

Predicting and Managing Invasiveness of the Q Biotype of the Sweetpotato Whitefly

Project Leader: Yves Carrière (University of Arizona Entomology)

Project Team Members: David Crowder (University of Arizona Entomology), Rami Horowitz (Agricultural Research Organization of Israel)

Location: Research will be conducted at the University of Arizona. Extension effort will be statewide.

Situation and Need:

The sweetpotato whitefly, *Bemisia tabaci*, is one of the world's most serious crop pests. An invasive new biotype of this pest, the Q biotype, which originated in Spain, was first reported in Arizona in December 2004. A subsequent nationwide survey found this pest had been introduced to at least 23 other states. This pest represents a serious threat to crop production in Arizona and other states, in part due to its ability to evolve resistance to insecticides. Multiple strains of the Q biotype collected in Arizona since 2004 are resistant to the major classes of insecticides currently used as part of the Arizona Whitefly Management Plan for the B biotype of *B. tabaci*, including insect growth regulators and neonicotinoids^{1,2}. Although this pest has only been found in greenhouses and plant stores in the US to date, the potential invasion of the Q biotype into field production systems, including cotton, melons, and vegetables, represents a serious threat to crop production in Arizona and the US.

Over the past year, we have conducted research focused on understanding factors that could affect the establishment and spread of the Q biotype in the US. Our research indicates that reproductive interference by the B biotype of *B. tabaci* could significantly limit the establishment and spread of the Q biotype. Differences between the response of the B and Q biotype to temperature, host crops, and insecticides could also affect the spread of the Q biotype. A proactive approach to understanding the effects of these factors on the outcome of competition between the B and Q biotype is essential to developing effective monitoring and prevention efforts for this invasive pest complex. In addition, data collected could also be invaluable for developing IPM programs for the Q biotype if and when it invades field crops.

Due to the proactive nature of the project, we have encountered difficulties in obtaining federal funding. We believe that a grant from the IPM program at this critical early stage of the project will allow us to supplement our research effort and collect data that will make us more competitive for future federal grant opportunities. All funds obtained from the APMC IPM program will be leveraged with other funding sources, including a fellowship and scholarship that provides salary support for David Crowder, salary support for Rami Horowitz (who is on sabbatical at Arizona), and other grant money (some already invested), to allow us to complete our research objectives in a timely manner.

¹ Palumbo, J.C., P.C. Ellsworth, T.J. Dennehy, and R.L. Nichols. 2003. Cross-Commodity Guidelines for Neonicotinoid Insecticides in Arizona. IPM Series 17. Publ. No. AZ1319. University of Arizona, College of Agriculture and Life Sciences, Cooperative Extension, Tucson, Arizona. 4 pp. URL: <http://cals.arizona.edu/pubs/insects/az1319.pdf>

² Ellsworth, P.C., J.C. Palumbo, S.E. Naranjo, T.J. Dennehy, R.L. Nichols. Whitefly Management in Arizona Cotton 2006. IPM Series No. 18. University of Arizona Cooperative Extension Bulletin, AZ1404, 5/2006. <http://cals.arizona.edu/pubs/insects/az1404.pdf>

Relevance to Priorities:

As part of the Agricultural IPM focal area, this research specifically addresses one priority in the RFP, "**new and emerging pest threats in Arizona**" and a major priority of Agricultural and Cross-commodity IPM identified at the APMC Summit, to "**prevent, detect, and mitigate exotic pest introductions**" by providing a better understanding of the factors that could affect the establishment and spread of a potentially devastating new crop pest in Arizona. In addition, the project will link applied IPM research with statewide outreach, by disseminating research data to extension personnel to develop and implement effective prevention and monitoring efforts for the Q biotype. This project addresses national IPM priorities by investigating a pest that threatens the production of field and greenhouse crops in many states. Thus, the project could have implications for multiple crop-production industries.

Outputs:

Activities:

We currently are maintaining one strain of the Q biotype and two strains of the B biotype in the laboratory. Four new strains of the Q biotype collected in Arizona in the winter of 2007 by Tim Dennehy are currently in culture and we expect some of them to become available for research soon. Funds will be used to conduct experiments to understand factors that could affect the establishment and spread of the Q biotype of *B. tabaci*. Specifically, we will:

- Measure key life history traits of the Q biotype, including developmental time, fecundity, and mortality
- Determine the outcome of competition with the B biotype of *B. tabaci* under various conditions in laboratory and population cage experiments
- Determine the effects of insecticide resistance on competition and life history traits

These data will be incorporated into simulation models to predict the outcome of competition under laboratory and field conditions, and to determine the relative importance of these key factors on the establishment and spread of the Q biotype in Arizona.

Extension:

Data collected during the course of this research will be disseminated to growers and extension agents through the Arizona Crop Information Site (ACIS) (<http://www.ag.arizona.edu/crops>) and the APMC (<http://cals.arizona.edu/apmc>). Information will be shared with extension faculty and county agents to be disseminated to growers. David Crowder will present results/ideas from the research at a local extension meeting in Marana. We will also contribute information from the project to the Cross-commodity Research and Outreach Program team. The overall goal of these activities is to aid in the development effective strategies to prevent the establishment and spread of the Q biotype, and to manage the Q biotype if it becomes established in field crops.

Expected Outcomes and Impacts:

Short Term:

- Understand key factors affecting the establishment and spread of the Q biotype of *B. tabaci*.
- Dissemination of research results to extension personnel and growers to aid in the development of monitoring and prevention efforts for the Q biotype
- Analyze the potential outcome of invasions under approximated field conditions.
- Creation of small-scale simulation models to predict the conditions under which invasions are most likely to occur in Arizona and other parts of the US.

Medium Term:

- Develop models with collaborators from Spain and Israel. Because extensive data on the occurrence of the B and Q biotypes in the field exist for each country at many locations in

each of 7-10 years, we will develop models not only to analyze but also *predict* the distribution and spread of the Q biotype in Spain and Israel.

- Use geographical information systems, and data collected above, to identify regions in Arizona most at risk of invasion.

Long Term:

- Expand geographical information systems (GIS) analysis to states other than Arizona to identify regions throughout the US most at risk of invasion
- Further improve and refine monitoring and prevention efforts for the Q biotype
- Aid in the development of IPM strategies for the Q biotype if field crops are invaded
- Demonstration of an approach that might be useful in testing, predicting, and managing invasiveness in other pest systems.

Evaluation:

Monitoring efforts of the Q biotype in field production systems in Arizona have been conducted every year in the laboratories of Drs. Xianchun Li and Timothy Dennehy at the University of Arizona. If this effort is maintained, we will use the results collected by these laboratories to determine if data collected in this project were effective in predicting the establishment and spread of the Q biotype in Arizona.

Inputs / Budget:

We are requesting \$4000 to cover the salary of David Crowder, who is currently a graduate student in Entomology but will be a postdoctoral associate in the laboratory of Yves Carrière beginning in August 2008. We are requesting \$6000 to partially cover research expenditures to conduct laboratory and population cage experiments.

Budget:

Salary Support:	\$4000
Research Expenditures:	
a) PCR supplies (we use PCR to regularly monitor our colonies to insure they only contain whiteflies of one biotype [B or Q]).	\$1000
b) Greenhouse supplies (to grow plants)	\$1000
c) Equipment for population cage experiments	\$1000
d) Costs to maintain whitefly colonies (money is needed for equipment and space to maintain 8 isolated whitefly colonies. We expect this number to increase soon when more Q biotype colonies become available for research)	\$3000
Total Amount Requested	\$10,000

Leveraging / Other Sources of Funding:

To date, Yves Carrière and David Crowder have invested approximately \$25k in funding for this project. David Crowder's salary as a graduate student until August 2008, during which time he will conduct the experiments, are covered with an Environmental Protection Agency STAR Fellowship (\$20k/yr) and an ARCS Foundation Scholarship (\$9k/yr). The salary of Dr. Rami Horowitz, who will conduct the population cage experiments along with David, is covered by his University while he is on sabbatical. The approximate cost to complete all short and long-term objectives of the project will be \$50k. Dr. Carrière plans to leverage any money obtained from the IPM program with an additional \$20k to complete the project. We are seeking funding from the Cotton Foundation and other organizations to obtain the remaining necessary \$20k needed to complete the project. Funding from the IPM program at this stage of the project will make proposals to these organizations more competitive.