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Author: McKenzie, C. L.

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EFFECT OF TOMATO MOTTLE VIRUS (TOMOV) ON *BEMISIA TABACI* BIOTYPE B (HOMOPTERA: ALEYRODIDAE) OVIPOSITION AND ADULT SURVIVORSHIP ON HEALTHY TOMATO

C. L. McKenzie
USDA-ARS, U.S. Horticultural Research Laboratory, 2001 South Rock Road, Ft. Pierce, FL 34945

The population dynamics of the sweetpotato whitefly, *Bemisia tabaci* (Gennadius) biotype B (= silverleaf whitefly, *Bemisia argentifolii* Bellows & Perring) are driven by seasonal climatic conditions, natural enemies (including entomopathogens), host-plant interactions, and IPM practices (Byrne & Bellows 1991; Coudriet et al. 1985; Nava-Cameros et al. 2001; Tsai & Wang 1996; Yee and Toscano 1996). Physiological disorders (Schuster et al. 1990, 1991) and the spread of geminiviruses (Blair et al. 1995; Polston & Anderson 1997) associated with whitefly infestations in Florida vegetables are becoming increasingly important limitations to grower profitability. The effect of plant viruses on the reproductive potential of the vector is key to understanding geminivirus epidemiology and developing effective control measures. The objective of this study was to determine the effect of tomato mottle virus (ToMoV) on whitefly oviposition and survival rates on healthy tomato.

Adult *B. tabaci* biotype B were obtained from laboratory colonies maintained by the U.S. Horticultural Research Laboratory, Ft. Pierce, FL. Whiteflies used in these experiments were originally obtained from Dr. Lance Osborne, University of Florida, Apopka, FL and have been maintained on dwarf cherry tomato (*Lycopersicon esculentum* cv. Florida Lanai) since 1996 by serial transfer. In 1997, a ToMoV whitefly colony was established by obtaining tomato plants infected with ToMoV from Dr. Philip Stansly, University of Florida, Immokalee, FL and infesting with whiteflies from the healthy colony. Whitefly biotyping was based on RAPD PCR analysis using primers developed by De Barro and Driver (1997). Nonviruliferous and viruliferous whitefly colonies were housed separately in screened Plexiglass cages located in separate growth chambers at 25 ± 1°C and a 16:8 L:D photoperiod. Whiteflies from the viruliferous colony were confirmed to be infected with ToMoV prior to infestation by PCR analysis (Sinisterra et al., 1999).

In each experiment, one male and one female whitefly of unknown age from healthy or ToMoV-infected whitefly colonies were confined in clip cages attached to the terminal leaf of the 3rd fully expanded leaflet of a healthy cv. Florida Lanai plant. Clip cages were made from clear plastic cups (PC100 30 ml cups, Jet Plastica, Harrisburg, PA) fitted with a foam seal on the bottom and an organdy window on top for ventilation. The foam bottom was backed with a thin square of balsa wood, and an aluminum hair clip was glued to the balsa wood and cup portion. Whiteflies were introduced through a small hole in the side of the cup. After a 48-h access period, adult whiteflies were removed and eggs were counted. Treatments were maintained separately at 25 ± 1°C and a photoperiod of 16:8 L:D. For each experiment, 20 test plants were typically used for each treatment; however, the final number of replicates (= clip cages) per treatment varied when leaves of test plants died or were severed during the experiment. A minimum of 8 replicates was used for all treatments. Experiments were repeated five times. There were no significant interactions between experiment*treatment ($F = 2.0$; df = 4,80; $P = 0.10$) or treatment*clip cage ($F = 0.66$; df = 19,80; $P = 0.85$) so results were pooled over experiments for mean comparison (Tukey option in SAS GLM procedure, SAS Institute 1998). In the last two experiments, progeny from cohorts used in the oviposition clip cage experiments ($n = 15$) were used to include survival to adult emergence which was evaluated 30 days after egg lay to ensure that all viable whiteflies had emerged.

Whiteflies infected with ToMoV deposited significantly more eggs ($F = 19.51$; df = 1,80; $P < 0.01$) on healthy tomato leaves than nonviruliferous whiteflies (Table 1) and supports earlier findings (McKenzie et al. 2002). There was no significant difference between virus-infected and nonviruliferous whiteflies for the number of adults emerged or the proportion of those adults surviving from the egg stage. There was no significant correlation between the number of eggs deposited per female and progeny survival rates on healthy tomato for whitefly infected with or without the virus (SAS CORR procedure, SAS Institute 1998).

A report by Costa et al. (1991) demonstrated that whitefly maintained on pumpkin for ~ 6 years had a higher rate of survival on virus-infected pumpkin compared to healthy pumpkin out of six virus-plant hosts evaluated, including tomato. In those experiments, researchers did not take host-plant adaptation time into consideration. For example, whitefly survival rates from egg to adult on tomato were 8% on virus-infected plants and 17% on noninoculated control plants, but the parental generation of whiteflies used in those experiments were maintained on pumpkin. In our experiments, high survival (Table 1) of both healthy and ToMoV-infected whitefly reflect this host-plant adaptation when compared to the previous work by Costa et al. (1991). Plants from

TABLE 1. MEAN NUMBER OF NONVIRULIFEROUS VERSUS VIRULIFEROUS *B. TABACI* BIOTYPE B EGGS/FEMALE/48-HR ACCESS, ADULTS AND PERCENT SURVIVAL ON HEALTHY TOMATO.

WF colony	Egg ± SE[1]	Adult ± SE[2]	% Survival ± SE[3]
Healthy	8.80 ± 0.70 a	7.28 ± 1.90 a	70.56 ± 14.11 a
ToMoV	14.69 ± 1.11 b	11.09 ± 2.16 a	77.44 ± 6.37 a

Means within a column followed by the same letter are not significantly different, $P < 0.05$, using Tukey studentized range test.
[1]$F = 19.51$; df = 1,80; P = < 0.01.
[2]$F = 3.16$; df = 1,11; P = 0.10.
[3]Proportion of whitefly surviving from egg to adult stage; $F = 0.44$; df = 1,8; P = 0.53.

the virus treatment exhibited characteristic ToMoV symptoms 30 days after clip cages were removed. This suggests adaptation to the host plant and virus by the vector could override any adverse effect the virus had on host plant physiology. McKenzie et al. (2002) found healthy plants infested with ToMoV-infected whiteflies consistently had 2.5-fold more eggs and 4.5-fold more nymphs than plants with nonviruliferous whiteflies ($P < 0.05$) 56 days after infestation with the same number of whitefly. In the present study, whiteflies were well adapted to the host plant, either with or without ToMoV.

SUMMARY

Whiteflies carrying ToMoV deposited significantly more eggs than nonviruliferous whiteflies when provided a healthy tomato host. Insect adaptation to the host-plant is a critical factor that should be considered on a host-by-host basis when evaluating insect biology and vector-host-plant interactions for polyphagous insect species.

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REFERENCES CITED

BLAIR, M. W., M. J. BASSETT, A. M. ABOUZID, E. HIEBERT, J. E. POLSTON, R. T. MCMILLAN, JR., W. GRAVES, AND M. LAMBERTS. 1995. Occurrence of bean golden mosaic virus in Florida. Plant Disease 79: 529-533.

BYRNE, D. N., AND T. S. BELLOWS. 1991. Whitefly biology. Ann. Rev. Entomol. 36:431-457.

COSTA, H. S., J. K. BROWN, AND D. N. BYRNE. 1991. Life history traits of the whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) on six virus-infected or healthy plant species. Environ. Entomol. 20: 1102-1107.

COUDRIET, D. L., N. PRABHAKER, A. N. KISHABA, AND D. E. MEYERDIRK. 1985. Variation in developmental rate on different hosts and overwintering of the sweetpotato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae). Environ. Entomol. 14: 516-519.

CARDOZA, Y. J., H. J. MCAUSLANE, AND S. E. WEBB. 2000. Effect of leaf age and silverleaf symptoms on oviposition site selection and development of *Bemisia argentifolii* (Homoptera: Aleyrodidae) on zucchini. Environ. Entomol. 29:220-225.

DE BARRO, P. J., AND F. DRIVER. 1997. Use of RAPD PCR to distinguish the B biotype from other biotypes of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae). Aust. J. Entomol. 36: 149-152.

MCKENZIE, C. L., R. G. SHATTERS, JR., H. DOOSTDAR, S. D. LEE, M. INBAR, AND R. T. MAYER. (2002). Effect of geminivirus infection and *Bemisia* infestation on accumulation of pathogenesis-related proteins in tomato. Arch Insect Biochem and Physiol. 49: 203-214.

POLSTON, J. E., AND P. K. ANDERSON. 1997. The emergence of whitefly-transmitted geminiviruses in tomato in the Western Hemisphere. Plant Disease 81: 1358-1369.

SAS INSTITUTE, INC. 1998. SAS/STAT® User's guide version 7. Cary, NC, USA: SAS Institute, Inc.

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. HortSci. 25: 1618-1620.

SCHUSTER, D. J., J. B. KRING, AND J. F. PRICE. 1991. Association of the sweetpotato whitefly with a silverleaf disorder of squash. HortSci. 26: 155-156.

SINISTERRA, X. H., J. E. POLSTON, A. M. ABOUZID, AND E. HIEBERT. 1999. Tobacco plants transformed with a modified coat protein of tomato mottle begomovirus show resistance to virus infection. Phytopath. 89: 701-706.

TSAI, J. H., AND K. WANG. 1996. Development and reproduction of *Bemisia argentifolii* (Homoptera: Aleyrodidae) on five host plants. Environ. Entomol. 25: 810-816.

YEE, W. L., AND N. C. TOSCANO. 1996. Ovipositional preference and development of *Bemisia argentifolii* (Homoptera: Aleyrodidae) in relation to alfalfa. J. Econ. Entomol. 89: 870-876.