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REVIEW

Emergence of a New Plant Pest, *Bemisia tabaci* (Gennadius), in the Lower Rio Grande Valley, Texas

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ABSTRACT

Plant species that served as excellent reproductive hosts of the sweetpotato whitefly, *Bemisia tabaci* (Gennadius), during 1991 were identified. Plant families recovered during this host survey had previously been recorded as *B. tabaci* hosts at similar genera or species levels throughout the world with the exception of Phytolaccaceae. The impact of the biological/natural control component on the population dynamics of the sweetpotato whitefly on cultivated crops and alternate weed hosts is unknown and currently being investigated to contribute to a consolidated management strategy for the Lower Rio Grande Valley, Texas.

RESUMEN

Se identificaron varias especies de plantas que sirvieron como excelentes hospederas para la reproducción de la mosca blanca del camote, *Bemisia tabaci* (Gennadius), durante 1991. Las familias de las plantas encontradas durante este muestreo habían sido anteriormente reportadas alrededor del mundo como hospederas de *B. tabaci* en niveles similares de género o especie con la excepción de Phytolaccaceae. El impacto del componente de control biológico/natural sobre la dinámica poblacional de la mosca blanca del camote en en los cultivos y los hospederos silvestres alternos es desconocido y esta siendo actualmente investigado para contribuir a una estrategia consolidada de manejo para la parte baja del Valle del Rio Grande, Texas.

Bemisia tabaci (Gennadius) has become an economically cosmopolitan pest in warm climatic regions during the last decade (Johnson et al., 1982; Dittrich et al., 1985). Their high reproductive rate under favorable conditions often leads to explosive populations that greatly affect plant growth with the sooty mold that develops on the honeydew excrement (Pollard, 1955). In addition to these heavy infestation levels, it transmits a number of plant viral agents affecting a wide variety of plants (Duffus and Flock, 1982; Brown et al., 1991b; Brown and Bird, 1992). *B. tabaci* is generally known as sweetpotato whitefly in the United States but has other common names such as tobacco whitefly and cotton whitefly in other parts of the world. It was first described as a pest of tobacco in 1889 in Greece; however, it is believed to have originated in the area of Pakistan or India (Cock, 1986).

B. tabaci was reported in Texas as early as 1946 on different host plants such as *Lantana sp. (Russell, 1975), but had not been an economic problem of cultivated crops until the fall of 1990 in the Lower Rio Grande Valley, Texas (LRGV). B. tabaci* was detected in bell pepper fields in the fall of 1987 and determined to be capable of transmitting a geminivirus provisionally designated Texas Pepper Geminivirus (Stenger et al., 1990). This whitefly was believed to also be causing problems on ornamentals in LRGV greenhouses in 1989 since chemical control failures were reported. Populations present during 1987 until the fall of 1990 remained at levels unnoticeable as a serious pest of cultivated crops in the LRGV. Extremely large populations were observed in a few cotton fields and several fall vegetable fields during the fall of 1990. Also, unusual symptoms on vegetables suggested to be systemic phytotoxemias were first observed in 1990 such as silverleaf of squash in Harlingen, TX and white streaking of broccoli in Alamo, TX. These symptoms were quite common during 1991 as well as whitefly populations on spring vegetables and cotton much larger and widespread than 1990. During 1991, this whitefly caused irregular ripening of tomatoes in Weslaco, TX as well as chlorotic leaf spots on young leaves of citrus in Donna, TX. Populations during 1992 were similar to those of 1990 and not nearly as destructive on cotton and vegetables as those of 1991. Reasons for the recent *B. tabaci* explosions are not easily explained, since this insect has been known to be present since 1946 in LRGV. However, several possible hypotheses could explain these explosions from events concluded from laboratory and field studies worldwide.

A hypothesis that has recieved much attention has been the increased use of recently-released insecticide classes, chiefly the synthetic pyrethroids(Johnson et al.,1982), which suggests the elimination of parasitoids and predators as the main factor influencing *B. tabaci* dynamics (Eveleens, 1983). The synthetic pyrethroids have been commercially available for the last decade. Synthetic chemicals are known to impact the parasitoids and predators of *B. tabaci* adversely (Butler and Henneberry, 1984). Coupled with this drastic impact on beneficials has been insecticide resistance of *B. tabaci* to many classes of insecticides, including the synthetic pyrethroids (Prabhaker et al., 1985).

A second hypothesis states that resistance has reached a level so widespread that *B. tabaci* is no longer effectively controlled by certain insecticide classes, chiefly organophosphates, and suggests reproductive stimulation by other insecticides classes (Dittrich et al., 1985). The application of certain synthetic

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chemicals has been shown to increase fertility (the number of eggs/female/day) significantly in *B. tabaci* (Dittrich et al., 1985).This hypothesis suggests the elimination of beneficials is an event of minor importance since patchy occurance and a delayed density dependence pattern of beneficials have had little impact on *B. tabaci* dynamics in studies (Dittrich et al., 1985).

A third hypothesis is based on data suggesting that a new biotype or strain exists and has been introduced from an unidentified source or that a genetic change has occured in the endemic populations (Brown et al., 1991a); and Cohen et al., 1991). This new biotype, tentatively called the "B" biotype, differs from the endemic population("A" biotype) in that it induces a systemic phytotoxemia on squash (squash silverleaf), broccoli (white streaking) and other crops under natural conditions (Maynard and Cantliffe, 1989; Brown et al., 1991a; Brown et al., 1992). Physiological differences include host preference ("B" biotype has a wider plant host range which includes Brassicaceae plants), larval development ("B" biotype is more prolific on Euphorbiaceae plants), and distinguishable by esterase isozyme banding patterns (Costa and Brown, 1990). This hypothesis suggests that these inherent physiological differences lends this new biotype to occupy a broader host range and develop on cool season plants such as brassicas (Perring et al., 1991). Therefore, population levels of the "B" biotype are much higher earlier in the season and then move to cotton (Malvaceae host) at numbers higher than previously capable by the "A" biotype and build to explosive populations (Perring et al., 1991). Other hypotheses are possible and have been discussed in the literature but these three have received the most attention in dealing with the recent *B. tabaci* explosions.

A survey of plant hosts was conducted during the summer and fall of 1991 to shed more light on explaining the *B. tabaci* population explosions. The results of the plant host survey are summarized in Tables 1 and 2. Plant hosts were categorized as excellent reproductive hosts by examining for the presence of honeydew/sooty mold on the leaves as well as pupal cases where adult whiteflies had emerged. Plant hosts that served as fair reproductive hosts were categorized to be plants with few pupal cases where adult whiteflies had emerged and no noticeable honeydew/sooty mold formation on the leaves. A wide range of plant hosts in the families Asteraceae, Brassicaceae, Cucurbitaceae, Euphorbiaceae, Malvaceae, Phytolaccaceae, Ranunculaceae, Solanaceae, and Verbenaceae served as excellent reproductive hosts. All these plant families, with the exception of Phytolaccaceae, have previously been recorded as *B. tabaci* hosts at similar genera or species levels (Cock, 1986). Plants in the families of Amaranthaceae, Apiaceae, Asteraceae, Euphorbiaceae, Rutaceae, Solanaceae, and Ulmaceae were considered fair reproductive hosts since reproduction was observed only when large numbers of adults were migrating from cotton fields during July and August. All these plant families have previously been recorded as *B. tabaci* hosts (Cock, 1986).

The fact that whiteflies can build to large populations depending on the interrelationship between the cropping systems within a given region is not new to the world or LRGV. The bandedwing whitefly, *Trialeurodes abutilonea* (Haldeman), reached similar population patterns and levels during the fall of 1965 in the LRGV and until that time had been considered a minor pest on cotton and tomatoes (Boling and Schuster, 1969). The majority of the cotton fields had been periodically sprayed with

Table 1. Excellent reproductive hosts of B. tabaci. Honeydew/sooty mold associated with plant samples as well as empty pupal cases from which adult whiteflies had emerged.

SCIENTIFIC NAME	COMMON NAME	PLANT FAMILY
Ambrosia psilostachya (DC.)	Western Ragweed	Asteraceae
Helianthus annuus (L.)	Hybrid Sunflower	Asteraceae
Sonchus oleraceus (L.)	Common Sowthistle	Asteraceae
Brassica oleracea (L.)	Cabbage, Collards, Kale	Brassicaceae
Citrullus lanatus (L.)	Watermelon	Cucurbitaceae
Cucumis spp. (L.)	Cucumber, Melons	Cucurbitaceae
Cucurbita spp. (L.)	Squash	Cucurbitaceae
Euphorbia hypericifolia (L.)	Tropical spurge	Euphorbiaceae
Euphorbia prostrata (Ait.)	Prostrate spurge	Euphorbiaceae
Arachis hypogea (L.)	Peanut var. Florunner	Fabaceae
Abutilon berlandieri (Gray)	Indianmallow	Malvaceae
Gossypium hirsutum (L.)	Cotton var. DES 119	Malvaceae
Malvastrum americanum (L.)	Malvaloca	Malvaceae
Rivina humilis (L.)	Pigeonberry	Phytolaccaceae
Clematis drummondii (T. and G.)	Texas Virginsbower	Ranunculaceae
Lycopersicon esculentum (Mill.)	Tomato var. Sunny	Solanaceae
Lantana horrida (Kunth)	Common Lantana	Verbenaceae

Table 2. Fair reproductive hosts of B. tabaci. No honeydew/sooty mold associated with plant samples but empty pupal cases from which adult whiteflies had emerged.

SCIENTFIC NAME	COMMON NAME	PLANT FAMILY
Amaranthus palmeri (S. Wats.)	Carelessweed	Amaranthaceae
Apium graveolens (L.)	Celery	Apiaceae
Helianthus annuus (L.)	Common Sunflower (wild)	Asteraceae
Ricinus communis (L.)	Castorbean	Euphorbiaceae
Citrus paradisi (Macf.)	Grapefruit var. Rio Red	Rutaceae
Capsicum annuum (L.)	Bell pepper var. Jupiter	Solanaceae
Solanum elaeagnifolium (Cav.)	Silverleaf nightshade	Solanaceae
Celtis laevigata (Willd.)	Sugar hackberry	Ulmaceae
Celtis pallida (Torr.)	Desert hackberry	Ulmaceae

methyl parathion for insect control and it was suggested that these applications may have reduced the beneficial populations thus allowing the whitefly to build up on cotton and migrate to fall tomatoes. Whitefly nymphs were found on all plant stages which caused severe curling of the leaves. Damage included death of tomato seedling plants (Boling and Schuster, 1969).

A similar situation has been observed in southwestern United States as well as many other places around the world where *B. tabaci* populations are greatly influenced by the proximity and interrelationship of the cropping systems (Butler et al., 1985). Studies in California and Arizona have shown the proximity of squash, cantaloupe, and watermelon fields to cotton influenced the early season buildup of *B. tabaci* in cotton (Butler et al., 1985). Areas with spring melons had more *B. tabaci* present early in the cotton growing season; thus, cotton sustained greater damage sooner than that which was present in past years (Butler et al., 1985; Perring et al., 1991). In India, *B. tabaci* has been overwintering since the 1930's on several weeds (*Convolvulus* spp. and *Euphorbia* spp.), ratooned cotton, potatoes, and cultivated brassicas from which adults then migrate to spring cucurbits, okra, and cotton causing severe economic losses within these crops (Husain and Trehan, 1933). In Israel, investigations have shown *B. tabaci* develops on sunflower and potatoes, which is sown earlier than cotton, from which adults then migrate to cotton (Melamed-Madjar et al., 1979).

Esterase analysis of adult whiteflies collected during July and August 1991 indicated the *B. tabaci* populations at that time to be the "B" biotype (J. Brown personal communication). Although parasitoids were recovered from plant hosts that included vegetables and cotton, the information is currently being investigated since several parasitoid species appear to be part of this beneficial complex. Small plot insecticide trials during 1990 and 1991 indicated that certain synthetic chemicals such as acephate induced higher levels of adults and immatures than the untreated check (A. Sparks and J. Anciso unpublished data). It is most likely that certain aspects of the three proposed hypotheses had some bearing on the extremely large *B. tabaci* populations observed during 1991. The plant host survey does not represent all the hosts attacked by the whitefly but major crops and common weeds found during the summer and fall in the LRGV. The wide range of plant families supports the new biotype hypothesis since many of the hosts had not been recorded in the LRGV.

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