Tomatoes Resistant to Key Diseases Evaluated on LI in 2010

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Long Island growers would benefit from having tomato varieties with resistance to important foliar fungal diseases occurring in the region. Tomato is a popular item at farm stands and one of the most common crops grown both conventionally and organically by diversified vegetable growers, as well as by home gardeners. Foliar fungal and bacterial diseases occur commonly in tomato crops. In addition to affecting fruit directly, which most foliar pathogens can do, loss of leaf tissue results in sunburnt fruit and poor fruit flavor. Therefore disease management is an important component of successful tomato production. Diseases are a common reason that crops are abandoned before all fruit are harvested.

Four major foliar fungal diseases affecting tomato are Septoria leaf spot, early blight, powdery mildew, and late blight. On LI, Septoria leaf spot is the most common fungal disease, especially in organically-produced crops due to the fungicides available. Powdery mildew has been increasing in occurrence. Early blight has been important especially in wet years. Late blight has occurred very unpredictably and also very sporadically, with the notable exception of 2009 when it was widespread in the greater northeast. It is the most destructive disease.

Fungicides currently are the main tool for managing foliar diseases. Using fungicides to manage diseases in tomato can be expensive due to the length of the production period and the need for multiple products when highly-effective targeted products are used. In addition to minimizing production costs, there is a general interest in reducing pesticide use. However, diseases can be difficult to manage in susceptible varieties when fungicide applications are started after a disease becomes established, therefore routine scouting is needed to detect initial symptoms. Late blight often is too severe to be stopped when first observed in a crop that has not received a protective, preventive fungicide application.

Varieties with resistance to foliar fungal diseases are becoming a reality. Therefore an evaluation was undertaken in 2010 at LIHREC to determine how these new varieties and experimentals perform on LI. They were evaluated in terms of yield, fruit quality, and susceptibility to diseases that developed naturally. The focus was varieties resistant to late blight because this disease is anticipated to occur more commonly than in the past as a result of changes in the pathogen, and resistant varieties will be an especially valuable management tool for this disease because it occurs sporadically and is challenging to manage in a susceptible crop without a preventive fungicide program. One reason that late blight has been occurring more often recently in the eastern US is that it has been occurring routinely in FL since 1993. Additionally, since 2005 late blight has continued developing into May in FL, which is several weeks later than in the past. This indicates there are new pathogen strains (genotypes) able to tolerate warmer temperatures, and it means this potential initial source of inoculum persists until crops are being produced north of FL. Additionally, new genotypes are more aggressive on tomato than the genotypes responsible for late blight in potato, which develop best under cool temperatures. Late blight now has the potential to occur any time during the growing season,

especially on tomato, because of these new genotypes and the fact the pathogen can infect when humidity is high (leaf wetness is not required). By at least slowing initial disease development, resistant varieties have the potential to enable diseases to be managed with fungicide applications started after disease detection. Resistant varieties can be an especially valuable tool for organic producers.

Methods: A replicated experiment was conducted at LIHREC. Plots consisted of 10 plants in a single row with 24-in plant spacing. Plants were grown on black plastic mulch with drip irrigation. They were staked and trellised following standard practice for fresh market production. No fungicides were applied. Leaves were examined routinely for symptoms of late blight and other diseases. Proportion of leaflets with disease symptoms were recorded. Yield data was taken on 26 Aug, 3, 9, and 21 Sept. Fruit characteristics were assessed. Fruit were provided to growers and consumers for rating. Consumers included Cornell Gardeners, other staff at LIHREC, and attendees at tastings during Open House events held at two local organic farms as well as at LIHREC.

There were eight varieties total. Mt Fresh was included as the industry standard for comparison. All others have resistance to late blight. Most produce standard red, round (beefsteak) fruit. One plum and one campari (large cherry) type were also tested. All named varieties tested are commercially available. The four experimentals from the Cornell Breeding Program also have resistance to early blight, one additionally has resistance to Septoria leaf spot.

Results: Powdery mildew was the first disease observed in this experiment. Incidence was very low in most plots at the first assessment on 16 Sep, which was late in the production season for disease development in the region. There were no significant differences in powdery mildew incidence between varieties (Table 1). No symptoms of Septoria leaf spot were found in the plots reflecting the fact this experiment was located in a field where tomatoes had not been grown, thus the pathogen was not present in the soil, and the planting was isolated from other tomato plantings, in case late blight developed, by sorghum sudangrass wind breaks, which might have interfered with any pathogen dispersal from other tomato plantings. Symptoms of late blight were not observed in any experiments at LIHREC in 2010.

Variation in yield and fruit quality were detected (Table 1). Mountain Magic produced the smallest fruit and the greatest number of fruit, which was as expected since it is a campari type. It also produced the greatest amount of fruit by weight, but this was not a significant difference; there were no significant differences in estimated total weight of fruit produced among the varieties. Mountain Fresh produced the largest fruit; only Cornell experimentals #2, #3, and #5 produced fruit that on average were not significantly smaller. Mountain Fresh and Mountain Magic were given the highest rating for 'Overall Satisfaction' by CCE staff, receiving a 7 and 8 respectively on a scale of 1-9 while the aforementioned plus Cornell #2 and Cornell #5 all received a 'Yes, I Would Buy it' rating; while Cornell #4 and Defiant PhR received the lowest rating (Table 2). A total of 70 growers and consumers evaluated fruit. Interestingly, this group of raters selected the same two varieties for the highest ratings and also the same two for the lowest ratings as CCE staff (Table 3).

2011 Trial. The project is being continued in 2011 to re-evaluate varieties examined in 2010 and examine new varieties and experimentals. Plants and fruit will be available to examine during meetings at LIHREC in 2011, including NOFA-NY Field Day on August 23 and Plant Science Day on September 8. Anyone interesting in seeing them at other times can contact Meg at 631-727-3595. Grower and consumer input are an important part of the evaluation.

Table 1. Yield and disease incidence for late blight resistant tomato varieties grown in 2010 at LIHREC in comparison to Mt Fresh.

Variety	Marketable fruit (#/plant) 21-Sep	Marketable fruit (#/plant) Season total	All fruit (marketable + unmarketable) (#/plant) [z] 21-Sep	All fruit (marketable + unmarketable) (#/plant) [z] Season total	Average wt of marketable fruit (lb)	Estimated weight of all fruit produced (lb/plant)	Powdery mildew incidence (%) [y] 16-Sep	Powdery mildew incidence (%) [y] 22-Sep
Mountain Fresh (std)	2.8 b [x]	9.5 b	15.4	25.1 b	0.42 a	90.9	1	30.5
Cornell Univ #2	5.5 b	12.2 b	18.0	26.6 b	0.36 abc	97.0	3	19.0
Cornell Univ #3	4.8 b	7.9 b	19.3	25 b	0.39 ab	88.4	0.5	1.8
Cornell Univ #4	5.8 b	12.5 b	19.4	29.7 b	0.30 bcd	76.3	0	0.3
Cornell Univ #5	5.2 b	16.5 b	16.9	31.7 b	0.30 abcd	77.5	20.4	51.3
Mountain Magic	14.0 a	70.2 a	60.7	123.0 a	0.07 e	98.3	0.2	2.2
Plum Regal	5.4 b	10.3 b	28.6	38.4 b	0.24 d	85.8	0	3.2
Defiant PhR	1.8 b	16.5 b	6.1	26.3 b	0.25 cd	62.8	1.5	13.2
P-value treatment	0.0001	<.0001	0.003	<.0001	<.0001	0.2219	0.2351	0.0744

[z] Unmarketable fruit on 21 Sep includes green fruit as well as damaged ripe fruit.

[y] Incidence of leaflets with symptoms.

[x] Numbers in each column followed by the same letter are not significantly different from each other according to Tukey's HSD (*P*=0.05).

Table 2. Characteristics of late blight resistant varieties compared to Mt Fresh from evaluations done by Vegetable Program staff. [*]

Variety	**Color**	**Shape**	**Firmness**	**External Defects**	**Smell**	**Texture**	**Taste**	**Overall Satisfaction**	**Buy? (Y / N)**
Mountain Fresh (std)	3.5	R	4	Sl YS	2	3, 5	4	7	Y
Cornell Univ #2	4	R	3	C	2	4	2	6	Y
Cornell Univ #3	ND	R	ND	ND	ND	ND	ND	ND	ND
Cornell Univ #4	4.5	R	2	YS	2	1, 2	2.5	5	N
Cornell Univ #5	4	R	3.5	ND	2	2	3	6	Y
Mountain Magic	5	C	3	none	2	4	5	8	Y
Plum Regal	ND	P	ND	ND	ND	ND	ND	ND	ND
Defiant PhR	2	R	4	YS	2	4	4	4	N

*A 1-5 scale was used for all except descriptors and 'Overall Satisfaction', for which a 1-9 scale was used with 1=no satisfaction, 5=satisfied, 9=great satisfaction. Color: 1=not appealing, 5=very appealing. Shape: C= cherry/campari, P= plum, R= round. Firmness: 1=very soft, 2=soft, 3=slightly soft, 4=firm, 5=very firm. Smell: 1=fruity, 2=herbal/green, 3=spicy, 4=caramel, 5=other. Texture: 1=soft, 2=juicy, 3=pulpy, 4=fibrous, 5=firm. Taste: 1=very tart (acidic), 2=slightly tart (acidic), 3=neutral, 4=slightly sweet, 5=very sweet. External defects: C=cracks, YS=yellow shoulder, Sl=slight. ND = no data obtained.

Table 3. Average characteristic ratings* of late blight resistant tomato varieties compared to Mountain Fresh from evaluations done by 70 growers and consumers. Varieties listed in order based on overall satisfaction.

Variety	Color	Shape	Smell	Texture	Taste	Overall Satisfaction	Would You Buy?
Mountain Magic	4.38	4.58	3.22	4.00	4.29	5.78	100%
Mt Fresh (standard)	4.39	4.85	2.90	4.08	3.96	5.00	93%
Cornell Univ #2	4.14	4.31	2.50	3.92	3.50	4.45	87%
Cornell Univ #5	4.21	4.38	2.90	3.85	3.13	3.91	73%
Plum Regal	3.71	4.38	2.50	3.08	2.50	3.71	47%
Cornell Univ #3	4.21	3.85	2.73	3.25	2.81	3.73	40%
Defiant PhR	3.88	4.08	2.67	3.15	2.73	3.09	36%
Cornell Univ #4	4.43	4.46	2.64	3.15	2.87	3.41	33%

*A 1-5 scale (poor – excellent) was used for all except 'Overall Satisfaction' (1-5 or 1-9).