HortScience 54(11):2067–2069. 2019. https://doi.org/10.21273/HORTSCI14003-19

‘RubyS’, a Small Apple

Soon-Il Kwon, Jeong-Hee Kim, Sun-Ae Kim, and Young-Soon Kwon
Apple Research Institute, National Institute of Horticultural & Herbal Science, Rural Development Administration, Gunwi 39110, Republic of Korea

Jinwook Lee
Department of Plant Science and Technology, Chung-Ang University, Anseong 17546, Republic of Korea

Additional index words. Malus domestica Borkh., apple breeding, self-incompatibility, self-thinning, preharvest fruit drop

‘RubyS’ (*Malus domestica* Borkh.) apple cultivar was developed from Korean Apple Breeding Program, at Apple Research Institute, National Institute of Horticultural & Herbal Science (NIHHS), Rural Development Administration (RDA), Republic of Korea and then commercially released as a new apple cultivar in 2014. ‘RubyS’ was selected from a hybrid between ‘Alpsotome’ and ‘Sansa’ cultivars. Fruit maturity is reached in the middle of August. Fruit are high quality small dessert apples with excellent storability and marketability. In addition, fruit are very attractive and flavorful. ‘RubyS’ cultivar is higher in fruit weight and yield than ‘Alpsotome’. Fruit shape and overall peel color coverage of ‘RubyS’ are ‘conic’ and ‘red’, respectively. Moreover, there was no preharvest fruit drop in ‘RubyS’ even though fruit drop was high in ‘Alpsotome’, the mother parent. The fruit flesh is cream-colored, aromatic, crispy, and juicy. Flesh firmness of ‘RubyS’ is 78.2 N at harvest, similar to that of ‘Alpsotome’. The soluble solids content is higher in ‘RubyS’, compared with ‘Alpsotome’. Suitable pollinizers for ‘RubyS’ cultivar are ‘Golden Delicious’, ‘Gala’, and ‘Fuji’. The fruit quality, in terms of firmness, juiciness, and flavor, was retained fairly well during long-term cold storage. ‘RubyS’ showed strong resistance to the most serious apple pests and diseases as does ‘Alpsotome’ cultivar and is self-thinning as well. Overall, the results indicated that tree characteristics and fruit quality of ‘RubyS’ apples are highly desirable in terms of fruitlet self-thinning ability, fruit sweetness, storability and low preharvest fruit drop, compared with those of ‘Alpsotome’ cultivar. In summary, ‘RubyS’ is a promising small apple cultivar.

Origin

The RubyS cultivar was selected among 320 seedlings that were originated from a cross between Alpsotome and Sansa cultivars (Fig. 1). Parental forms were crossed in 2004. The seedling resulting in ‘RubyS’ plants was selected in 2014 and then registered in 2016 in the Republic of Korea. The selections were propagated by grafting on apple rootstock M.9. The selections were evaluated for 5 consecutive years (5 to 9 years of tree age) in Gunwi (36°16′ N, 128°27′ E, elevation 71 m), Republic of Korea. The soil of the experimental orchard at a depth of 0 to 50 cm was a clay loam, slightly acidic (pH 6.5), with low (2.21%) organic matter content. Maximum day air temperature is 36.6 °C in August, and minimum day air temperature is –16.7 °C in January at the experimental orchard.

As the parents of ‘RubyS’, the seed parent ‘Alpsotome’, produced in Japan, was selected in 1964 as an open-pollinated seedling of ‘Fuji’ by Hatagoshi, a private breeder (Soejima et al., 1998). ‘Alpsotome’ cultivar is a very small apple with an average fruit fresh weight of 37 g, which is high in soluble solids content and has fruit storability and palatability. Small size apple fruit have utility for school meals, baking, snacks, and other uses because apple consumers may prefer to have a small “snack-size” apple rather than regular-size apples, leading to increased demand and marketability. However, before ‘RubyS’, no small-size apple cultivars were commercialized that had little or no preharvest fruit drop and high storability and marketability. ‘Alpsotome’ is widely used as the pollinator of different varieties but is not compatible to use with ‘Fuji’, which is the most cultivated apple in Korea, because the self-incompatibility genes are the same in the two genotypes (Shogo et al., 2008). In contrast, pollen parent Sansa, bred in 1987 in Japan, is an early season apple cultivar with high palatability, juiciness, no preharvest fruit drop, and excellent storability. Furthermore, it is strongly resistant to bitter rot (Yoshida et al., 1989). *S*-genotype of

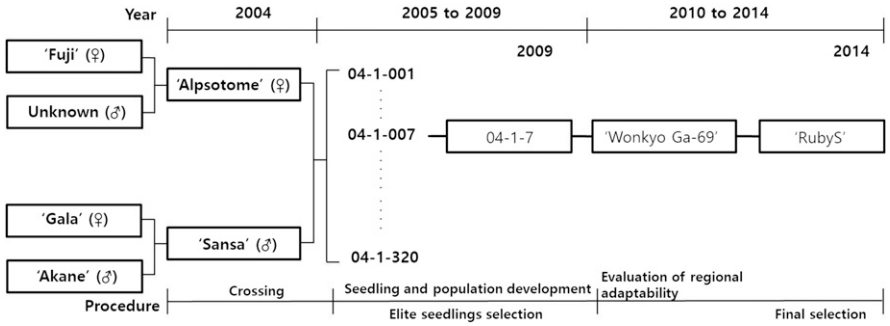

Fig. 1. Pedigree and timeline of breeding procedures used in the development of RubyS apple cultivar.

Fig. 2. Trees (**left**) and fruit (**right**) of RubyS apple cultivar.

Received for publication 27 Feb. 2019. Accepted for publication 23 Apr. 2019.
This work was carried out with the support of the Cooperative Research Program for Agriculture, Science & Technology Development (Project no. PJ01194001), Rural Development Administration, Republic of Korea.
Y.-S.K. is the corresponding author. E-mail: peat1004@korea.kr.

Table 1. Physiological characteristics of tree growth performance in RubyS, Alpsotome, and Sansa apple cultivars at Gunwi, Republic of Korea.

Characteristics	RubyS	Alpsotome[z] (♀)	Sansa[y] (♂)
		Tree	
Tree vigor	Intermediate	Intermediate	Weak
Tree type	Ramified	Ramified	Ramified
Bearing type	On spurs and long shoots	On spurs and long shoots	On spurs and long shoots
		Flower	
Predominant color at balloon stage	Light pink	Light pink	Light pink
Diameter with petals pressed into horizontal position (mm)	38.6 ± 0.15	42.7 ± 0.21	51.8 ± 0.28
		Leaf	
Leaf blade length (mm)	75.7	71.3	80.0
Leaf blade width (mm)	48.1	39.4	49.4
Petal arrangement	Overlapping	Intermediate	Intermediate
First flowering time	Early (21 Apr.)	Early (19 Apr.)	Early (20 Apr.)
Harvest time	Early (mid-Aug.)	Intermediate (mid-Sept.)	Early (late Aug.)

[z]Alpsotome, bred from Japan in 1968, is the only small fruit size apple cultivar in Korea and was used as a mother plant for 'RubyS'.
[y]'Sansa', bred from Japan in 1987, has excellent fruit quality and was used as a father plant for 'RubyS'.

'Sansa' is S_5S_7 (Shogo and Kotakara, 2000) and thus highly cross-compatible with 'Fuji' (S_1S_9) and 'Hongro' (S_1S_3) cultivars (Heo et al., 2011). Furthermore, it is good enough to be used as a pollen tree due to the high amount of pollen yield (Heo et al., 2011). Nonetheless, the preference and popularity of 'Sansa' apples have decreased in Korea due to general lower tree vigor, fruit weight, fruit yield, and production (MAFRA, 2015). Therefore, to overcome 'Alpsotome' limitations of having severe preharvest fruit drop and poor shelf life, it was bred with 'Sansa'.

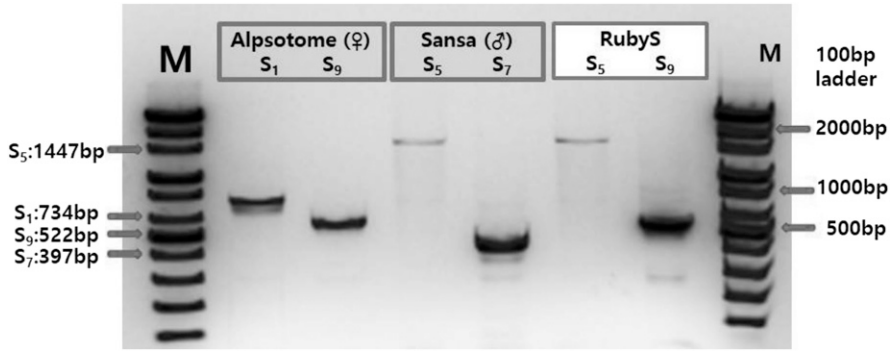

Fig. 3. Self-incompatibility gene bands of RubyS and its parent cultivars.

Description

Trees, flowers, and leaves. The proposed cultivar RubyS was described per the UPOV standard protocol (UPOV, 1994). 'RubyS' tree grows well in fertile, acidic, well-drained sandy soils and loams, which are typical for apple cultivation (Barden and Neilsen, 2003). Grafted on M.9 rootstocks, 'RubyS' trees show low vigor and a tree height of ≈2 m (Fig. 2). Because the tree shape is a slender spindle, semidwarf rootstocks are recommended, such as M.7 at conventional apple orchards. 'RubyS' scions grafted with M.7, MM.106, and MM.111 rootstocks were normally responded without any symptoms of incompatability, such as swelling at the union. First fruiting occurred when trees were in their second year. In the southern region of South Korea, 'RubyS' starts flowering ≈1 to 3 d after 'Alpsotome', depending on the orchard locations and weather conditions. Full bloom of 'RubyS' occurs between 20 and 22 Apr. (data from 3 years) and 10 and 20 Apr. for 'Alpsotome' and 'Sansa', respectively. A predominant color at balloon stage is light pink; petal diameter pressed into a horizontal position is 38.6 mm in 'RubyS but 42.7 mm and 51.8 mm in 'Alpsotome' and 'Sansa', respectively; arrangement of petals is overlapping in 'RubyS' but intermediate in 'Alpsotome' and 'Sansa' apples (Table 1). The self-incompatible genotype of 'RubyS' is S_5S_9 (Fig. 3). Therefore, it is possible to use pollen for pollination with 'Gala' (S_2S_5), 'Golden Delicious' (S_2S_3), and 'Fuji' (S_1S_9). On average, leaf size is 75.7 mm in length and 48.1 mm in width (Table 1).

Table 2. Physiological fruit characteristics in RubyS, Alpsotome, and Sansa apple cultivars at Gunwi, Republic of Korea.

Characteristics	RubyS	Alpsotome[z] (♀)	Sansa[y] (♂)
Fruit size (g)	Small (74 ± 14)	Very small to small (40 ± 12)	Medium (218 ± 16)
Fruit shape	Conic	Globose	Conic
Ribbing	Absent or weak	Absent or weak	Absent or weak
Crowning at calyx end	Absent or weak	Absent or weak	Absent or weak
Fruit ground color	Yellowish green	Yellowish green	Yellowish green
Relative area of over color	Very large	Very large	Large
Hue of over color	Red	Red	Red
Pattern of over color	Only solid flush	Only solid flush	Only solid flush
Area of russet around stalk attachment	Absent	Absent	Medium
Stalk length (mm)	28.7 (medium)	34.4 (medium)	26.1 (medium)
Stock thickness (mm)	1.9 (thin)	1.5 (thin)	2.8 (medium)
Soluble solids content (%)	14.5 ± 0.21	13.2 ± 0.95	14.6 ± 0.29
Titratable acidity (%)	0.53 ± 0.28	0.64 ± 0.01	0.54 ± 0.01
Preharvest fruit drop	None	Severe	None

[z]Alpsotome, bred from Japan in 1968, is the only small fruit size apple cultivar in Korea and was used as a mother plant for 'RubyS'.
[y]'Sansa', bred from Japan in 1987, has excellent fruit quality and was used as a father plant for 'RubyS'.

Table 3. Fruit yield of 'RubyS' trees affected by fruit thinning treatment.

Treatment	Fruit fresh weight (g/fruit)	Fruit no. per tree	Fruit yield[z] (Mt/ha)	Coloring ratio[y] (%)
Control	51.0	605	39	80
Fruit thinning	72.7	240	22	95

[z]Planted area of 4 m × 2m; survey from 2014 to 2018; 5 years old in 2014.
[y]Relative area of over color.

Fruit. Fruit produced from 'RubyS' are small, only 53.7 mm in length and 59.4 mm in diameter (Table 2). The fruit length-to-diameter ratio is intermediate; fruits show conic shape; ground color is yellow-green; and skin is smooth, without russeting, shiny, of medium thickness, and 80% to 100% covered with red, flushed blush (Fig. 2).