"Q" Biotype Whitefly: How Big a Threat?

Phil Stansly[1] and Cindy McKenzie[2]
[1] University of Florida/IFAS, Southwest Florida Research and Education Center, Immokalee FL 34142, pstansly@ufl.edu
[2] U.S. Horticultural Research Laboratory, USDA-ARS, 2001 South Rock Road, Fort Pierce, FL 34945, cmckenzie@ushrl.ars.usda.gov

A new strain of *Bemisia tabaci*, "Q" biotype, was first detected in the US on poinsettias purchased at a retail outlet during December 2004 in Tucson by a team from the University of Arizona. The plants were said to have been purchased from a wholesale dealer in California. Although indistinguishable in appearance from silverleaf whitefly, these insects proved markedly less susceptible to pyriproxyfen, buprofezin, imidacloprid, acetamiprid, and thiamethoxam. Electrophoresis, polymerase chain reaction (PCR) and sequencing of the mitochondrial cytochrome oxidase 1 gene revealed their unique genetic identity. The debut of a new whitefly on poinsettia is reminiscent of a scenario 19 years ago that culminated in unprecedented losses for Florida tomato growers and a new pest pandemic. Are we in for an equally devastating invasion?

History of Whitefly Biotypes

Prior to 1986, *B. tabaci*, known as the sweetpotato whitefly, was thought to be pretty much the same everywhere it occurred throughout the tropics, subtropics and mild temperate regions of the world. Then massive numbers suddenly turned up in greenhouse poinsettias in Florida, spreading quickly to field grown vegetables and other crops (Price 1987). Clouds of whiteflies in tomato fields produced quantities of sooty mold and a nuisance for pickers, followed by a new plant disorder, tomato irregular ripening (Schuster et. al. 1990) and a new geminivirus, Tomato Mottle (Polston and Anderson 1997). First dubbed the "poinsettia" whitefly or even the "Florida" whitefly, it came to be known as *B. tabaci* biotype "B" to distinguish it from the former biotype "A". Biotype "A" had been relatively benign in Florida but caused serious losses in California and Arizona as a cotton pest and a vector of the "crinivirus" lettuce infectious yellows in lettuce and melons (Duffus 1995).

The term "biotype" is synonymous with "strain" or even "subspecies" and biotypes of the same species should be able to produce fertile offspring when crossed. Although biotypes of *B. tabaci* cannot be separated visually, biotype "B" was described in 1994, though not universally accepted, as a new species, *Bemisia argentifolii* or "silverleaf" whitefly (Bellows et. al. 1994). Species status was conferred on the basis of biological differences such as the ability to cause physiological disorders such as squash silverleaf or tomato irregular ripening, as well as failure to produce hybrids with biotype "A" whiteflies in the laboratory (Perring et. al 1993).

Since the discovery of the silverleaf whitefly, numerous other biotypes of *B. tabaci* have been described on the bases of genetic differences at the molecular level and some biological distinctions (Costa et al. 1991; Frohlich et al. 1999). These biotypes form two main groups, New World types and Old World types. The Old World types are more diverse, and often exhibit broader host ranges that facilitate maintenance of high populations within different agroecosystems, and movement of viruses among crops. Old world types include the "B" biotype probably originating in southwestern Asia, and the "Q" biotype that dominates in much of the Mediterranean region (De Barro et al. 2005).

"B" VS "Q"

The "B" and "Q" biotypes are similar genetically and in many of their biological characteristics. Both are major pests of a wide range of crops including most vegetables. Both transmit TYLCV, although "Q" is reported as a more efficient vector than "B" (Sánchez-Campos et al. 1999). Both may also move many other geminiviruses as well as a number of criniviruses including tomato chlorosis and tomato infectious chlorosis ("TIC" and "TOC") (Jones 2003). However, there are also some notable differences. "Q" only causes squash silverleaf and tomato irregular ripening at very high infestation levels in contrast to "B". On the other hand, Q appears to quickly evolve resistance to the most commonly used insecticides for whitefly control (Cahill et al. 1996a, 1996b). That means "Q" will probably out-compete "B" under selective pressure from insecticides. Furthermore, the resistance appears to be stable, meaning that it does not diminish over time. However, resistance has its cost, and in the absence of

Table 1. Comparison of biological characteristics of "B" vs "Q" biotypes.

Characteristic	Biotype "B"	Biotype "Q"
Biotic potential	xxxx	xxx
Host plant range	xxxx	xxxx
TYLCV vector	xxx	xxxx
Plant disorders	xxxx	x
Insecticide resistance	xx	xxxx
Biological control candidate	xxx	xxxx

x = weak, xx = moderate, xxx = strong, xxxx = very strong.

insecticides "B", with its presumably greater biotic potential, will likely out-compete "Q" on most crops (Beitia et al. 1997). It may also be true that "Q" is more readily attacked than "B" by certain parasitic wasps, notably *Eretmocerus mundus* which was released in the US from Spain (Stansly et al 2004, 2005). A similar species, *E. near emiratus* has come be the dominant parasitoid attacking *B. tabaci* in parts of Florida and California and would certainly be a positive element in managing "Q". However, many of these presumed differences, summarized in the table below, require experimental confirmation.

LIKELY IMPACT OF BIOTYPE "Q" IN FLORIDA

The new biotype will certainly not reek anything like the havoc that followed the last whitefly invasion. Biotype "B" rapidly overwhelmed the old "A" biotype whitefly in Florida and elsewhere with its ability to build up high populations on numerous different crops. In contrast, "Q" would find itself faced with well established populations of "B" on virtually any potential host plant and may not compete effectively unless assisted by insecticidal selection. Thus, Q might not achieve a foothold in dooryard ornamentals but could in production greenhouses where a captive whitefly population might be continually exposed to a limited toolbox of products. Thus, the first control problems are most likely to appear in the greenhouse/screenhouse ornamental industry, as presaged by the find in Arizona.

WHITEFLY SURVEYS: PAST AND PRESENT

An extensive survey of *B. tabaci* populations in 15 economically important crops (including tomato) and 8 weed species in Florida was conducted from March 2000 to May 2001 (McKenzie et al. 2004). Biotype analysis by RAPD/PCR indicated the presence of only the B biotype of *B. tabaci* in all collections. These data suggested that in Florida, the B biotype of *B. tabaci* had excluded the native non-B biotypes (A biotype) in agricultural ecosystems. Whitefly surveys were resumed in 2005 after the discovery of the "Q" biotype in California and Arizona and figure 1 indicates the locations of sample sites by county, past and present. Since the "Q" biotype was found in the U.S., samples have been collected and analyzed in Florida from Naples (Collier), Palm Bay (Brevard), Homestead (Dade), Parrish (Manatee), New Port Richey (Pasco), Vero Beach (Indian River), Tallahassee (Leon), and Altamonte Springs (Seminole). Currently, only the B biotype has been detected in Florida. In cooperation with APHIS, DPI, USDA-ARS and University researchers and concerned growers across the state, extensive surveying of Florida will continue to determine if the "Q" biotype has invaded Florida. The goal of the survey is to first identify and then monitor apparent movement of the "Q" biotype and predict downstream impacts on crops and areas. The highest priority should be on sampling greenhouses, and whitefly host crops in proximity to greenhouses as well as retail outlets such as Home Depot. Knowing who and where the enemy is has always been the foundation of a good IPM program and should aide growers in making sound management decisions.

ACTION PLAN

Soon after discovery in Arizona, an ad hoc Q-Biotype Whitefly Taskforce was formed of interested scientists and administrators from the regulatory and research communities. Officials from USDA-APHIS Plant Protection and Quarantine (PPQ) stated that their agency would apply the current policy for the B-Biotype of the whitefly, *Bemisia tabaci* ("non-reportable/ non-actionable"), to the recently detected Q-Biotype. Thus, there will be no specific federal barriers to movement of this pest. As yet there has been no policy statement from Florida DACS-DPI, but it seems unlikely that movement of whitefly-infested plant material will be regulated in Florida either. However, both agencies are cooperating in a national monitoring effort to track movement of "Q" biotype, and so far (June 2005), there have been no new reports of "Q" biotype in the US. Additionally, entomologists at the Universities of Arizona and California have embarked on a program to evaluate insecticide susceptibility of the "Q" biotype populations in their respective states.

As movement of the new pest and associated control problems become more apparent, additional research will be directed at ways to mitigate the impact. Meanwhile growers and consultants are advised to keep a sharp lookout for unusual whitefly activity, and to apply even more rigorously the principals of IPM and resistance management that have served us well in the past. Mitigating the threat of biotype "Q" is just one more reason to practice good IPM and resistance management practices: (1) use insecticides only as needed based on scouting, (2) employ alternate management strategies such as host free periods, clean transplants, rouging of symptomatic plants, (3) limit exposure of whiteflies to neonicotinoids by using only once in tomato and abstaining if possible in other crops, (4) rotate classes of insecticide. Sound insecticide management is our best insurance against biotype "Q" and the increased threat of insecticide resistance that it represents.

LITERATURE CITED

Beitia, F., I. Mayo, E.M. Robles-Chillida, P. Guirao, J.L. Cenis. 1997. Current status of *Bemisia tabaci* (Gennadius) in Spain: the presence of biotypes of this species. Bulletin of the OILP/SROP. 20:99-107.

Bellows, Jr., T.S., T. M. Perring, R.J. Gill, and D.H. Headrich. 1994. Description of a species of *Bemisia tabaci* (Homoptera: Aleyrodidae). Ann. Entomol. Soc. Am. 76:310-313.

Cahill, M., W. Jarvis, K. Gorman, and I. Denholm. 1996a. Resolution of baseline responses and documentation of resistance to buprofezin in *Bemisia tabaci* (Homoptera: Aleyrodidae). Bull Entomol Research 86:116-122.

Cahill, M., K. Gorman, S.Day, I. Denholm, A. Elbert, and R. Nauen. 1996b. Baseline determination and detection of resistance to imidacloprid in *Bemisia tabaci* (Homoptera: Aleyrodidae). Bull Entomol Research 86:343-349.

Costa, H.S. and J.K. Brown. 1991. Variation in biological characteristics and esterase patterns among populations of *Bemisia tabaci* Genn and the association of one population with silverleaf symptom induction. Entomologia Experimentalis et Applicata. 61:211-219.

De Barro, P.J., J.W.T. Trueman, and D.R. Frohlich. 2005. *Bemisia argentifolii* is a race of *B. tabaci* (Hemiptera: Aleyrodidae): the molecular genetic differentiation of *B. tabaci* populations around the world. 95:193-203.

Duffus, J.E. 1995. Whitefly transmitted yellowing viruses of the Cucurbitaceae. Pages 12-16 In: Cucurbitaceae '94. G.E. Lester and J.R. Dunlap, eds. Gateway Printing, Weslaco, TX.

Frohlich, D., I. Torres-Jerez, I.D. Bedford, P.G. Markham, and J.K. Brown. 1999. a phylogeographical analysis of the *Bemisia tabaci* species complex based on mitochondrial DNA markers. Mol. Ecol. 8: 1593-1602.

Jones, David R. 2003. Plant viruses transmitted by whiteflies. J Plant Path. 109:195-219.

McKenzie, C. L., P.K. Anderson, and N. Villreal. 2004. Survey of *Bemisia tabaci* (Homoptera: Aleyrodidae) in agricultural ecosystems in Florida. Florida Entomol. 87(3): 403-407.

Perring, T. M., A.D. Cooper, R.J. Russell, C.A. Farrar, and T.S. Bellows Jr.. 1993. Identification of a whitefly species by genomic and behavioral studies. Science259:74-77.

Polston, J.E. and P.K. Anderson. 1997. The emergence of the whitefly–transmitted geminiviruses in tomato in the Western Hemisphere. Plant Dis. 81:1358-1369.

Price, J. F. 1987. Controlling a new pest. Greenhouse Grower 570:72-74.

Sánchez-Campos S., J. Navas-Castillo, R. Camero, C. Soria, J.A. Díaz, and E. Moriones. 1999. Displacement of tomato yellow leaf curl virus (TYLCV)-Sr by TYLCV-Is in tomato epidemics in Spain. Phytopathology 89:1038-1043.

Schuster, D.J., T.F. Mueller, J.B. Kring, and J.F. Price. 1990. Relationship of the sweetpotato whitefly to a new tomato fruit disorder in Florida. HortScience 25:1618-1620.

Stansly, P.A., P.A. Sánchez, J.M. Rodríguez, F. Cañizares, A. Nieto, M.J. López Leyva, M. Fajardo, V. Suárez, A. Urbaneja. 2004. Prospects for biological control of *Bemisia tabaci* (Homoptera: Aleyrodidae) in greenhouse tomatoes of southern Spain. Crop Protection 23:701-712.

Stansly, P.A., F.J. Calvo, and A. Urbaneja. 2005. Augmentative biological control of *Bemisia tabaci* biotype "Q" in Spanish greenhouse pepper production using *Eretmocerus* spp. 2005. Crop Protection 24(9): 829-835.

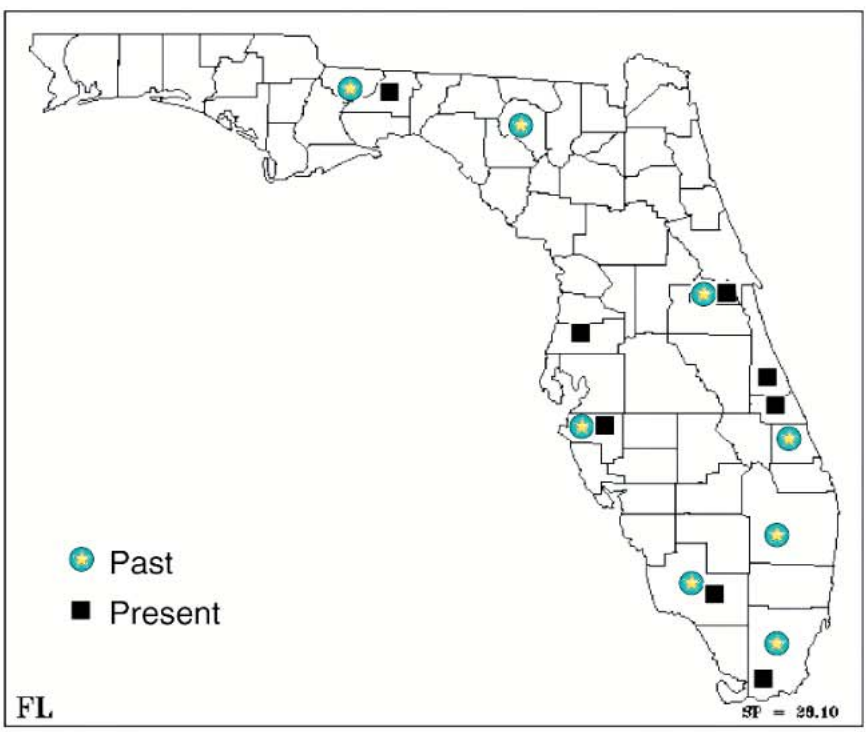

Figure 1. Whitefly surveys conducted in Florida by county, past (2000-2001) and present (2005).