CARIBBEAN FOOD CROPS SOCIETY 44

Forty Fourth
Annual Meeting 2008

Miami, Florida, USA

Vol. XLIV – Number 2 Continued
Poster Session Abstracts
With Some Posters Expanded as Full Papers

MEETING HOST:
UF UNIVERSITY of FLORIDA
IFAS

2008 Proceedings of the Caribbean Food Crops Society. 44(2):571-575. 2008

Poster #54

Evaluation of Acibenzolar-S-Methyl, PGPR and Silicon for Their Effects on Growth and TYLCV of Tomato

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ABSTRACT.
TYLCV is a major limiting factor for tomato production in south Florida. There is no single method which provides adequate control of TYLCV on tomato. In the greenhouse assays, Actigard® at 3 mg/l, plant growth-promoting rhizobacteria (PGPR) strains SE34 and IN937b at 1×10^7 CFU/ml, and silicic acid at 1.5 mM and 0.15 mM applied as soil drench significantly increased plant height when compared with the nontreated control. SE34, IN937b and silicic acid significantly increased stem caliper, and IN937b increased the chlorophyll content in the leaves of tomato seedlings. All treatments with disease resistance inducers significantly reduced disease severity of TYLCV compared to the nontreated control. In the field trial, tomato plants treated with Actigard® at 3 mg/l had significantly less disease than the nontreated control plants 4 weeks after transplanting.

KEYWORDS: Tomato yellow leaf curl virus, TYLCV, growth promotion, induced disease resistance, tomato

INTRODUCTION

Tomato yellow leaf curl disease, caused by Tomato yellow leaf curl virus (TYLCV), has become one of major disease problems of tomato in south Florida (Polston et al., 1999). TYLCV is only transmitted by the sweet potato whitefly (Bemisia tabaci Biotype B = Bemisia argentifolii) which has a broad host range including vegetable, ornamental crops and weed species (Cohen and Antignus, 1994; Mansour and Al-Musa, 1992). Tomato plants can be severely stunted if infected at an early stage, and consequently this can result in substantial yield losses. Chemical control is relied on heavily to reduce the impact of TYLCV. However, chemical control methods have become progressively less effective due to high whitefly population densities and their mounting resistance to insecticides (Schuster, 2007). Although the development of resistant cultivars holds promise in reducing the impact of TYLCV (Lapidot et al., 2001) and the highly resistant cultivars are now available for use, they are lacking in the ideal horticultural traits appropriate for Florida. Production practices are only partially effective in ameliorating TYLCV disease because reservoirs of whiteflies exist year-round, and population levels of whiteflies are very high in south Florida. Development of alternatives including induced disease resistance is imperative for management of TYLCV on tomato in south Florida. The specific objective of this research was to evaluate acibenzolar-S-methyl (ASM), plant growth-promoting rhizobacteria (PGPR) and silicic acid for their potential (i) to enhance plant growth and (ii) to ameliorate the impact of TYLCV on tomato production in south Florida.

MATERIALS AND METHODS

Greenhouse experiments were conducted with tomato cv. 'FL47'. Seeds of tomato were planted in Styrofoam flats (Speedling, Inc., Sun City, FL) containing potting mix. Four applications at weekly intervals of the disease resistance inducers were each applied as a soil drench (5 ml/plant) beginning at 1 week after planting (WAP). The treatments were ASM (Actigard® 50 WG, Syngenta, Inc.) at 30 and 3 mg/l, PGPR strains SE 34 and IN937b each at 1×10^7 CFU/ml, and silicic acid at 1.5 and 0.5 mM. Tomato plants treated with imidacloprid (Merit®) served as the standard chemical control and nontreated plants served as the blank control. Plants were transplanted at 5 WAP following the last treatment into 4-inch diameter pots containing potting mix. Treatments were arranged as randomized complete blocks with twelve replications for each treatment and one plant per replication. Plant height, stem caliper and chlorophyll content in leaves of tomato plants were measured at 6 WAP using SPAD-502 (MINOLTA Co., LTD, Japan).

For TYLCV infection, one plant from each treatment (a total of eight plants) was placed in a cage for 1 week containing viruliferous whiteflies (kindly provided by Dr. D. J. Schuster). Tomato plants were then transferred onto greenhouse benches for 2.5 weeks when the disease severity of TYLCV was rated based on a 0-4 scale described by Lapidot et al.(2001): 0 = no visible symptoms, inoculated plants grow similarly as noninoculated plants; 1 = very slight yellowing of leaflet margins on apical leaves; 2 = some yellowing and minor curling of leaf ends; 3 = a wide range of leaf yellowing, curling and cupping with reduction in size, yet plants continue to develop; and 4 = very severe plant growth stunting and yellowing, pronounced leaf curling and cupping, and plants stop growing.

A field trial was carried out at the Tropical Research and Education Center, University of Florida, Homestead, FL in the spring of 2008. Tomato (cv. 'FL47') seedlings in Speedling trays treated with the same compounds or PGPR at 2, 3 and 4 WAP were transplanted into the field beds 5 WAP on March 3, 2008. Two more applications by soil drench of the inducers were made at 1.5 and 2.5 weeks after transplanting (WAT). A randomized complete design was employed with four replications for each treatment and fifteen plants for each replication. Tomato plants were naturally infected with TYLCV by whiteflies. Severity of TYLCV disease was rated at 4 WAT based on a rating scale as described above.

Data from greenhouse and field experiments were analyzed by analysis of variance using JMP software (SAS Institute Inc., Cary, NC). The significance of effects of treatments was determined by the magnitude of the F value ($P = 0.05$). When a significant F test was obtained for treatments, the separation of means was accomplished by Fisher's protected Least Significant Difference (LSD).

RESULTS AND DISCUSSION

In the greenhouse experiment, all treatments except Actigard® at 30 mg/l significantly increased plant height by 6 WAP compared to the nontreated control ($P < 0.05$) (Table 1). Stem caliper was significantly increased by treatment with PGPR strains SE34 and IN937b and by silicic acid at both test concentrations; the chlorophyll content in the leaves of tomato plants treated with IN937b was significantly greater than that of the nontreated control plants.

For TYLCV disease, all treatments in the greenhouse assay except for imidacloprid (Merit®) significantly reduced disease severity of TYLCV compared to the nontreated control (Figures 1, 2). In the field trial, tomato plants treated with Actigard® at 3 mg/l had significantly less disease than the nontreated control plants (Figure 3). The whitefly populations had become very high at the time when the field trial was performed, the occurrence of TYLCV disease was found in the tomato field as early as 2 WAT. The disease severity of TYCV by 6 WAT was high, and most plants were severely stunted by TYLCV. The incidence of TYLCV disease was nearly 100%, and the disease severity rating was 3 or 4. Therefore, this field trial should be repeated in the winter and early spring seasons in south Florida when the whitefly population densities are low or moderate. We plan to retest the disease resistance inducers for their effects on TYLCV in the 2008-2009 winter tomato production seasons.

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Table 1. Effects of ASM, PGPR and silicic acid on plant growth of tomato in greenhouse assays

Treatment	Plant height (cm)	Stem caliper (mm)	Chlorophyll content
Actigard® 30 mg/L	13.7 d [z]	5.8 f	31.0 b
Actigard® 3 mg/L	16.1 c	6.5 de	30.5 b
silicic acid 1.5 mM	16.7 bc	7.3 ab	29.4 b
silicic acid 0.15 mM	17.7 a	7.8 a	29.5 b
SE34	17.3 ab	7.1 b	30.0 b
IN937b	16.0 c	6.7 cd	33.3 a
CK	13.4 d	6.0 ef	30.7 b

[z] Means within each column with a letter in common are not significantly different (P=0.05, LSD).

Figure 1. Effect of ASM and PGPR treatments on TYLCV disease of tomato in the greenhouse. Treatments (left to right): nontreated control, ASM, PGPR strains IN937b and SE34

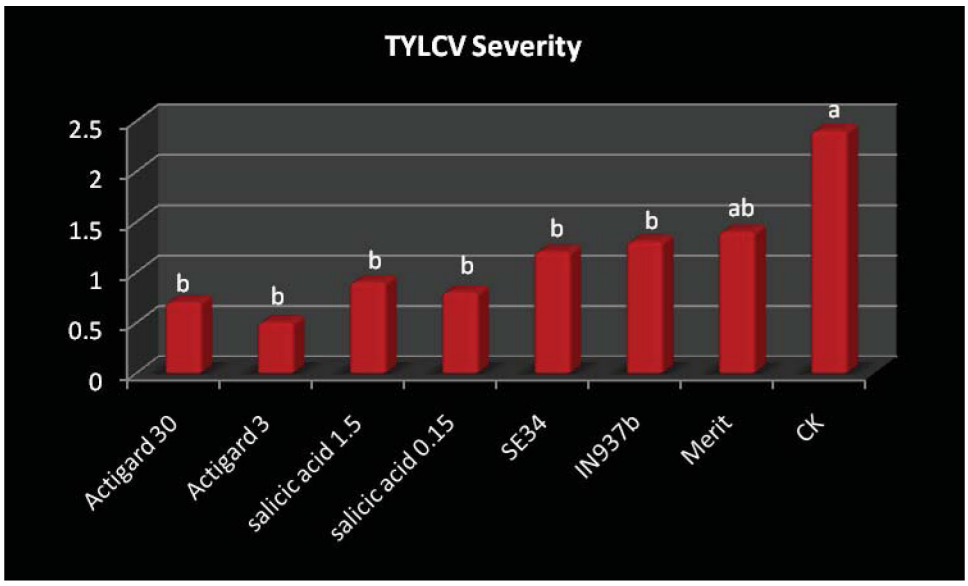

Figure 2. Suppression of TYLCV on tomato by ASM, PGPR and silicic acid in the greenhouse. values with a letter in common are not significantly different (P=0.05, LSD).

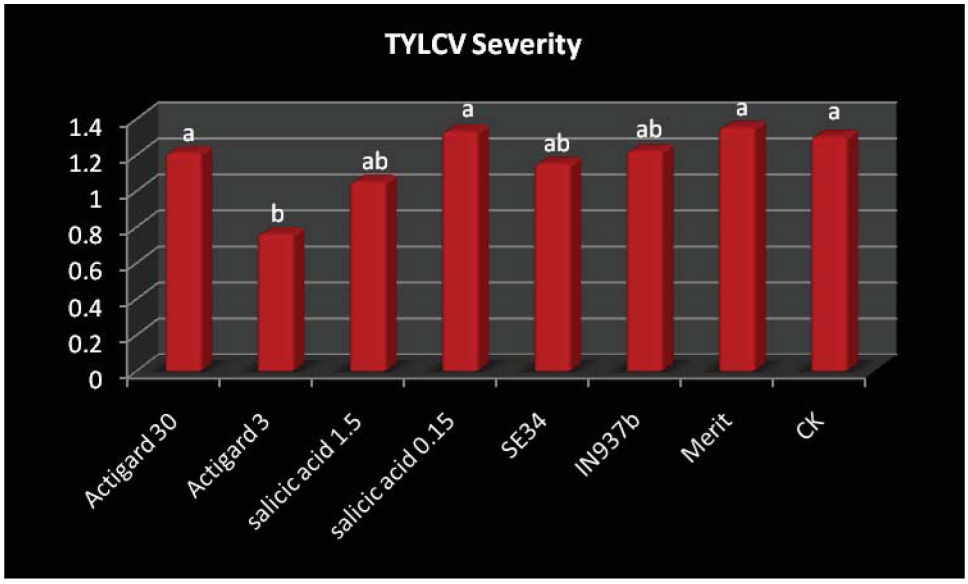

Figure 3. Effect of ASM, PGPR and silicic acid on TYLCV of tomato in the field trial. Values with a letter in common are not significantly different (P=0.05, LSD).