EFFECT OF WHITEFLY ON COTTON PRODUCTIVITY

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Introduction

The silverleaf whitefly (SLW) *Bemisia tabaci* strain 'B' (= *B. argentifolii* Bellows and Perring) has been a severe pest of numerous field and vegetable crops for many years. A better understanding of the complex interactions between the SLW and the host could serve as a basis for reducing the risk of high pest population buildup. The plant's influence on the insect's establishment and developmental success can be manifested in several ways, from signaling the insect where to land to facilitating proper feeding, oviposition and development to maturity (e.g. Bernays and Chapman 1994). Previous experiments and observations conducted with cotton plants have shown that the plant physiological state, e.g. water or mineral-nutrition status, may affect the level of SLW infestation (Mor, 1986; Bentz et al., 1995; Skinner, 1996); however the basis for this effect is not clear yet. Another unexplored aspect of the plant-SLW interaction is the mechanism via which the insect interferes with plant productivity. In tomato, feeding injury caused by SLW reduced leaf chlorophyll content, photosynthetic capacity and stomatal conductance (Buntin et al., 1993). A reduction in photosynthetic capacity caused by SLW has also been reported for cotton (Shtaynmetz, 1990; Yee et al., 1996). This study was aimed at investigating the effects of SLW on cotton productivity and their underlying physiological mechanisms.

Materials and methods

Cotton plants (*Gossypium hirsutum* L. cv. Siv'on) were examined in two factorial-design experiments conducted over successive years. The following factors were examined: (a) irrigation -- well-watered or water-stressed, (b) N fertilization -- N application equivalent to 320 kg/ha or N-deficient (equivalent to 0 and 32 kg/ha in the two respective experiments), and (c) SLW -- non-infested or infested. Plants were grown in pots in a screenhouse divided into non-infested and SLW-infested compartments. Treatments were replicated four times, with twenty plants per plot. Application of irrigation and fertilization treatments started at the beginning of the square period, whereas SLW was introduced at the onset of flowering. Plants were grown over an entire season, during which various physiological measurements were taken and the SLW populations monitored.

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Results and Discussion

Buildup of the SLW population was markedly affected by N fertilization. In the first year, over 300 SLW adults were found on the maximally infested leaf of N-fertilized plants, vs. about 100 adults on N-deficient plants. In the second year, significant but smaller differences in SLW infestation were found between the N treatments during most of the season. A similar trend was found in both years for all the physiological parameters examined. SLW infestation significantly reduced photosynthetic rate, by about 10% 30 days post-infestation and about 50% 60 days post-infestation. This reduction was associated with reduced stomatal conductance and chlorophyll variable fluorescence (Fv/Fm), but no substantial change was found in leaf chlorophyll content. These results indicate that SLW infestation reduced the rate of the photosynthetic system's photochemical reaction. The relative photosynthetic rate of infested vs. non-infested plants over an entire season was significantly correlated with the number of SLW adults on the maximally infested leaf (r^2=0.46, n=32; data from the two years). Seedcotton yield was reduced under all combinations of irrigation and N treatment, in both years, by about 40%. Seedcotton yield reduction (non-infested minus infested-treatment yield) was significantly correlated with the number of SLW adults on the maximally infested leaf 30 days post-infestation (r^2=0.94, n=4 and r^2=0.91, n=4, for the first and second years, respectively), with similar response curves for both years. The mechanism via which SLW impairs the plant's photosynthetic system is currently under investigation.

References

Bentz, J-A., J. Reeves, P. Barbosa and B. Francis. 1995. Nitrogen fertilizer effect on selection, acceptance, and suitability of *Euphorbia pulcherrima* (Euphorbiaceae) as a host plant to *Bemisia tabaci* (Homoptera: Aleyrodidae). Environ. Entomol. 24:41-45.

Bernays, E. A. and R.F. Chapman. 1994. Host plant selection by phytophagous insects. Chapman and Hall, 312 pp.

Buntin, G.D., D.A. Gilbertz and R.D. Oetting. 1993. Chlorophyll loss and Gas exchange in tomato leaves after feeding injury by *Bemisia tabaci* (Homoptera: Aleyrodidae). J. Econ. Entomol. 86:517-522.

Mor, U. 1986. Physiological differences between dryland and irrigated cotton and their effect on whitefly *Bemisia tabaci* (Genn.). PhD. thesis, The Hebrew University of Jerusalem, 97 pp.

Shtaynmetz, Y. 1990. The effect of sucking insects on photosynthesis and yield of cotton. M.Sc. thesis, The Hebrew University of Jerusalem, 56 pp.

Skinner, R.H. 1996. Response of *Bemisia argentifolii* (Homoptera: Aleyrodidae) to water and nutrient stressed cotton. Environ. Entomol. 25:401-406.

Yee, W.L., N.C. Toscano, C.C. Chu, T.J. Hennerberry and R.L. Nicholas. 1996. Photosynthesis and stomatal conductance of cotton infested by different whitefly threshold levels. pp. 1011-1015. Proc. Beltwide Cotton Conf., National Cotton Council of America, Memphis, TN.