

‘Mountain Merit’: A Late Blight-resistant Large-fruited Tomato Hybrid

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‘Mountain Merit’ is a large-fruited, determinate, fresh-market F₁ hybrid tomato (*Solanum lycopersicum* L.) resistant to late blight [*Phytophthora infestans* (Montagne, Bary)]; verticillium wilt (*Verticillium dahliae*); fusarium wilt [*Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) W.C. Snyder and H.N. Hans] races 1, 2, and 3; tomato spotted wilt virus (TSWV); and root-knot nematodes (*Meloidogyne* spp.). ‘Mountain Merit’ provides a highly adapted cultivar for North Carolina tomato growers and carries multiple resistances to important tomato diseases not currently combined in any other tomato cultivar.

Origin

‘Mountain Merit’, the F₁ hybrid of NC 1CELBR × NC 123S (Fig. 1), resulted from a tomato breeding effort to develop a large-fruited, fresh-market tomato hybrid with combined late blight, fusarium wilt, verticillium wilt, root-knot nematodes, and tomato spotted wilt virus resistances adapted to vine-ripe production in North Carolina (NC). NC 1CELBR was developed for resistance to late blight (*Ph-2* and *Ph-3* genes combined) and early blight (C. 1943 and PI 126445 sources) along with verticillium wilt resistance (*Ve* gene) and fusarium wilt races 1 and 2 resistance (*I* and *I-2* genes) (Gardner and Panthee, 2010). NC 123S resulted from selfing the F₁ hybrid ‘Amelia’ and was selected for resistance to TSWV (*Sw-5* gene), verticillium wilt (*Ve* gene), root-knot nematodes (*Mi* gene) and races 1, 2, and 3 of fusarium wilt (*I*, *I-2*, and *I-3* genes). NC 1CELBR and NC 123S were released through the North Carolina State University (NCSU) Breeders Release Board and disclosed through the NCSU Office of Technology Transfer.

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‘Mountain Merit’ (NC 0694) was tested in observational trials in 2006 at MHCREC, Mills River (formerly Fletcher) and advanced to conventional replicated trials at MHCREC where it was tested each summer from 2007 to 2009. ‘Mountain Merit’ was tested in a replicated organic trial at Waynesville in 2009. Each trial consisted of two replicates with six plants per replicate. In-row spacing of plants was 45 cm and between-row spacing was 150 cm. The conventional trials were planted in early season (first week of June) and late season (first week of July) each year, whereas the organic trial was planted in the second week of June.

Description

When averaged over five conventionally grown trials, ‘Mountain Merit’ did not differ in non-graded or U.S. combination grade (U.S. No. 1 + U.S. No. 2 fruit) from widely grown standard cultivars (Table 1). ‘Mountain Merit’ was later than ‘Mountain Glory’, ‘Mountain Fresh’ (Gardner, 1999), and ‘Fletcher’ as indicated by its lower early-season yield (first three harvests). Average fruit weight of ‘Mountain Merit’ was less than that for ‘Mountain Fresh’ but did not differ from ‘Mountain Glory’ and ‘Fletcher’ (Table 1).

Fruit of ‘Mountain Merit’ develop deep red color and are firm in the fully ripened stage. Immature fruits have a glossy, uniform green color (*u* gene). Fruit pedicels are jointed. The fruit are deep oblate to flattened globe in shape with generally smooth blossom end scars and have good resistance to fruit cracking and weather check. ‘Mountain Merit’ has performed well in observational trials in research station and grower fields throughout the mountains and piedmont of North Carolina. Plant growth habit is vigorous determinate (*sp*) similar in height to that of ‘Mountain Fresh’ when staked. Foliage provides adequate, but not dense, cover for fruit protection. Single dominant disease resistance genes include *Verticillium dahliae* Kleb. (*Ve* gene); races 1, 2, and 3 of *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) Snyd. and Hans (*I*, *I-2*, and *I-3* genes); root-knot nematodes (*Mi* gene); and TSWV (*Sw-5* gene). It has the *Ph-2* and *Ph-3* genes in heterozygous

condition conferring incomplete resistance to late blight.

In an organic culture trial at Waynesville, NC, in the summer of 2009, ‘Mountain Merit’ did not differ in total or marketable fruit yield from the two early blight-susceptible cultivars Pink Brandywine and Cherokee Purple (Table 2). However, late blight did not occur until mid-August after much fruit of the susceptible cultivars, both earlier in maturity than ‘Mountain Merit’, had been harvested from the trial. ‘Mountain Merit’ had no late blight symptoms on foliage when there was an extremely high level of inoculum pressure of *Phytophthora infestans*, which developed complete disease within 1 week in the susceptible control (‘Pink Brandywine’). Late blight was present on some fruit of ‘Mountain Merit’ but was much less than for the susceptible cultivars Pink Brandywine and Cherokee Purple harvested after late blight appeared (Table 2). Observational trials in late blight resistance breeding plots in 2006, 2007, and 2009 at Waynesville and Mills River also indicated a high level of resistance to late blight in ‘Mountain Merit’.

‘Mountain Merit’ is the first known tomato cultivar to combine resistances to fusarium wilt, verticillium wilt, root-knot nematodes, TSWV, and late blight. The combined disease resistances allow conventional growers to more economically control important soil-borne and foliar diseases and allow organic growers who have limited approved chemical pesticides to manage these important diseases, especially late blight. ‘Mountain Merit’ lacks resistance to tomato mosaic virus. Although NC 1CELBR has early blight resistance, it is lacking in the NC 123S parent. Because early blight resistance is recessive (Nash and Gardner, 1988), expression of resistance in the F₁ hybrid is not of a sufficient level to be useful.

Use

‘Mountain Merit’ provides growers in North Carolina and other states with similar growing conditions a high-yielding, disease-resistant, fresh-market tomato cultivar with acceptable fruit quality. The combined resistances to late blight, TSWV, and root-knot nematodes are valuable additions in disease resistance for growing areas where these diseases are a problem. ‘Mountain Merit’ should also be of interest to other tomato breeders as a single source of combined resistances to numerous important tomato diseases and nematodes.

Availability

‘Mountain Merit’ was released on an exclusive basis for seed production and sales to Bejo Seeds, and commercial seed should be available in 2011. Distribution of seed of NC 1CELBR and NC 123S to other breeders requires a signed seed transfer agreement, which can be downloaded at the following

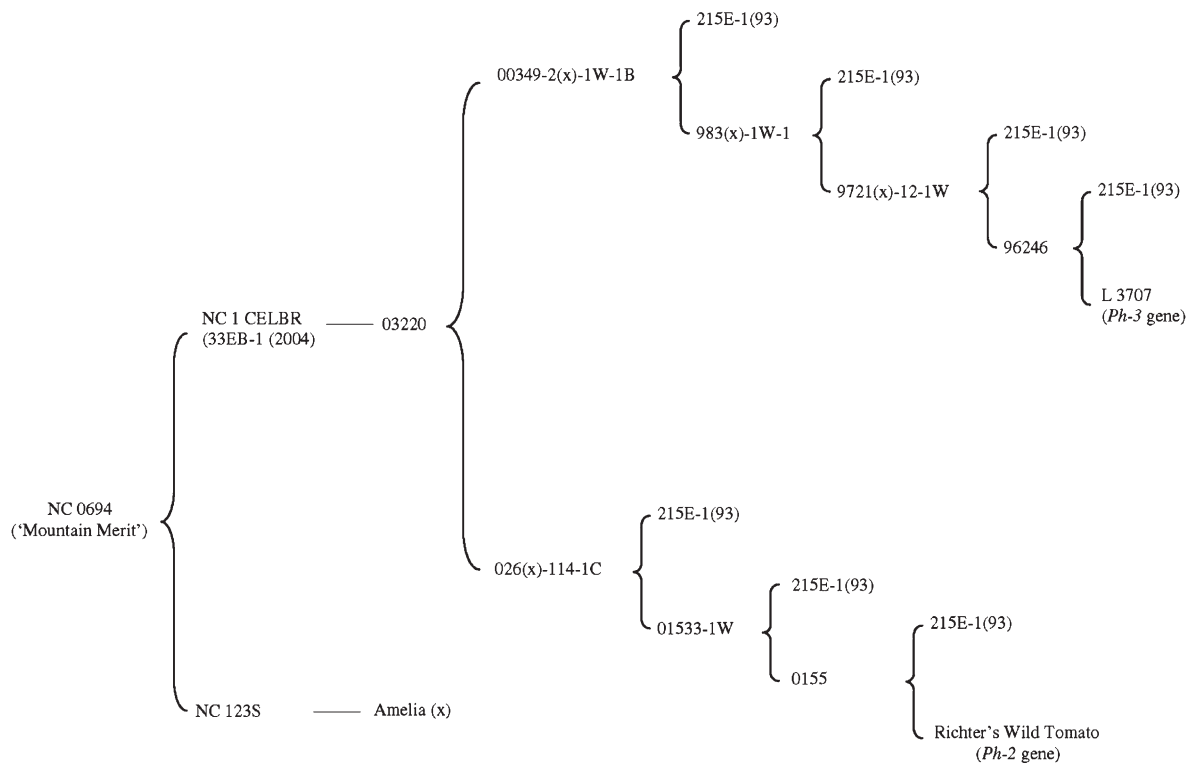


Fig. 1. Pedigree of 'Mountain Merit' hybrid tomato.

Table 1. Average performance of 'Mountain Merit' and control hybrid tomatoes on the basis of five replicated trials conducted at Mountain Horticultural Crops Research and Extension Center, Mills River, NC (2007 to 2009).

Cultivar	Non-graded yield (t·ha ⁻¹) ^z	Marketable yield (t·ha ⁻¹) ^{z,y}	Marketable (%)	Fruit wt (g)	Jumbo fruit (%)	Extra-large fruit (%)	Large fruit (%)	Medium fruit (%)	Early season yield ^x
Fletcher	97	62	63	297	30	40	24	6	46
Mountain Fresh	102	65	63	327	41	37	17	5	40
Mountain Glory	96	70	73	301	29	42	23	6	46
Mountain Merit	102	68	64	289	25	40	28	7	30
LSD _(0.05)	NS	NS	8	16	9	5	6	NS	11

^zAverage of five replicated trials conducted during 2007 through 2009. Data were analyzed by MIXED Procedure of SAS (SAS Institute Inc., 2007). Heterogeneity of error variance tested and found non-significant ($W = 0.978$; $P > 0.05$).

^yMarketable yield is U.S. No. 1 and No. 2 grade of tomato fruit.

^xNon-graded yield in first three harvests.

LSD = least significant difference; NS = nonsignificant.

Table 2. Performance of 'Mountain Merit' and heirloom tomatoes in replicated trial for yield and response to late blight (*Phytophthora infestans*) conducted under organic conditions at Mountain Research Station, Waynesville, NC, 2009.

Cultivar	Non-graded yield (t·ha ⁻¹) ^z	Marketable yield (t·ha ⁻¹) ^{z,y}	Marketable (%)	Fruit wt (g)	Jumbo fruit (%)	Large fruit (%)	Late blight score on plant ^x	Late blight score on fruits ^w
NC 131L(2007)-Bk	80	63	79	432	93	7	0.0	1.1
Pink Brandywine	76	47	62	467	95	5	4.8	4.1
Cherokee Purple	60	41	69	298	74	25	4.8	4.5
Mountain Merit	78	63	81	323	56	44	0.0	1.5
LSD _(0.05)	NS	NS	16	45	16	21	0.9	1.6

^zAverage of two replicated trials conducted during 2009. Data were analyzed by two-way analysis of variance (SAS Institute Inc., 2007).

^yMarketable yield is U.S. No. 1 and No. 2 grade of tomato fruit.

^xLate blight scored at 0 to 5 scale on leaf and plant, in which 0 = no disease and 5 = completely covered with late blight or dead plant. Disease development was based on natural inoculums. Plants were at fruiting stage when late blight infection took place.

^wLate blight scored at 0 to 5 scale on fruits, in which 0 = no disease, 1 = 1% to 20%, 2 = 21% to 40%, 3 = 41% to 60%, 4 = 61% to 80%, and 5 = more than 80% fruits infected with late blight. Percentage of late blight infected fruits determined by comparing the number of fruits infected with late blight and total number of fruits.

LSD = least significant difference; NS = nonsignificant.

web site: <http://www.mountainhort.ncsu.edu/programs/tomato/releases/tomato-seed-transfer-agreement.pdf>. Small trial samples of 'Mountain Merit' are available from D.R. Panthee (dilip_panthee@ncsu.edu), MHCRC, 455 Research Drive, Mills River, NC 28759.

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