

‘Hanareum’ Grape

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In Korea, consumer demand for seedless grapes with high quality and large berries is increasing. Although a lot of effort into introducing European stenospermocarpic grape cultivars in Korea has been made, it did not work because they were not adaptable to growth conditions in Korea. In Korea, most seedless grapes are currently produced by applying plant growth regulators twice, using seeded grape cultivars such as Kyoho and Shine Muscat. Because this method is time-consuming and labor intensive, it is becoming more important to breed and introduce seedless grape cultivars that can reduce labor and time. The characteristics of parthenocarpy, stenospermocarp, and triploidy, which are found in grapes, have been applied to breeding seedless grapes (Heo et al., 2007; Pratt, 1971; Stout, 1936). Recently, hypo- and hypertetraploids have also been suggested as a good way to breed seedless grapes with large berries. Hypo- and hypertetraploidy are a sort of aneuploidy, and refer to the loss or the gain of individual chromosomes from the tetraploid chromosome set. They show similar growth characteristics with tetraploid grapes, but they do not have the fertility of pollen. Hence, they provide the chance to produce seedless fruit with large berries via a one-time application of a growth regulator during the full blooming period (Park et al., 2015). Despite such an advantage, no hypo- or hypertetraploid grape cultivar—with the exception of ‘Takao’, which is a chance seedling from the open-pollinated tetraploid Kyoho—has been released worldwide because the occurrence rate and identification of hypo- and hypertetraploid seedlings is extremely low and difficult, respectively (Park et al., 2016). To improve breeding efficiency for the development of hypo- or hypertetraploid grape cultivars, we tried to establish a system for identifying and producing hypo- and hyper-

tetraploids more easily. During this process, we also investigated their growth and fruit characteristics for the past 15 years. As a result, we have released the hypotetraploid grape cultivar Hanareum, with its excellent horticultural characteristics.

Origin

As the first step to producing hypo- and hypertetraploid grape seedlings, we effected open pollination using four tetraploid grape cultivars—Cannon Hall Muscat, Kyoho, Red Pearl, and Yufu—as well as cross-pollination among 13 tetraploid grape cultivars at the Gangwondo Agricultural Research and Extension Services orchard in Chuncheon, Korea, in 2002. Because it has been reported that most hypo- and hypertetraploid grape cultivars have abnormal cotyledons at the seedling stage, we collected 49 and 59 seedlings, respectively, with abnormal cotyledons among 3029 seedlings obtained from open-pollinated tetraploid grapes and 1730 seedlings obtained from crosses between tetraploid grape cultivars under nursery box soil after 1 year of open or cross-pollination (Park et al., 2010). Afterward, their chromo-

some numbers were investigated and, eventually, 24 hypo- and hypertetraploid seedlings were identified. Identified hypo- and hypertetraploid seedlings were transplanted for evaluation of their vine performance and fruit characteristics. Vines for the field trial were planted at a spacing of 4 m between rows and 3 m between plants, and were trained to an overhead arbor. Bearing branches were spur-pruned to two buds every February. From our 5-year test, we found the initially named ‘GWA 2002-23’ ($2n = 4x - 1 = 75$), which originated from open pollination of the tetraploid grape ‘Kyoho’, had the best fruit characteristics among all the hypo- and hypertetraploid grape seedlings (Figs. 1 and 2); it had stable growth characteristics like the commonly cultivated tetraploid grape cultivars. Thus, we performed regional adaptation tests at farms located in Chuncheon and Hongcheon from 2010 to 2018, and it was registered with the official name ‘Hanareum’ in 2018 from the Korea Seed & Variety Service (KSVS) because it showed stable fruit and growth characteristics, as we reported.

Description

‘Hanareum’ shows a vigorous shoot growth similar to ‘Kyoho’, which is the most common tetraploid grape cultivar in Korea. Because it has vigorous growth characteristics, one compound bud of ‘Hanareum’ frequently generates more than three shoots. All buds of ‘Hanareum’ constantly produce shoots with one to three flower clusters. The flowers of ‘Hanareum’ are hermaphroditic, as observed in ‘Kyoho’, and they bloom at almost the same time. Pollen produced from flowers of ‘Hanareum’ has very low viability (range, 0% to 0.1%), which allows farmers to produce seedless fruit with a one-time application of 25 ppm GA₃ at the full-bloom stage. The full bloom date of ‘Hanareum’ observed at Chuncheon

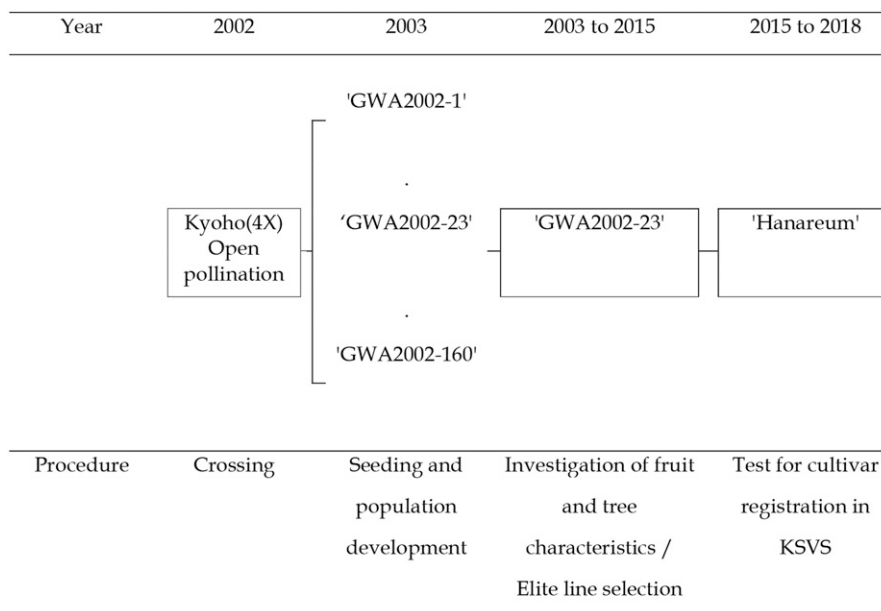


Fig. 1. Pedigree of ‘Hanareum’ grape. KSVS = Korea Seed & Variety Service.

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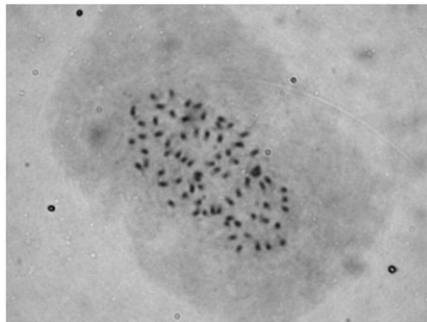


Fig. 2. Mitotic metaphase chromosomes in root-tip cells of 'Hanareum' ($2n = 4x - 1 = 75$).

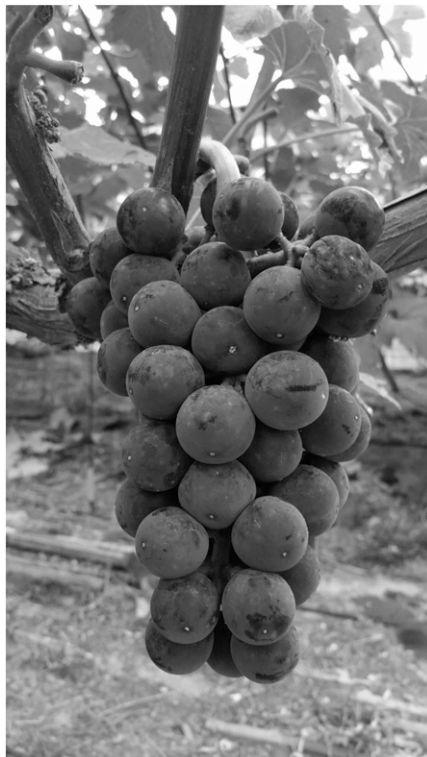


Fig. 3. Appearance of 'Hanareum' fruit.

is 8 June for the average of years 2015, 2016, and 2017, which is similar to 'Kyoho' (Table 1). However, the harvest date of Hanareum is 5 Sept., which is 10 d earlier than 'Kyoho' at Chuncheon. Fruit prices of early-maturing grape cultivars tend to be higher and are competitive in Korea. Most seedless grapes cultivated in Korea are shipped mainly from late September, and 'Hanareum' could be one of the earliest seedless grapes produced in Korea. Hence, cultivating 'Hanareum' can provide an advantage to farmers.

'Hanareum' vines have a relatively high disease resistance to ripe rot, but they have relatively low resistance to downy mildew relative to 'Campbell Early'. Thus, it is rec-

Table 1. Vine and fruit characteristics of 'Hanareum' and 'Kyoho' grapes. Values are means recorded from 2016 to 2018 in Chuncheon and Hongcheon, Republic of Korea.

Characteristics ^z	Hanareum		Kyoho	
	Chuncheon	Hongcheon	Chuncheon	Hongcheon
Vigor	Vigorous	Vigorous	Vigorous	Vigorous
Flowering date	5 June	8 June	8 June	10 June
Harvest date	5 Sept.	10 Sept.	15 Sept.	20 Sept.
Cluster shape	Conical (conical) ^y	Conical (conical) ^y	Conical	Conical
Berry shape	Circular (circular) ^y	Circular (circular) ^y	Circular	Circular
Berry skin color	Black (black) ^y	Black (black) ^y	Purple black	Purple black
Cluster weight (g) ^y	457 (93.3)	468 (85.9)	402	412
Berry weight (g) ^x	10.2 (2.4)	10.8 (2.5)	8.2	8.9
Total soluble solids (°Brix) ^w	19.3 (19.6)	19.0 (19.4)	18.1	17.9
Titrateable acidity (%) ^w	0.43 (0.42)	0.45 (0.47)	0.51	0.55
Fruit firmness (kg/φ5 mm)	1.42	1.62	0.57	0.62
Aroma	No	No	No	No
Yield (kg·ha ⁻¹)	1,934	1,964	1,834	1,840

^zTen clusters were taken randomly from each of the five vines at the optimum harvest period to investigate fruit characteristics. The fruit characteristics were observed for 3 years; mean data collected for 3 years are represented.

^yCluster weight was calculated from the total average weight of 50 clusters.

^xBerry weight was determined by dividing fruit weight by the number of berries.

^wTen berries were sampled from each cluster to assess total soluble solid content and titrateable acidity.

^vText in parentheses is the result of fruit characteristics without GA₃ application.

ommended that the vines be cultivated under plastic film houses to protect them from rain. 'Hanareum' vines are adaptable to the harsh winter weather at Chuncheon, with temperatures as low as -20 °C. Most tetraploid grape cultivars grown in Korea, including 'Kyoho' and 'Pione', are very sensitive to freezing injury, and their vines should be covered to avoid freezing injury during the winter at Chuncheon. Hence, the relatively greater freezing tolerance of 'Hanareum' compared with other tetraploid grape cultivars is also advantageous to farmers who want to cultivate grapes with large fruit even in cold regions of Korea.

When the trimmed flower clusters of 'Hanareum' are dipped in a solution of 25 ppm GA₃ at the full-bloom stage, the clusters show a uniform shape at harvest. The skin color of the berry is black (Fig. 3). The fruit has medium thickness and is juicy. In addition, the mean cluster weight is 457 g, and it has a potential yield of 19.3 t/ha, which indicates that the fruit productivity of 'Hanareum' is similar to that of 'Kyoho'. The average total soluble solids concentration of 'Hanareum' is 19.3 °Brix, which is as high as that of 'Kyoho'. Berry cracking is not observed in 'Hanareum', and better fruit firmness is also seen when compared with it of 'Kyoho'. Therefore, storage ability has been good.

In conclusion, 'Hanareum' has stable vine growth characteristics and excellent berry characters in comparison with 'Kyoho'. In addition, seedless, large fruit can be produced with less labor compared with other grape cultivars used for seedless grapes. For this reason, it is expected that the introduction of

'Hanareum' will contribute to the diversification of Korean grape cultivars as well as to the enhancement of competitiveness in the Korean grape industry.

Availability

'Hanareum' is a patented cultivar from KSVS in Korea and is owned by Gangwondo Agricultural Research and Extension Services. Requests for cuttings for research purposes may be addressed to Young-Sik Park (yspark06@korea.kr).

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