

Late Blight Resistant Tomato Variety Evaluation Using Organic Production Practices — New York 2011

Margaret T. McGrath, Cornell University, Riverhead, NY 11901

Laura K. Hunsberger, Cornell University, Riverhead, NY 11901

Sandra Menasha, Cornell Cooperative Extension-Suffolk County, NY

Tomato is an important crop that is routinely affected by diseases. It is important for both organic and conventional diversified vegetable growers, which are common in the northeastern United States. Fresh local tomatoes are one of the most popular items during summer, therefore they are grown by many organic and conventional growers.

There are several foliar disease affecting tomatoes, including Septoria leaf spot, early blight, bacterial speck and spot, late blight, powdery mildew, and leaf mold. Foliar diseases are a common occurrence wherever tomatoes are grown. All plantings are affected, even those grown under protection (greenhouses and high tunnels) and in small home gardens.

Resistant varieties would be a valuable tool for managing these diseases, particularly late blight because it occurs sporadically and can be difficult to control with fungicide applications started after onset. Organic growers on Long Island have identified tomato as a high priority for research. The goals of this experiment, which is part of a multi-year project, were to evaluate new tomato varieties and experimental hybrids with resistance to late blight in terms of (1) susceptibility to naturally-occurring foliar diseases and (2) yield and fruit quality.

Materials and Methods

The experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, in a field dedicated to research with organically produced vegetable crops. The soil type is Haven loam. Tomato seed were sown in an organic seeding mix on May 6. A rye cover crop was flail chopped and baled on May 24. Pro-Grow 5-3-4 and 4-3-7 organic fertilizer at 1,100 lb/A were spread and then incorporated by disking on May 10. Two layers of black plastic mulch were laid for managing yellow nutsedge as well as other weeds. Additionally, on May 16 white clover was spread at 35 lb/A between the rows of plastic by hand and incorporated with a rake to serve as a living mulch for weed management and to improve soil health. Seedlings were transplanted on June 8. Fish emulsion (Neptune's Harvest) was poured into the transplant hole before setting the seedlings.

All plots had between five and ten plants at 2-foot spacing with a yellow cherry type tomato plant separating plots within rows. Rows were spaced 68 inches apart. A completely randomized block design with four replications was used. There were four additional entries included for observation and thus not planted in the replicated experiment. Plants were staked and trellised as they grew using the Florida weave trellising system with 4-foot stakes placed between plants. Water was provided as needed through drip tape laid beneath the plastic mulch.

A very early outbreak of late blight in the region, which included this experiment, started in early July and necessitated applying fungicides to minimize impact of unmanaged late blight on other experiments and commercial crops nearby. Fungicides were selected with targeted activity for

the late blight fungus (*Phytophthora infestans*) to avoid impacting other foliar diseases. A mefenoxam-sensitive strain (US-23) was present. Fungicides applied were Ridomil Gold (0.25 pt/A) on July 6; Previcur Flex (1.5 pt/A) on July 6 and 27, and August 4; Revus (8 fl oz./A) on July 6 and July 15, and August 20; Presidio (4 fl oz./A) on August 25; Ranman (2.75 fl oz./A) on August 20; and Curzate (5 oz/A) on September 2. Insect pests were controlled with Entrust (2 oz/A) applied on August 4, 20, and 25 for lepidopterous larvae; and ABBA (16 fl oz/A) plus the adjuvant LI-700 (1 pt/100 gal) applied on August 4 for russet mite.

Leaves were examined for disease symptoms three times from August 10 to September 27. Incidence of plants with symptoms of late blight was recorded on July 14 and 21. Powdery mildew was assessed by estimating the percentage of leaves in each plot with symptoms (incidence) and the severity of symptoms on these affected leaves. Canopy severity was calculated with these values. Fruit were harvested on August 12, 18, 23, and 31. Fruit quality attributes assessed included Brix (% soluble sugar) measured with a refractometer and taste was rated on a 1-9 scale with 9 being excellent.

Average monthly high and low temperatures (°F) were 79/61 in June, 87/68 in July, 82/66 in August, and 76/63 in September. Rainfall (inches) was 6.1, 2.35, 10.61, and 6.88 for these months, respectively. There was a hurricane (August 28) and several atypical intensive rain events during the 2011 growing season on Long Island.

Results and Discussion

There were few symptoms of late blight in July therefore it was assessed as incidence of plants with symptoms. Late blight lesions on varieties were observed on 40% of Mountain Fresh plants on July 14 versus on 3-32% of plants of resistant varieties and on 80% versus 8-46% of these plants, respectively, on July 21. Mountain Magic had the fewest affected plants on both dates.

All resistant hybrids evaluated have both the *Ph2* and *Ph3* genes for resistance to late blight. The fungicide program used to suppress late blight during the main part of the growing season combined with hot, dry weather during July stopped late blight development even in the susceptible variety. Symptoms of Septoria leaf spot were not observed. Powdery mildew developed to a limited degree late in the growing season. There were no significant differences among varieties (Table 1). The campari-type varieties (Mountain Magic and Cornell M) produced the greatest number and weight of fruit (Table 1), and these fruit had the highest taste ratings (Table 2).

Table 1. Yield and disease incidence of late blight-resistant tomato varieties grown at LIHREC, 2011.

Variety ²	Seed Source ³	Powdery mildew severity (%) ¹			Yield/plant			
		26 Aug.	2 Sept.	AUDPC	Market-able Fruit #	Market-able Fruit Wt. (lb)	Total Fruit #	Wt/Fruit (oz)
Mountain Fresh (S)	CU	1.1 ⁴	5.0	3.4	4.9 b	1.4 cd	7.4 b	6.9 abc
Defiant PhR	JS	0.3	2.5	1.1	11.2 b	3.1 abc	14.4 b	4.8 abc
Mountain Merit	BS	2.3	4.3	7.0	6.1 b	1.0 d	8.7 b	7.1 ab
853 x 426	JS	0.6	4.9	1.7	6.2 b	1.2 cd	9.6 b	7.9 a
Cornell B	CU	1.7	2.9	5.0	7.9 b	1.8 bcd	11.4 b	5.1 abc
Cornell C	CU	1.7	3.8	5.2	1.7 b	0.9 d	3.9 b	8.5 a
Cornell E	CU	0.2	1.5	0.5	2.6 b	0.6 d	6.6 b	6.3 abc
Mountain Magic (BS)	BS	0.6	2.9	1.8	52.7 a	4.1 a	62.4 a	1.3 bc
Mountain Magic (CU)	CU	0.4	2.1	1.4	48.7 a	4.4 a	57.1 a	1.3 bc
Cornell M	CU	0.1	0.8	0.3	62.2 a	3.8 ab	74.6 a	1.0 c
<i>P-value (treatment)</i>		0.3240	0.1293	0.3198	<.0001	<.0001	<.0001	0.0004

¹Canopy severity was calculated from assessments of the percentage of leaves in each plot with symptoms (incidence) and the severity of symptoms on these affected leaves.

²S=Susceptible; BS=Variety obtained from Bejo Seeds; CU=Variety obtained from Cornell. Due to a seed mix up there was a duplicate entry of Mountain Magic. Mountain Magic and Cornell M produce campari-type fruit; other entries produce round red slicer type fruit. The 'female pedigree' X 'male pedigree' for the Cornell entries was CU101253 x NC33EB1 for B, CU101254 x NC33EB1 for C, CU101256 x NC33EB1 for E, and CU101265 x NC2Grape for M.

³JS=Johnny's Seed; CU=Cornell; BS=Bejo Seeds

⁴Numbers in each column followed by the same letter or no letter are not significantly different from each other according to Tukey's HSD ($P=0.05$).

Table 2. Descriptive characteristics of late-blight resistant tomatoes grown at LIHREC, 2011.

Variety ¹	Appearance	Brix ²	Taste	Comments
Mountain Fresh	6.5	5.4	4	Mealy, dry, bland
Tasti Lee	8	5.2	4	Bland, very chewy skin, mealy, off flavor
Mountain Merit	7	4.8	7	Juicy, mild flavor, chewy skin, slightly mealy
Defiant PhR	8.5	5.5	6	Good flavor, acidic, mealy, very tough skin
Cornell A	6.5	5.0	4.5	Mealy, chewy skin, meaty flesh
Cornell B	7.5	5.0	6.5	Juicy, slightly mealy, strong tomato flavor
Cornell C	7	4.2	6.5	Slightly bland and mealy, firm flesh
Cornell E	6.5	4.4	6	Chewy skin, slightly juicy, meaty flesh, acidic
853 x 426 (JS)	8	5.1	6	Juicy, acidic, strong tomato flavor, mealy
Mountain Magic (BS)	8	7.0	8.5	Sweet, juicy, slightly chewy skin
Mountain Magic (CU)	8.5	6.1	8	Strong flavor but sweet and acid balanced
Cornell M	8	6.4	8	Meaty flesh, sweet, slightly chewy skin
Cornell K	7.5	5.9	8	Sweet, juicy, slightly chewy skin
Cornell J	8	6.4	7.5	Sweet, juicy, bland, slightly chewy skin

¹Mountain Magic and the three Cornell experimental varieties listed below it produce campari-type fruit; other entries produce round red slicer type fruit. Mountain Fresh and Tasti-Lee do not have resistance to late blight.

²Brix was measured with a refractometer. Appearance and taste rated on a 1-9 scale with 9 being excellent.

Tomato Variety Fruit Descriptions

Mountain Fresh

Medium to medium-large, round, red tomato. Some variability in size. Flat blossom end. Some radial cracking and zippering.

Tasti-Lee

Medium-size fruit were round and red in color. Slightly flat blossom end. Uniform.

Mountain Merit

Medium to medium-large, round fruit were red to orange in color. Rounded blossom end and deep scarring at stem end.

Defiant PhR

Uniform, round fruit were small to medium in size and had a pink to dark red coloring. Flat blossom end. Yellow shoulder and slight zippering.

853 x 426 (JS)

Large to medium, round fruit were orange to red in color. Fruit were a good size and shape with a rounded blossom end. Slight cracking.

Cornell A

Orange to red fruit was medium to large in size and round to oval in shape. Blossom end was round to slightly pointed.

Cornell B

Fruit of this variety were round, small to medium-large in size, and red to orange in color. Good yields. Round blossom end. Slight zippering and cracking.

Cornell C

Round to oval, medium-size fruit. Light orange to red in color. Slightly flat blossom end. Variable in size and shape. Slight zippering and cracking.

Cornell E

Medium-size, round to oval fruit, medium red to orange in color. Slightly pointed blossom end. Radial cracking.

Mountain Magic (BS)

Orange to red, small to medium, round fruit. Yellow shoulder and cracking.

Mountain Magic (CU)

Fruit of this variety were round, small to medium in size with orange to red coloring. Slight cracking.

Cornell M

Slightly oval to round fruit were small to medium in size and orange to red in color. Good yields.

Cornell K

Small, oval fruit were red in color with a rounded blossom end. Fruit were variable in size.

Cornell J

Fruit of this variety were small, round, and red. Very uniform. Rounded blossom end.

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