

TYLCV-resistant Tomato Cultivar Trial and Whitefly Control Strategies

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Summary: Tomato yellow leaf curl virus (TYLCV) and tomato spotted wilt virus (TSWV) are common diseases of tomato in Florida. TYLCV occurs in central and southern Florida whereas TSWV occurs in northern Florida and throughout all states of the southeastern USA. TYLCV-resistant cultivars and advanced breeder's varieties are available for commercial use, but vegetable producers don't often use them. A variety trial was conducted to compare yield and horticultural characteristics of TYLCV-resistant genotypes to that of the susceptible cultivar 'Florida 47'. Thirteen entries were grown in a replicated trial during the 2006 winter-to-spring growing season at the Southwest Florida Research and Education Center in Immokalee. Whitefly populations were low until after first harvest and disease incidence was low throughout the duration of the study. 'Florida 47' and two entries from Abbott & Cobb exhibited disease incidences of 5% to 8%, indicating that these entries were not resistant genotypes. TYLCV was not detected among the other entries. HA 3075 (Hazera) produced the highest total yield of three harvests, though its total yield was similar to that of S-50257, VT-60774, and VT-60780 (Zeraim Gedera). HA 3075 was the only entry to produce significantly greater total yield than 'Florida 47'. HA 3075 also produced the highest yield of 5x6s (extra large fruit), though yield of this size category was similar to that of 'Florida 47'. BHN 745 (BHN Seeds) produced the largest average fruit size of 5x6s, at 9.4 oz/fruit, and this was similar to that of 'Florida 47' and 'Tygress' at 9.1 oz/fruit. S-50260 produced the highest percentage of cull fruit, though its percentage of cull fruit was similar to that of HA 3074, Fla 8477, and BHN 745. Defects of fruit of S-50260, S-50252, and Fla 8477 were mostly due to zipper scarring and catfacing. *Based on marketable yield, cull categories, and size and shape of marketable fruit, TYLCV-resistant entries from this trial that could be recommended for observation in small blocks are HA 3075, S-50257, VT-60774, VT-60780, and BHN 745.*

Another trial was conducted at SWFREC to evaluate the interaction of cultivar and control strategies. 'Tygress' (TYLCV-resistant) and 'Florida 47' (TYLCV-susceptible) were grown during spring 2006. Whitefly control strategies included selected combinations and rates of JMS Stylet oil, Platinum, Courier, Admire, Knack, Oberon, and a growth inhibitor Nichino 0101. The resistant variety showed little or no virus symptoms, resulting in a trend toward better yield although the difference was not significant, probably because of low virus incidence. However, unsprayed resistant or susceptible plants yielded the same. Nichino 0101 provided control of whiteflies comparable to the standard treatment of adults. Weekly oil treatment after the Admire drench also provided good whitefly control although the yield suffered somewhat compared to

plants treated with Platinum at the low rate followed by the standard sprays. *Although this trial did not demonstrate a clear advantage to using the resistant variety under conditions of low virus pressure, neither was there any disadvantage. Thus, use of 'Tygress' in the spring growing season could provide an extra measure of security to the grower, over and above the standard insecticidal regime.*

Introduction

Commercial tomato growers in most of the rest of the country try to limit losses due to a disease vectored by thrips called tomato spotted wilt virus. Not so in south and central Florida. Here growers strive to limit losses due to tomato yellow leaf curl virus (TYLCV), a disease vectored by whitefly and a problem the region shares in common with other tropical and semi-tropical regions of the world. This report presents results of two trials conducted in southwest Florida during Spring 2006 to evaluate management of TYLCV in commercial tomato plantings using resistant cultivars and whitefly pest control strategies.

Variety Trial

One way to control losses due to TYLCV is for the plant to do most of the work. Tomato cultivars resistant to TYLCV have been available for many years, but for one reason or another they have not been well received by Florida growers. It is demanded of cultivars used on commercial farms to produce plants that are strong, disease resistant, highly productive and that yield large, round fruit with outstanding holding and shipping ability. Excellent choices are available, but often these cultivars were developed for other markets, such as markets that prefer smaller-sized fruit or a more flattened shape.

Twelve entries of TYLCV-resistant cultivars and advanced breeders' selections and one entry of a standard TYLVC-susceptible cultivar (Table 1) were evaluated in a replicated trial located at the Southwest Florida Research and Education Center (SWFREC). Seed were planted in flats and grown on site. Plants were then transplanted to the field on Feb. 20. Seed of Zeraim Gedera arrived late and were planted in flats on and transplanted to the field on Feb. 24. The crop was grown on raised beds with black plastic mulch and was irrigated and fertilized with drip tubing. A standard insect and disease control program was used throughout the entire duration of the crop, including an imidacloprid drench at transplant and whitefly control thereafter. The goal of the trial was to evaluate horticultural characteristics of each entry and not the level of virus resistance. Tomatoes were harvested three times, May 10, 24, and June 6. At each harvest, marketable fruit were separated by mature green and later maturities and then graded by size, counted, and weighed. Unmarketable fruit were separated by cull categories and also counted and weighed. The experimental design was a randomized complete block and data were statistically analyzed to determine significant differences.

Growing conditions were excellent with little rainfall and relatively warm, sunny days. Whitefly populations were low until the second harvest at which time populations became well established in the planting. At the time of final harvest, TYLVC-resistant cultivars had no virus-affected

plants and susceptible cultivars had a low level of incidence (Table 1). The two entries from Abbott & Cobb had higher levels of TYLVC disease than the standard cultivar Florida 47. This indicates these entries probably were not resistant genotypes. A previous trial at this location experienced a high level of disease in susceptible cultivars (Gilreath et al. 2000).

HA 3075 (Hazera) produced the highest total yield after three harvests, though its total yield was similar to that of S-50257, VT-60774, and VT-60780 (Zeraim Gedera). HA 3075 was the only entry to produce significantly greater total yield than 'Florida 47' (Table 2). HA 3075 also produced the highest yield of 5x6s, though yield of this size category was similar to that of 'Florida 47' (Table 3). Despite having the highest yield, HA 3075 did not produce the largest fruit in this size category. BHN 745 (BHN Seeds) averaged 5x6 fruit of 9.4 oz/fruit and this was similar to that of 'Florida 47' and 'Tygress' at 9.1 oz/fruit. HA 3075 averaged 8.3 oz/fruit in the 5x6 size category. S-50260 produced the highest percentage of cull fruit, though its percentage of cull fruit was similar to that of HA 3074, Fla 8477, and BHN 745. Defects of fruit of S-50260 and Fla 8477 were mostly due to zipper scarring and catfacing. Fruit of S-50252 also exhibited a high percentage of zipper scarring and catfacing compared to most other entries.

In conclusion, several entries produced total yields equal to or better than the standard cultivar. Based on marketable yield, cull categories, and size and shape of marketable fruit, TYLCV-resistant entries from this trial that could be grown for observation in small blocks on commercial farms are HA 3075, S-50257, VT-60774, and VT-60780, and BHN 745.

Cultivars in Combination with Whitefly Control Strategies

A trial was conducted at SWFREC to evaluate the interaction of cultivar and control strategies. One TYLCV-resistant cultivar, Tygress, and one TYLCV-susceptible cultivar, Florida 47, were planted 22 Feb. 2006 in raised beds with black plastic mulch and drip irrigation. Whitefly control strategies were applied to cultivars in an unbalanced experimental design, with more treatments applied to 'Florida 47' than 'Tygress'. All treatments (Table 4) were replicated four times.

Average numbers of whitefly adults during the first six weeks of the trial were low, but numbers increased dramatically during the later five weeks. Most adult whiteflies were observed on untreated 'Tygress' plants, although not significantly more than on the untreated 'Florida 47'. Numbers of adults seen on plants treated with the low (8 oz) rate of Platinum followed by the standard spray combination were not different from either untreated check (Fig. 1). Fewest whiteflies were observed on plants treated with Admire at planting, then the low rate of NNI 0101, though not less than plants treated the same except with the higher rate of NNI 0101, in turn not significantly different from plants sprayed with the standard or with oil following the Admire drench. Fewest whitefly eggs were seen on plants sprayed following the Admire drench with the high rate of NNI 0101 twice and Courier once or weekly with JMS Stylet oil, with no differences compared to the untreated controls exhibited by the other treatments (Fig. 2).

The checks were not significantly different in regard to small nymphs than the remaining treatments with significantly fewer of these seen in all remaining treatments. Fewest small nymphs were seen on plants treated with the high rate of NNI 0101, though not significantly so

compared to treatments with either rate of Platinum instead of Admire, or by substituting these sprays with the standard spray schedule or JMS Oil. More large nymphs were seen on unsprayed 'Florida 47' than unsprayed 'Tygress', with no differences between this latter control and all remaining treatments except the high (11 oz) rate of Platinum.

Few plants were observed with symptoms of TYLCV throughout the course of the trial, and they aggregated in unusual ways with most seen on plants treated with 11 oz of Platinum followed by the standard spray schedule. However, no virus symptoms were seen on the 'Tygress' plants except for one possible case in an unsprayed plot, although this was not significantly different than the other treatments except for 'Florida 47' treated according to the standard schedule or the aforementioned Platinum and standard sprays. All treated plants yielded more marketable fruit than untreated plants, with most harvested from 'Tygress' receiving the standard treatment, though not significantly different from all but oil, Platinum and check plants. Similarly, fewest culls were taken from plants receiving the standard treatment regardless of variety, though not significantly less than plants receiving either rate of Platinum, NNI 0101 or oil.

In conclusion, resistant varieties showed little or no virus symptoms, resulting in a trend toward better yield although the difference was not significant, probably because of low virus incidence. However, unsprayed resistant or susceptible plants yielded the same. Nichino 0101, a growth inhibitor, provided control of whiteflies comparable to the standard treatment of adults. Weekly oil treatment after the Admire drench also provided good whitefly control although the yield suffered somewhat, comparable to plants treated with Platinum at the low rate followed by the standard sprays. Although this trial did not demonstrate a clear advantage to using the resistant variety under conditions of low virus pressure, neither was there any disadvantage. Thus, use of 'Tygress' in the spring growing season could provide an extra measure of security to the grower, over and above the standard insecticidal regime.

Literature Cited

Gilreath, P., P. Stansly, K. Shuler, J. Polston, T. Sherwood, G. McAvoy, and E. Waldo. 2000. Tomato yellow leaf curl virus resistant tomato variety trials. Proc. Fla. State Hort. Soc. 113:190-193.

Table 1. Cultivars and advanced breeder's varieties evaluated in this study along with seed source and percentage of diseased plants observed at the end of the trial.

Entry	Source	Diseased plants (%)^z
Florida 47	Seminis	5
Tygress	Seminis	0
Fla 8477	UF/IFAS	0
BHN 745	BHN	0
HA 3074	Hazera	0
HA 3075	Hazera	0
ACR-242	Abbott & Cobb	8
ACR-2012	Abbott & Cobb	7
S-50252	Zeraim Gedera	0
S-50257	Zeraim Gedera	0
S-50260	Zeraim Gedera	0
VT-60774	Zeraim Gedera	0
VT-60780	Zeraim Gedera	0

^z Percentage of TYLVC-affected plants at end of trial, after third harvest. Values are means of four replications of 10-12 plants.

Table 2. Marketable yield by size category, percent of total yield at breaker stage or beyond, and average weight of 5x6 (extra-large), 6x6 (large), and 6x7 (medium) sized fruit.

Treatments	Marketable yield (boxes/acre) ^z				%	Avg fruit wt (oz)		
	5x6	6x6	6x7	Total		Color	5x6	6x6
Florida 47	2,380 ab	158 h-j	226 e-g	2,760 b-e	30 ef	9.1 a	5.6 a-c	4.7 ab
Tygress	2,310 b	115 j	131 g	2,550 d-f	29 ef	9.1 a	5.5 a-d	4.6 a-d
Fla 8477	1,760 de	369 d-f	379 cd	2,500 ef	37 de	7.6 de	5.6 ab	4.7 a
BHN 745	2,240 bc	133 ij	184 fg	2,560 d-f	20 f	9.4 a	5.5 b-d	4.4 d
HA 3074	2,120 b-d	265 f-h	267 d-g	2,650 c-e	53 bc	8.2 bc	5.6 a-c	4.8 a
HA 3075	2,780 a	238 g-i	248 d-g	3,270 a	37 de	8.3 b	5.7 a	4.6 a-c
ACR-242	2,040 b-d	396 de	331 de	2,760 b-e	54 a-c	7.5 de	5.5 a-d	4.5 b-d
ACR-2012	2,200 bc	396 de	368 cd	2,960 a-c	44 cd	7.9 cd	5.7 a	4.8 a
S-50252	1,880 cd	519 bc	489 bc	2,880 b-d	63 a	7.4 ef	5.6 a-d	4.7 ab
S-50257	1,420 ef	757 a	761 a	2,940 a-c	64 a	6.9 g	5.5 dc	4.4 cd
S-50260	1,290 f	465 cd	481 bc	2,240 f	61 ab	7.1 fg	5.4 d	4.6 a-d
VT-60774	2,360 b	332 e-g	317 d-f	3,010 a-c	39 de	7.9 cd	5.5 b-d	4.6 a-d
VT-60780	1,880 cd	585 b	591 b	3,050 ab	61 ab	7.6 de	5.5 a-d	4.6 a-d
<i>Significance</i>	<.001	<.001	<.001	0.001	<.001	<.001	0.063	0.017

^z Marketable yield is mature green fruit plus later maturities but minus unmarketable (cull) fruit. Values are means of four replications of 10 or 12 plants. Means followed by the same letter are not statistically different at $P \leq 0.05$.

Table 3. Unmarketable (cull) categories and total unmarketable weight. Blossom end scar (BES), zipper and catface, sunscald and yellow shoulder (SS, YS), radial and concentric cracking (Crk), misshapen (Mspn), and other cull categories.

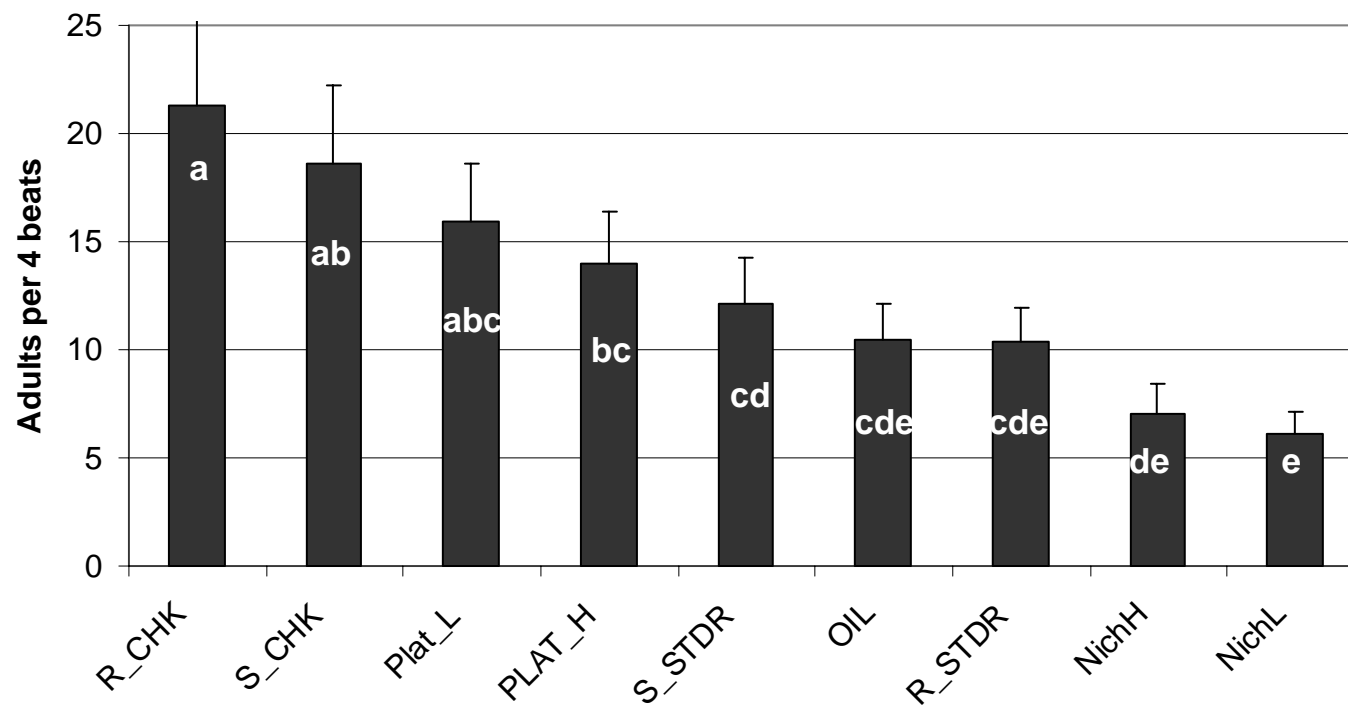
Treatments	Unmarketable fruit by cull category (%) ^z						Total (boxes/acre)	
	BES	Zip +Catface	SS, YS	Crk	Mspn	Other		
Florida 47	0.3 de	4.5 f-h	0.5	1.2 c-e	1.8 ab	1.3 de	9.6 e-g	326 bc
Tygress	0.3 de	7.1 de	0.5	1.1 c-e	0.8 cd	2.5 bc	12.2 de	372 bc
Fla 8477	1.3 c	10.4 b	0.7	0.4 e	1.2 bc	3.8 a	17.8 ab	710 a
BHN 745	2.8 b	7.9 cd	0.5	2.1 bc	1.0 b-d	2.6 a-c	16.9 a-c	690 a
HA 3074	2.5 b	6.4 d-f	0.7	4.7 a	0.8 cd	3.0 ab	18.2 ab	726 a
HA 3075	1.1 cd	1.4 i	1.0	2.2 bc	1.4 bc	1.9 b-e	9.0 f-h	362 bc
ACR-242	0.6 c-e	2.7 hi	0.4	0.7 de	1.3 bc	2.1 b-d	7.7 gh	241 c
ACR-2012	3.7 a	5.3 e-g	0.5	1.8 b-d	2.3 a	2.0 b-e	15.6 bc	711 a
S-50252	0.7 c-e	9.9 bc	1.4	0.6 de	0.3 d	1.7 c-e	14.6 cd	592 a
S-50257	0.1 e	5.1 e-g	1.2	0.5 e	1.2 bc	0.9 e	8.9 f-h	322 bc
S-50260	0.3 de	13.7 a	1.7	0.4 e	0.7 cd	2.5 bc	19.3 a	700 a
VT-60774	0.4 de	3.2 g-i	1.4	2.9 b	0.7 cd	2.4 b-d	11.0 ef	419 b
VT-60780	0.7 c-e	1.5 i	1.3	0.4 e	0.9 b-d	1.7 c-e	6.5 h	229 c
<i>Significance</i>	<.001	<.001	0.314	<.001	0.006	<.001	<.001	<.001

^z Unmarketable (cull) categories reported as percentage of total number of marketable plus unmarketable fruit. Values are means of four replications of 10 or 12 plants. Means followed by the same letter are not statistically different at $P \leq 0.05$.

Table 4.

Treatment	Cultivar	Product	Rate	Week														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	
R_Chk	Tygress	untreated	--															
S_Chk	Florida 47	untreated	--															
R_Stdrd	Tygress	Admire Pro 4.6L	7 fl oz per acre	x														
		Oberon 2SC	8 fl oz per acre							x		x						
		Knack .86L	9 fl oz per acre											x	x			
S_Stdrd	Florida 47	Admire Pro 4.6L	7 fl oz per acre	x														
		Oberon 2SC	8 fl oz per acre							x		x						
		Knack .86L	9 fl oz per acre											x	x			
Plat_L	Florida 47	Platinum 2SC	8 fl oz per acre	x														
		Oberon 2SC	8 fl oz per acre							x		x						
		Knack .86L	9 fl oz per acre											x	x			
Plat_H	Florida 47	Platinum 2SC	11 fl oz per acre	x														
		Oberon 2SC	8 fl oz per acre							x		x						
		Knack .86L	9 fl oz per acre											x	x			
Oil	Florida 47	Admire Pro 4.6L	7 fl oz per acre	x														
		JMS Stylet Oil	1 % v/v				x		x	x	x	x	x	x	x	x	x	x
Nich_L	Florida 47	Admire Pro 4.6L	7 fl oz per acre	x														
		Courier 40SC	12 fl oz per acre													x		
		NNI-0101	0.2 lb per acre a.i.								x		x					x
Nich_H	Florida 47	Admire Pro 4.6L	7 fl oz per acre	x														
		Courier 40SC	12 fl oz per acre													x		
		NNI-0101	0.3 lb per acre a.i.								x		x					x

Figure 1. Average number adult whiteflies collected in 4 beats over 11 sample weekly dates.



Columns designated by the same letter represent means that are not significantly different (LSD, $P < 0.05$)

Figure 2. Average number of eggs, small nymphs and large nymphs over 10 weekly sample dates.

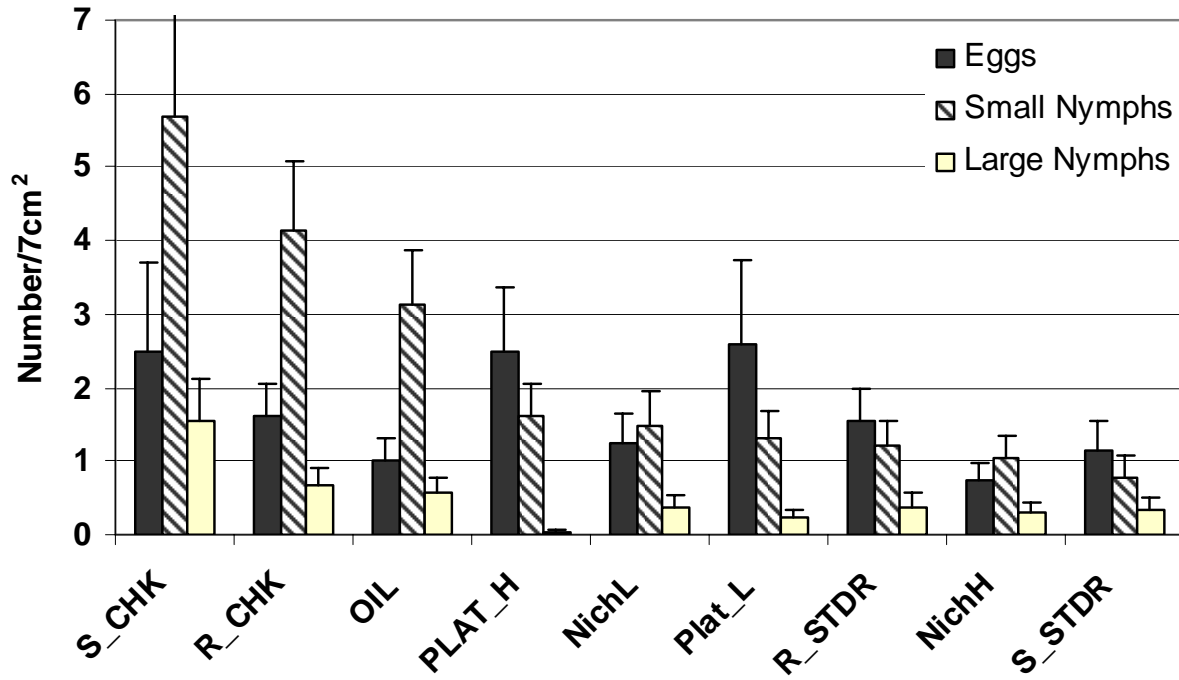
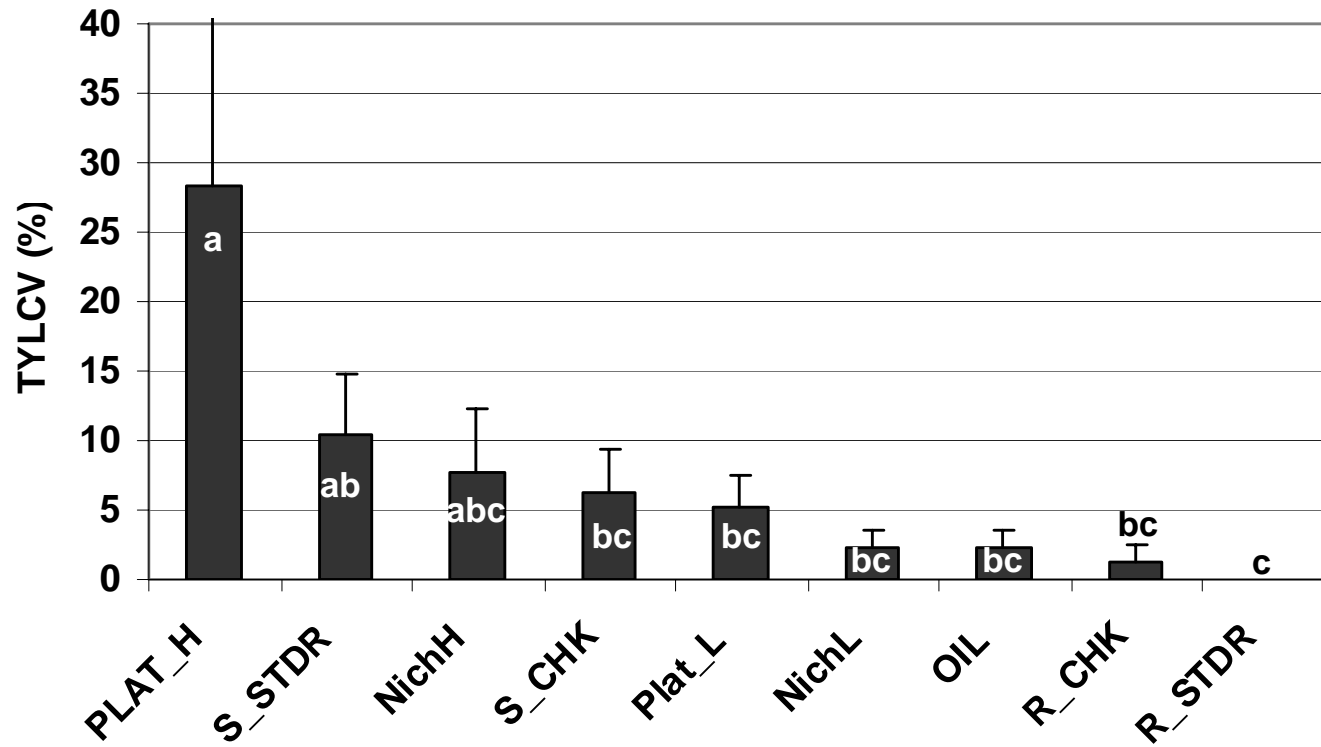
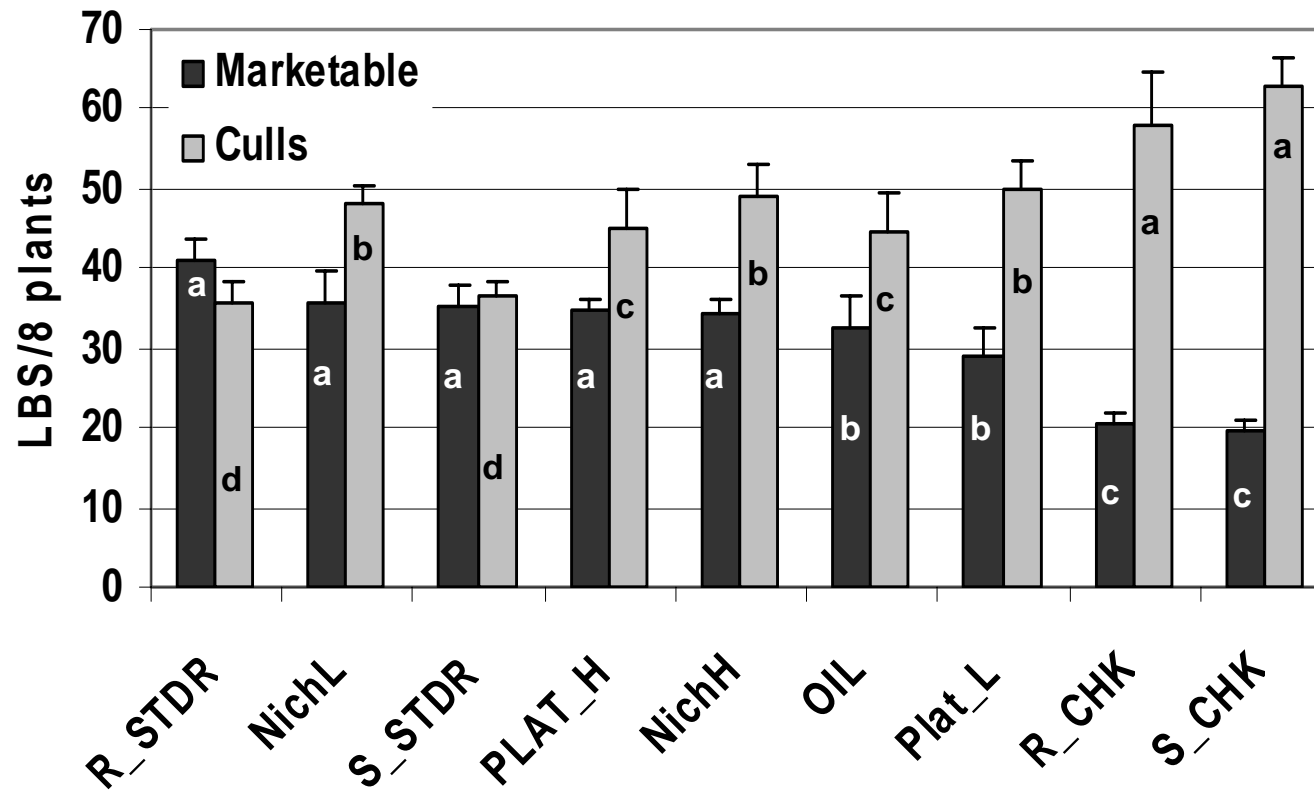


Figure 3. Mean incidence of plants with TYLCV symptoms in tomato plots.



Columns designated by the same letter represent means that are not significantly different (LSD, $P < 0.05$)

Figure 4. Mean weight from 8 plants of marketable and unmarketable fruit yield from 6 harvests.



Columns designated by the same letter represent means that are not significantly different (LSD, $P < 0.05$). Columns representing marketable yield were analyzed separate from columns representing unmarketable yield.