California Melon Research Board

2014 Annual Report

I. Project title

Comparative evaluation and breeding of new sources of host plant resistance to CYSDV and sweet potato whitefly biotype B, and continued efforts to develop a field-based serological detection method for CYSDV

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IV. Locations where work was performed

A. USDA-ARS, U.S. Agricultural Research Station, Salinas, California
B. University of California, Desert Research and Extension Center (DREC), Holtville

V. Objectives

A. Characterize host plant resistance to CYSDV and introgress to western U.S. shipping type background adapted to the desert southwest U.S.
   1. Continue advancement of selections from crosses of PI 313970, TGR-1551 and TGR-1937 for CYSDV resistance and western U.S. shipping type fruit quality.
   2. Assess CYSDV resistance potential of selfed selections of seven putative resistant sources identified in previous years.
   3. Evaluate virus concentration in selected plant materials from this field experiment along with susceptible and resistant parent controls.

B. Test germplasm identified in 2012 as potential sources of resistance to SPWF-B. Repeat fall 2013 test under spring season growing conditions without insecticides.

VI. **Results and Analysis**

Objective A. Characterize host plant resistance to CYSDV and introgress to western U.S. shipping type background adapted to the desert southwest U.S.

Advanced backcross progenies from crosses involving PI 313970, TGR-1551 and TGR-1937 were evaluated in an unreplicated test along with five putative, new sources of resistance to CYSDV and their crosses with susceptible cultivars. The test was planted the week of August 18, and evaluated 5- and 9-weeks post-planting. Sweet potato whiteflies (SPWF) were very abundant, and CYSDV infection was virtually 100% with foliar symptoms strongly and uniformly expressed across the field in the fall season. *Cucurbit leaf crumple virus* (CuLCrV) was present throughout the field and may have been 100% but symptoms were not always obvious due to gene silencing that naturally occurs later in the disease cycle (McCreight et al., 2008). A new virus closely related to *Squash vein yellowing virus* (SqVYV) was also found in the field, associated with its initial identification in California during the fall season (Batuman et al., 2015). SqVYV, the cause of watermelon vine decline, was first recognized on watermelon in Florida in 2003 (Adkins et al., 2007). Studies in progress are seeking to characterize the relationship of the new virus to SqVYV.

1. Continue advancement of selections from crosses of PI 313970, TGR-1551 and TGR-1937 for CYSDV resistance and western U.S. shipping type fruit quality.

   PI 313970, TGR-1551 (PI 482420) and TGR-1937 (PI 482431) have been known for sometime to exhibit genetically controlled resistance to CYSDV. TGR 1551 was initially reported to have dominant gene for resistance (López-Sesé and Gómez-Guillamón, 2000), but our data from field plantings in 2013 and 2014 (spring and fall seasons) indicated recessive inheritance of resistance in TGR 1551. Resistance in PI 313970 is recessive (McCreight and Wintermantel, 2011), and we found resistance in TGR 1937 also to be recessive (McCreight et al. 2013).

   Nearly 900 plants in 30 progenies from crosses of PI 313970, TGR 1551, TGR 1937 and were evaluated. Cuttings were taken from 29 plants of 13 progenies for cross and self-pollination in a greenhouse at Salinas (Table 1). Additional pollinations will be made from

remnant seed of several additional progenies grown from seed-grown plants in the same greenhouse.

2. Assess CYSDV resistance potential of selfed selections of seven putative resistant sources identified in previous years.

   Sufficient seed for the test was produced for five of the seven putative resistant accessions. The five putative new sources of CYSDV resistance compared favorably to the previously reported sources of resistance (Table 2). Like the previously reported sources (PI 313970, TGR-1551 and TGR-1937), the F_1 progenies from crosses with 'Green Flesh Honeydew', 'Impac', or 'Top Mark' were susceptible (data not shown), thus resistance in these five lines is also genetically recessive. Some of the putative resistance sources, unlike the previously reported resistance resources, exhibit some dessert fruit qualities, i.e., they or their F_1 progeny produced large fruit with light netting (Fig. 1). PI 122847 was especially notable as a potential source resistance to SPWF (Fig. 2) based on its overall vigorous appearance 9-weeks post-planting (Table 2) and *ad hoc* comparisons with 'Top Mark' and other lines for presence of adult SPWF on the foliage (Fig. 2). PI 122847 and 'Top Mark' differed significantly for numbers of SPWF adults in two-minute vacuum and on leaf turn samples 5- and 10-weeks post-planting (Fig. 3). There were also differences between the two genotypes for numbers of SPWF eggs, crawlers, nymphs and red eyes per sampled leaf (data not shown).

3. Evaluate virus concentration in selected plant materials from this field experiment along with susceptible and resistant parent controls.

   A stronger correlation between symptom severity and CYSDV titer was observed in previous years when virus titer was determined early (within 7-weeks of planting), than when virus titer was sampled later and plants expressed higher levels of disease severity (9-weeks post-planting or later). When virus titers were measured late in the season in 2011 and 2013, results suggested a lower correlation between virus titer and symptom severity. In contrast, when sampling was conducted at 7-weeks or earlier, in 2010 and 2014 (Fig. 4) and symptoms were not yet fully developed, results indicated that symptom severity is correlated with rate of virus accumulation when virus symptoms are still developing. These results confirm results of the previous studies indicating that correlation of virus levels with disease severity is most effective when evaluated as symptoms are spreading down vines, but not fully developed. Virus titer of an individual leaf is not influenced significantly by the location of the leaf on the vine, based on spring 2014 data. In future studies it will be important to evaluate virus titer during the early stages of symptom development as

   Objective B. Test germplasm identified in 2012 as potential sources of resistance to SPWF-B. Repeat fall 2013 test under spring season growing conditions without insecticides.

   Fourteen lines were assessed in a replicated field test that was a repeat of the fall 2013 test. SPWF samples were collected weekly for seven weeks beginning 19 June (7-weeks post-planting). The lines differed significantly for CYSDV symptom severity (Fig. 5) and plant condition (data not shown).

Differences among the 14 lines were significant five of the seven weeks for number of adult SPWF (Fig. 6). There were fewer significant differences among the 14 genotypes over the seven-week sampling period for numbers of eggs (Fig. 7), crawlers, nymphs and red eyes per leaf (data not shown). The putative SPWF-resistant lines identified in fall 2012 did not, however, exhibit higher levels of resistance to SPWF than the three CYSDV resistance sources, PI 313970, TGR 1551 (PI 482420) and TGR 1937 (PI 482431).

Literature Cited

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Table 1. Summary of the number of selections form crosses of PI 313970, TGR 1551, and TGR 1937.

Generation	No. selected plants
$S_1BC_1F_1$(Top Mark x TGR 1937 C) TGR 1937	4
F_3 (TGR 1551 MGG x Top Mark)	3
F_2 (PI 313970 x Impac)	4
BC_1 Impac [S_2[BC_1F_2(PI 313970 x TGR1551) Impac]]	1
BC_1 Green Flesh Honeydew [S_3[BC_1F_2 (PI 313970 x TGR 1551) Impac]]	2
BC_1F_5 Green Flesh Honeydew (PI 313970 x TGR 1551)	1
BC_1F_5(PI 313970 x TGR 1551) Top Mark	1
F_5(PI 313970 x TGR 1551)	2
S_1 [BC_1F_2(PI 313970 x TGR 1551) Impac]	5
S_2 [BC_1F_2(PI 313970 x TGR 1551) Impac]	1
S_4 [BC_1F_2(PI 313970 x TGR 1551) Impac]	5

Table 2. CYSDV symptom severity, plant size, and condition ratings of three previously reported and five putative sources of CYSDV resistance 9-weeks post-planting. Two CYSDV ratings (initial and second impressions) reflect the difference between the percentage of foliage with readily observed symptoms (bright yellow) and the percentage of leaf area with readily observable symptoms and subtle symptoms evident upon a closer and more thorough assessment of the foliage.

	CYSDV[z]		Plant	
Accession	Initial	2nd	Size[y]	Condition[x]
Previoulsy reported				
PI 313970	3	4	9	6
TGR 1551 (PI 482420)	5	6	9	6
TGR 1937 (PI 482431)	3	4	9	6
Putative				
PI 122847	4	5	9	7
PI 123496	5	6	9	4 and 5
PI 124550	5	6	9	4
PI 145594	5	7	9	6
PI 614486	3	6	4 and 5	4 to 6

[z]Rated using a visual scale from 1 (≤10%) to 10 (100%) scale that estimated the percentage leaf area exhibiting CYSDV symptoms.

[y]Plant size rated using a 1 to 9 visual scale where 1 = extremely stunted, ca. size of a newly emerged seedling and 9 = large, dense plant canopy that completely spans and covers the 80-inch bed. Two ratings or a range of ratings indicate variation among different progenies of the accession.

[x] Plant condition rated using a 1 to 9 visual scale where 1 = dead and 9 = large, vigorously growling plant canopy free of disease or other types of stress symptoms and healthy terminal buds. Two ratings or a range of ratings indicate variation among different progenies of the accession.

Figure 1. Fruit 9-weeks post-planting: PI 123496 (top left), F_1 Top Mark x PI 123496 (top right), and PI 145594 and F_1 Impac x PI 145594 (right).

Figure 2. Nine-weeks post-planting: PI 122847 exhibited healthy terminal leaves (top left) and near absence of adult SPWF (top right); ‘Top Mark’ exhibited severe CYSDV yellowing and stunting of terminal leaves due to CuLCrV infection (bottom row).

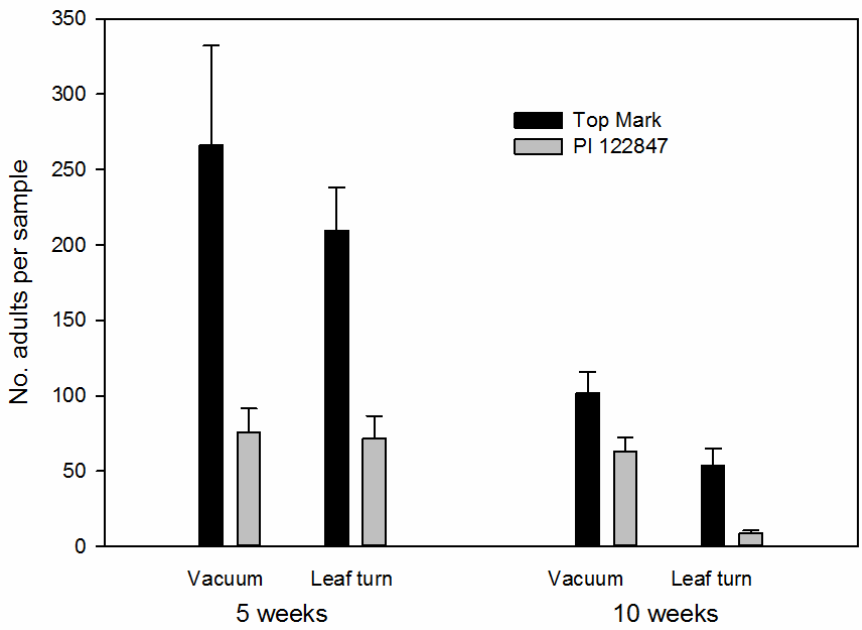

Figure 3. Numbers of SPWF adults on 'Top Mark' and PI 122847 5- and 10-weeks post-planting as determined by two sampling methods: 2-min. vacuum from the foliage and turn of the 5th leaf from the crown on a main branch; n = 10 for each sampling date and sampling method.

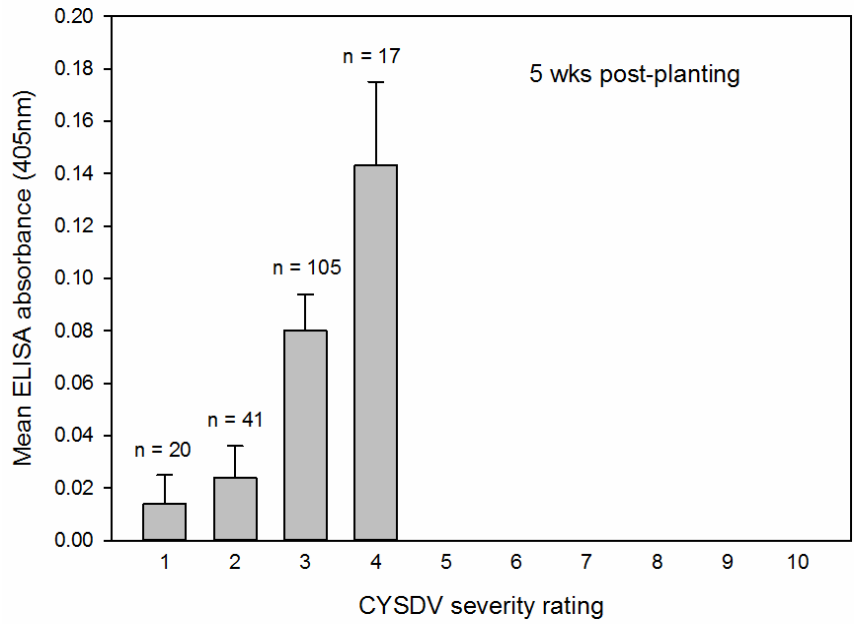

Figure 4. Mean CYSDV titer expressed as absorbance at 405nm and mean symptom severity ratings 5-weeks post-planting in 2014. CYSDV symptom severity of 10 melon genotypes rated on a visual scale from 1 (≤ 10%) to 10 (100%) that estimates percent symptomatic foliage.

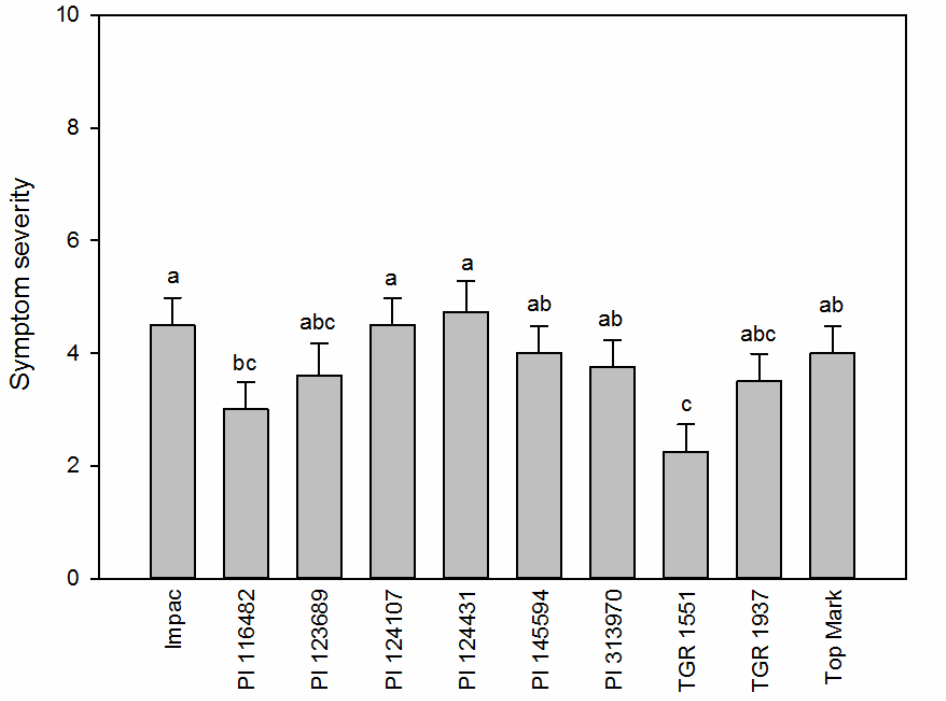

Figure 5. CYSDV symptom severity of 10 melon genotypes rated on a visual scale from 1 (≤ 10%) to 10 (100%) that estimates percent symptomatic foliage; error bars capped by different letters are significantly different, $P_{0.05}$.

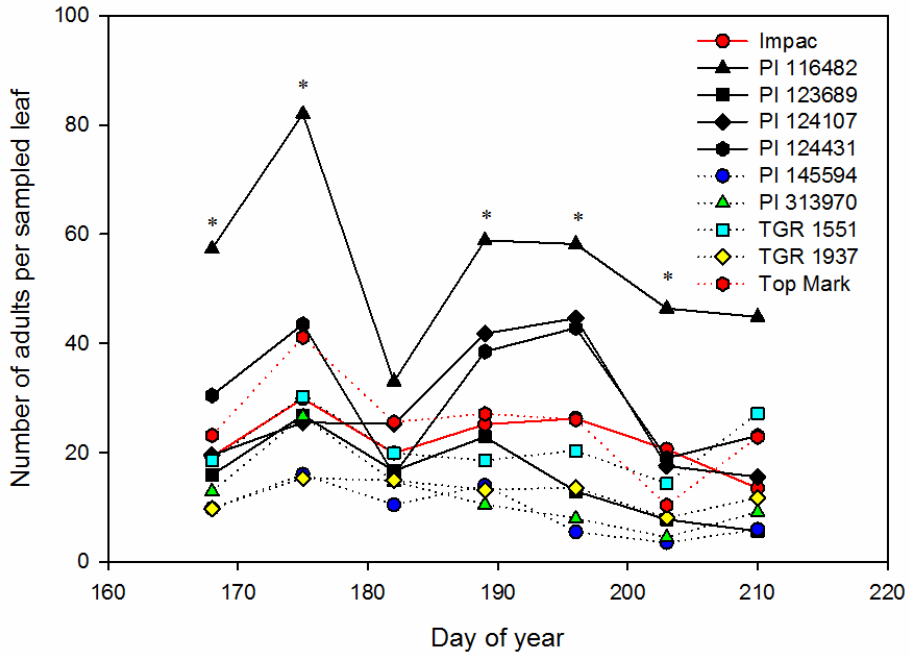

Figure 6. Numbers of SPWF adults in 10 melon cultivars and plant introductions sampled weekly from 19 June through 31 July (* significant differences among the means on that sampling date, $P_{0.05}$).

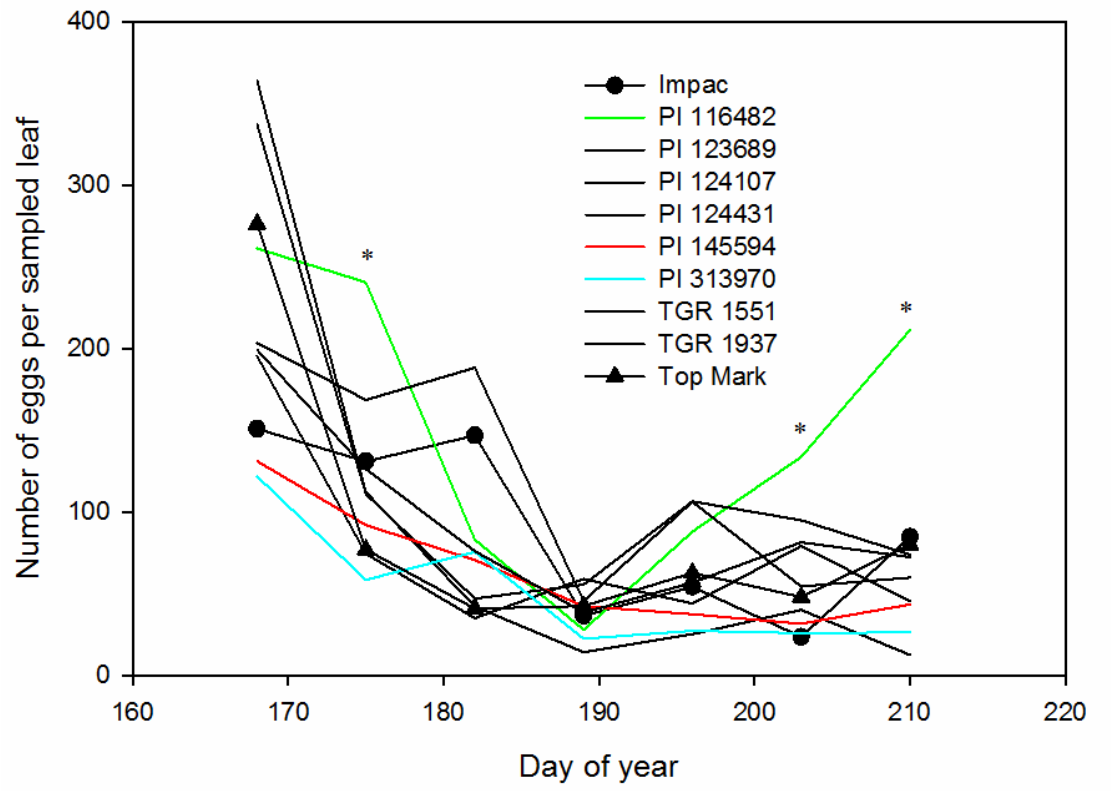

Figure 7. Numbers of SPWF eggs in 10 melon cultivars and plant introductions sampled weekly from 19 June through 31 July (* significant differences among the means on that sampling date, $P_{0.05}$).