

# UMH 1200, a Breeding Line within the Muchamiel Tomato Type Resistant to Three Viruses

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Muchamiel is a tomato landrace that is very popular in southeastern Spain as a result of its organoleptic fruit quality. Fruits of the Muchamiel cultivars have a melting texture and mild flavor, are large in size (180 g to 300 g), flattened, and strongly ribbed. However, this landrace is severely endangered and at risk of extinction as a result of its high susceptibility to several viruses such as those caused by the *Tomato mosaic virus* (ToMV), *Tomato spotted wilt virus* (TSWV), and *Tomato yellow curl virus* (TYLCV) (Picó et al., 2002). To introgress genetic resistances to ToMV, TSWV, and TYLCV into the Muchamiel landrace, a breeding program has been carried out over the last 10 years at Miguel Hernández University (Spain). Breeding line UMH 1200 is the first release produced by this breeding program. UMH 1200 has medium-sized fruits (150 to 190 g) and organoleptic characteristics similar to those of the original landrace. This homozygous breeding line suffers from a yield penalty compared with the original landrace, which is variable depending on the growing conditions, but its tolerance/resistance to ToMV, TSWV, and TYLCV has been demonstrated in several field and greenhouse trials.

## Origin

Breeding line UMH 1200 was obtained by crossing a Muchamiel line (accession M18, previously selected for high yield and uniformity) with the commercial cultivar Anastasia F<sub>1</sub> (Seminis Vegetable Seeds) followed by five generations of backcrossing to the Muchamiel cultivar. Anastasia was used as the donor parent of the *Tm-2<sup>a</sup>*, *Sw-5*, and *Ty-1* genes (Pérez de Castro et al., 2005), conferring resistance to ToMV, TSWV, and TYLCV, respectively. 'Anastasia' is a popular tomato cultivar in Spain with indeterminate and vigorous plant growth as well as good foliage cover. Marker-assisted selection was used in each generation

to select the plants that carried the three resistance genes. In addition, a high selection pressure for Muchamiel characteristics was applied during each backcross generation. After five additional generations of selfing and selection, the pure-breeding line, UMH 1200, homozygous for the three introgressed virus resistance genes, was selected from a single BC<sub>5</sub>F<sub>5</sub> family whose seed was multiplied by self-pollination. UMH 1200 resistances to ToMV and TSWV have been additionally verified by mechanical inoculation assays, and tolerance to TYLCV has been demonstrated in several assays performed in naturally infested fields.

## Description

UMH 1200 is homozygous for the *Tm-2<sup>a</sup>*, *Sw-5*, and *Ty-1* genes. As is the case with the cultivar M18, the breeding line has indeterminate growth with intermediate foliage density, ripe fruits do not separate easily from pedicels during harvest, and they sometimes have yellow shoulders. However, the green shoulders of UMH 1200 fruits are frequently less intense than those of the original landrace fruits. In trials carried out in 2010, no significant differences in yield were found between the breeding line and cultivar M18 in the

greenhouse (Table 1). However, there was a very important yield decrease in UMH 1200 in the open field crops. Similar results were obtained for the number of fruits per plant and the average fruit weight. These results as well as additional, as-yet unpublished data indicate that the introgression of the resistance genes affects traits of importance for fresh tomatoes. Whether the observed effects are the result of one, two, or three of the introgressed resistance genes, or the result of genes associated through linkage drag, is an important question that we are studying, although the yield problems are mainly as a result of the introgression of the *Ty-1* gene (Rubio et al., 2010). Negative effects associated with the introgression of resistance genes have been reported previously in tomato (Tanksley et al., 1998) as well as in other crops (Brown, 2002; Lewis et al., 2007). However, the comparison of the sensory profiles and volatile composition of the breeding line to the original landrace during cold storage indicated that organoleptic fruit quality had been recovered through the backcrossing program. Moreover, fruits of the breeding line demonstrated better postharvest behavior with higher firmness achieving better scores in odor and aroma at the end of the storage period (Alonso et al., 2010). Because no specific selection for better postharvest behavior was performed during backcrossing, this result could very well be the effect of the introduction of the genetic resistance to the viruses. Data we obtained reinforce the idea that genetic improvement for disease resistance in the Muchamiel landrace can be achieved without reducing the sensory quality and aroma complexity of the fruits (Alonso et al., 2009).

## Use

Breeding line UMH 1200 has genetic tolerance/resistance to the three most important viruses in tomato in southeastern Spain. The incidence of these viruses greatly reduces the profits obtained by farmers and even makes the cultivation of landraces nonviable in many

Table 1. Yield traits, titratable acidity (TA), and soluble solids concentration (SSC) of the breeding line UMH 1200, the Muchamiel landrace (accession M18), and Boludo F<sub>1</sub>, grown in the open field (2009 and 2010) and greenhouse (2010), in the spring–summer crop cycle.

	Marketable yield (kg/plant) <sup>z</sup>	Avg fruit wt (g) <sup>z</sup>	Fruit number per plant <sup>z</sup>	TA (g/100 g) <sup>y</sup>	SSC (°Brix) <sup>y</sup>
Open field 2009					
UMH 1200	2.05 a <sup>x</sup>	145 a	14.7 a	0.53 a	4.6 a
Accession M18	3.14 b	220 b	14.1 a	0.54 a	4.3 a
Boludo F <sub>1</sub>	4.25 c	101 a	40.0 b	0.60 b	5.4 b
Open field 2010					
UMH 1200	2.15 a	190 a	10.7 a	0.37 a	4.9 b
Accession M18	4.75 b	227 b	20.7 b	0.33 a	4.2 a
Boludo F <sub>1</sub>	4.82 b	169 a	24.3 b	0.71 b	7.4 c
Greenhouse 2010					
UMH 1200	3.83	141 b	27.3 a	0.30 a	3.9 a
Accession M18	4.40	182 c	24.5 a	0.34 b	3.8 a
Boludo F <sub>1</sub>	4.84	102 a	50.2 b	0.48 c	4.6 b

<sup>z</sup>Mean of six plants per plot for two replicates.

<sup>y</sup>Mean of six fruits per plot for two replicates.

<sup>x</sup>Mean values in a column followed by a different letter are significantly different according to Duncan's multiple range test ( $P < 0.05$ ).

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areas, especially in the open field. Despite the yield decrease associated with the introgressed resistances, the breeding line is available for cropping in open fields, where the viruses' incidence is especially intense, allowing farmers to obtain an acceptable harvest. This breeding line may also be used in breeding programs to facilitate the introgression of the resistance genes into other landraces. We are also developing F<sub>1</sub> hybrids by crossing UMH 1200 with other selected Muchamiel lines to increase yield by using the genetic resistance in a heterozygous state.

#### Availability

Small trial seed samples of the UMH 1200 breeding line are available for research purposes (contact the authors).

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