California Melon Research Board

2017 Annual Report

I. Project title

Evaluation of new sources of host plant resistance to sweetpotato whitefly biotype B.

II. Principal investigators

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III. Location(s) where work was performed

1. USDA-ARS, U.S. Agricultural Research Station, Salinas, California

2. University of California, Desert Research and Extension Center (DREC), Holtville

IV. Objectives

Evaluate germplasm identified as potential sources of resistance to SPWF-B. Compare whitefly-resistance in PI 122847 and 10 other putative sources of resistance to whitefly.

V. Results and Analysis

Melon host plant resistance to SPWF comparisons among eleven melon accessions and 'Top Mark' were included in a spring-season field test planted at DREC on April 26, 2017 (day 116). This was the third in a series of annual spring-season field tests utilizing the experimental design of randomized complete-block with insecticide in a split-plot design with four blocks (replications) and insecticide treatment as the split (control and insecticide treated). Seeds were sown at 1-ft spacing on standard 84-inch beds; experimental units (plots) were 40-ft long. This allowed side-by-side comparisons of host plant resistance to SPWF with minimal insecticide (control treatment with a single drip irrigation applied at 7-days after planting) and aggressive insecticide treatment that had additional, foliar spray as follows. Venom® insecticide for whitefly control was injected at a rate of 4 dry oz/acre on May 3, 2017 in the control and insecticide treatments. Foliar sprays to the insecticide treated split plots were, Brigade 2 EC 6.4 fl oz/acre on May 17, Brigade 2 EC 6.4 fl oz/acre plus Closer 4.5 fl oz/acre on June 19, and Oberon 2 SC 8.5 fl oz /acre on June 23. Five repeated population measures of whitefly adult and immature stages (sum of eggs + nymphs + crawlers + red eyes) were obtained beginning May 16 (Table 1).

Adults

The adult whiteflies were counted on the 5th leaf from the tip of one branch on each of five randomly selected plants per plot. Comparison by date between the control and insecticide treated split-plots, for numbers of adult whiteflies, showed no material differences across the 12 melon lines (Table 1 and Figure 1). The following discussion is, therefore, largely limited to the control treatment. Adult numbers increased on both treatments through June 6 (day 157), but declined dramatically thereafter as the melon plants senesced due to vine maturation, whitefly feeding and *Cucurbit yellow stunting disorder virus* symptom severity (CYSDV). The 12 lines differed significantly for numbers of adults at every sampling date ($P \leq 0.05$), though differences among the accessions within each treatment are readily apparent in the middle three sampling dates (Figure 1).

On May 16 (day 136), three lines, PI 532841, PI 124107 and PI 116482 had significantly more adults than the other nine lines, including 'Top Mark', that did not differ from each other (Figure 1). Four lines had significantly more adults on May 24 (day 144) than six other lines, which had 10 to 22 adults per leaf. At this time, number of adults on TGR 1551 greater, but not significantly so, than the best lines, e.g., PI 122847, and was significantly lower than 'Top mark'.

By June 6 (day 157), numbers of adults per leaf increased markedly and differences among the 12 melon lines are more apparent (Figure 1). PI 313970 and PI 122847 had the fewest adults, and yet had approximately the same number of adults as 'Top Mark' had on May 24 (two weeks prior). Adults on PI 313970 and PI 122847 were not significantly lower than five other lines (PI 145594,PI 532841, PI 414723, TGR 1551 and PI 161375).

On June 15 (day 166), PI 122847 and PI 414723 had the fewest adults but did not different differ significantly from six other melon lines (Figure 1). Number of adults on PI 122847 remained about the same as on June 6 (nine days prior), while numbers of adults on nine other lines declined. Numbers of adults on PI 123496, PI 161375, and TGR 1551 remained almost unchanged. The adult population decreased markedly over the final 13-days before the final sampling on June 28 (day 179) to levels similar to those on May 16 (day 136). PI 161375 had significantly more adults than the other 11 melon lines. PI 122847 had the fewest but did not significantly differ from nine other lines.

Table 1. Mean (± Std Err) numbers of adult whiteflies per leaf (5^{th} leaf on the tip of one branch on each of five plants per plot) and immatures (sum of eggs + nymphs + crawlers + red eyes) per 10-cm^2 of sampled leaf by treatment at five sampling dates, across 12 melon lines that included ‘Top Mark’ as the susceptible control.

Sample date	Treatment	n	Adults	Immatures
05/16/2017	insecticide	47	4.9 ± 0.7	114.2 ± 15.9
	control	46	5.5 ± 1.2	99.1 ± 16.4
05/24/2017	insecticide	48	31.9 ± 2.9	312.7 ± 26.1
	control	48	31.8 ± 3.2	312.1 ± 32.1
06/06/2017	insecticide	48	121.2 ± 7.3	348.3 ± 35.5
	control	48	115.0 ± 7.1	526.6 ± 45.8
06/15/2017	insecticide	48	90.9 ± 6.7	327.3 ± 32.1
	control	48	95.6 ± 6.4	543.7 ± 60.8
06/28/2017	insecticide	48	3.6 ± 1.0	596.8 ± 71.1
	control	48	5.2 ± 1.5	799.0 ± 60.7

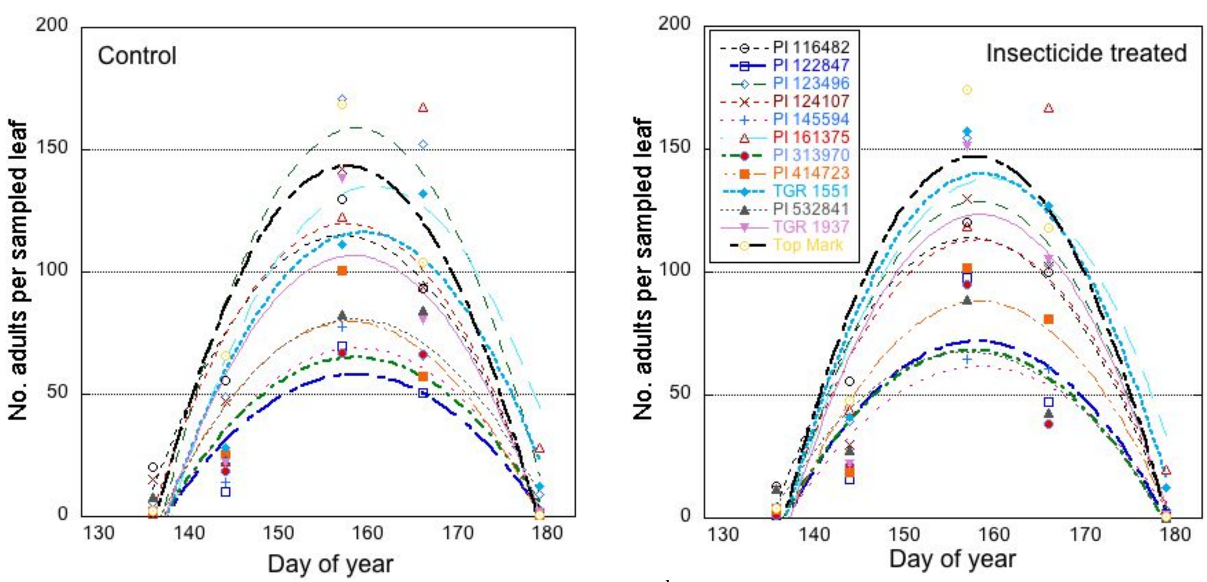

Figure 1. Mean number of adult whiteflies on the 5^{th} leaf from the tip of one branch on each of five plants per plot of 12 melon accessions, including susceptible ‘Top Mark’, on five sampling dates from May 16 (day 136) through June 30 (day 181), 2017; DREC, Holtville, California; four reps.

Immatures
Population levels of immature stages of SPWF-B were evaluated on the same days that adult whiteflies were sampled. A basal leaf was taken from 5 random plants of each accession in every replicate. SPWF-B eggs and nymphs were counted, using a dissecting binocular microscope, on the abaxial surface of a 2-cm^2-diameter leaf disk from the lower left-hand quadrat of each leaf. All immature stages were combined for each group of 5 leaves; means were calculated per 10-cm^2 of sampled melon leaf area. The results for whitefly immatures were as follows.

Insecticide treatment reduced numbers of immatures over the 12 melon lines by 29% overall 12 melon lines compared with the control. Insecticide effects were evident by the third sampling date (Figure 2). For example, immatures on TGR 1551 (PI 482420) were 250 per cm^{-2} in the control *vs.* 150 per cm^{-2} in the insecticide treatment at the final sampling. Despite the wide range in mean numbers of immature in the insecticide treated plots at the final sampling date, there were no significant differences among them; probability of a greater F was 0.08.

For the control treatment, there were no differences on May 16 (day 136) among the lines for numbers of immatures per area of sampled leaf, as in the insecticide treatment. There were differences among them on May 24 (day 144) when PI 313970 had the fewest numbers of immatures but it was not significantly less than eight other melon lines (Figure 2). 'Top Mark' and four other lines had more than twice the number matures on PI 313970 on May 24 (day 144)..

Numbers of immatures on TGR 1551 (PI 482420) control increased through the test and was significantly greater than 'Top Mark' at the fourth sampling date. TGR 1551 had the second highest number of immatures on June 6 (day157), and had the most on June 15 (day 166) and 28 (day 179), though not significantly more then one or three other lines, depending upon the date. This may have been due in part to the relatively better plant condition of TGR 1551 compared with 'Top Mark' (Figure 3).

PI 313970 in the control was comparable to PI 122847 at the first two samplings but had more immatures than PI 122847 from the third through the final sampling date.

PI 122847 in the control had the fewest numbers of immatures across the five sampling dates (Table 2), though it was not significantly fewer than three other lines: PI 145594, PI 532384, and PI 313970. Insecticide treatment did not result in a significant reduction in immatures on PI 122847. On June 28 (day 179), PI 122847 was not significantly different from Top Mark, perhaps due to differences in plant condition (Figure 3).

Table 2. Mean (least squares) numbers of immature whiteflies per 10-cm^{-2} of sampled leaf area on 12 melon lines, including susceptible 'Top Mark', across five sampling dates from May 16 (day 136) through June 30 (day 181), 2017; DREC, Holtville, California; five leaves sampled in each of four reps each date.

Line	Mean number of immature whiteflies
PI 161375	834.3 a
PI 482420	757.6 a
TGR 1937	530.9 b
PI 116482	523.0 bc
PI 123496	514.0 bcd
Top Mark	507.2 bcd
PI 414723	433.0 bcd
PI 124107	412.6 bcd
PI 145594	384.2 bcde
PI 532841	299.7 cde
PI 313970	295.2 de
PI 122847	162.1 e

Probability of a greater *F* was <0.0001; means separation by Student's *t*-test ($P_{0.05}$)

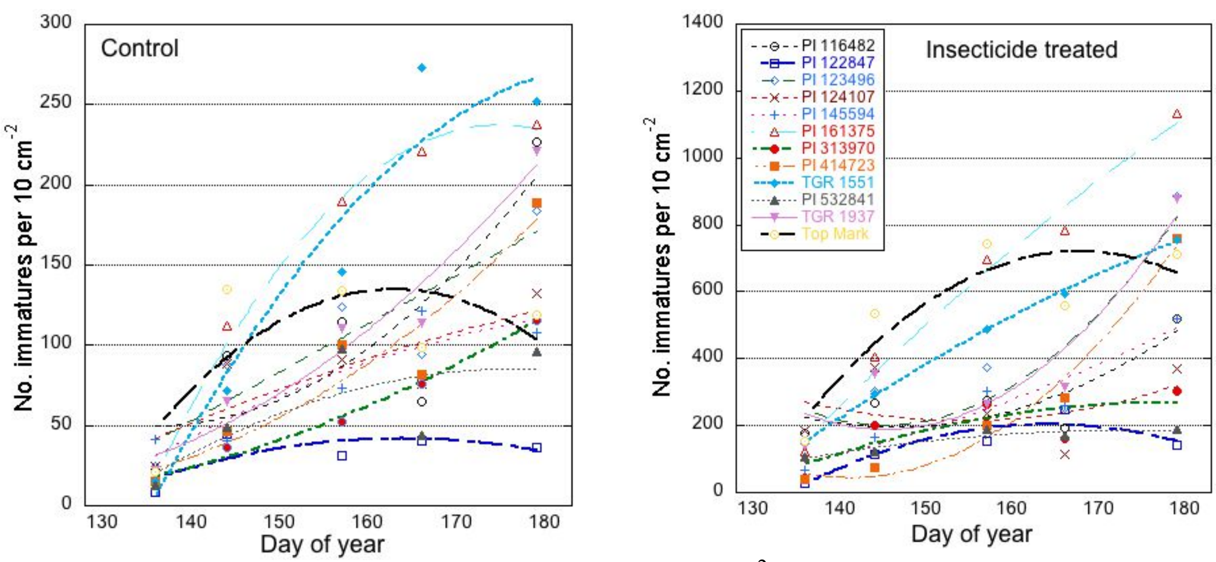

Figure 2. Mean numbers of immature whiteflies per 10 cm^{-2} of sampled leaf area on 12 melon accessions, including susceptible 'Top Mark', on five sampling dates from May 16 (day 136) through June 30 (day 181), 2017; DREC, Holtville, California; five leaves sampled in each of four reps.

Plant Parameters

Plant size and condition were evaluated using 1 to 9 scales as follows. Plant size estimated the area of the bed covered by the plants where 1 = very small plants (comparable to a 1 to 2 leaf plant) and 9 = large plants completely covering the bed and growing into the next bed. Plant condition was an assessment of the general appearance and reflects effects of diseases and stress, where 1 = dead and 9 = actively growing plant with healthy terminal buds, many flowers open, no sign of disease symptoms. CYSDV symptoms were evaluated on a 1 (0 to 10% yellowed canopy) to 10 (100% yellowed canopy) visual scale. The results for plant size and condition, and CYSDV symptom severity were as follows:

Plant size differed significantly among the 12 lines at all three dates regardless of insecticide treatment, i.e., control *vs.* insecticide treated (Figure 3). TGR 1551 and PI 161375 were significantly smaller at the first evaluation. For the control treatment at the second evaluation, PI 161375 was significantly smaller than TGR 1551, which was not significantly smaller than PI 313970, TGR 1937, 'Top Mark', or PI 145594. For the insecticide treatment at the second evaluation, PI 161375 was significantly smaller the others, and TGR 1551 was not significantly smaller than PI 532841, TGR 1937, 'Top Mark', or PI 145594. At the third evaluation, with the exception of PI 161375, the lines did not differ significantly for plant size. Plant size was not materially different between the insecticide treatments for any of the three evaluations.

Plant condition of PI 414723 was the lowest at all three dates (Figure 4), which may have been due in large part to apparent extreme susceptibility to CYSDV, as evidenced by symptom severity (Figure 5). PI 414723 had the fewest immatures in the insecticide treated plants through the third sampling date (Figure 2) and was not different from PI 122847 at the fourth date, but immatures increased greatly on it by the fifth date.

PI 532841 had relatively low numbers of immatures in the control, though always greater than PI 122847 (Figure 2, Table 2), but with insecticide treatments they were virtually identical. Plant condition rating for PI 532841 was, however, low, essentially identical to PI 414723 and 'Top Mark' in the control and insecticide treatments (data not shown).

Entries differed significantly for plant condition at all three dates (Figure 4), and plant condition decreased on all 12 entries through the test (not all entries shown). At the final sampling date PI 122847 = PI 161375, which were significantly better than PI 313970 = TGR 1551 (PI 482420) > PI 414723 = 'Top Mark' (Figure 4; not all entries shown).

Insecticide treatment did not reduce CYSDV symptom severity exhibited by 'Top Mark' or PI 414723, whereas severity on PI 122847, PI 313970 and TGR 1551 was slightly reduced (Figure 5).

Summary

The 12 melon lines in included in this study differed significantly for numbers of adult and immature whiteflies. Insecticide treatment in addition to the initial application of Venom® ca. 7-day days post planting appear to have little effect on numbers of adults, overall, but had marked effects on immatures. Numbers of immature on PI 122847 did not differ between the control and insecticide treatments, and is, therefore, a potential source of unique genes for resistance to the whitefly. Resistance mechanisms in TGR 1551 (PI 482420) are being investigated and exploited by researchers in Spain, but in Imperial Valley under the relatively low whitefly pressure in late Spring-early Summer conditions it fared poorly for numbers of immatures.

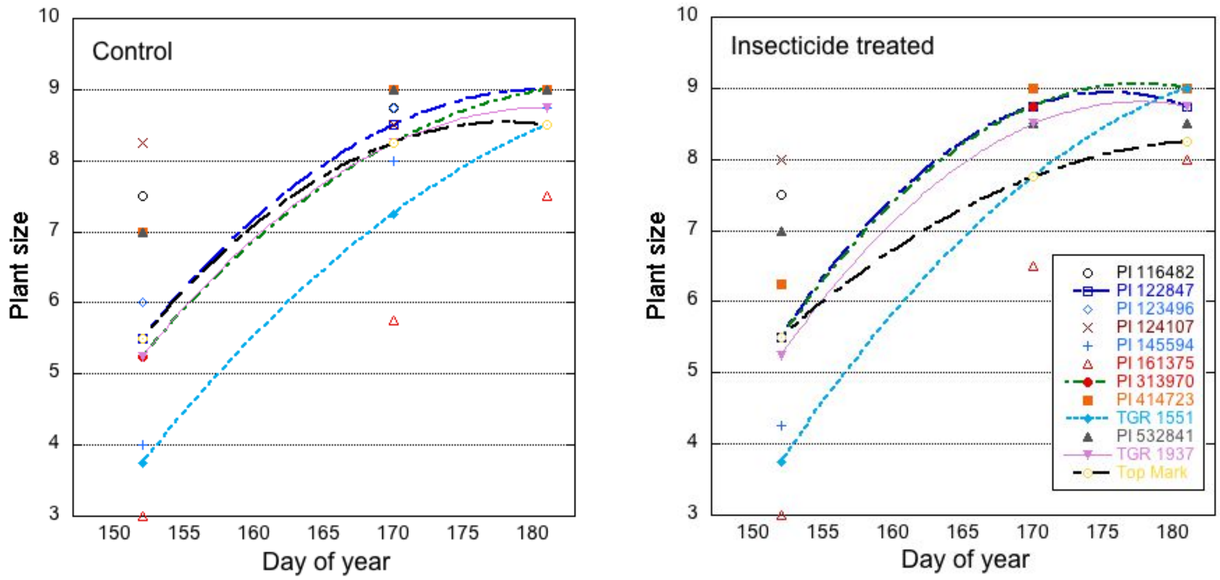

Figure 3. Plant size (plot basis) of five melon accessions, including susceptible ‘Top Mark’, on June 2 (day 153), 20 (day 171), and 30 (day 181), 2017; DREC, Holtville, California; four reps; plant condition rated on a 1 to 9 visual scale where 1 = very small plants (comparable to a 1 to 2 leaf plant) and 9 = large plants completely covering the bed and growing into the next bed

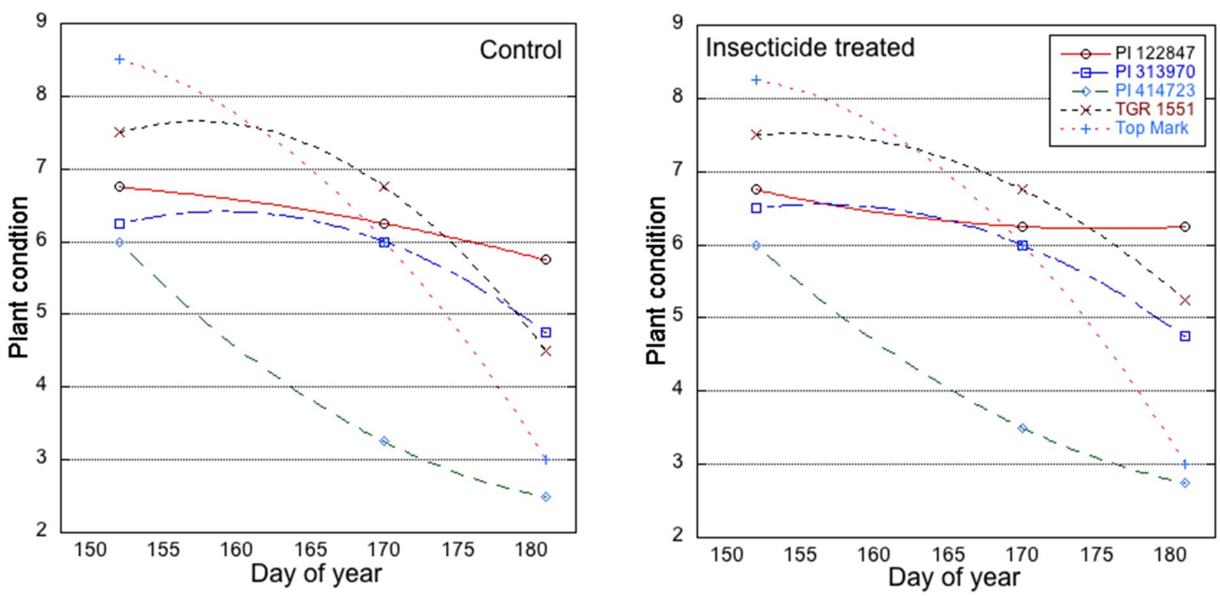

Figure 4. Plant condition (plot basis) of five melon accessions, including susceptible ‘Top Mark’, on June 2 (day 153), 20 (day 171), and 30 (day 181), 2017; DREC, Holtville, California; four reps; plant condition rated on a visual scale from 1 (dead) to 9 (vigorous, flowering, asymptomatic).

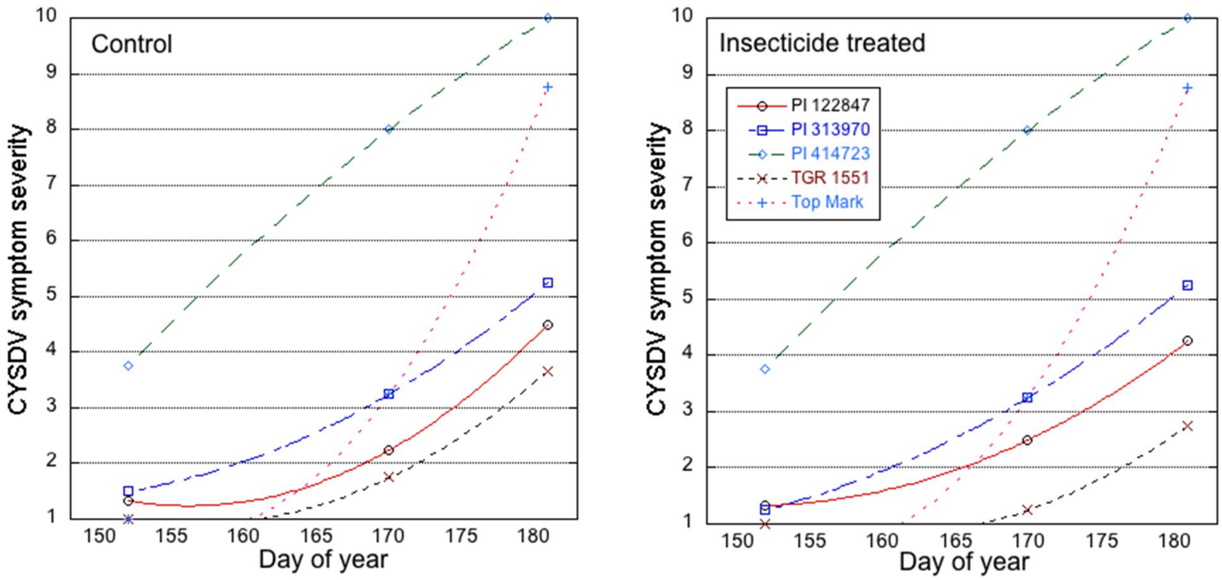

Figure 5. *Cucurbit yellow stunting disorder virus* symptom severity (CYSDV) of five melon accessions, including susceptible 'Top Mark', on June 2 (day 153), 20 (day 171), and 30 (day 181), 2017; DREC, Holtville, California; four reps; symptom severity rated on a plot basis using a visual scale from 1 (≤ 10% symptomatic foliage) to 10 (100% chlorotic foliage).