

Project Title: Statewide survey of the distribution of Q Biotype of *Bemisia tabaci*

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Location: Statewide

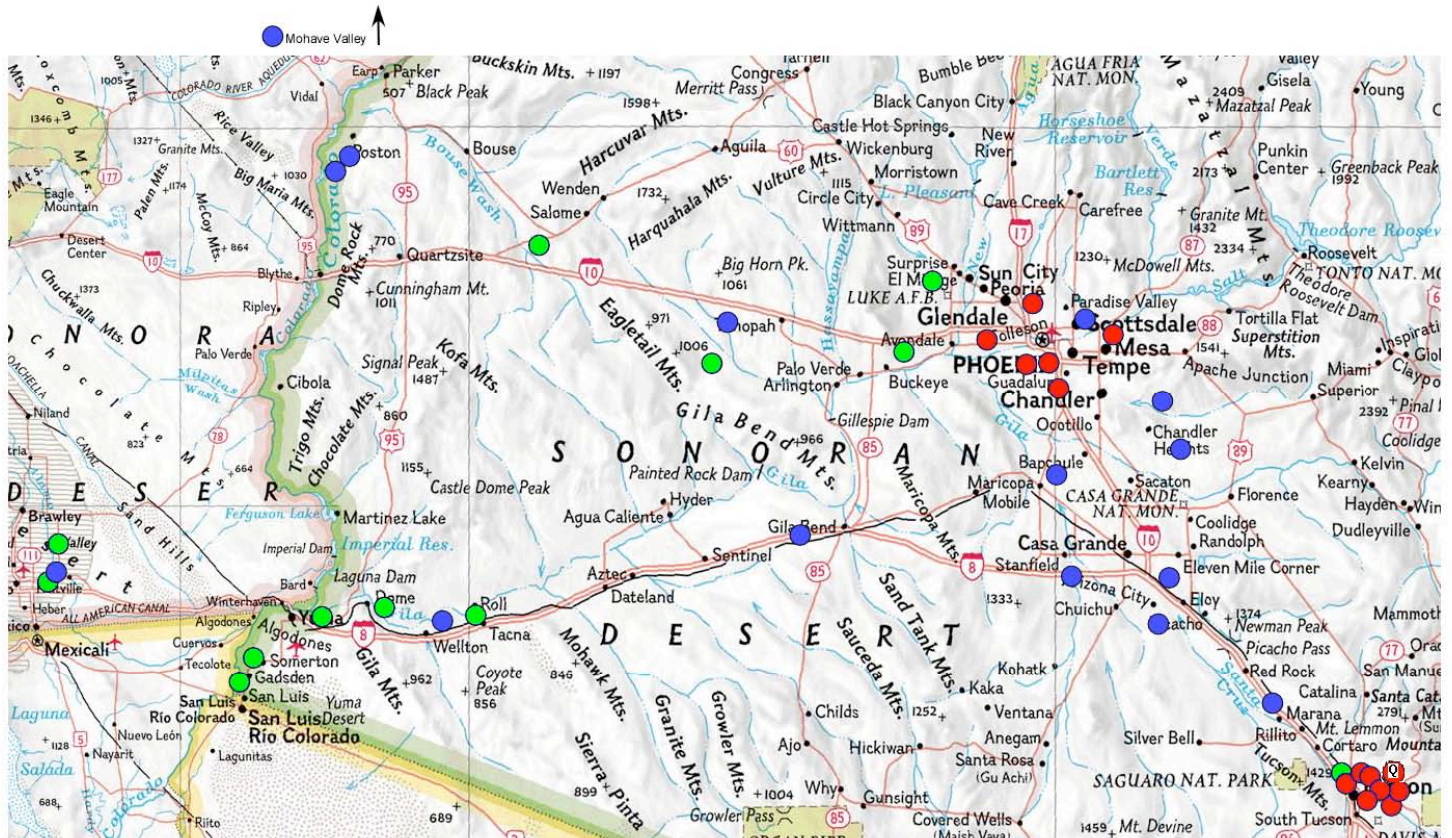
Critical Issues

The whitefly *Bemisia tabaci* is one of the world's most destructive and invasive crop pests. A devastating new biotype of this insect, called the Q biotype, originated from the Mediterranean region and spread to other countries including the U.S. via human-mediated movement of plant materials. Since its first detection in the New World by Dr. Dennehy in Arizona in December 2004, the invasive, insecticide-resistant Q whitefly biotype has been found in 24 other states. So far, it has been detected in the U.S. only on greenhouse-grown herbaceous or ornamental plants. However, like the B biotype in the 1980s, there is the possibility that it could spread to a wide variety of other hosts of whiteflies in Arizona including cotton, melons, and vegetables. If so, it could cause millions of dollars of damage statewide, as did the currently prevalent B biotype. The Q biotype has demonstrated the ability to rapidly evolve resistance to many insecticides, including the insect growth regulators and neonicotinoid insecticides that now control the B biotype in Arizona. Thus, the Q biotype threatens Arizona's crop production.

At this time we do not know for sure the severity of the threat posed by this new biotype. We do know for certain, however, that the introduction of the B biotype devastated IPM programs throughout the Southwest starting in the late 1980s. We do know for certain that the two Q biotype strains we detected and established in lab colonies, Poinsettia'04 and Poinsettia'06, had extremely elevated levels of resistance to a broad range of insecticides, relative to B biotype whiteflies in Arizona field crops (Dennehy et al. 2005; Dennehy et al. unpublished data). Given the possible impact, the only prudent approach to this new threat is to plan for the worst and hope for the best. Planning for the worst requires pro-actively monitoring the location and spread of the Q biotype within our production systems and then exploring ways to manage it before it becomes widely established. To that end, a statewide survey of the distribution of Q biotype has been initiated by Dr. Dennehy since 2004 and was partially supported by the APMC IPM program in 2007. This led to the first detection of Q biotype in the New World in 2004, which in turn resulted in the establishment of a national Q-biotype Whitefly Task Force to survey states for the Q biotype.

Results from the 2007 survey (Fig. 1 and 2; analyses of the 2007 open field samples are still underway) include detection of 4 Q-biotype samples (1 from the 2006 samples and 3 from the 2007 samples) and establishment of four Q-biotype lab strains resulted from the four Q-type samples. This brings the total number of Q-biotype samples detected in Arizona to eleven (1 in 2004, 6 in 2005). Although no Q biotype whiteflies have been detected from open fields,

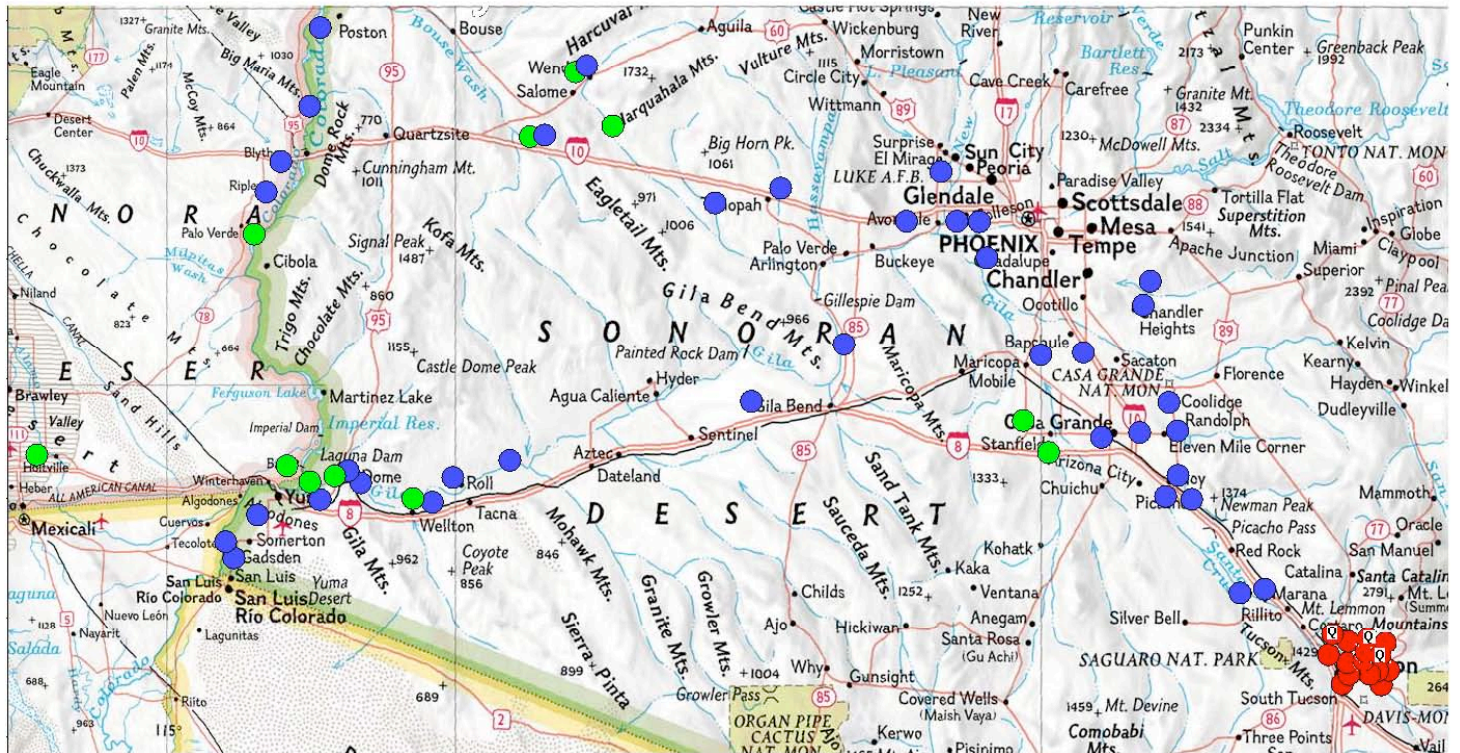
the more readily establishment and maintenance of Q biotype lab strains from the 2006 and 2007 Q samples than from the 2004 and 2005 ones indicate an ever-increasing adaptability and potential fitness of Q biotypes on open field crops. This implies that the risk of invasion of field crops by Q biotype may be on the rise. Therefore, we request that the UA-IPM program contribute partial funding to continue this survey in 2008



Legend

- Cotton
- Melon/vegetables
- Greenhouse/urban

Figure 1. The 2006 distribution map of B and Q biotypes. A total of 55 samples (18 from cotton, 13 from melon/vegetables, and 21 from greenhouse/urban) were collected in 2006 and analyzed in 2007. All samples but one (06-124 collected from poinsettia in Tucson was Q biotype) were B Biotype. The Q-biotype lab strain established from the only Q sample, designed as Poinsettia 06, is highly resistant to multiple insecticides including pyriproxyfen, buprofezin, neonicotinoids, and spiromesifen.



Legend

- Cotton
- Melon/vegetables
- Greenhouse/urban

Figure 2. The 2007 distribution map of whitefly collection sites. A total of 64 whitefly samples were collected from cotton (37), melon/vegetables (11), and greenhouse/urban (15 from poinsettia or hibiscus) in 2007. Among the 15 poinsettia/hibiscus samples, 3 of them were pure Q biotypes. All the three Q samples have been maintained on cotton in lab and bioassays will be conducted to estimate their resistance to pyriproxyfen, buprofezin, and neonicotinoids. Analyses of the 48 open field samples are still underway.

Objectives / Activities

To provide up-to-date information on the distribution of the Q biotype, we will accomplish the following objectives:

- 1) We will sample whiteflies on the following field commodities at locations throughout the lower desert of Arizona: summer cotton and melons, fall melons, winter vegetables

(principally Cole crops and leafy greens), spring melons. In addition, we will sample transplants that are hosts of whiteflies at nurseries throughout Arizona. Lastly, from Thanksgiving to New Years we will intensively sample poinsettias in retail outlets throughout Arizona.

We cannot predict with accuracy where and when whiteflies will occur on the hosts that we sample. Typically, we find whiteflies on only a very small percentage of winter vegetables and greenhouse crops because these crops are frequently treated with neonicotinoid insecticides. However, our objective will be to obtain 10 collections each from cotton, melons, and vegetables (30 total) and 10 collections each from greenhouse-grown transplants and poinsettias (20 total). A sample will constitute a minimum of 10 adult whiteflies.

- 2) Use the mitochondrial cytochrome oxidase I (mtCOI) PCR-RFLP (CAP method) to analyze each sample.
- 3) Validate the Q biotype with either the esterase banding (i.e., allyzome assay) or mtCOI gene sequencing methods
- 4) Integrate the biotyping results into a statewide distribution map of the Q and B biotypes
- 5) Deliver the distribution map to the decision makers/stakeholders and end-users including extension agents, ornamental industry, and growers through the Arizona Cooperative Extension Network (<http://www.ag.arizona.edu/extension/>) and the Arizona Pest management Center (<http://cals.arizona.edu/apmc/>).

This statewide whitefly biotype survey will increase our knowledge and understanding of their statewide distribution, spreading, host crop suitability, and establishment in Arizona. Such information is extremely valuable for the decision makers/stakeholders to assess the severity of the threat posed by this new biotype and the risk of its establishment in Arizona and design rational strategies towards the Q biotype threat accordingly.

Relevance to APMC Priorities

This proposal directly addresses “Detection & Diagnostics > Insects” and “Agricultural IPM > Cross-commodity” two focal areas of the APMC. It also addresses the IPM priorities of “projects that specifically link applied IPM research with statewide outreach.”

Inputs/Budget

Proposed Budget	
Salary	\$6500
Materials & Supplies	\$2500
Total	\$9000

Collections will be made by Ben DeGain of the Extension Arthropod Resistance Management Laboratory (EARML) and Peter Ellsworth. Laboratory analyses will be conducted by

Xianchun Li and PhD student Weihua Ma with the assistance of EARML research technician Ben Degain. We will use mtCOI gene PCR-RFLP to biotype whitefly samples as our previous surveys have indicated that this method is reliable, fast, and cost-effective. But we will occasionally use the mtCOI gene sequencing or esterase banding pattern to double check the results, especially for the Q biotype.

The total cost of collecting and analyzing whiteflies for this project is estimated to exceed \$30,000. The \$6500 for salary will be used for partial support of PhD student Weihua Ma during 2008. Ben Degain's salary will be funded from other sources. Thus, the \$9000 from APMC will be leveraged with an estimated \$21,000 in funds from other sources (Arizona Cotton grower association, \$35,000).

We will use 2008 funding to: 1) analyze the remaining samples collected in 2007, 2) collect and analyze new samples in 2008.

Outcomes/Impacts

Short-term: Increase in knowledge and understanding of the statewide distribution, spreading, host crop suitability, and establishment of the whitefly Q biotype in Arizona. A distribution map of the Q and B biotypes will be delivered to the decision makers/stakeholders including extension agents, ornamental industry, and growers through the Arizona Crop Information Site (ACIS) and the Arizona Pest Management Center.

Medium-term: Informed assessment of the severity of the threat posed by the Q biotype and the risk of its establishment in Arizona.

Long-Term: Design and implementation of rational strategies for management of the Q biotype.

Evaluation: We will measure the relative frequency of the B and Q biotypes in terms of locations and crops.

Outputs: We anticipate the following: 1) A statewide distribution map of the Q and B biotypes in Arizona; 2) Results communicated to the decision makers/stakeholders and end-users including extension agents, the USDA Task Force on the Q biotype, ornamental industry, and growers. In addition to posting the distribution map online, a Powerpoint presentation of the map will be provided to John Palumbo, Peter Ellsworth, and county agents for inclusion in local updates to the grower community at meetings and workshops; and 3) Publication of the survey results as a "Cotton Report" in our CALS publication on the progress of the project.