

Natural Enemies of the Banded-Wing Whitefly, *Trialeurodes abutilonea* (Hemiptera: Aleyrodidae)¹

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ABSTRACT

Four species of hymenopterous parasites were reared from puparia of the banded-wing whitefly, *Trialeurodes abutilonea* (Haldeman), at Urbana, Ill.: *Encarsia quaintancei* Howard, *E. pergandiella* Howard, *Eretmocerus haldemani* Howard, and *Amitus aleurodinus* Haldeman. Morphological features of both sexes of the parasites are illustrated. Three of these parasites overwinter within

whitefly puparia at Urbana. Field populations on 2 species of native host plants were much more heavily parasitized than those on its preferred host, *Abutilon theophrasti* Medic., an introduced weed. This situation existed despite higher whitefly populations on *Abutilon*. Predators and fungi in association with *T. abutilonea* also are discussed.

The banded-wing whitefly, *Trialeurodes abutilonea* (Haldeman), is widely distributed in North America, from the Atlantic to the Pacific Coasts, and ranges south to the northern coast of South America. No collection records are known outside this area, and the insect is presumably indigenous to the Nearctic Region (Russell 1948). According to Russell (1963), the banded-wing whitefly is able to complete its development on at least 140 species of plants representing 33 plant families. Occasionally populations of *T. abutilonea* develop to injurious levels on such cultivated plants as cotton, beans, cabbage, and other crucifers. In Illinois the most important host plant is a malvaceous weed, *Abutilon theophrasti* Medic.

The life stages of the insect include the egg, 4 larval instars, a pupal instar covered by a pupal case or puparium, and the adult. Adults are winged and are active fliers. Females deposit stalked eggs on the underside of the leaves of the host plants. The first-instar larvae possess legs, but move only a few millimeters before settling down to feed, and after feeding has begun the insect remains attached to the leaf and immobile throughout its development to the adult stage.

HYMENOPTEROUS PARASITES

During this investigation, 784 hymenopterous parasites were reared from pupal cases of the banded-wing whitefly. These represented 3 species of Eulophidae and 1 species of Platygasteridae. All 4 species are solitary, internal parasites of the larvae and pupae, and have not previously been reported from *T. abutilonea*. No hyperparasites were found during this study.

To isolate parasites emerging from aleyrodid material, sections of leaves bearing puparia were pinned to the bottom of a cork which was then inserted into the neck of a glass vial. When large numbers of parasitized aleyrodid pupae were used, these were placed in 1-gal paper cartons for emergence of the parasites.

One other eulophid species, *Encarsia coquillettii* Howard, is known to parasitize *T. abutilonea* (Landis et al. 1958), but it was not encountered in this study.

All hymenopterous parasites were identified by B. D. Burks and C. F. W. Muesebeck of the Entomology Research Division, USDA.

Encarsia quaintancei Howard

This species accounted for 63% of the total number of parasites reared from pupal cases of *T. abutilonea*. Morphological structures of the female are illustrated in Fig. 1. Note the differences in the antennae of the 2 sexes (Fig. 6). The middle tarsus of the female is 4-segmented.

Eggs of this species are deposited singly, immediately below the dorsal surface of the young fourth-instar larva. Other immature stages of the whitefly are used as oviposition sites, but oviposition most commonly occurs on fourth instars which are still flat. Upon hatching from the egg, the parasite larva feeds internally, on the body contents of the whitefly puparium. When mature, the wasp larva pupates within the aleyrodid pupal case, from which the adult parasite escapes by chewing a circular opening in the top (Fig. 9). The life cycle of the parasite, from egg to adult, takes 10–25 days, depending on the temperature. At greenhouse temperatures, however, the duration of the life cycle of this parasite was always less than that of its host, *T. abutilonea*. Whitefly puparia parasitized by *E. quaintancei* darken as the parasite within nears the completion of its development.

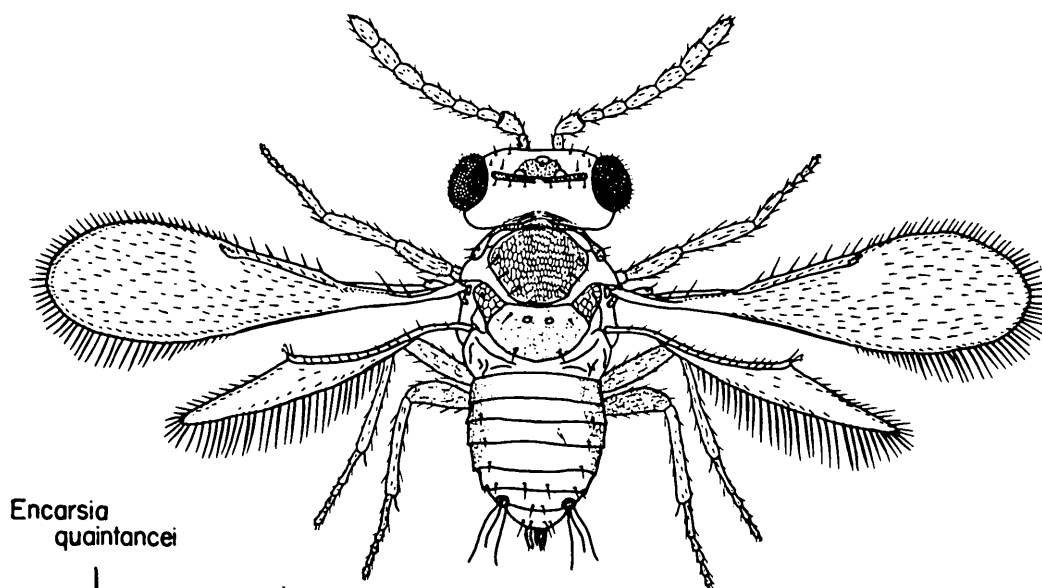
Other than *T. abutilonea*, the only other host reported in the literature for *E. quaintancei* is that given with the original description by Howard (1907): "*Aleyrodes* sp. on *Polygonum*, Bladenburg Road, D.C." Possibly the specimen originally described was reared from a pupa of *T. abutilonea*.

During the winter of 1958–59, several adult females of *E. quaintancei* were reared from overwintering pupae of *T. abutilonea*, demonstrating that this parasite can winter out of doors at the latitude of Urbana, Ill.

Encarsia pergandiella Howard

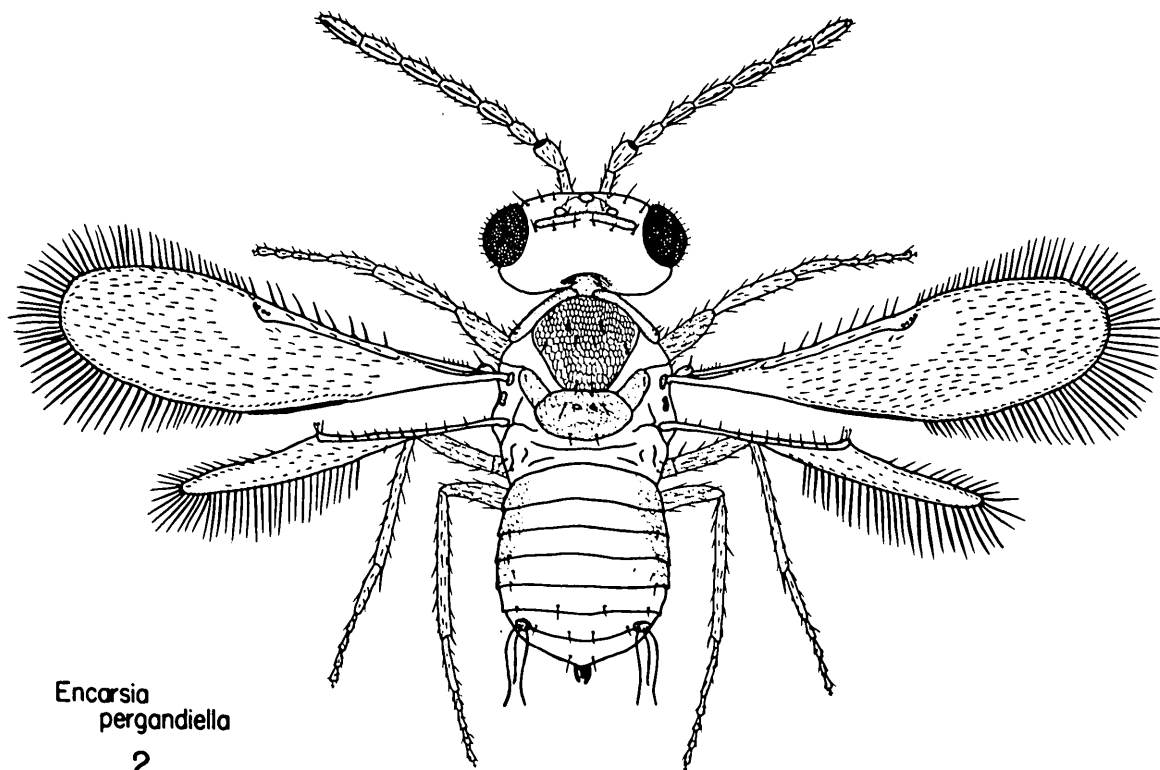
This species accounted for more than 23% of the total number of parasites reared from pupal cases of *T. abutilonea*. Morphological structures of the adult female are illustrated in Fig. 2. As with *E. quaintancei*, the sexes can be distinguished by comparing the antennae (Fig. 7). The middle tarsus of the fe-

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Encarsia
quintancei

1



Encarsia
pergandiella

2

FIGS. 1-2.—Dorsal views of adult females. 1, *Encarsia quintancei*, $\times 85$. 2, *E. pergandiella*, $\times 100$.

male is 5-segmented, which affords a means of distinguishing the females of this species from those of *E. quintancei*.

The general biology of this species appears to be the same as that presented here for *E. quintancei*. Adult females were reared in April 1959 from pupae of the banded-wing whitefly, indicating that this parasite is able to survive the winter in this locality.

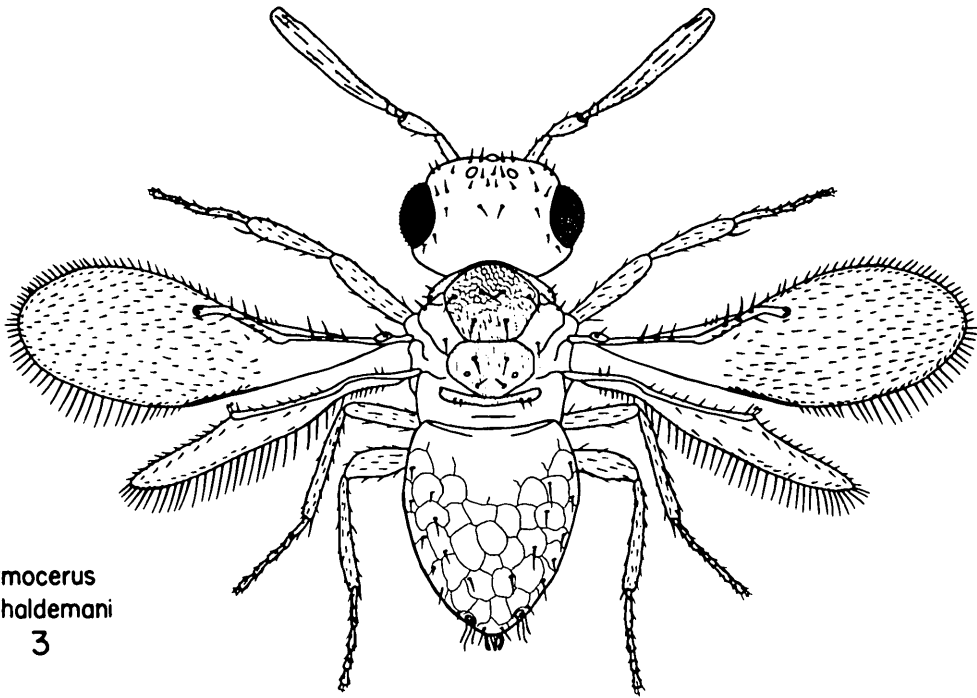
E. pergandiella has been reported to parasitize

Trialeurodes vaporariorum (Westwood) (Garman and Jewett 1922, McDaniel 1924), and Muesebeck et al. (1951) also list *Aleuroplatus coronatus* (Quaintance) as a host.

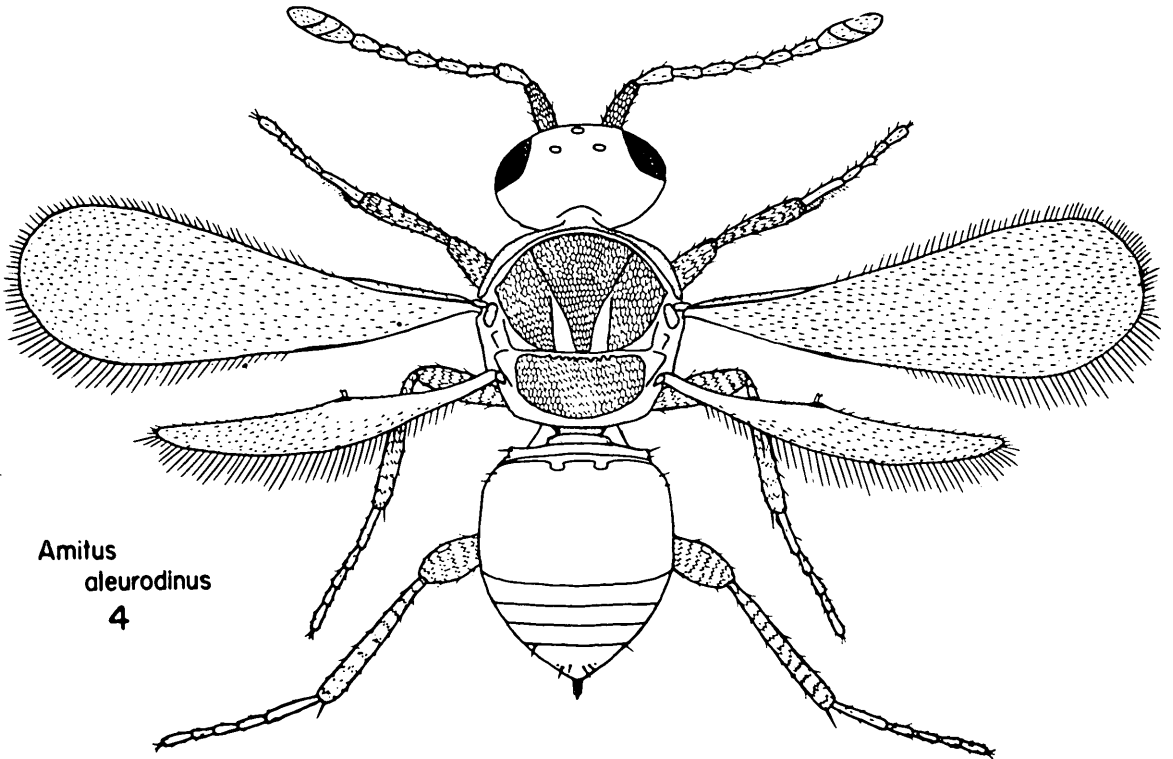
Amitus aleurodinus Haldeman

The specific name *aleurodinus*, so written by Haldeman (1850) in the original description, has frequently been misspelled *aleurodinis* in the literature.

Eretmocerus
haldemani
3



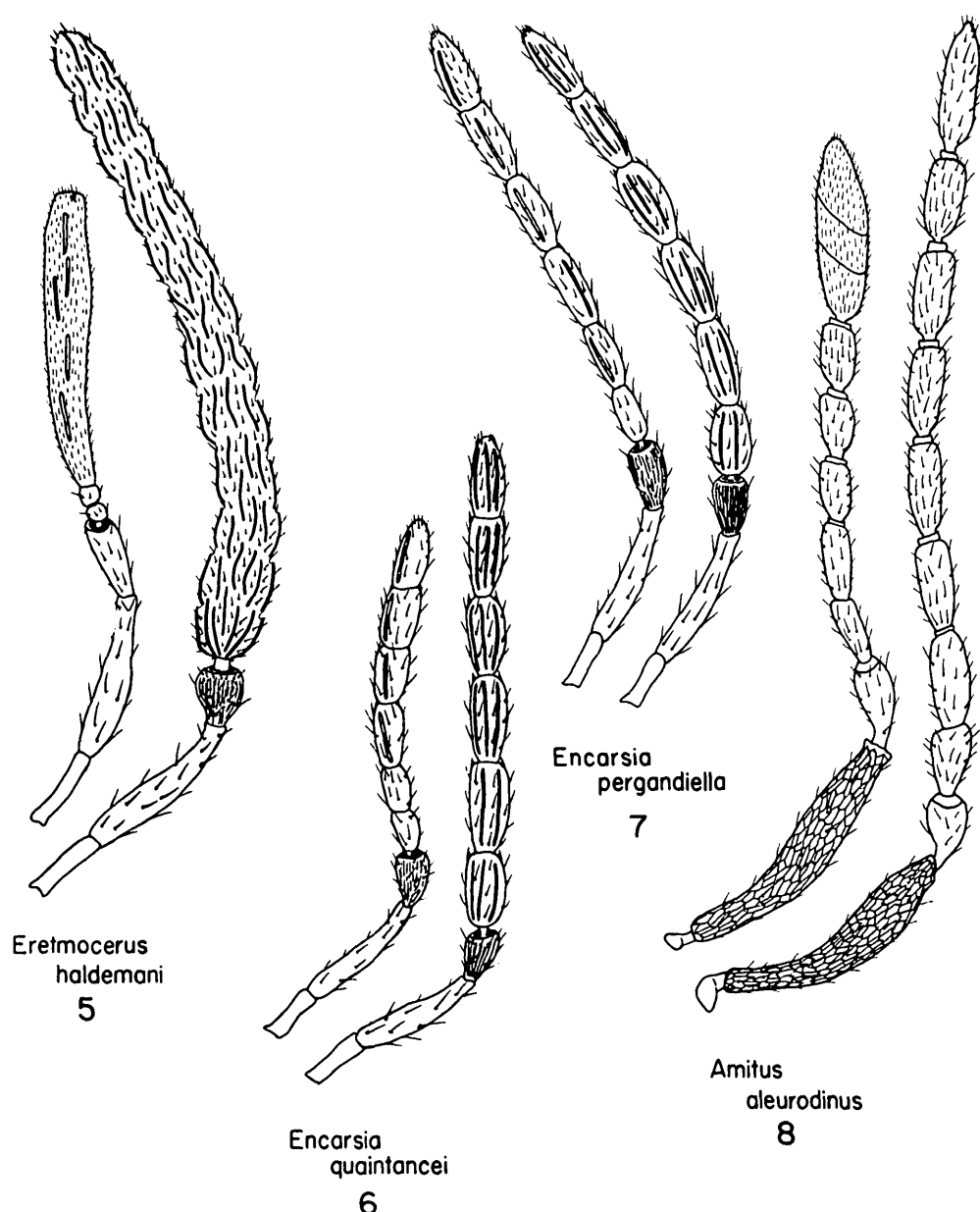
Amitus
aleurodinus
4



FIGS. 3-4.—Dorsal views of adult females. 3, *Eretmocerus haldemani*, $\times 90$. 4, *Amitus aleurodinus*, $\times 88$.

Approximately 12% of the parasites reared during the present study were of this species. The adult female is illustrated in Fig. 4, and the antenna of each sex in Fig. 8. This is the largest of the parasites known to attack the banded-wing whitefly. Nothing is known of its biology.

In addition to *T. abutilonae*, its reported hosts include: *Aleurodes corni* Haldeman (Haldeman 1850); *Aleurochiton forbesii* (Ashmead) (syn. *Aleurodes aceris*) (Forbes 1885); *Aleuroplatus plumosus* (Quaintance) (Gahan 1927); and *Trialeurodes fernaldi* (Morrill) (Gahan 1927).



FIGS. 5-8.—Antennae, female on left, male on right. 5, *Eretmocerus haldemani*, $\times 192$. 6, *Encarsia quaintancei*, $\times 252$. 7, *Encarsia pergandiella*, $\times 225$. 8, *Amitus aleurodinus*, $\times 209$.

During April 1959, several adult females of *Amitus aleurodinus* were reared from overwintered pupae of *T. abutilonea*. Thus this parasite, too, is capable of overwintering out of doors at this latitude.

Eretmocerus haldemani Howard

Of the 784 parasites reared in this study, only 10 were of this species. The adult female is shown in Fig. 3, and the antenna of each sex in Fig. 5. The generic name *Eretmocerus* stems from the oar-shaped terminal segment of the female antenna.

Watson (1915) and Watson and Berger (1937) have described the biology of *E. haldemani* as a para-

site of the wooly whitefly, *Aleurothrixus floccosus* (Maskell). The last-mentioned authors state: "This insect lays its eggs in the larvae of the whitefly. The grub of the parasite feeds on the substance of the whitefly nymph and finally kills it. The parasite pupates inside its host, which markedly swells, and emerges about the time the whitefly should emerge. These parasites are so abundant that they have invariably controlled infestation of this whitefly, usually before any serious harm has been done."

Besides *T. abutilonea*, other hosts reported are: *Aleuroplatus coronatus* (Howard 1908); *Aleurothrixus floccosus* (Watson 1915); *Aleyrodes* spp., and *Trialeurodes vaporariorum* (Compere 1936).

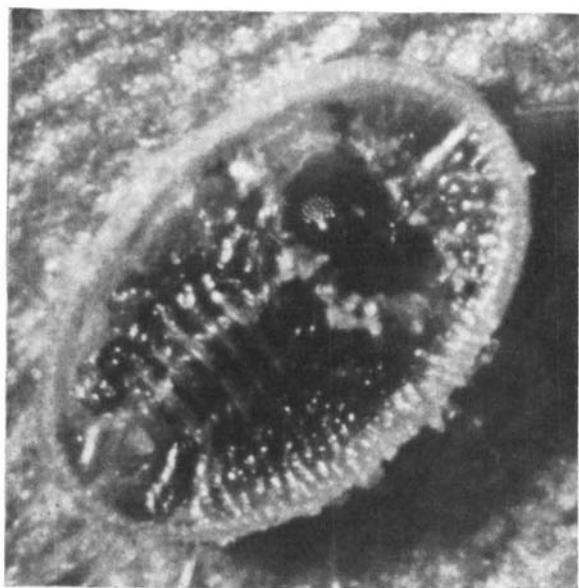


FIG. 9.—Adult of *Encarsia quaintancei* chewing a circular emergence hole in the pupal case of the banded-wing whitefly. The head of the wasp can be seen within the pupal case. $\times 100$.

PARASITISM

To determine the effect of parasitism on the banded-wing whitefly in the field, extensive rearings of *T. abutilonea* were made during the late summer of 1958. Mature pupal cases were collected at intervals, counted, and incubated in the laboratory. These counted puparia were from 3 host plants, *Polygonum hydropiperoides*, *Abutilon theophrasti*, and *Sida spinosa*. The parasites reared from these pupal cases were counted, and were later identified to species. The data in Table 1 show the extent of total parasitism by the 4 parasites of *T. abutilonea* on each of the respective host plants. Parasitism in the pupal cases on *Polygonum* was always much higher than in those on *Abutilon* or *Sida*, and reached a maximum (44%) there in August 1958.

In addition to these rearings, more than 600 parasites were mass reared from an uncounted number of pupal cases collected during the same months of 1958, from 4 host plants—*Polygonum*, *Abutilon*, *Sida*, and a milkweed vine, *Ampelamus albidus*. Leaves of each plant that bore puparia were placed in 1-gal cartons in the laboratory for incubation of the parasites, and when these emerged they were collected, counted, and identified. Table 2 presents a summary of the parasites reared from hosts attached to the respective plants.

DISCUSSION

The results of this study indicate that the level of parasitism of *T. abutilonea* was higher on *Ampelamus* and *Polygonum* than on *Abutilon* or *Sida*. This higher level was not the result of greater host density on the first 2 plants; in fact, the *Abutilon* plants always harbored greater numbers of whitefly hosts than any of the other 3. But the data suggest that such

Table 1.—Parasitization of *Trialeurodes abutilonea* on 3 host plants. Urbana, Ill. 1958.

Whitefly host plant	Month	No. whitefly pupae		Percent parasitized
		Collected	Parasitized	
<i>Polygonum</i>	Aug.	100	44	44.0
	Sept.	152	17	11.2
	Oct.	189	56	29.6
<i>Abutilon</i>	Aug.	100	1	1.0
	Sept.	100	1	1.0
<i>Sida</i>	Sept.	50	1	2.0
	Oct.	50	3	6.0

plants (i.e., *Abutilon*) were neglected, if not avoided, by the searching adult parasites. The following hypothesis is offered as an explanation for this parasite behavior.

With regard to host-plant selection, the banded-wing whitefly has been shown to be extremely flexible and adaptive—so flexible, in fact, that its preferred host in this area is an introduced weed (*Abutilon*). The parasites, on the other hand, evidently have a rather rigid behavior pattern, and concentrate their host-searching activities on native, whitefly-host plants. Thus, while the whitefly has adapted to a very wide range of host plants, the parasites apparently are restricted to a limited number of these same host plants.

If this explanation is valid, it would constitute further evidence supporting the theory of the native origin of this species of whitefly.

PREDATORS

In the field, the following predaceous insects have been observed feeding on various stages of the banded-wing whitefly.

Orius insidiosus (Say) (Hemiptera, Anthocoridae).—Nymphs and adults of this species feed on the eggs, larvae, and puparia of *T. abutilonea* throughout the summer. Adult *Orius* feeds on the pupal stage by inserting its stylets through the side of the pupal case and ingesting the fluids within the case.

Nabis fesus (L.) (Hemiptera, Nabidae).—Both nymphs and adults feed on the larvae and pupae of *T. abutilonea*.

Geocoris punctipes (Say) (Hemiptera, Lygaeidae).—Adults were observed feeding on third- and fourth-instar larvae and pupae.

Chrysopa oculata Say (Neuroptera, Chrysopidae).—Both larvae and adults of this lacewing were seen feeding on eggs, larvae, and puparia of *T. abutilonea*.

Coleomegilla maculata (DeGeer) (Coleoptera, Coccinellidae).—Larvae and adults of this species feed on eggs, larvae, and puparia of *T. abutilonea*. Larvae of this lady beetle frequently are found in large numbers on plants which are heavily infested with the whitefly.

FUNGI

During this study, fungi of 3 genera were found in association with *T. abutilonea*. They were identi-

Table 2.—Summary of parasite rearings from pupal cases of *Trialeurodes abutilonea*, showing relationships between parasites, hosts, and host plants. Urbana, Ill. 1958.

Whitefly host plant	<i>Encarsia quaintancei</i>	<i>Encarsia pergandiella</i>	<i>Amitus aleurodinus</i>	<i>Eretmocerus haldemani</i>	Total
<i>Ampelamus albidus</i>	349	91	7	5	452
<i>Polygonum hydropiperoides</i>	135	58	88	5	286
<i>Abutilon theophrasti</i>	5	37	0	0	42
<i>Sida spinosa</i>	3	0	1	0	4
Totals	492	186	96	10	784

fied by Dr. D. P. Rogers, of the Department of Botany, University of Illinois, as follows: On honeydew, *Cladosporium* sp.; on puparia, *Alternaria* sp. and *Cladosporium* sp.; on adults, *Alternaria* sp., *Cladosporium* sp., and *Penicillium* sp. According to Dr. Rogers, their relationship to the puparia and adults of *T. abutilonea* is of a saprophytic nature, and possibly weakly parasitic. The pupae and adults were always dead when found infected, with mycelial strands throughout their bodies. Frequently *Cladosporium* growth on the leaves becomes so profuse (Fig. 10) that its mycelial mat prevents the emergence of adult whiteflies from the pupal cases.

In the literature, only 1 report could be found in which a fungus attacking *T. abutilonea* was identified by name. Morrill and Back (1912) found a rank growth of *Aschersonia aleyrodis* Webber on the banded-wing whitefly at Orlando, Fla. This is the so-called red aschersonia which is parasitic on several whitefly species in the citrus-growing areas of Florida. Its principal hosts are the citrus whitefly, *Dialeurodes citri* (Ashmead), and the cloudy-winged whitefly,

D. citrifolii (Morgan). Petch (1925) concluded that *A. aleyrodis* is the conidial stage of *Hypocrella libera* Sydow.

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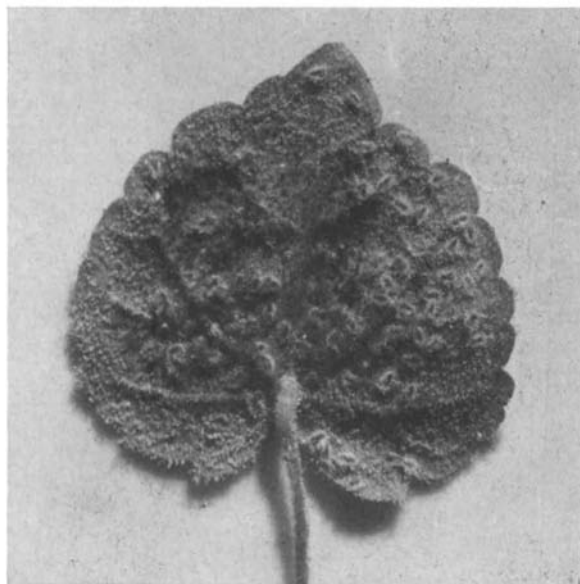


FIG. 10.—Under side of *Abutilon* leaf with profuse fungal growth (*Cladosporium* sp.) in association with immature stages of the banded-wing whitefly. $\times 2.8$.