Parasitoids and Predators of Insect Pests on Chrysanthemums in Hawaii

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ABSTRACT

Trials were conducted at a commercial cut-chrysanthemum nursery in Mountain View, Hawaii to evaluate biological control of chrysanthemum insect pests. No chemical pesticides were applied throughout the growing season. Numerous parasitoids and predators of the agromyzid leafminer, *Liriomyza trifolii* (Burgess), the green peach aphid (GPA), *Myzus persicae* (Sulzer), and the variegated cutworm (VC), *Peridroma saucia* (Hübner), were recovered. The two dominant parasitoid species of *L. trifolii*, *Diglyphus intermedius* (Girault), and *Ganaspidium utilis* Beardsley, provided biological control during the first 7 to 9 weeks after planting when the unmarketed portion of the chrysanthemum foliage was growing. Additional biorational or chemical control methods are necessary for GPA, VC, and *L. trifolii* when their damage affects the marketable portion of the crop.

Major insect pests of chrysanthemums on the Island of Hawaii include the agromyzid leafminer, *Liriomyza trifolii* (Burgess), the green peach aphid (GPA), *Myzus persicae* (Sulzer), and the variegated cutworm (VC), *Peridroma saucia* (Hübner). Numerous parasitoids and/or predators have been purposely introduced into Hawaii since 1890 to bring these insect pests under biological control (Funasaki et al. 1988). Other natural enemies of these pests have also inadvertently become established in Hawaii.

In Hawaii, most commercial chrysanthemums are grown in open-sided greenhouses. As a result, there is unrestricted movement of insects, such as parasitoids and predators, into and out of the greenhouse. However, growers frequently rely on chemical insecticides for complete insect control to maintain zero aesthetic injury on the chrysanthemum crop. Parrella and Jones (1987) found that the first 5 weeks of cut-chrysanthemum growth were never marketed. Therefore, aesthetic injury to these unmarketed portions of the plant can be tolerated. Thus, biological control becomes a viable alternative to chemical insecticides, at least during the early part of crop growth.

A study was conducted to identify and evaluate the effectiveness of the parasitoids and predators of *L. trifolii*, *M. persicae*, and *P. saucia* on Hawaiian produced chrysanthemums in which no chemical pesticides were applied during the entire crop.

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MATERIALS AND METHODS

The experiment was conducted at a cut-chrysanthemum nursery in Mountain View, Hawaii (671 m elev.), in one section of a polyethylene-covered greenhouse (9.1 m × 30.5 m) with open sides. Rooted cuttings of the Blue Chip, Polaris, and White Marble cultivars were obtained from Yoder Brothers, Inc. (Barberton, Ohio) and planted into 1.0 m × 7.6 m plots with 150 plants/plot on 16 June 1983. Each plot consisted of a single cultivar planted in 6 rows. A 1.0 m × 1.0 m buffer area with no plantings between plots and a 0.6 m walkway between rows were provided. Ten days after planting, plants were soft-pinched and, 18 days later, thinned to 3 lateral branches per plant. Two weeks before harvest, the terminal bud of each stem was removed. Plants received the grower's standard fertilization and watering procedures. No chemical pesticides were applied throughout the entire crop.

The three youngest leaves with developing *L. trifolii* mines from each of 10 plants per cultivar were randomly sampled weekly from each plot for a total of 30 leaves per sample. Leaves were held at room temperature (23 ± 1° C) for one month in 3.8 liter glass jars covered with organdy cloth and secured with rubber bands. They were observed for leafminer and parasitoid emergences. Plant terminals were also inspected weekly for GPA and VC. GPA infested plant terminals were held in the laboratory in petri dishes for parasitoid emergences. VC collected from plots were placed in 3.8 liter jars similar to leafminers, fed chrysanthemum leaves, and held until VC adult and parasitoid emergences. Egg parasitoids of VC were not evaluated. At harvest, leafminer damage was assessed by inspecting 50 single-stem chrysanthemums per cultivar. The criterion for leafminer damage was at least one completed mine.

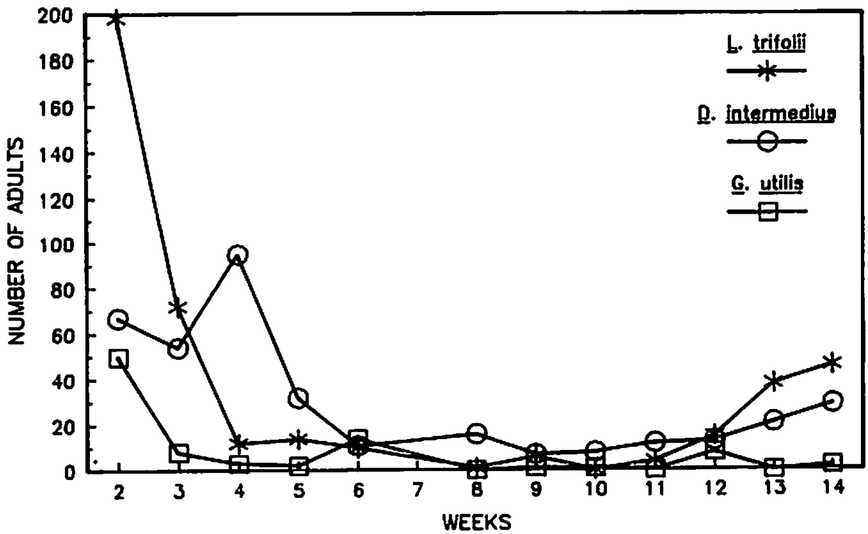

FIGURE 1. Adults of *L. trifolii, D. intermedius,* and *G. utilis* recovered from leaf samples of 'Blue Chip' chrysanthemum during 2 to 14 weeks after planting.

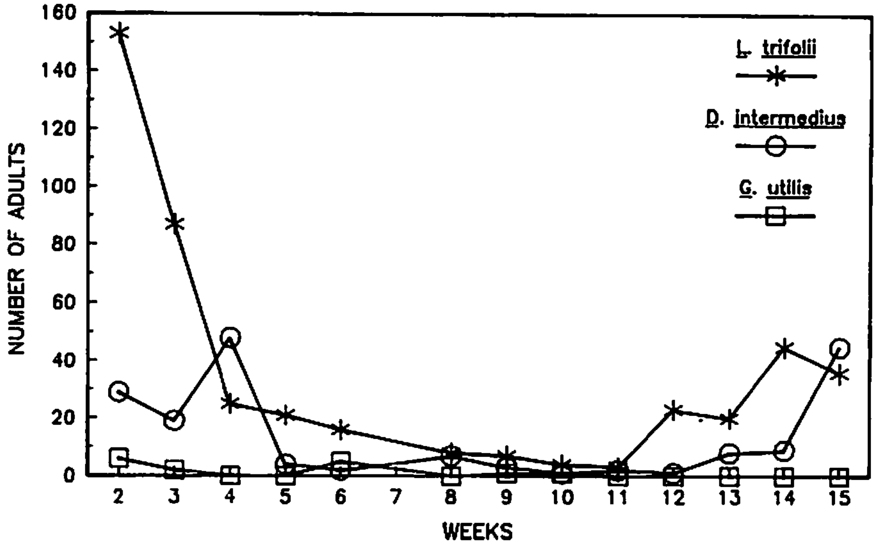

FIGURE 2. Adults of *L. trifolii*, *D. intermedius*, and *G. utilis* recovered from leaf samples of 'Polaris' chrysanthemum during 2 to 15 weeks after planting.

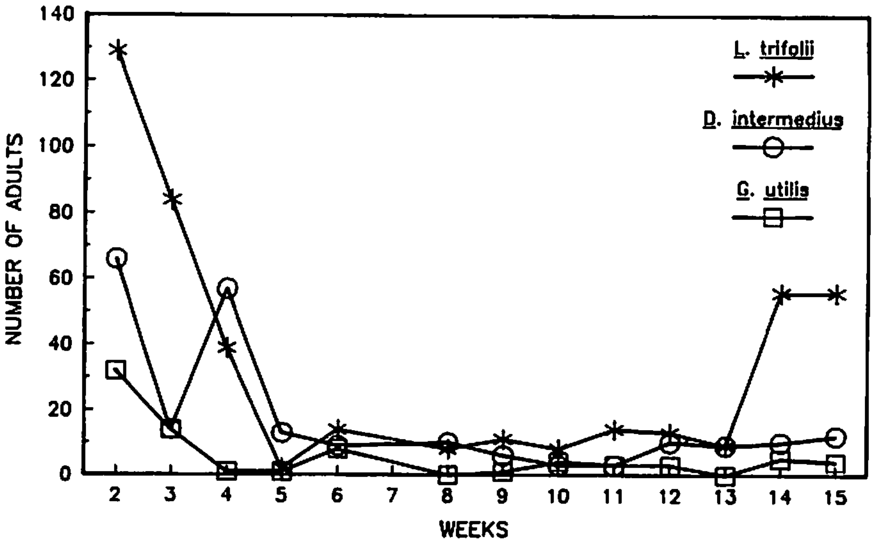

FIGURE 3. Adults of *L. trifolii*, *D. intermedius*, and *G. utilis* recovered from leaf samples of 'White Marble' chrysanthemum during 2 to 15 weeks after planting.

RESULTS AND DISCUSSION

All leafminers reared from infested chrysanthemum leaves were identified as *L. trifolii*. The two dominant parasitoid species of *L. trifolii* were a eulophid, *Diglyphus intermedius* (Girault) and a eucoilid, *Ganaspidium utilis* Beardsley, which accounted, respectively for 78% (n=365) and 19% (n=89) of the total parasitoids recovered. *D. intermedius* was first collected in Hawaii in 1944 (Higa 1981) and *G. utilis* introduced from Texas was first released in Hawaii in 1976 (Beardsley 1988). The remaining 3% (n=15) of the recovered parasitoids was composed of the eulophids, *Chrysocharis* sp., *Chrysonotomyia formosa* (Westwood), *D. begini* (Ashmead), *Hemiptarsenus semialbiclavus* (Girault), and a braconid, *Opius dissitus* Muesebeck. Figures 1-3 present data on leafminers and parasitoids recovered throughout the experimental period from leaf samples of Blue Chip, Polaris, and White Marble cultivars. High numbers of leafminers and parasitoids were recovered at 2 to 4 weeks after planting and near harvest at 13 to 15 weeks. Populations of leafminers as well as their natural enemies were low during 6 to 11 weeks after planting. At harvest, the percentages of leaves with completed leafmines were 85.5%, 95.2%, and 84.8% for the Blue Chip, Polaris, and White Marble cultivars, respectively. The patterns of leaf production in the 3 cultivars are shown in Fig. 4. In this chrysanthemum crop, the upper 6 to 8 leaves were marketed and the lower leaves produced during the first 7 to 9 weeks after planting were removed. Therefore, the concept of aesthetic injury level proposed by Parrella and Jones (1987) can be implemented. In this chrysanthemum crop, growers could have relied on

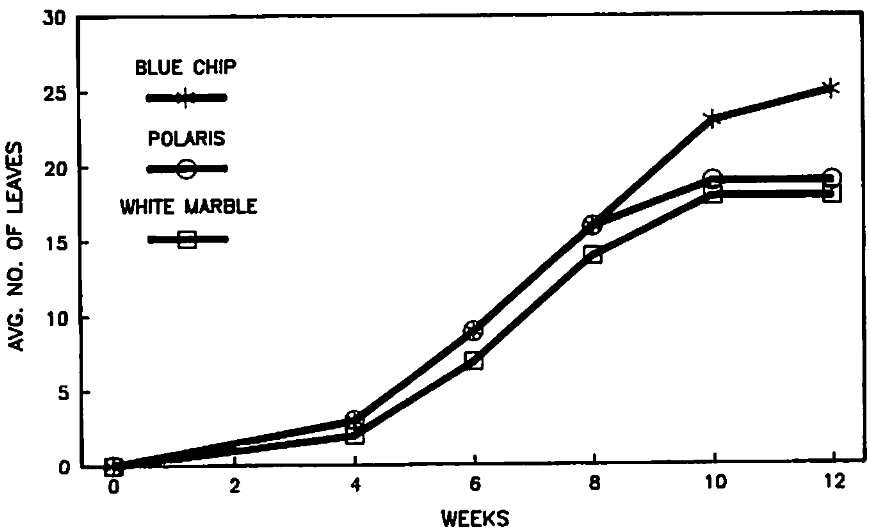

FIGURE 4. Average number of leaves on 'Blue Chip', 'Polaris', and 'White Marble' chrysanthemum plants during 0 to 12 weeks after planting.

parasitoids of *L. trifolii* during the first 7 to 9 weeks, and an effective chemical insecticide (e.g., abamectin) could have been applied against leafminers only during the 8th or 10th week to harvest, to prevent aesthetic injury to the marketed portion of chrysanthemums. Jones et al. (1986) were successful in biological control of *L. trifolii* in a commercial chrysanthemum greenhouse by inundative releases of *D. intermedius* and only one application of abamectin (Avid) near harvest to control *L. trifolii*.

VC also detrimentally affected desired plant characteristics. They severed one or more of the lateral branches and induced the growth of excessive lateral shoots. Damage to plants averaged 64% during the 4th week and 85% during the 5th week after planting. The following parasitoid species were recovered from VC: *Hyposoter exiguae* (Viereck) (Ichneumonidae) — 48% (n=21); *Cotesia marginiventris* (Cresson) (Braconidae) — 25% (n=11); *Meteorus laphygmae* Viereck (Braconidae) — 25% (n=11); *Chaetogaedia monticola* Bigot (Tachinidae) — 2% (n=1). Table 1 shows that total percent parasitism ranged from 33.3 to 80.0% during 2 to 6 weeks after planting.

TABLE 1. Number of variegated cutworms and parasitoids collected at Mt. View, Hawaii in chrysanthemum plots during 2 to 6 weeks after planting.

Weeks after planting	No. larvae	No. parasitoid reared				Total (%) parasitism
		Meteorus laphygmae	*Cotesia marginiventris*	*Hyposoter exiguae*	*Chaetogaedia monticola*	
2	10	1	3	4	0	80.0
3	15	4	0	1	0	33.3
4	23	5	4	4	0	56.5
5	22	0	4	9	1	63.6
6	9	1	0	3	0	44.4

Mummified aphids consistently yielded the braconid, *Lysiphlebus testaceipes* (Cresson). Also present were *Allograpta obliqua* (Say) (Syrphidae) and *Nesomicromus* sp. (Hemerobiidae). All are well known natural enemies of aphids. However, their combined activity did not provide economic control of aphids as greater than 50% of the crop was unmarketable because of sooty mold.

In conclusion, naturally occurring parasitoids and predators provided partial biological control of these pests, but not economic control. Natural enemies of *L. trifolii* can provide biological control of this leafminer for slightly more than half of the crop growth period. Additional biorational or chemical insecticides are needed for VC, GPA, and *L. trifolii* when their damage affects the marketable portion of the crop. Biorational insecticides are highly desirable because of their compatibility with parasitoids and predators. The use of biorational insecticides, such as the entomopathogenic nematode, *Steinernema carpocapsae* (Weiser) for leafminers; the fungus, *Cephalosporium lecanii* (Zimm.) Viegas for aphids; and *Bacillus thuringiensis* (Berliner) plus *S. carpocapsae* for cutworms, may provide economic control of insect pests of chrysanthemum with minimal use of chemical insecticides.

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