

CALS IPM Grant Report
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PROJECT TITLE: Which Wasp?

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PARASITOID DISPERSAL*

We have nearly completed data collection for our comparative vertical flight chamber studies. Subjects are females from five whitefly parasitoids species (Table 1). The purpose of these experiments is to test three main hypotheses: (1) oogenesis and pre-oviposition dispersal are negatively correlated (as predicted by competition for nutrients or increased wing loading with increased egg load), (2) oogenesis and pre-oviposition dispersal are positively correlated (as predicted by increased risk of time limitation with increased early reproductive effort and a relaxation of wing loading constraints in minute insects), and (3) the null hypothesis that oogenesis and pre-oviposition dispersal are not correlated. Interspecifically, *Eretmocerus* spp. (high early reproductive effort, short adult lifespan) show a markedly higher propensity for dispersal when compared to *Encarsia* spp. (low early reproductive effort, long adult span). We are currently examining the relationship between intraspecific variation in egg load and both flight duration and propensity (after controlling for body size and weather factors) across the test species. Future research endeavors on this topic include: (1) comparative flight chamber studies where host density and oviposition experience are varied, (2) concurrent comparative studies of parasitoid dispersal and pest suppression in large scale greenhouses and open-field agriculture, and (3) flight chamber studies of larger parasitoid species to examine the generality of the trends observed in this study.

Data collected to date appear in Table 1.

Table 1. Flight parameters of selected sweet potato whitefly, *Bemisia tabaci*, parasitoids.

Species	N	% Flew	Mean Distance (m) ¹	Distance Range (m)	% Cue Response
<i>Encarsia formosa</i>	118	5.1	13.9 ± 13.9	0 – 55.8	0.0 ± 0.0
<i>En. pergandiella</i>	106	6.6	46.5 ± 19.4	0 – 138.3	2.9 ± 2.7
<i>En. sophia</i>	55	14.5	21.9 ± 10.4	0 – 52.8	18.1 ± 4.7
<i>Eretmocerus emiratus</i>	20	80.0	32.1 ± 16.7	0 – 109.9	63.4 ± 28.9
<i>Er. eremicus</i>	111	44.1	74.8 ± 25.4	0 – 641.5	38.4 ± 5.7

FLIGHT FUELS:

Our most nascent project concerns an examination of the chemical classes that are used by whitefly parasitoids to fuel flight. Mike Salvucci and I have learned that we can detect levels of soluble carbohydrates in the aphelinid whitefly parasitoid *Eretmocerus eremicus* Rose & Zolnerowich using HPLC methods. They contained significant

¹ Mean rate of ascent times duration of those rates.

amounts of glucose and fructose, along with those of an unknown carbohydrate that appears consistently. We are investigating GLC techniques to determine levels of lipids and glycogen. We are flying these untethered wasps in our vertical flight chamber to see which class is diminished as a function of flight duration. This should provide an indirect measure of which class of compounds is important during which period of flight.

TANGENTIAL RESEARCH

Trehalulose is a structural isomer of sucrose with a different disaccharide bond linkage between the glucose and fructose moieties. It has been identified as a major portion of the honeydew of *Bemisia tabaci*, although the function has not been conclusively demonstrated. Trehalulose may represent an important mechanism through which whiteflies are able to meet their nutritional demands under varying environmental conditions. A ketose reductase enzyme in whiteflies has been shown to convert fructose to sorbitol, a molecule shown to accumulate in heat-stressed whiteflies and widely believed to be important in toleration of environmental extremes. We have begun experiments to further understand the relationship between trehalulose and sorbitol production in whiteflies experiencing thermal and other environment variation. The importance of feeding on carbohydrates has been demonstrated for parasitoids, whether feeding on plant sugars (sucrose and its components) or insect-modified sugars (e.g. trehalulose) in honeydew. We have performed feeding trials to measure the longevity of parasitoids fed on trehalulose compared with a sucrose control. We included in our study a suite of whitefly parasitoids, including *Eretmocerus eremicus*, *Encarsia formosa* and *Encarsia pergandiella*. We also included a non-whitefly parasitoid, *Nasonia vitripennis*, a well-studied pteromalid parasitoid of Diptera. Our results show no significance in longevity for parasitoids between diets of sucrose and trehalulose. As a continuation of these carbohydrate-feeding studies, we plan to investigate the relative importance of carbohydrates from plant sources or honeydew in providing energy for flight fuels in the dispersal of these small parasitoids.

STAKEHOLDERS

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IMPACT STATEMENT

- Determining the flight duration and calculating a potential dispersal range for a group of parasitoids attacking *Bemisia tabaci* (Gennadius) will be invaluable in selecting the best biological control agent to release as part of management programs in both open agriculture and under protected cultivation. This is particularly important when you are concerned about a very mobile pest such as the sweet potato whitefly (documented to migrate up to 7 km in a morning).
- Determining which flight fuels are used by these same aphelinids may play a similar, but potentially less significant, role in selecting agents.