

**PROJECT TITLE:** Have We Underestimated Dispersal by the Sweet Potato Whitefly?  
**PROJECT LEADER & TEAM MEMBERS:** David N. Byrne, John C. Palumbo, & Jesse A. Hardin

**LOCATION:** Multiple Counties

**CRITICAL ISSUES:** While there is ebb and flow to whitefly population levels from year to year, the sweet potato whitefly, *Bemisia tabaci*, has been a consistent pest of vegetable and cotton crops since population levels greatly expanded in the early 1980s. This was likely the result of an introduction of a new strain, strain A, into our production system. A similar occurrence took place in the late 1980s with the arrival of strain B, and now we face the possibility of a reoccurrence with the arrival of a third strain, strain Q. Strain Q has not been reported in the field in Arizona, however. Expanding populations are, in part, attributable to an expansion of host range as more and more commodities have become involved. As a result, this insect is of continuing concern to our stakeholders.

One aspect of sweet potato whitefly behavior that persists in its importance is their ability to move between crops. Information concerning movement helps address many of the applied concerns for, e.g., estimates of distance traveled between potential source populations. “A neighbor refuses to plow down his watermelon field that is 3 miles away. Are those whiteflies going to affect my field?” Better information regarding whitefly dispersal and migration<sup>1</sup> allows us to better understand the spread of plant pathogens vectored by this whitefly. The pathogen of interest in 2006 was cucurbit yellow stunting disorder virus. (Examinations of pest movement are listed among the research priorities outlined in Pest Management Strategic Plan for California and Arizona Lettuce Production [see below]).

There is some confusion concerning dispersal distances that seems to stem from statements made during recent extension meetings about sweet potato whiteflies annually reinvading the Southwest from Mexico and points south. This would suggest that they are capable of long range dispersal. These assertions are in conflict with our previous understanding that small resident whitefly populations live through the winter in Arizona and serve as insect pest sources each spring.

Adding to the confusion concerning whitefly movement was our previous belief whitefly dispersal rarely exceeded our estimates of a 2-mile range. Even slightly longer flights were not thought to be within the capabilities of the sweet potato whitefly. We are now refining our estimates of short dispersal distances because of evidence that individual whiteflies are capable of flight on multiple days. Therefore, reasons for reexamining whitefly dispersal are two-fold. We need empirical evidence as to whether or not whiteflies engage in dispersal of several hundred miles. At the same time we need to redefine short range dispersal distances beyond the 2-mile estimates we have been using.

We do have preliminary laboratory evidence that sweet potato whiteflies can fly on more than one day (Fig. 1). These data were generated in the laboratory using a vertical flight chamber. While has been common to find whiteflies that engaged in non-migratory flight on more than one day, and although we have observed 98 individuals, only two have engaged in migratory flight, i.e., flights that would carry them beyond 2

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<sup>1</sup> Dispersal refers to movement in general, a moving apart. Migration refers to dispersal designed to carry insects to a new habitat.

miles. We need to double our number of laboratory observations to determine if sweet potato whiteflies conduct migratory flights on multiple days. If they do, we will have to recalculate our estimates of how far these insects can disperse. This will allow us to better answer the sort of grower questions we have discussed.

**INPUTS:** To determine whether sweet potato whiteflies fly on multiple days, we have begun a laboratory study to better control confounding variables. Leaf punches with large nymphal populations are taken from cowpea leaves and placed in Petri dishes with agar-filled bottoms. The next day, newly emerged whiteflies are placed individually in similar dishes. The following day, these insects are transferred to small vials and placed in the flight chamber. They are given 3 minutes to fly toward a sky cue. We counted as having flown insects that initiate any flight, regardless of whether it simply flitted from the vial or flew for as long as 18 minutes. The proportion initiating flight, their rate of ascent, and number that continued to fly toward the sky cue are recorded<sup>2</sup>. After being in the chamber, insects are returned to new Petri dishes with new leaves. This process has been repeated for up to 10 consecutive days (8 were more usual) or until the individual whiteflies are either lost or died.

To date we have observed a total of 98 individual whiteflies<sup>3</sup>. We did find that certain of these whiteflies flew on multiple days (Fig. 1). This figure indicates that 50% of observed whiteflies flew on Day 1. Of those that flew on Day 1, 47% flew on Day 2. These data are shown to Day 10. Although we present our data on consecutive day flights above, we do not know the importance of multiple day flights toward total lifetime movement by individual insects. What we have not yet determined, for example, is whether or not insects that flew on Day 5 also on Day 2. This information is available, but data have not yet been analyzed. We also have information that shows that some females had flights as many as 10 days following emergence. No male flew after Day 5. Our current data set will need to be expanded in order to make statements about multiple migratory flights.

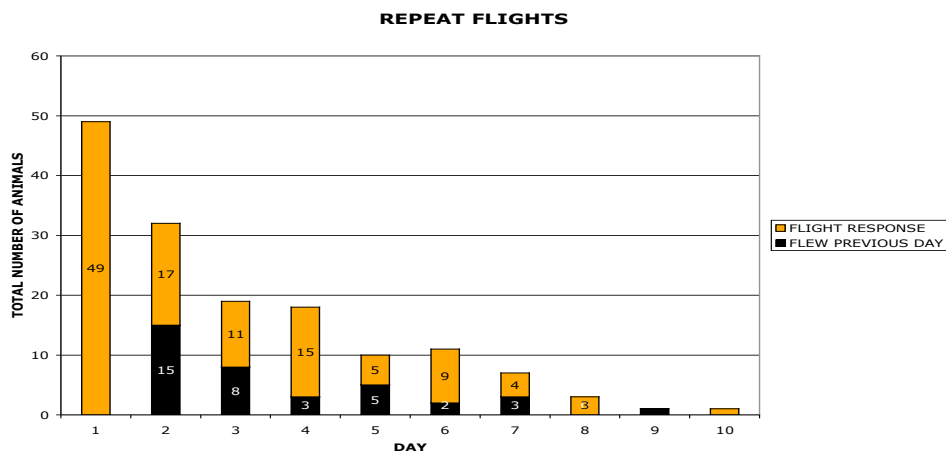


Fig 1. Results of days on which whiteflies fly as related to flight on previous day.

<sup>2</sup> If they continued to fly toward the sky cue (a 550 nm light source) and ignored the plant cue (a 480nm light), they were identified as being migratory.

<sup>3</sup> In the beginning, most insects are lost, squashed, or disappeared into the ethers. As techniques improved, our sample size has increased.

Because laboratory results need to be corroborated in the field, we are also proposing a series of experiments at the Yuma Agricultural Center. In these trials whitefly populations will be marked in melon fields using Day-Glo fluorescent dust. As in previous experiments, they will be captured down range to a distance of 3 miles. Whiteflies captured in fan traps will be placed on leaf punches in agar-filled Petri dishes to keep them alive during transport. These will be returned to the laboratory where they will be tested in our flight chamber to measure flight response over subsequent days. We can determine if their migratory phase lasts for several days. If so, we will revise our estimates of total distance flown.

To conduct these experiments we are requesting \$5,600 (\$1,300 for travel to Yuma, \$1,400 for supplies and repairs to flight chamber, and \$2,900 for student wages for assistance in the laboratory and field).

**Relevance to APMC Priorities**

Since whiteflies move readily during the year, we feel an examination of their crop-to-crop movement meets the APMC priority of “Agricultural and Cross-commodity IPM”. We also feel that this research addresses the need to “Develop effective, economical management techniques for whiteflies” identified as a High Critical Research Need in the Pest Management Strategic Plan for California and Arizona Lettuce Production. Our results can be used to better inform growers about planting distances as recommended in the cultural practices for IPM programs, thereby “educating growers on alternate pest control methods aimed at reducing pesticide usage.”

**OUTPUTS:** David Byrne and John Palumbo will produce an extension bulletin concerning dispersal by whiteflies, and other small insect, across the agricultural landscape, with particular references concerning predictions of distances moved. We will also discuss their importance to agricultural production. Additionally, our findings will be reported in the University of Arizona's annual vegetable report. The information generated by this research will be included in a series of extension meetings this year and next. Our principal audience will be pest control advisors and farm production managers. These are the individuals who are responsible for making recommendations concerning crop placement and timing. We will also focus on Arizona growers who are responsible for plowing their own fields and who must influence neighbors to plow theirs.

**OUTCOMES AND IMPACT:** *Short Term:* Utilize laboratory and field experiments to re-evaluate the role of dispersal and migration on successive days by *Bemisia tabaci* in predicting the intercrop movement of this important pest. *Middle Term:* It is important that we conduct research that will allow the scientific community to provide growers predictions of dispersal distances by whiteflies that are as accurate as possible. We will develop extension bulletins that highlight the impact of intercrop movement by whiteflies that includes this updated information. *Long Term:* We hope to influence Arizona's farming community that management of whiteflies is highly dependent not only on the individual success of growers, but is also dependent on the actions of others in their community. As an example, what happens in neighboring fields does have direct influence on whitefly population levels throughout the region.

**PLAN FOR EVALUATION:** Kurt Nolte has agreed to include questions concerning the importance of considerations of insect movement to IPM. The first of these questionnaires will be used at a Yuma County extension meeting where DNB will be speaking on February 11, 2008. A similar assessment will take place in the fall.