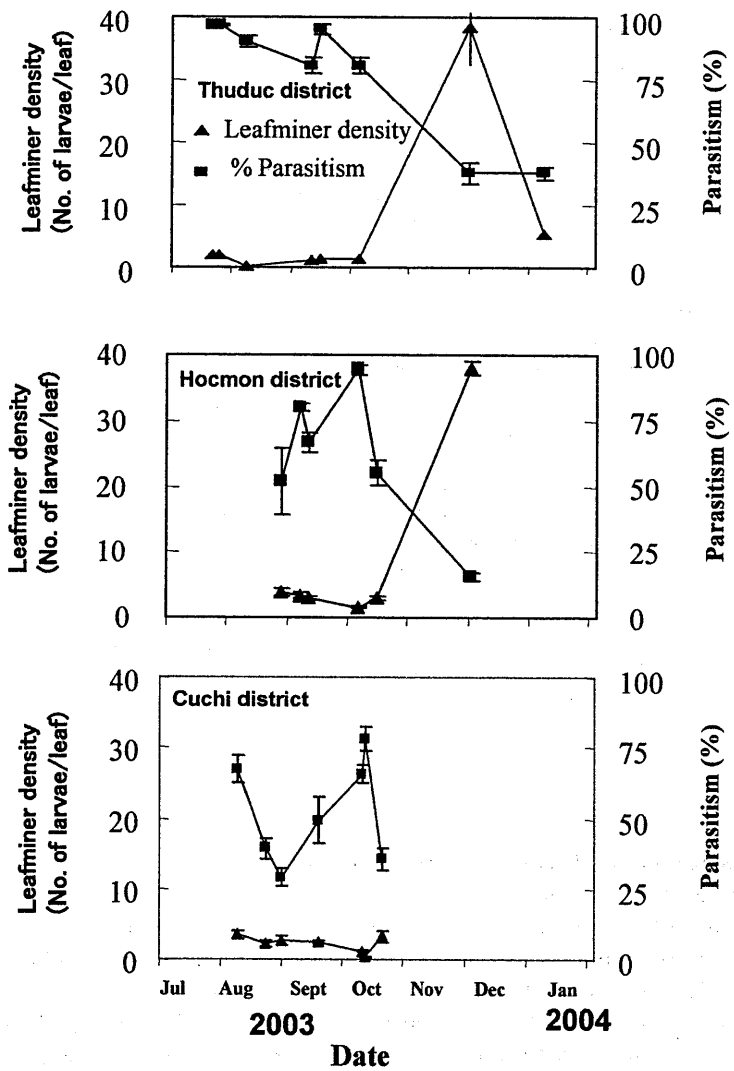

Fig. 1. *Liriomyza sativae* population density and its parasitism on cucumber in Hochiminh, Vietnam

(Parrella, 1987).

The impacts of *L. sativae* on cucumber plant growth and yields were not investigated in this study, but the plants were completely lost to the pest during the dry season. The densities of *L. sativae* larvae were low in the rainy season and increased in the dry season (Fig. 1). Previous survey on tomato in Indonesia have also shown that infestations of *L.*

hudobrensis during the rainy season were generally low, and occurred in the end of the dry season (Rauf and Shepard, 1999). It was considered that the infestations were associated with crop phenology; populations of leafminers increased slowly during the vegetative growth and increased rapidly during the generative growth, followed by a decline as plants entered into senescence (Rauf and Shepard, 1999). In our survey, rate of parasitism decreased just before rapid increase of leafminer density in all of three districts (Fig. 1). This suggested that activity of the parasitoids was low caused high density of the leafminer in the dry season.

Waterhouse and Norris (1987) reported more than 40 parasitoid species of *Liriomyza* leafminers, but few of these species occur in the Pacific region. Our study confirms that the parasitoid complex on *L. sativae* on cucumber in the Hochiminh region of Vietnam is limited to 7 species found. Leafminer parasitoids are abundant in the Philippine highlands of the Cordilleras, with at least ten species recorded, including *A. delucchii*, *N. formosa*, *N. okazakii* and *H. varicornis* (Joshi, 2001). *Ascodes delucchii* is a Palaearctic parasitoid found recently in Southeast Asia (Joshi, 2001), and become second most abundant parasitoid species of *L. sativae* on cucumber in the Hochiminh region of Vietnam (Table 2). Shuster and Wharton (1993) reported that *Diglypus intermadius*, *Diglypus begini*, and *Neochrysocharis punctiventis* were the most abundant parasitoids reared from *L. sativae* and *L. trifolii* on tomato in Florida. Many studies have identified parasitoids of *L. sativae* (Jonhson *et al.*, 1980b; Chandler, 1983; Parrella, 1987; LaShalle and Parrella, 1991; Chen *et al.*, 2003), but parasitoid complex was different from each other. Even in the Oriental Region, any of ten species of *L. sativae* parasitoids recorded from Hangzhou, China by Chen *et al.* (2003) were not obtained in our survey. Petcharat *et al.* (2002) reported 6 parasitoids of *Liriomyza* spp. from Southern Thailand. Among them, 2 species, *C. ambiguus* and *H. varicornis*, were collected in our survey. Moreover, the dominant species were quite different from one another. Thus, it seems that component and dominant species of parasitoid complex of *Liriomyza* in the Oriental Region are variable. The importance of the parasitoidsl in controlling the leafminer population was not clear in this study, but the pest population was low when parasitism was high in all fields sampled (Fig. 1). The observation that *Neochrysocharis* sp. and *A. delucchii* could reach high rate of parasitism on *L. sativae* on cucumber in Hochiminh suggests that they could be considered as potential agents for biological control program.

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