‘Shiny Star’: A Cold-hardy Seedless Table Grape

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‘Shiny Star’ is a cold-hardy seedless table grape developed by the Rural Development Administration (RDA) grape breeding program in Korea. In recent years, table grapes from Chile and the United States have been increasingly imported to Korea. The imported grapes are seedless and have nonslippery skin. Korean consumers prefer grapes with those traits rather than the traditional Korean cultivars, which are seeded and have more slippery skin. The imported cultivars are not suitable for cultivation in Korea because of the hot and humid summers and cold winters. ‘Shiny Star’ meets the demands of both consumers and producers in Korea. The cultivar Himrod is the seedless pollen parent of ‘Shiny Star’, which has greater cold hardiness than ‘Himrod’. ‘Shiny Star’ has yellow berries with soft flesh, nonslippery skin, a foxy flavor, and a mean weight of 3.8 g. ‘Shiny Star’ is not prone to berry shattering or cracking during storage or postharvest transportation, thereby increasing its marketability.

Origin

‘Shiny Star’ was derived from a cross between ‘Tano Red’ and ‘Himrod’. The cross was performed in 2001 at the National Institute of Horticultural and Herbal Science (NIHHS), RDA, Suwon, Korea. The pedigree is shown in Fig. 1. ‘Shiny Star’ was first selected in 2007 and tested as ‘Wonkyo RA-44’ in seven

different locations (Chuncheon lat. 37°53′ N, long. 127°44′ E; Suwon lat. 37°16′ N, long. 127°02′ E; Yesan lat. 36°41′ N, long. 126°51′ E; Okcheon lat. 36°20′ N, long. 127°45′ E; Iksan lat. 35°56′ N, long. 126°59′ E; Jinju lat. 35°11′ N, long. 128°06′ E; and Naju lat. 35°01′ N, long. 126°43′ E). Own-rooted vines were planted in five random plots at each site. Fruit production and vine quality were evaluated from 2012 to 2015. Based on the evaluation, we named the selected line ‘Shiny Star’.

Description and Performance

‘Shiny Star’, ‘Himrod’, and ‘Campbell Early’ vines were grown in Suwon, Korea. ‘Campbell Early’ is the most commonly grown grape cultivar in Korea. The vines

were trained to a modified T-trellis (2.7-m single arm), and 27 shoots per vine were maintained by spur pruning. The vines were spaced 2.7 m × 2.7 m apart, which provided a vineyard density of 1200 vines/ha. Standard table grape culture practices were used.

Berry, cluster, and vine characteristics were evaluated annually from 2012 to 2015. The average values reported for the various characteristics were based on data collected from five replicate vines grown in the Suwon area during each harvest year. Fifty berries were randomly collected from five different vines, with two clusters taken from each vine and five berries collected from each cluster. The berries were used to determine berry weight, soluble solids content, and titratable acidity.

The cold hardiness of the shoot was estimated by measuring electrolyte leakage (EL) using the methods described by Arora et al. (1992) and Lee et al. (2013) with slight modifications. Fifty 10-cm shoots were excised from five separate vines (10 shoots per vine) of each cultivar. The excised shoots were rinsed under cold distilled water. Then, each shoot sample was placed in a 50-mL test tube containing 1 mL distilled water. The test tubes were placed in a chamber (VS-1203P4S-3C; Vision Scientific Co. Ltd., Seoul, Korea) and cooled to the target temperature at a rate of 2 °C/h. Control shoots were placed in a refrigerator for 2 h. Six target temperatures ranging from –6 to –36 °C were used. The test tubes were maintained at each target temperature for 2 h. Each shoot was then cut into seven 1-cm segments. All seven segments were then placed in a single 15-mL test tube containing 8 mL distilled water and vacuum-filtrated for 1 min. The tubes were then shaken on an orbital shaker (Supertech; Seoulin Bioscience, Seoul, Korea) at 125

Fig. 1. Pedigree of the ‘Shiny Star’ seedless table grape.

Table 1. Characteristics of three table grape cultivars grown in Suwon, Korea, from 2012 to 2015.

Cultivar	Harvest date	Seed status	Cluster wt (g)	Berry wt (g)	Soluble solids (°Brix)	Titratable acidity (%) ²	Yield/vine (kg)
Shiny Star	31 Aug.	Seedless	330.8 ± 21.1	3.8 ± 0.5	19.5 ± 0.9	0.54 ± 0.05	17.9 ± 1.1
Himrod	20 Aug.	Seedless	300.1 ± 24.2	3.0 ± 0.4	18.5 ± 0.8	0.43 ± 0.05	12.2 ± 1.0
Campbell Early	30 Aug.	Seeded	372.7 ± 21.9	5.7 ± 0.4	15.1 ± 0.9	0.48 ± 0.05	20.1 ± 1.2

Data represent mean ± SEM.

²Percentage of tartaric acid by volume.

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Fig. 2. Clusters of 'Shiny Star' seedless table grapes.

rpm for 24 h at room temperature. The electrical conductivity (EC) of the liquid contents of the tubes was then measured using an EC meter (Model 1461-81; Cole-Parmer, Vernon Hills, IL). The tubes were autoclaved at 120 °C and 117.2 kPa for 30 min, and the EC was measured again. Membrane injury (%) in the samples was calculated according to the method of Arora et al. (1992) as:

$$\text{Injury (\%)} = \frac{(\% \text{EL}_{(t)} - \% \text{EL}_{(4^{\circ}\text{C})})}{(100 - \% \text{EL}_{(4^{\circ}\text{C})})} \times 100$$

where % EL_(t) and % EL_(4°C) are the ratios of the initial EC to final EC of shoots incubated at each target temperature (t) and of the nonfrozen control shoots (4 °C), respectively. The percentage membrane injury data were adjusted according to the method of Lim et al. (1998). Samples treated by extreme freezing at -80 °C in an ultra-low-temperature freezer (WiseCryo; Daihan Scientific, Seoul, Korea) were considered 100% freeze-injured samples. The injury percentage was transformed as follows:

Table 2. Cold hardiness of the shoots of the three table grape cultivars.

Cultivar	Pedigree	T _{max} (°C)
Shiny Star	Tano Red × Himrod	-28.2 ± 0.11
Himrod	Ontario × Sultanina	-24.7 ± 0.16
Campbell Early	Moore Early × (Belvidere × Muscat Hamburg)	-27.0 ± 0.15

T_{max} indicates the temperature at which the greatest rate of cold injury was observed.

$$\text{Adjusted injury (\%)} = \left(\frac{\% \text{Injury}_{(t)}}{\% \text{Injury}_{(-80^{\circ}\text{C})}} \right) \times 100$$

Using the adjusted injury percentage data, the temperature at which the rate of injury was greatest (T_{max}) was calculated using the Gompertz function (Lim et al., 1998).

Flowers. 'Shiny Star' has perfect, self-pollinating flowers. The flowers bloom late in the season (approximately 7 June in Suwon, Korea) after a late-season budbreak (1 May).

Berry characteristics. 'Shiny Star' berries are seedless. The seed traces are very small and barely discernible, with a fresh weight of 1.57 mg, or 62% of that of 'Himrod' seed traces (2.54 mg). The 'Shiny Star' berry skin has medium thickness compared with the 'Himrod' berry skin and adheres to the flesh. The berries are round, of medium size, and have an average weight of 3.8 g (Table 1). 'Shiny Star' berries have a weight similar to that of seedless 'Himrod' berries, but they weigh less than seeded 'Campbell Early' berries. 'Shiny Star' ripens between 26 Aug. and 4 Sept. in Suwon, Korea, similar to 'Campbell Early', but 11 d later than 'Himrod'. The average soluble solids content of 'Shiny Star' berries is 19.5 °Brix, which is higher than that of 'Campbell Early' (15.1 °Brix) and 'Himrod' (18.5 °Brix) berries. The titratable acidity of 'Shiny Star' berries is 0.54%, which is similar to that of 'Campbell Early' berries and higher than that of 'Himrod' berries. The grapes have a foxy flavor when fully ripe.

Cluster characteristics. The average cluster weight of 'Shiny Star' is 330.8 g. The clusters are conical, sometimes cylindrical, and the berries are set tight in the cluster (Fig. 2). The uniform shape and yellow skin color of the berries result in an excellent cluster appearance. The harvested clusters were stored at -2 °C with ≈70% to 80% relative humidity for 2 months. Berry shattering and cracking rarely occurred during storage. Six-year-old 'Shiny Star' vines yielded ≈21,400 kg/ha. In comparison, the yields of 'Himrod' and 'Campbell Early' were ≈14,600 kg/ha and 24,100 kg/ha, respectively.

Vine characteristics. 'Shiny Star' vines with their own roots had slightly vigorous growth.

The vines had a uniform cluster size and ripening period as a result of spur pruning. The vines were observed to be moderately resistant to downy mildew (*Plasmopara viticola* Berl. & de Toni) and resistant to powdery mildew (*Erysiphe necator* Schw.) during cultivation.

Cold hardiness evaluation. During the test period (2012–15), the lowest average monthly temperature in Suwon was -8.1 °C (Dec. 2012), and the lowest average temperature for a single day was -18.1 °C (4 Jan. 2013). None of the three cultivars assessed for cold hardiness were damaged by cold temperatures in the field. The T_{max} values for the three cultivars ranged from -24.7 ± 0.16 °C to -28.2 ± 0.11 °C (Table 2). The cold hardiness of 'Shiny Star' was similar to that of 'Campbell Early' and greater than that of 'Himrod'. The latter is widely cultivated in New York (Reisch et al., 1993), indicating that 'Shiny Star' can be cultivated in similarly cold regions such as Korea.

Availability

'Shiny Star' was registered at the Korea Seed and Variety Service in 2018. Requests for nonindexed cuttings for research purposes may be addressed to Youn Young Hur (E-mail: yyhur76@korea.kr).

Literature Cited

- Arora, R., M.E. Winsniewski, and R. Scorza. 1992. Cold acclimation in genetically related (sibling) deciduous and evergreen peach [*Prunus persica* (L.) Batsch]. 1. Seasonal changes in cold hardiness and polypeptides of bark and xylem tissues. *Plant Physiol.* 99:1562–1568.
- Lee, J.I., D.J. Yu, J.H. Lee, S.J. Kim, and H.J. Lee. 2013. Comparison of mid-winter cold-hardiness and soluble sugars contents in the shoots of 21 highbush blue berry (*Vaccinium corymbosum*) cultivars. *J. Hort. Sci. Biotechnol.* 88:727–734.
- Lim, C.C., R. Aurora, and E.C. Townsend. 1998. Comparing Gompertz and Richards functions to estimate freezing injury in *Rhododendron* using electrolyte leakage. *J. Amer. Soc. Hort. Sci.* 123:246–252.
- Reisch, B.I., R.M. Pool, D.V. Peterson, and M.-H. Martens. 1993. Table grape varieties for cool climates. *Information Bulletin* 234, 3 p. Cornell Coop. Ext., Cornell Univ., Geneva, NY. Unauthenticated.