SWEETPOTATO WHITEFLY ON COTTON IN THE SOUTHWEST U.S.

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Abstract

Studies in Arizona cotton have shown that sweetpotato whitefly (SPW), *Bemisia tabaci* (Gennadius) infestations, if uncontrolled, reduce yield, cause cotton lint stickiness and transmit the virus that causes cotton leaf crumple. *B. tabaci* Biotype B was first recognized in the mid-1980's and has been shown to be more aggressive, have an expanded host range and higher reproductive potential compared with the previously encountered SPW type A in the U.S.

Introduction

Sweetpotato whiteflies (SPW) *Bemisia tabaci* (Gennadius), have been a serious pest of cotton in various parts of the world for many years (Misra and Lamba 1929, Roberts 1929, Avidov 1956, Cowland 1934). In the United States, SPW-transmitted cotton leaf crumple virus caused cotton yield reductions greater than 40% in Southern California in the 1960s (Van Schaik et al. 1963). SPW pest status in cotton rose dramatically beginning in the Sudan in the 1970's (Dittrich et al. 1985), Turkey in 1974 (Sengonca 1975), Israel in the mid-seventies and the United States in the late 1970's and early 1980's (Henneberry and Castle 2001). Many factors have been suggested as the cause of the increasing SPW population levels. These include insecticide reduction of beneficial insects, insecticide resistance, insecticide stimulation of SPW fertility, crop intensification, and modification of crop production inputs (See Castle 1999, for review).

Changing Biological Characteristics

It became obvious in the mid 1980's that SPW infestations in many geographical locations differed from those induced by indigenous types in host range, ability to produce plant physiological disorders, and biochemical and molecular level esterases (Perring et al. 1993, Bellows et al. 1994, Brown et al. 1995). A new biotype was suggested (Costa and Brown 1990) and ultimately a new species described (Bellows et al. 1994) which has not been universally accepted. The nomenclatural issue remains unresolved but it is generally accepted in the U.S. Southwestern cotton growing areas that the B biotype is a more aggressive pest with an expanded host range and the reproductive potential to develop more damaging populations compared with previously encountered SPW types.

Damage to cotton can result from lint contamination with honeydew, fungal growth on lint associated with the honeydew, direct feeding and associated yield reductions (Henneberry et al. 1995), and lastly transmission of cotton plant viruses (Brown 1994) (cotton leaf crumple virus in the United States and cotton leaf curl virus in several African countries, Pakistan and India).

Seasonal Occurrence

Typically, in untreated cotton, SPW adults and nymphs remain low through early July (Figure 1). Populations begin to increase in mid-July and if untreated continue to increase through mid-September.

SPW and Lint Stickiness

Typically, for upland cottons planted about the second week in April in Arizona, open mature cotton bolls begin to occur by the third week in August (Figure 1). Peak numbers of open bolls occur in early September and 95% of all bolls produced for the season are open by 15 September.

The SPW produced honeydew sugars, trehalulose and melezitose and cotton lint stickiness (thermodetector counts) accumulate with increasing time after boll opening (Table 1). Insecticide applications can keep stickiness below levels of concern (Henneberry et al. 1995), but must be continued at long as cotton is actively growing even though most (95%) of the crop has been produced (Henneberry et al. 1998). Extending the season without continued protection increases the risk of sticky cotton development in late season. Early defoliation and crop termination are alternatives, but careful consideration of grower economic inputs in relation to profit returns need to be considered.

SPW Relationships to Cotton Yields

Cotton yields are negatively impacted by increasing SPW populations (Figure 2). However, when insecticide applications are applied at action threshold levels of 5 to 10 adults per leaf the greatest net return occurs (Naranjo et al. 1998). Yields at thresholds of 2.5, 5.0, and 10.0 adults per leaf generally do not differ significantly. However, increased numbers of insecticides are required at the lower thresholds.

Cotton Leaf Crumple Disease (CLC)

CLC disease was first observed in California in 1948 (Dickson et al. 1954). Substantial losses occurred as well as in Arizona (Allen et al. 1960, Van Schaik et al. 1962). In California, reduced cotton yields of 81, 23, and 41%, respectively, in 1958, 1959 and 1960 occurred in CLC diseased cotton as compared to nondiseased cotton (Van Schaik et al. 1962). Higher incidences of CLC in Arizona occurred in stubbed (ratoon) cotton compared to seeded cotton (virus carryover in perennially grown cottons) and reduced incidence of the disease occurred coincident with reduced stub cotton acreages during 1960 to 1961. A severe CLC outbreak also occurred in 1981 and 1982 in Arizona and California and in the Mexicali Valley of Mexico, also believed to be associated with stubbed cotton. From 1991to 1994, CLC was widespread throughout cotton-growing areas in Arizona because of the introduction of the B biotype (Brown 1994).

Discussion

Significant progress has been made in developing ecologically acceptable SPW management methods. Although these methods are mostly insecticide based, SPW sampling, action thresholds and resistance management (rotations, mixtures, new chemistry) have contributed to maintaining insecticide efficacy stability. In addition, biological and behavior information, natural enemy conservation, cultural controls, and improved water and crop management have been incorporated in an overall environmentally sound SPW control system.

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Table 1. Trehalulose and Melezitose (mg) per gram of Cotton Lint and Thermodetector Counts in Untreated and Insecticide-treated Cotton.

	***Bemisia* Sugar**		
Sample date/treatment[a]	**Trehalulose**	**Melezitose**	**Thermodetector counts**
29 Aug			
Insecticide			
Untreated	0.90 a	0.36 a	8.67 a
Treated	0.23 b	0.21 b	3.08 b
05 Sep			
Insecticide			
Untreated	1.34 a	0.43 a	12.71 a
Treated	0.22 b	0.03 b	2.83 b
13 Sept			
Insecticide			
Untreated	1.83 a	0.47 a	13.00 a
Treated	0.23 b	0.16 b	2.38 b
20 Sept			
Insecticide			
Untreated	2.28 a	0.59 a	13.17 a
Treated	0.45 b	0.26 b	3.75 b

[a] Means of 4 replications with 2 observations per replication. Means in a column within insecticide-treated-untreated groups not followed by the same letter are significantly different (LSD; P £ 0.05) (Modified from Henneberry et al. 1998).

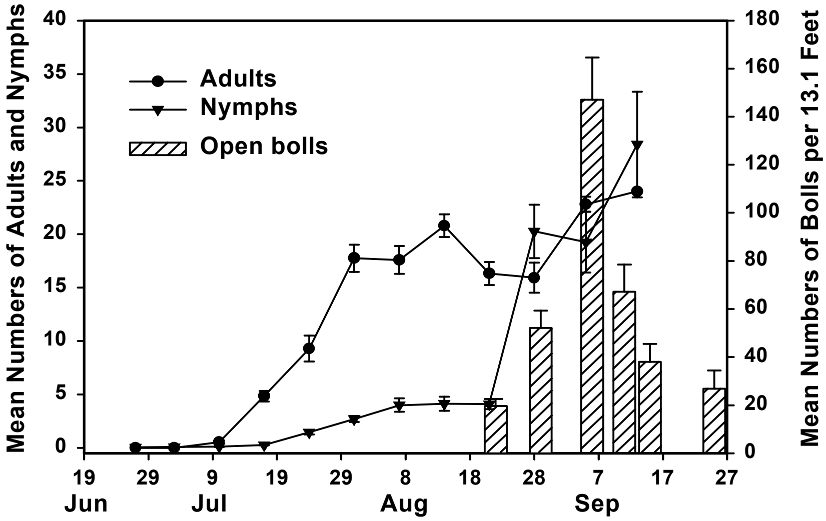

Figure 1. Seasonal mean (± SE) numbers of sweetpotato whitefly per leaf turn and nymphs per square centimeter of leaf disk in relation to the seasonal mean numbers of mature open cotton bolls (Modified from Henneberry et al. 1998).

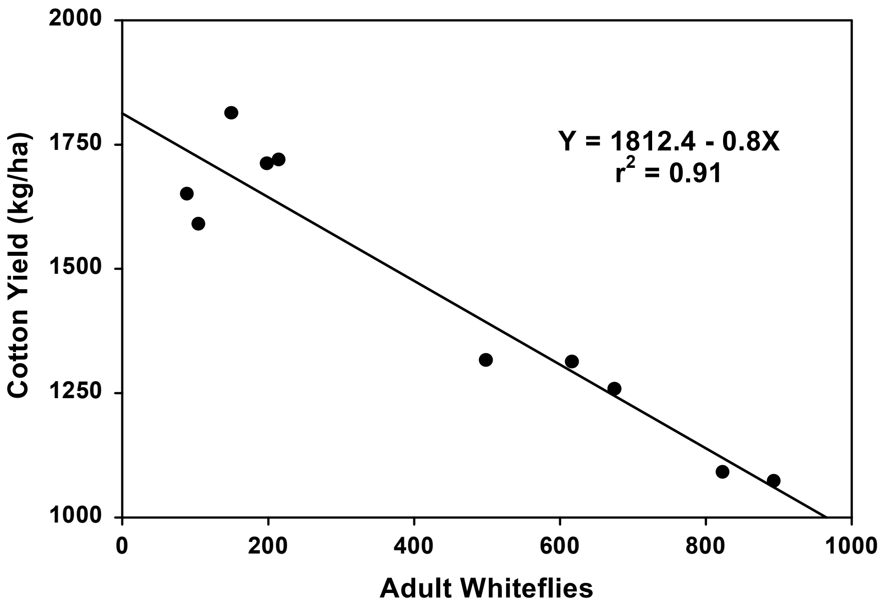

Figure 2. Regression of the increasing seasonal mean numbers of adult whiteflies per black pan sample and decreasing cotton lint yields in Arizona. (Modified from Henneberry et al. 1995).