

Composition and Relative Abundance of Parasites Associated with Aphid Populations on Strawberry in Southern California¹

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ABSTRACT Four primary parasites and seven secondary parasites (hyperparasites) were reared from mummies of five species of aphids collected from winter plantings of strawberries in southern California in 1981 and 1982. In order of abundance, the primary parasites were *Lysiphlebus testaceipes* Cresson, *Aphelinus semiflavus* Howard, *Aphidius urticae* Haliday, and *Ephedrus californicus* Baker. *L. testaceipes* accounted for 47.8 and 77.1% of all primaries in 1981 and 1982, respectively, and was reared most commonly from the strawberry aphid, *Chaetosiphon fragaefolii* (Cockerell), in 1981 (56.3%) and from the melon aphid, *Aphis gossypii* Glover, in 1982 (74.5%). *Dendrocerus aphidum* (Rondani) and *Alloxysta magourae* "complex" were the most common secondary parasites, accounting for 34.6 and 19.2% of all secondaries, respectively, in 1981 and for 55.8 and 23.4% in 1982. *C. fragaefolii* was the most common aphid present both years, reaching damaging populations in 1982 despite the parasite activity.

Few reports are available on the parasite complex associated with aphids infesting strawberries. Dicker (1952) found only eight specimens of *Aphidius* spp. and four individuals of *Aphelinus asychis* Walk. in England from 1943 to 1951. In northern California, *Aphelinus semiflavus* Howard and *Lysaphidus rosaphidis* (Smith) (reported as *Aphidius rosaphidis* Smith) have been documented (Schaefers and Allen 1962). In conjunction with studies to determine the temporal occurrence and spatial dispersion of aphids on annual winter-planted strawberries in southern California (Trumble et al. 1983a,b), mummified (parasitized) aphids were collected to document the role of parasites in aphid population dynamics and determine the relative abundance of primary and secondary (hyperparasites) parasites.

Results of a previous study (Oatman and Platner 1972) indicated that parasites were an important mortality factor affecting the melon aphid, *Aphis gossypii* Glover, and the potato aphid, *Macrosiphum euphorbiae* (Thomas), on strawberry, but not the strawberry aphid, *Chaetosiphon fragaefolii* (Cockerell), which was the most common aphid present.

Materials and Methods

Aphid populations were monitored on annual winter plantings of "Tufts" strawberries at the University of California's South Coast Field Station in Orange County, Calif., in 1981 and 1982. Detailed descriptions of the materials and methods used in establishing and conducting the studies were given previously (Trumble et al. 1983a,b). Weekly counts of mummies were recorded from 144 randomly selected plants in 1981 and 72 to 118 plants in 1982. Arbitrarily selected leaflets, bearing mummified aphids, were removed from the plants each week and placed in 1-pint (ca. 443.6) ice cream cartons. In the laboratory, the mummies were removed from the leaflets, separated to apparent species, and placed individually in gelatin capsules (size 000). When high

numbers (<100) of mummies of any one aphid species occurred on a given sampling date, only 50 were processed. After emergence and death, the parasites were recorded as to host aphid and date of host collection, and later identified to species.

Results and Discussion

A total of four primary parasites and seven secondary parasites (hyperparasites) were reared from mummies of five species of aphids (Tables 1 and 2). Three of the primaries, *Aphidius urticae* Haliday, *Ephedrus californicus* Baker, and *Lysiphlebus testaceipes* Cresson, are in the family Aphididae. The remaining one, *Aphelinus semiflavus* Howard, is in the family Aphelinidae. Of the secondary parasites, *Alloxysta megourae* "complex," *A. schlingeri* Andrews, and *Phaenoglyphis americana* Baker are in the family Claripidae; *Asaphes californicus* Girault and *Pachyneuron siphonophora* (Ashmead) are in the family Pteromalidae; and *Aphidencirtus aphidivorus* (Mayr) and *Dendrocerus aphidum* (Rondani) are in the families Encyrtidae and Megaspilidae, respectively.

As in previous studies on strawberries (Oatman and Platner 1972), *L. testaceipes* was the most common primary parasite present. In the present study, it accounted for 47.8 and 77.1% of all primaries and 34.7 and 56.9% of all parasites (both primary and secondary) which emerged from all aphid mummies in 1981 and 1982, respectively (Tables 1 and 2). *L. testaceipes* was most commonly reared from *C. fragaefolii* (56.3%) in 1981 and from *A. gossypii* (74.5%) in 1982. It was not reared from *M. euphorbiae* in either year. *Aphelinus semiflavus* was the second most common primary parasite, accounting for 42.0 and 7.8% of all primaries and 30.5 and 5.8% of all parasites (both primary and secondary) which emerged from all aphid mummies in 1981 and 1982, respectively. It was reared from all five aphid species in both years. *Aphidius urticae* accounted for 8.7 and 8.3% of all primary parasites in 1981 and 1982, respectively, and *E. californicus* accounted for 1.4 and 6.9%. *E. californicus* was reared only from *M. euphor-*

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Table 1. Composition and relative abundance of parasite species emerging from aphid mummies collected from strawberry plants in the 1980-1981 winter planting, Irvine, Calif.

Parasite species	% Of parasites emerging from the following aphid species:					
	<i>C. fragaefolii</i>	<i>A. gossypii</i>	<i>M. euphorbiae</i>	<i>M. persicae</i>	Unknown aphid	All aphid species
Primary: <i>Lysiphlebus testaceipes</i>	56.3 (27) ^a	26.3 (5)	0	12.5 (1)	0	34.7 (33)
<i>Aphelinus semiflavus</i>	22.9 (11)	5.3 (1)	11.1 (1)	75.0 (6)	90.9 (10)	30.5 (29)
<i>Aphidius urticae</i>	0	0	66.7 (6)	0	0	6.3 (6)
<i>Ephedrus californicus</i>	0	0	11.1 (1)	0	0	1.1 (1)
Secondary: <i>Dendrocerus aphidum</i>	12.5 (6)	10.5 (2)	0	12.5 (1)	0	9.5 (9)
<i>Alloxysta megourae</i> "complex"	0	26.3 (5)	0	0	0	5.3 (5)
<i>Asaphes californicus</i>	2.1 (1)	5.3 (1)	0	0	9.1 (1)	3.2 (3)
<i>Aphidencyrtus aphidivorus</i>	2.1 (1)	0	11.1 (1)	0	0	2.1 (2)
<i>Phaenoglyphis americana</i>	2.1 (1)	10.5 (2)	0	0	0	3.2 (3)
<i>Pachyneuron siphonophora</i>	2.1 (1)	10.5 (2)	0	0	0	3.2 (3)
<i>Alloxysta schlingeri</i>	0	5.3 (1)	0	0	0	1.1 (1)

^aNumbers in parentheses indicate total number emerged from mummies.

biae in 1981 and only from *M. euphorbiae* and *M. persicae* in 1982. *A. urticae* was not reared from *C. fragaefolii* in either year, and only one individual emerged from *A. gossypii* in 1982. Though only seven total specimens of *E. californicus* and *A. urticae* were reared in 1981, all emerged from *M. euphorbiae* (Table 1). Of 33 total reared in 1982, 31 were reared from *M. euphorbiae* and *M. persicae* (Table 2), indicating a considerable degree of host specificity. Altogether, 95 and 295 total parasites (both primary and secondary) emerged from the aphid mummies (all species) held in 1981 and 1982, respectively, of which 72.6 and 73.9% were primary parasites. The higher numbers of primary parasites present in 1982 was a direct reflection of the higher numbers of all aphid species present that year (Trumble et al. 1983a,b).

D. aphidum and *A. megourae* "complex" were the two most common secondary parasites present, accounting for 34.6 and 19.2% of all secondary parasites, respectively, in 1981 and for 55.8 and 23.4% in 1982. They were most abundant in 1982, reflecting the higher numbers of primary parasites present (Tables 1 and 2).

Of the total number of parasites which emerged, secondaries accounted for 27.4 and 26.1% in 1981 and 1982, respectively. As would be expected, the highest numbers of most of the secondary parasite species emerged from mummies of either *C. fragaefolii* or *A. gossypii* (Tables 1 and 2), which were the two most common aphids present both years.

The percentage of total aphids parasitized remained below 2.0 through 26 March and 2 March in 1981 and 1982, respectively, reaching 12.8 and 5.8% on 2 April and 23 March when parasite activity was at its peak (Fig. 1). No data were taken on 21 May 1981, or on 16 March and 4 May 1982. As reported previously (Trumble et al. 1983a), the mean number of aphids (all species) reached peaks of 25.1 and 192.5 per plant on 26 March and 2 March in 1981 and 1982, respectively, before declining to 1.7 and 0.9 per plant at the end of the respective studies on 28 May and 11 May. The aphid populations were not only lower in 1981, but also declined more rapidly than in 1982. The percentage of total aphid population parasitized was lower after the aphid population declined in 1981 (4.0 to 10.5% through 28

Table 2. Composition and relative abundance of parasite species emerging from aphid mummies collected from strawberry plants in the 1981-1982 winter planting, Irvine, Calif.

Parasite species	% Of parasites emerging from the following aphid species:					
	<i>C. fragaefolii</i>	<i>A. gossypii</i>	<i>M. euphorbiae</i>	<i>M. persicae</i>	Unknown aphid	All aphid species
Primary: <i>Lysiphlebus testaceipes</i>	50.0 (28) ^a	74.5 (137)	0	14.3 (3)	0	56.9 (168)
<i>Aphelinus semiflavus</i>	8.9 (5)	0.5 (1)	4.2 (1)	9.5 (2)	80.0 (8)	5.8 (17)
<i>Aphidius urticae</i>	0	0.5 (1)	20.8 (5)	52.4 (11)	10.0 (1)	6.1 (18)
<i>Ephedrus californicus</i>	0	0	54.2 (13)	9.5 (2)	0	5.1 (15)
Secondary: <i>Dendrocerus aphidum</i>	30.4 (17)	11.4 (21)	4.2 (1)	14.3 (3)	10.0 (1)	14.6 (43)
<i>Alloxysta megourae</i> "complex"	0	9.8 (18)	0	0	0	6.1 (18)
<i>Asaphes californicus</i>	1.8 (1)	2.2 (4)	4.2 (1)	0	0	2.0 (6)
<i>Aphidencyrtus aphidivorus</i>	3.6 (2)	0.5 (1)	12.5 (3)	0	0	2.0 (6)
<i>Phaenoglyphis americana</i>	1.8 (1)	0.5 (1)	0	0	0	0.7 (2)
<i>Pachyneuron siphonophora</i>	0	0	0	0	0	0
<i>Alloxysta schlingeri</i>	3.6 (2)	0	0	0	0	0.7 (2)

^aNumbers in parentheses indicate total number emerged from mummies.

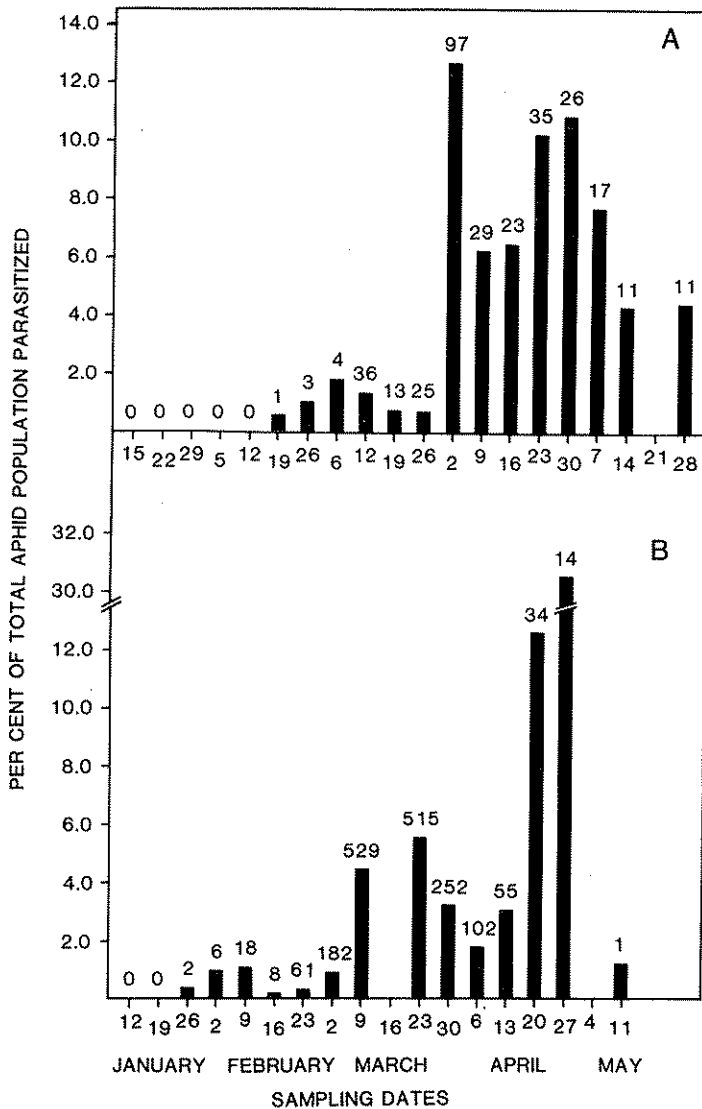


FIG. 1. Percentage of total aphid population parasitized in 1980-1981 (A) and 1981-1982 (B) winter strawberry plantings near Irvine, Calif. Values above histogram bars indicate the numbers of parasitized aphids (mummies) recorded on each sampling date.

May) than in 1982 (1.8 to 31.0 through 11 May) (Fig. 1). The data thus show that parasitization was not an important mortality factor in 1981 or 1982, because parasite density only increased to substantial levels after host populations collapsed.

Because *C. fragaefolii* was the most common aphid present both years (<60%) and *L. testaceipes* was the most common primary parasite, an apparent preference by *L. testaceipes* for parasitization of *A. gossypii* in 1982 (Table 2), especially in January and February, may have been an important factor in the delayed reduction of the aphid populations in 1982. A hyperparasitization rate of 30% during both seasons almost certainly reduced the ability of primary parasites to respond effectively to host population fluctuations. Nevertheless, parasites were not a sufficiently effective mortality factor to prevent the

increase of *C. fragaefolii* populations on strawberry in southern California in 1981 and 1982.

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