

‘Black Eye’: A Unique Korean Grape Variety Developed from a Cross between ‘Muscat Bailey (*V. labrusca* × *V. vinifera*) A’ and Korean Wild Grape (*V. amurensis*)

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Vitis amurensis is a member of the family Vitaceae and is found in China, Japan, and Korea (Venuti et al., 2013). Several researchers have reported that it has high disease resistance and freezing tolerance (Jiao et al., 2015; Liu and Li, 2013) and contains many health-promoting compounds such as anthocyanin and resveratrol (He et al., 2015). Therefore, although *V. amurensis* has received great attention in Korea (Park et al., 2015), it has been mainly used for making processed products because of its generally low fruit quality (Heo et al., 2016). Important agricultural traits found in commercial grape cultivars can be introduced into *V. amurensis* by a traditional breeding approach to counteract weaknesses. Therefore, our breeding program aimed at developing unique hybrid grape cultivars with attractive vine and fruit characteristics by crossing commercial grape cultivars with *V. amurensis*. As a result, we developed a novel hybrid grape cultivar named ‘Black Eye’ that produces high-quality black berries with an intense aroma and excellent disease resistance. These qualities make ‘Black Eye’ well suited for diverse use and cultivation in Korea.

Origin

‘Black Eye’ was derived from a cross between ‘Muscat Bailey A’ (MBA) (*V. labrusca* ×

V. vinifera) and ‘KW-51’ (*V. amurensis*) in 2004 (Fig. 1). ‘MBA’ originated from a cross between ‘Bailey’ and ‘Muscat Hamburg’. ‘KW-51’ is one of the most valuable *V. amurensis* genetic resources collected from Korea; initially, we collected a total of 155 Korean native clones of *V. amurensis* from

several regions of Korea and evaluated their agricultural traits (Park et al., 2005a, 2005b). From pilot experiments, we found that a wide genetic variation existed among accessions and that ‘KW-51’ had attractive agricultural characteristics such as unique fruit characteristics and high disease resistance.

The original ‘Black Eye’ seedling was planted in 2005. Because of its self-fertile flowers, high disease resistance, and high strength of fruit attachment to the bunch, it was propagated for further field tests. From 2008 to 2010, vine and fruit characteristics of ‘Black Eye’ were compared with those of its parents and one reference grape cultivar (Gaeryangmeoru) that had been developed from a cross between wild grape species and the ‘Concord’ grape cultivar (Park et al., 2007). Five vines of each cultivar/line were established at the Gangwondo Agricultural Research and Extension Services farm in Chuncheon, Korea. Vines for the field examination were spaced 4 m (between rows) × 2 m (between plants) and trained to an overhead arbor. No special irrigation was applied, and the soil surface was managed by sod culture during the growing season. Bearing branches were spur-pruned to two buds every February. Owing to its superior performance, ‘Black Eye’ was selected in 2010 and sent to the Korea Seed & Variety Service (KSVS) in 2011. In May 2016, after a 5-year evaluation at the KSVS, ‘Black Eye’ became the protected cultivar because it stably expressed the traits we reported.

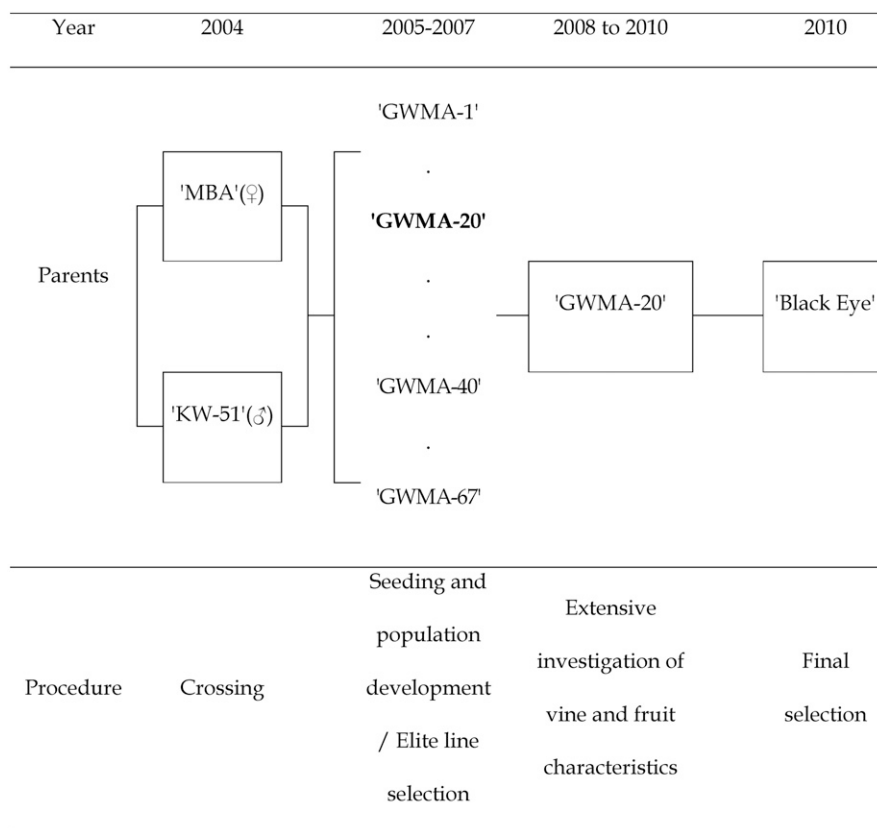


Fig. 1. Pedigree of ‘Black Eye’ grape.

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Table 1. Vine and fruit characteristics of ‘Black Eye’, ‘Gaeryangmeoru’, ‘MBA’, and ‘KW-51’ grapes.

Characteristics	Cultivar/line			
	Black Eye	Gaeryangmeoru	MBA	KW-51
Vine				
Vigor	Moderately vigorous	Vigorous	Moderately vigorous	Vigorous
Flowering date	6 June	10 June	12 June	7 June
Harvest date	22 Sept.	3 Oct.	5 Oct.	20 Sept.
Days from flowering to maturity	106	113	125	103
Fruit				
Cluster weight (g) ^z	193.5	84.2	361.7	38.6
Cluster shape	Conical	Conical	Conical	Conical
Berry weight (g) ^z	2.9	1.6	4.8	1.1
Berry shape	Circular	Circular	Circular	Circular
Berry skin color	Black	Black	Black	Black
Total soluble solids (%) ^y	18.2	15.4	17.3	17.7
Titrateable acidity (%) ^y	0.94	1.01	0.75	1.68
Anthocyanin content (mg/g) ^x	23.4	18.7	13.9	35.3
Resveratrol content (μg/g) ^x	0.17	0.15	0.13	0.22
Aroma	Yes	No	No	Yes
Disease resistance				
Downy mildew	Highly resistant	Resistant	Moderately resistant	Highly resistant
Gray mold	Grade 1	Grade 2	Grade 2	Grade 1

^z‘MBA’ = ‘Muscat Bailey A’.

^zMeans of cluster weight and berry weight were measured from 10 clusters taken from each of the five vines ($n = 50$).

^yAverage total soluble solids and titrateable acidity were measured from a total of 500 berries.

^xAnthocyanin and resveratrol contents were measured using the extract obtained from 100 mg of berry skin. The data were collected from three samples.

Description

‘Black Eye’ is diploid and has moderate vine vigor. The number of days from flowering to harvest (“fruit growth period”) for ‘Black Eye’ averages 106 d (Table 1). For perspective, ‘Campbell Early’ has a short fruit-growth period of ≈ 90 d, and ‘MBA’ has a long fruit-growth period of ≈ 120 d. Accordingly, ‘Black Eye’ has a medium fruit-growth period. The harvest date for ‘Black Eye’ is around the last week of September, and ‘Black Eye’ can be harvested just before the Chuseok holiday. Because fruit prices tend to soar on the Chuseok holiday in Korea, cultivating ‘Black Eye’ can be very profitable.

Ten clusters were taken from each of the five vines at optimum maturity to investigate fruit characteristics. Fruit cluster weight was calculated from the total average weight of 50 clusters, and berry weight was determined. Ten berries were sampled from each cluster to evaluate total soluble solid content and titrateable acidity. Anthocyanin and resveratrol contents were measured using the extract obtained from 100 mg of berry skin. The cluster appearance of ‘Black Eye’ is excellent, with a uniform shape, and the berries are not susceptible to cracking from rainfall near or at maturity. The mean cluster weight of ‘Black Eye’ is 193.5 g, much greater than those of ‘Gaeryangmeoru’ and ‘KW-51’. Average berry weight is 2.9 g, with abundant juice and a soft texture. Potential yield for ‘Black Eye’ is expected to reach 16 ton/1 ha because retaining two bearing clusters does not delay fruit development or maturity. Although the cluster weight of ‘Black Eye’ is smaller than that of ‘MBA’, which is widely cultivated in Korea, the fruit productivity of ‘Black Eye’ can be similar to that of ‘MBA’. Fully ripe fruit of ‘Black Eye’ distinguishes itself by a rich aroma and an intense purple skin color (Fig. 2). The mean

total soluble solid content of ‘Black Eye’ is 18.2%, which is higher than that of the three other examined grapes. Titrateable acidity of ‘Black Eye’ is also lower than that of ‘Gaeryangmeoru’ and ‘KW-51’. It also contains relatively high amounts of anthocyanin and resveratrol, which is one of the most important factors to consumers choosing fruits and vegetables in the Korean agricultural market.

Novel grape cultivars must be resistant to downy mildew and gray mold to be widely cultivated in Korea, and resistance to these diseases was evaluated in the field and in vitro, respectively. Resistance to downy mildew was determined by a severity evaluation using a graded scale ranging from 1 to 9 as follows: 1 = highly resistant; 3 = resistant; 5 = moderately resistant; 7 = susceptible; and 9 = highly susceptible (IPGRI, UPOV, OIV, 1997). Gray mold resistance was investigated by inoculating aqueous suspensions of *Botrytis cinerea* on fruit. The severity of the gray mold was rated using a graded 1 to 5 scale for surface lesion appearance as follows: 1 = no visual evidence; 2 = less than 10% infected; 3 = 10% to 30% infected; 4 = 30% to 70% infected; and 5 = greater than 70% infected (Archbold et al., 1997). Field evaluations under high temperatures and humidities favorable to the development of disease show that ‘Black Eye’ is highly resistant (grade 1) to downy mildew. In vitro tests demonstrated that ‘Black Eye’ is highly resistant (grade 1) to gray mold. ‘Black Eye’ is extremely frost hardy, and bud damage does not occur even in Chuncheon, the coldest region in Korea. Hence, it can be easily cultivated in Korea, which has humid summers and relatively cold winters.

‘Black Eye’ has superior fruit quality and stable fruit productivity that can compete with commercial grape cultivars. Moreover, it has the agriculturally attractive traits of *V. amurensis*, such as high disease and freezing



Fig. 2. Fruit appearance of newly bred ‘Black Eye’ grape at harvesting season.

tolerance. Introduction of ‘Black Eye’, therefore, is expected to contribute to the diversification of Korean grape cultivars and to maintain the competitiveness of the Korean grape industry.

Availability

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

Literature Cited

- Archbold, D.D., T.R. Hamilton-Kemp, M.M. Barth, and B.E. Langlois. 1997. Identifying natural volatile compounds that control gray mold (*Botrytis cinerea*) during postharvest storage of strawberry, blackberry and grape. *J. Agr. Food Chem.* 45:4032–4037.
- He, F., W.K. Chen, K.J. Yu, X.N. Ji, C.Q. Duan, M.J. Reeves, and J. Wang. 2015. Molecular and biochemical characterization of the UDP-glucose: Anthocyanin 5-O-glucosyltransferase from *Vitis amurensis*. *Phytochemistry* 117: 363–372.
- Heo, J.Y., N.Y. Um, S.K. Jeong, and Y.S. Park. 2016. Quality characteristics of red wine from

- 'Cheongsan (*Vitis amurensis*)' grape cultivar. J. Korean Soc. Intl. Agr. 28(2):237–242.
- IPGRI, UPOV, OIV. 1997. Descriptors for grapevine (*Vitis* spp.). International Union for the Protection of New Varieties of Plants, Geneva, Switzerland/Office International de la Vigne et du Vin, Paris, France/International Plant Genetic Resources Institute, Rome, Italy.
- Jiao, L., Y. Zhang, J. Wu, H. Zhang, and J. Lu. 2015. A novel U-box protein gene from "Zuoshanyi" grapevine (*Vitis amurensis* Rupr. cv.) involved in cold responsive gene expression in *Arabidopsis thaliana*. Plant Mol. Biol. Rpt. 33:557–568.
- Liu, L. and H. Li. 2013. Review: Research progress in amur grape, *Vitis amurensis* Rupr. Can. J. Plant Sci. 93(4):565–575.
- Park, Y.S., J.Y. Heo, I.J. Kim, S.J. Heo, K.H. Kim, B.C. Jeong, and S.M. Park. 2005a. Growth and fruit characteristics of *Vitis amurensis* Rupr. collected in Gangwondo. Hanguk Yakyong Changmul Hakhoe Chi 13(6):226–233.
- Park, Y.S., I.J. Kim, B.C. Jeong, J.Y. Heo, and S.M. Park. 2005b. Pollen characteristics of flower type and cross compatibility with table grape in *Vitis amurensis* Rupr. Hanguk Yakyong Changmul Hakhoe Chi 13(6):234–240.
- Park, Y.S., I.J. Kim, J.Y. Heo, B.C. Jeon, I.M. Choi, and S.M. Park. 2007. Identification of Gaeryangmeoru (*Vitis* sp.)'s origin using isozyme analysis. Hort. Environ. Biotechnol. 48(6):404–407.
- Park, Y.S., J.Y. Heo, N.Y. Um, D.K. Hong, and S.M. Park. 2015. Development of a new wine grape cultivar 'Cheongpung'. J. Amer. Pom. Soc. 69:222–225.
- Venuti, S., D. Copetti, S. Foria, L. Falginella, S. Hoffmann, D. Bellin, P. Cindric, P. Kozma, S. Scalabrin, M. Morgante, R. Testolin, and D. Gaspero. 2013. Historical introgression of the downy mildew resistance gene Rpv12 from the Asian species *Vitis amurensis* into grapevine varieties. PLoS One 8(4):e61228. doi: 10.1371/journal.pone.0061228.