

North Carolina Agricultural Research Service

North Carolina State University

Raleigh, North Carolina

Notice of Release of NC 4Grape Tomato Breeding Line

The North Carolina Agricultural Research Service announces the release of NC 4Grape tomato breeding line. Conception and crossing to develop NC 4Grape was initiated in 2002 in the greenhouse. The breeding objective was to incorporate the *Sw-5* gene for resistance to tomato spotted wilt virus (TSWV) and *I-3* gene for fusarium wilt race 3 resistances into a compact, indeterminate, brachytic-growth-habit grape tomato breeding line that could be used as a parent to widen disease resistances and other traits in a ‘Smarty’ type grape tomato hybrid. Other traits sought were the crimson gene (*og^c*) for improved red fruit color and increased lycopene content and the male sterile gene (*ms-10*) linked to the green stem seedling marker gene (*aa*).

NC 4Grape has a complex pedigree tracing back to numerous other released and unreleased lines in the program (Fig. 1). An F4 generation selection derived from selfing the F1 hybrid ‘Amelia’ was the source of the *Sw-5* and *I-3* genes. This selection was crossed to NC EBR-7, a crimson-fruited (*og^c* gene) plum tomato line. An F3 selection, 034(x)-69-1, of the resultant hybrid that was homozygous for the *Sw-5* and *I-3* genes, as indicated by molecular markers, was crossed to NC 2Grape tomato. The 0579 hybrid from this cross was selected in segregating generations to produce the F4 generation inbred line 0579(x)-43-7-4 that tested homozygous resistant for the *Sw-5* and *I-3* genes based on molecular marker results. The 0579 line has compact indeterminate growth habit conditioned by the brachytic (*br*) gene derived from the NC 2Grape parent and has a grape type tomato with large size.

On the other side of the pedigree for NC 4Grape, the F3 generation grape tomato line 032(x)-5-11gsms, which is determinate, crimson, and has the *ms-10*, *aa* linked gene combination was crossed with NC 2Grape, the male parent of ‘Smarty’, to produce the F1 hybrid 042. The crimson (*og^c*) and determinate (*sp*) genes are tightly linked so a very large population from the F2 generation of the 042 hybrid had to be grown to break the gene linkage and recover the *og^c* gene linked to the indeterminate growth habit gene from NC 2Grape. A population of 2000 plants of the F2 generation of 042 was grown in the greenhouse in 24-cell trays and selected at flowering for the homozygous, recessive crimson gene based on distinctive dark golden stripes on the flower petals associated with *og^c*. Plants that appeared indeterminate based on having 3 leaves between the first and second flower cluster were potted to larger pots and grown for confirmation of indeterminate growth habit. 042(x)-1GH, an F2 generation plant with indeterminate growth habit, the crimson gene, and the *ms-10*, *aa* gene combination was crossed to NC 2Grape. The resultant hybrid, 051, was selfed and grown in the F2 generation.

051(x)-66gsms, a plant homozygous for crimson (*og^c*) and compact, indeterminate growth habit (*br*) and also having the *ms-10*, *aa* gene combination was crossed to the 0579(x)-43-7-4 line to produce the F1 hybrid 07310. A population of 192 F2 plants derived by selfing the 07310 hybrid was grown in the greenhouse and selection made for plants with the most desirable combination of fruit traits. Seedlings of 27 F3 generation lines that segregated for the *ms-10*, *aa* gene combination were screened for molecular markers linked to the *Sw-5* and *I-3* genes. An outstanding plant with the *og^c* gene from a line that tested homozygous for *Sw-5* and *I-3* according to molecular marker results and that also segregated for the *ms-10*, *aa* gene combination was selected to produce the F4 generation. 07310(x)-14-1-9 was selected from a field plot in the summer of 2009 based on desirable plant and fruit characteristics and its segregation for *ms-10*, *aa*. Additional testing with molecular markers confirmed this selection to be homozygous for *Sw-5* and *I-3* genes conferring resistance to tomato spotted wilt virus and fusarium wilt race 3, respectively. The 07310(x)-14-1-9 selection was bulked in additional selfed generations produced in the greenhouse and is being released as NC 4Grape.

NC 4Grape is a unique tomato breeding line with a desirable combination of disease resistance genes and horticultural traits. It has a compact, indeterminate growth habit conditioned by the *br* gene for short internodes and produces heavy foliage cover for fruit protection. Fruit average around 10 grams. The fruit are a desirable elongate grape tomato shape, develop deep red exterior and interior color as a result of the crimson gene, are crisp in texture with a sweet flavor, and are firm in the fully ripened stage. Ripe fruit have good resistance to bursting and cracking. Immature fruit have a glossy, uniform light green color (*u* gene). Fruit pedicels are jointed, and the fruit separate easily from the pedicels at harvest. NC 4Grape is heterozygous for the *ms-10* male sterile gene linked to the green stem seedling marker gene *aa*. This allows for selection of male sterile plants at the seedling stage for use of NC 4Grape as a female parent for making F1 hybrids without need to emasculate flowers when making crosses. NC 4Grape has the single dominant gene *Sw-5* for resistance to TSWV and the *I-3* gene for resistance to fusarium wilt race 3. In addition to use of molecular markers to identify the *Sw-5* and *I-3* genes, hybrids produced using NC 4Grape as a parent had good resistance to TSWV in grower fields in coastal SC where TSWV was prevalent. Resistance to fusarium wilt race 3 was verified in an inoculated seedling screen in a growth chamber. NC 4Grape likely has other genes such as the *Ve* gene for verticillium wilt resistance, and the *I* and/ or *I-2* genes that confer resistance to races 1 and 2 of fusarium wilt respectively. However, tests have not been done to confirm these genes.

NC 4Grape has shown good combining ability as a female parent in F1 hybrids and is being released in conjunction with the release of two new F1 hybrid cultivars, 'Mountain Vineyard' and 'Mountain Honey', that use it as a parent. It should prove useful to other breeders because of its combination of the *Sw-5* and *I-3* genes along with the crimson gene in a compact indeterminate background and its male sterility linked to the *aa* gene, which facilitates its use as a female parent in producing F1 hybrids.

Breeders seed of NC 4Grape are available by contacting Dr. Dilip Panthee, Mountain Horticultural Crops Research and Extension Center, 455 Research Drive, Mills River, NC 28759 or by telephone: 828.684.3562; fax: 828.684.8715; email addresses: dilip_panthee@ncsu.edu. A fully executed tomato seed transfer agreement with NC State University's Office of Technology Transfer will be required to acquire seed of NC 4Grape for research or breeding purposes.

Director, North Carolina Agricultural Research Service

Date

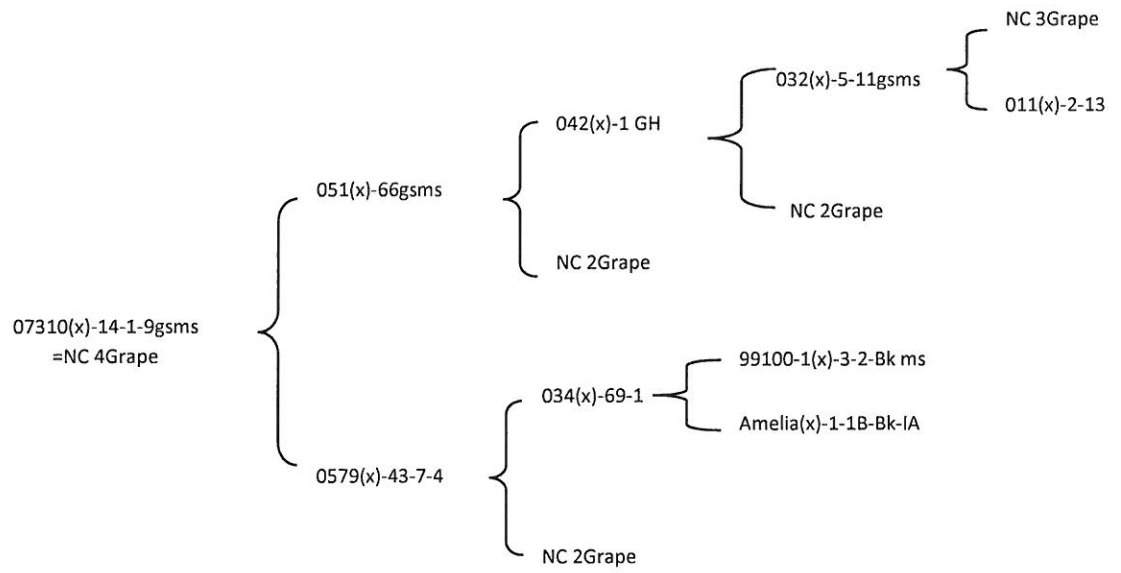


Figure 1. Pedigree for NC 4Grape Tomato Breeding Line