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# An Interspecific Hybrid Grape Cultivar: Black Sun

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Although many efforts have been made to breed new grape cultivars in Korea (Heo and Park, 2016; Kim et al. 2020; Park et al. 2022), they are mainly bred by crossing European and American grape cultivars and have relatively low resistance to cold and diseases. Because Korea experiences high precipitation in the summer and cold weather in the winter, the occurrence of damage due to diseases and cold can increase when grapes are grown in unfavorable environments, such as cold regions and open fields. Korea mostly comprises forested areas, which account for 63% of the land area, and it is becoming increasingly difficult to secure agricultural land for grape cultivation due to industrialization. To introduce a sustainable growth system for the grape industry from a long-term perspective, it is important to breed and introduce grape cultivars that can be cultivated in fallow areas where grapes are not currently grown. *Vitis amurensis* grows naturally in the mountains of Korea and is known to have excellent cold and disease resistance (Wang et al. 2021), which makes it ideal for cultivation in harsher environments. In addition, it contains high levels of resveratrol and polyphenolic compounds, which are well-known health-promoting substances. It has been identified as a valuable genetic source. Despite its advantages, fruit set is affected by the flowering time of male and female individuals because pollinators are required for fruit

production of *V. amurensis*, often resulting in unstable fruit production and limited utilization (Park et al. 2005). Recently, *V. amurensis* cultivars have been developed to use its beneficial characteristics (Park et al. 2017), and technologies to use them efficiently have been established (Kwon et al. 2019). However, it is expected that superior horticultural advantages can be obtained by hybridizing commercial grape cultivars with *V. amurensis* genotypes, rather than using *V. amurensis* directly. Therefore, we aimed to breed new interspecific hybrid grape cultivars that have good fruit characteristics and can be cultivated in an unfavorable environment. The result was a cultivar called Black Sun, and we report its major characteristics.

## Origin

'Black Sun' is a hybrid of the diploid grape cultivar Muscat Bailey A (*Vitis labrusca* × *Vitis vinifera*), which is used for both fresh eating

and winemaking, and the diploid *V. amurensis* genotype K-183, which has high disease and cold resistance (Fig. 1). It was bred on the farm (37°94'73.80N, 127°75'44.30E) of Gangwondo Agricultural Research and Extension Services (GARES) in 2004. A total of 228 seedlings were obtained from the cross, and their initial growth characteristics and disease outbreaks were examined for the next 2 years. 'Black Sun' showed stable growth patterns, and no diseases or physiological disorders were observed; thus, it was selected as the primary hybrid under the name GW05-22 in 2007. It was propagated via hardwood cuttings and replanted at the GARES farm at intervals of 4 m (between rows) × 2 m (between the vines) in 2008. During the cultivation period, standard grapevine management practices made by the Rural Development Administration in Korea (2010) were applied for vine management. The extensive vine and fruit characteristics were evaluated from 2012 to 2014 according to the method presented in Park et al. (2015) and further investigation regarding characteristics required for cultivar protection was conducted according to the guidelines of The International Union for the Protection of New Varieties of Plants standard. Throughout 3 years of repeated investigations, GW05-22 was confirmed to have useful characteristics beyond the reference cultivar Black Eye [*V. amurensis* × (*V. labrusca* × *V. vinifera*)], which is the first grape cultivar bred by crossing *V. amurensis* with a commercial grape cultivar in Korea. The final selection was made by naming it 'Black Sun' in 2014.

## Description and Performance

'Black Sun' is likely to have characteristics similar to those of 'Campbell Early' and 'Kyoho' grapes, which are two of the most important grape cultivars in Korea in terms of growth habits, such as vine vigor, shoot development, and overall plant architecture. In Chuncheon, Korea, bud sprouting starts on April 18, which is ~5 days later than that of the reference cultivar Black Eye (Table 1). The full bloom and veraison dates of 'Black Sun' are June 1 and September 20, respectively, which are 5 and

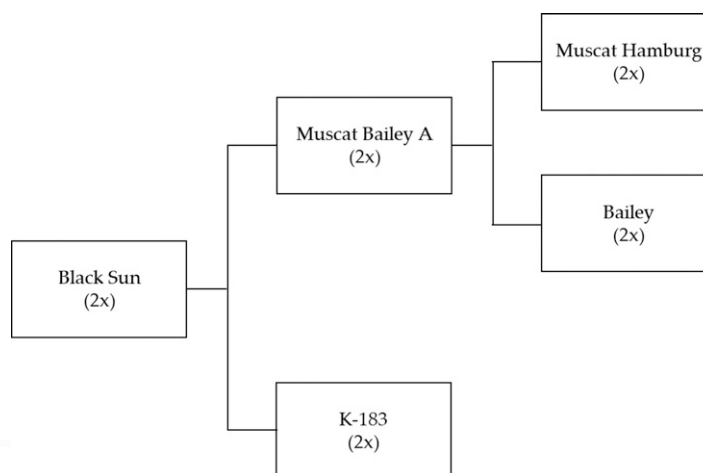


Fig. 1. Pedigree of 'Black Sun' grape.

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Table 1. Major characteristics of Black Sun and Black Eye grape cultivars.

Characteristics <sup>i</sup>	Cultivar	
	Black Sun	Black Eye
Vine		
Vigor	Moderately vigorous	Moderately vigorous
Bud sprouting date	18 Apr	13 Apr
Flowering date	1 Jun	6 Jun
Fruit		
Maturing date	24 Sep	22 Sep
Cluster shape	Conical	Conical
Berry shape	Round	Round
Cluster weight (g) <sup>ii</sup>	338.5	129.7
Berry weight (g) <sup>iii</sup>	2.2	1.8
Total soluble solids (TSS) (°Brix) <sup>iv</sup>	20.8	18.2
Titrateable acidity (TA) (%) <sup>v</sup>	1.0	1.1
TSS/TA ratio	20.8	16.5

<sup>i</sup> All values are means investigated from 2012 to 2014 in Chuncheon, Republic of Korea.

<sup>ii</sup> Ten clusters were sampled randomly from five vines at the optimum harvest period for calculation.

<sup>iii</sup> Determined by dividing total fruit weight by the number of berries.

<sup>iv</sup> Ten berries were randomly sampled from each cluster. TSS was measured on each berry by expressing juice from each side of the fruit onto a digital refractometer (Atago PR-101, Tokyo, Japan).

<sup>v</sup> TA was measured with an automatic titrator (Schott Titro-line alpha, Mainz, Germany), where the juice was titrated to an endpoint of pH 8.2 using 0.1 N sodium hydrogen phthalate.

2 days later than those of ‘Black Eye’. *V. amurensis* was used as the male parent in this study, and it has aborted pistils; however, the stamens and ovary of ‘Black Sun’ are morphologically complete. It has self-fertilizing flowers and a strong attachment of fruit to the bunch. The berry of ‘Black Sun’ is well-set, and the cluster appearance has a uniform shape.

The weather in Korea is characterized as hot and humid during summer and relatively cold in winter, which is unfavorable for grape cultivation. In Korea, most farmers take great measures to protect vines from downy mildew and gray mold in the summer and prevent frost damage in the winter; thus, breeding a new grape cultivar that is resistant to these conditions is important. Gray mold and downy mildew rarely occur in ‘Black Sun’ during field cultivation without the application of fungicide. The occurrence frequency and level are lower than those of ‘Campbell Early’ and ‘Kyoho’. The daily mean temperature and the lowest temperature recorded in Chuncheon in January over the past 20 years are  $-4.1^{\circ}\text{C}$  and  $-27.9^{\circ}\text{C}$ , respectively. Sometimes the temperature can drop as low as  $-20^{\circ}\text{C}$ . Therefore, Chuncheon is regarded as one of the coldest regions in Korea. ‘Black Sun’ has

received no special management and has not suffered from frost damage for the past 15 years. These results suggest that ‘Black Sun’ can be defined as a cold-tolerant cultivar and can be easily cultivated in diverse regions with unfavorable environments.

When the fruits of ‘Black Sun’ are fully mature, they are the same black color as the reference cultivar (Fig. 2). The cluster and berry shapes are conical and circular, respectively, making them commercially viable. The berries are in close contact but are small and do not require berry thinning. Berry cracking and dropping are observed very rarely. The average cluster and berry weight of ‘Black Sun’ are 338.5 g and 2.2 g, respectively, which are  $\sim 200$  g and 0.4 g heavier than those of the reference cultivar. Total soluble solids (TSS) of ‘Black Sun’ are 20.8°Brix, and the titrateable acidity (TA) is 1.0%. Although the TSS value is marginally high, the ratio TSS/TA, an important index for determining the taste preference of consumers, has a lower level than that (29) of common table grape cultivars such as Campbell Early in Korea due to the high TA value. However, Bae et al. (2020) reported that ‘Black Sun’ can be a resource to produce wine, and Park et al. (2021)



Fig. 2. Appearance of ‘Black Sun’ grape.

reported that the wine made by ‘Black Sun’ received a favorable evaluation from sommeliers. Regarding this, it should be noted that wine produced from ‘Black Sun’ by Korean winemakers is currently available on the commercial market. More importantly, it can be easily maintained in vineyards and cultivated in poor environments like mountains as well as open fields owing to its high biotic and abiotic stress tolerance. For these reasons, we expect its cultivation area for the production of alcoholic beverages will increase in areas where unfavorable conditions exist in Korea. In addition, it will be a useful source for breeding new grape cultivars with high abiotic and biotic stress tolerance.

### Availability

‘Black Sun’ was submitted for Plant Variety Protection at the Korea Seed & Variety Service (KSVS) in 2015 and was officially registered as a grape variety in Korea in 2017. Hence, Black Sun is a patented Korean cultivar from KSVS and is owned by GARES. Requests for cuttings for research purposes may be addressed to Young-Sik Park (yspark06@korea.kr).

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