'SuperMac' Apple

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Additional index words. *Malus ×domestica* (Borkh.), apple scab resistance, long shelf life,
antioxidant, fruit breeding, cider production, winter hardy

Abstract. 'SuperMac' (*Malus ×domestica* Borkh) is being released as a replacement for 'Spartan', which is presently being grown in Eastern Canada for its excellent shelf life. However, it is susceptibility to scab [*Venturia inaequalis* (Cke) Wint.], the most common apple disease. This new cultivar produces larger fruit than 'Spartan' and is resistant to apple scab. It is very attractive (Fig. 1), has a pleasant taste and an excellent shelf life, and keeps very well and longer compared with the 'Spartan'. 'SuperMac' is a 'McIntosh'-type apple. The tree is hardy to –30 °C, and the fruit and leaves are resistant to the common races of apple scab resulting from the presence of the *V_f* gene derived from *Malus floribunda* 821.

Origin

'SuperMac', tested as FAR124-A56 and in replicated trials as SJC7123–2, originated from a cross made in 1971 between 'McIntosh' and PRI 674 (Fig. 2) at Agriculture and Agri-food Canada (AAFC), Horticultural Research and Development Center (CRDH), Quebec. The pollen of PRI 674 was sent to us by Dr. William (Purdue University, Department of Botany and Plant Pathology, Lilly Hall of Life Sciences, Lafayette, Ind.) on 18 May 1971 and used as male parents to make the cross number 71–23. PRI 674 was derived from a heterozygous scab-resistant selection, F226829–2–2 originating from crosses involving a clone (821) of the small-fruited *Malus floribunda* made in the early 19th century by Dr. C. S. Crandall at the University of Illinois.

The seedling FAR124-A56 was selected for its resistant to scab and planted in 1974 at

AAFC, CRDH, Quebec and evaluated since then for its hardiness, disease resistance, fruit quality, chemical composition (antioxidant), and storage life in controlled atmosphere (CA) and also in an ordinary cold room (4–5 °C). It was selected after extensive testing in Frelighsburg, at the substation of AAFC, CRDH, Quebec, based on its winterhardiness (similar to 'McIntosh'), resistance to scab, and fruit quality. It was then planted in replicated trials under the name SJC7123–2 and compared with two known commercially grown cultivars 'Spartan' and 'Macspur'.

Compared with 'Spartan' and 'Macspur', this new cultivar has similar hardiness, it retains its fresh eating in storage, and it is resistant to the common races of apple scab, reducing the need for fungicide applications.

Inoculation of SuperMac using naturally infected leaves showed 0% of scab incidence on the vegetative and reproductive organs compared with 'Spartan' (3%) and 'Macspur' (5%) with no fungicide application.

Description

Tree characteristics. 'SuperMac' trees are vigorous and have an upright to slightly

spreading habit when grafted on the M.26 rootstock. Fruit are borne on spurs and shoots, which are generally 1 to 3 years of age, and the fruiting zone tends to move away from the trunk to the outside of the tree (type III bearing habit according to Lespinasse, 1977). 'SuperMac' trees are hardy at Frelighsburg, Quebec (latitude 45°N, longitude 72°W), which has a sandy soil and an average winter minimum temperature of –25 °C. 'SuperMac' is also tested at L'Acadie (latitude 45.32 N, longitude 73.35 W), which has clay loam and an average winter minimum temperature of –35 °C. There have been no signs of powdery mildew [*Podosphaera leucotricha* (Ell. & Ev.) Salm.] or fireblight [*Erwinia amylovora* (Burr.) Winslow et al.] infections during the evaluation period.

The leaves are medium to large in size, elliptic, and the margins are mainly serrate but can sometimes be doubly serrated. The abaxial surface is hairy, the apex is acuminate, and the base is obtuse. The average leaf length to width ratio is 1:7 and the petioles are hairy, 2.2 to 3.6 cm long with thin to medium stipules of varying length (mainly medium) when young. The surfaces of the leaves are dull and medium green.

Flower and fruit characteristics. Flowering starts at the same time as 'Macspur' and 'Spartan' (e.g., 20 May) in Frelighsburg. Flower buds are reddish-purple (58A-B; Royal Horticultural Society Colour Chart [RHS], 1995) on a white base in full balloon stage and the flowers are single. When fully open, petals are oblong to slightly rounded, touching to slightly overlapping, and are mainly white with a blush of medium to dark pink (61C-D) on both sides. The pedicels are mainly green but sometimes have a red stripe. The pollens are fertile but fruits get larger with a pollinizers like those recommended for 'McIntosh' and 'Spartan'.

'SuperMac' fruit ripen mid to late October in Frelighsburg, ≈3 to 4 weeks after 'McIntosh' and 2 weeks after 'Cortland' based on starch index. Fruits are large; they have a transverse diameter between 7.5 to 8.0 cm and an average weight of 192 g at harvest without thinning. Opposite to McIntosh, the fruit does not drop at maturity. Fruit shape is mainly globose. The sides of the fruit are slightly ribbed along the body and can be a bit lopsided. The skin is smooth, waxy, fairly thick, and a bit tough at harvest but good after storage in CA. When harvested for CA storage, skin color is dark red blush (RHS185A) becoming washed over a green background (RHS145A) and the flesh is white. Some dark red (RHS185A) stripes are noticeable on the washed colored areas. Surface bloom is scant. Low numbers of large lenticels appear near the stem but increase to high numbers near the calyx and lenticels are conspicuous over the red areas. The length of the stem is short to medium, variable in diameter (small to medium), a little pubescent, and is green, although it can be a bit red on one side. The cavity is mainly

Received for publication 27 Jan. 2006. Accepted for publication 10 May 2006.

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Fig. 1. Fruits of 'SuperMac' at maturity.

obtuse, but it can be acute in some fruit, broad, shallow to medium depth, and has very low amount of russetting. The basin is wavy to somewhat crowned, medium to somewhat deep with a medium to somewhat broad width and a little pubescent. The medium-sized calyx is persistent with erect lobes, half-open to open, and the stamens are in median to slightly basal position. The large size core is open in the distant position with clasping core lines. The carpels are round, distal end truncate, slightly tufted inside, and the cells are unsymmetric and abaxile. The seeds are brown, plump with a normal to elongated end, slightly tufted, and the tip is acute. At harvest, the flesh is crisp, juicy, and firm (8.1 kg as measured by a EPT-1 pressure tester; Lake City Technical Products Inc., Kelowna, B.C., Canada) with a very low to low discoloration depending on time after cutting. The flavor is pleasant, aromatic, and slightly tart. The titratable acidity is 0.66% (malic acid) and the soluble solids are 11.5% (Brix).

Antioxidant composition. The content of eight different phenolic compounds were determined using HPLC analysis (Rekika et al., 2005). On the basis of phenolic standards of protocatechuic acid, (+)-catechin, chlorogenic acid, caffeic acid, p-coumaric acid, vanillin acid, coniferal and sinapinic acid, the phenolic compounds in the apple samples were identified by comparison of retention time of standards; the results expressed as percent peak areas from high-performance liquid chromatograms. On the eight given phenolic compounds, there was significant difference in the percent peak areas of (+)-catechin, chlorogenic acid, p-coumaric acid, and coniferal between 'SuperMac' and 'McIntosh' genotypes. The 'SuperMac', scab resistance with excellent shelf life, was characterized by higher chlorogenic acid and coniferal (8.10% and 7.98% peak area, respectively) and lower percent peak area in both p-coumaric acid (0.06) and (+)-catechin (0.41). In contrast, 'McIntosh' type, scab-sensitive with little shelf life presents a dif-

ferent behavior for these same phenolic compounds: chlorogenic acid, coniferal, p-coumaric acid, and (+)-catechine (1.3%, 0.48%, 5.21%, and 10.2% peak area, respectively). Furthermore, it has been shown that oxidation product of chlorogenic acid was toxic to pathogens (Nicholson and Hammerschmidt, 1992). Clark et al. (1959) have reported that an addition product of chlorogenic acid with caffeic acid and six amino acids present in potato skin are highly toxic to race 1 of *Helminthosporium carbonum*. Scab resistance of our 'SuperMac' could be the result of the higher chlorogenic acid content and is worth further investigation. In our data, 'SuperMac' (scab-resistant) had much higher chlorogenic acid than 'McIntosh' (scab sensitive). Similar resistance was also noted for selected strawberry cultivars and other fruits in relation to antioxidant activities (Rekika et al., 2005; Tsao et al., 2006).

Storage and other agronomic characteristics. After 6 months of storage in CA (2.5% O₂, 4.5% CO₂, 2–3 °C), the fruit was medium-firm (6.2 kg), the acidity was low (0.43%), and the soluble solids were medium (11.8%); its fresh eating qualities are excellent and taste and aroma are good. The fruit kept for at least 2 more months in a regular cold room after CA storage. Fruit quality was superior in texture and taste to that of 'Spartan' stored under similar conditions.

'SuperMac' is presently being evaluated at several research centers in Europe by Meiosis inc. (Bradbourne House, Stable Block, East Malling, Kent, U.K.) and by other AAFC research centers, including New Brunswick (Bouctouche), Manitoba (Morden), and also by the Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario, in comparison with other known local cultivars.

Replicated four trees of each cultivar ('SuperMac', 'Spartan', and 'Macspur') were planted 2.0 m apart within the row and 4.5-m spacing between the rows in a randomized complete block design and evaluated since 2000 at L'Acadie experimental farm. 'SuperMac' (26.41 kg) had similar cumulative yield (includes fruit drop) compare (2001–2005) to 'Macspur' (25.00 kg) and 'Spartan' (19.00 kg) but larger fruit size (192 g) than 'Spartan' (170 g) and 'Macspur' (175 g).

Availability

A Canadian Plant Breeder's Right has been issued (Application No. 03-3687, <http://www.inspection.gc.ca/english/plaveg/pbrpov/cropreport/app/ap-p00004388e.shtml>) and limited quantities of nonindexed budwood are available for research purposes (universities and research stations) from Canadian Food Inspection Agency or Shahrokh Khanizadeh (North America) or from Meiosis Inc. (Europe) with a written request. Interested nurseries may inquire about "nonexclusive licenses" directly from AAFC.

Fig. 2. Pedigree of 'SuperMac' apple.

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