Grape breeding in China

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Summary: The paper introduces the achievements of grape breeding in China since 1950. So far, around 50 new varieties and many new lines of grape have been produced. Some new varieties are cold resistant, disease resistant with high yield and are suitable for making wine. Some are early maturing with large, seedless berries. Some are suitable for the climate of high humidity and for cultivation in rainy areas of southern China. Some bear large clusters and berries of beautiful appearance and are of high yield and quality. Some are suitable for canning and making juice.

Key words: breeding, variety of vine, Vitis amurensis, China, wine grape, table grape, juice, yield, must quality, maturation, frost resistance, disease resistance, salt resistance, ecology.

Although viticulture has a history of over 2000 years in China, grape breeding was only started in the early 1950s. So far, the best method for breeding new varieties of grape is cross-breeding. Therefore interspecific hybridization and intervarietal hybridization are carried out widely at different institutions and colleges all over China. Around 50 new varieties and many new lines of grape have been produced through selection, evaluation and cultivation experiments in the past 40 years and remarkable success has been achieved.

In 1951, Jilin Institute of Pomology produced Gongniang No. 1 (Muscat Hamburg x *Vitis amurensis*) and Gongniang No. 2 (*V. amurensis* x Muscat Hamburg).

Gongniang No. 1 is a highly cold resistant variety which can overwinter safely without being buried for protection, even in places where the lowest temperature reaches -22 °C. It is also a disease resistant variety with high yield and good quality. Tonghua Winery of Jilin Province won a prize in the National Wine Competition 1984, for its 'Princess Red Wine' made from grapes of Gongniang No. 1. This variety is cultivated in large areas in Jilin, Heilongjiang, Liaoning, Gansu Provinces and the Inner Mongolia Autonomous Region.

The grape variety Heishan was produced by Xingcheng Institute of Pomology, Chinese Academy of Agricultural Sciences by crossing Black Hamburg and *V. amurensis*, and Shanmeigui was produced by crossing Muscat Hamburg and *V. amurensis* in 1952.

Beichun, Beimei and Beihong were produced by crossing Muscat Hamburg and *V. amurensis* at the Beijing Botanical Garden, Institute of Botany, Chinese Academy of Sciences in 1954. Beichun, in particular, is a disease resistant variety with high yield, cold resistance and high sugar content in fruits, suitable for making red wine. It can overwinter safely without being buried for protection in northern China. It is also disease resistant, tolerant to humid condition and very adaptable to rainy areas of southern China. It is distributed everywhere in China.

Besides these, several table grape varieties were bred by the Beijing Botanical Garden in 1960 through hybridization between varieties. These include Jingzaojing (Queen of the Vineyards x Thompson Seedless) and Jingkejing (French Blue x Black Monukka), which are seedless and early maturing varieties, Jingyu (Italia x Queen of the Vineyards), which is an early maturing variety with large berries, and Jingfeng (Queen of the Vineyards x Black Monukka), which is a late maturing variety with high yield. Among these, Jingzaojing is outstanding, producing large and handsome clusters with berries bigger than those of Thompson Seedless. The berries are oval, yellowish-green, with thin skin, crisp pulp, and of high quality, weighing on average 2.6 g. It is also suitable for making raisins and for canning. It is cultivated in large areas in Xinjiang, Gansu and Inner Mongolia of China.

In 1956, Hongshan Horticulture Farm, Pingdu County in Shandong Province produced the new table grape varieties Zexiang, Zeyu and Zefeng by crossing Muscat Hamburg and Longyan. The variety Zexiang is disease resistant and has high yield. Clusters are medium and conical; berries are medium, elliptical or oval, weighing on average 5.6 g each, yellowish-green, with strong muscat flavor similar to Muscat Hamburg, and of good quality. It has been cultivated widely in Shandong Province.

In 1957, breeding work for wine varieties was started in the Shandong Institute of Wine Grape. The main target was breeding varieties which are good for making high quality red or white wine and suitable for cultivation in the area of middle and lower reaches of the Yellow River. At the same time, breeding for table grape varieties and varieties for canning and juice-making was also carried out at this Institute. Varieties produced include Quanbai (Riesling x Verdot) and Quanyu (Riesling x Muscat Hamburg), suitable for making dry white wine, Meiyu and Meinong, suitable for making dry red wine, Meichun, suitable for making red wine and Hongzhilu, suitable for making red wine and for pigment. The parents of the last four varieties are Merlot and Verdot. In addition, the quality variety Baotuhong which is cold resistant, disease resistant and suitable for making red wine was produced at this Institute by crossing Sweet Water and *V. amurensis* in 1964. These varieties all have high yield and the wines made from them are of good quality. They are favoured by growers and are widely distributed.

Table grape varieties, Shandong Zaohong, Zaohuang, Quanlongzhu and Honglianzi were bred at the same Institute by crossing Muscat Hamburg and Queen of the Vineyards in 1963, Cuihong and Hongxiangjiao were bred by crossing Muscat Hamburg and Triumph in 1964. Shangdong Zaohong is a good variety producing medium clusters, with medium berries weighing on average 4-5 g each. It is a disease resistant variety with high yield and the berries ripen in early July in Jinan, Shandong Province. It is an early maturing variety of good quality, the colour, flavor and taste of its berries are just like those of Muscat Hamburg. It is a favorite of people in large areas and is being disseminated.

In 1960, The Institute of Saline-Alkali Soil Utilization in Liaoning Province produced Zifeng (Black Hamburg x Niagara), which has the distinguished feature of tolerating saline-alkali conditions and can grow normally in a soil with 0.22 % salinity.

A F_1 hybrid progeny produced from Muscat Hamburg x *V. amurensis* was obtained in 1961 by Agronomy College in Xiongyue of Liaoning Province. A new cold resistant variety Xiongyuebai was bred in 1967 with Longyan as the maternal parent, and the best hybrid progeny of Muscat Hamburg x *V. amurensis* as the male parent. It has been evaluated as a fine variety suitable for making high quality white wine through selection, cultivation trials and experience with wine making for several years. It is presently very popular.

In 1962, Zhengzhou Institute of Pomology, Chinese Academy of Agricultural Sciences bred Zhengzhou Zaohong (Muscat Hamburg x Pearl of Csaba), and Heijianiang (Seibel No. 2 x Carignane), the latter shows strong disease resistance, uniform maturity and produces ruby-coloured high-quality wine. These two varieties are now popular in the area of the former course of the Yellow River.

In 1963, Zaomeigui was produced by the Department of Horticulture, Northwest Agricultural University by crossing Muscat Hamburg and Pearl of Csaba. It is an early maturing variety, with grapes harvested in early July in Baoji of Shaanxi Province. Its yield is higher than that of Pearl of Csaba. The berries are purple-red, with strong muscat flavor and the quality is also higher than that of Pearl of Csaba.

In 1963, Baimeikang and Zimeikang were bred by the Department of Horticulture, Jiangxi Agricultural University by crossing Muscat Hamburg and Campbell Early, Meiye was bred by crossing Muscat Hamburg and *V. flexuosa*, and Meiyehei by crossing Meiye and Black Hamburg. These varieties are adapted to climates of high humidity.

In order to solve the problem of insufficient supply of grapes with rich pigments to the wine making industry, two new good varieties, Yan No. 73 and Yan No. 74 (Alicante Bouschet x Muscat Hamburg), which bear dark-colour berries, were bred by Yantai Wine-making Company in 1966. These two varieties played a positive role in adjusting wine colour and improving wine quality.

In 1973, the Institute of Forestry and Pomology, Beijing Academy of Agricultural Sciences started to breed table grape varieties. The target was to produce early-maturing or seedless varieties. Zaomanao, Cuiyu and Yanhong were bred by crossing Muscat Hamburg and Jingzaojing; Zizhenzhu was bred by crossing Muscat Hamburg and Pearl of Csaba. Among them, Zaomanao has high yield, large clusters and very beautiful, medium-sized berries, weighing 4.2 g each on average. The berry is oblong, purple-red, and of high quality, with thin skin. crisp pulp and sweet taste. These four varieties were already being grown on a trial basis in Beijing, Liaoning, Jilin, Ningxia, Gansu, Shandong, Henan and Hebei Provinces.

In 1973, the Institute of Pomology, Shanxi Academy of Agricultural Sciences produced a new table grape variety, Guibao, by crossing Ispissar and Muscat VIRa. The main characteristic of this variety is the large and uniform cluster with beautiful appearance. The berries are also large, purple-red, with crisp pulp and strong muscat flavor. It produces high yields of good quality. The berries do not drop or split and tolerate transportation. The variety is suitable for cultivation in Shanxi Province.

Different new grape varieties were produced by Dalian Institute of Agricultural Sciences in 1973 through hybridization between varieties. Some bear extra large berries of beautiful appearance, produce high yields and are of quality; some bear seedless, large berries, produce high yields and are of quality; some are suitable for making wine or for canning; some have strong cold resistance and disease resistance; such as Jifeng (Kyoho x Jixiang), Fenghuang No. 12 (Muscat of Alexandria x Flame Tokay and Pobeda), Fenghuang No. 51 (Muscat of Alexandria x Cardinal), Meigui Seedless (Muscat of Alexandria x Jingzaojing), etc. Among them, Fenghuang No. 51 is an early maturing variety, its clusters and berries are large, berries are of special shape, purple-red, with thin skin, thick pulp, and sour-sweet flavour. The berries do not split or fall off, tolerate transportation, and are of fine texture. In short it is a variety of high quality and high yield, which has been well received by a great number of cultivators. Its area of cultivation is expanding.

A number of institutions have engaged in grape breeding, they are: Institute of Pomology, Academy of Agricultural Sciences in Shanxi; Shandong Agricultural University, Shanxi Agricultural University; Jilin Institute of Special Local Products; Institute of Horticulture, Xinjiang Academy of Agricultural Sciences; Shanshan Research Center of Grape, Melon and Fruits Exploitation of Xinjiang; Institute of Horticulture, Shanghai Academy of Agricultural Sciences; Inner Mongolian Institute of Horticulture; Changli Institute of Pomology in Hebei Province; and others.

These institutions have not only bred new varieties, but also studied the genetics of parents and hybrid progenies, including the inheritance of cold resistance, flower types, phenological phases and economic characters of fruits of progenies of hybrids between different species. These studies and analyses provided guidelines for cross-breeding and parent selecting.

Chinese grape breeders agree that the native wild species of China, *V. amurensis*, is an excellent cold resistant parent for breeding cold resistant grape varieties. Some of the F_1 hybrids produced can overwinter safely without being buried for protection even at -29 °C. When repeated hybridization was performed between cultivars and F_1 hybrids, the cold resistance decreased, but the characters and quality of the fruits were improved.

V. amurensis is dioecious. In the 1950s the Beijing Botanical Garden hybridized hermaphrodite cultivars and male plants of *V. amurensis*. As the result of this hybridization, 50 % male flowers appeared. Recently, a hermaphrodite-flowered form of *V. amurensis* was obtained in

China. Jilin Institute of Pomology has crossed the hermaphrodite form of *V. amurensis* with hermaphrodite cultivars, and the ratio of hermaphrodite flowers in the progeny was more than 70 %. When the female-flowered form of *V. amurensis* was crossed with the hermaphrodite cultivars, the ratio of hermaphrodite flowers in the progeny was 50 %. Therefore, the hermaphrodite form of *V. amurensis* is the best parent for breeding a cold resistant variety.

When *V. amurensis* was crossed with early maturing or late maturing varieties, the progeny tended to be mid-late or late maturing, neither early maturing nor extremely late maturing progeny appeared.

The cluster of *V. amurensis* is loose, berries are small, and the berries of *labrusca-vinifera* hybrid varieties have strawberry or foxy flavor. Since the fragrance of strawberry affects the quality of wine, *vinifera* varieties which are of high yield and could make good wine were selected as parents to be crossed with *V. amurensis* for breeding cold resistant wine varieties. No *labrusca-vinifera* hybrid variety was selected.

The inheritance tendency of wild characters of *V. amurensis* is strong. Cultivars which bear large and high-quality fruits should be selected to cross with *V. amurensis* for breeding cold resistant table grape varieties. After that, the excellent plants among the progeny should be selected for repeated hybridization.

Experiments have demonstrated that Pearl of Csaba and Queen of the Vineyards are good parents for breeding early maturing table grapes. Jingzaojing, Thompson Seedless, Black Monukka are good parents for breeding seedless grapes. Muscat Hamburg, Muscat of Alexandria, Black Hamburg and Flame Tokay are good parents for breeding table grape varieties. *Vinifera* varieties which are of high yield and good for making wines should be selected for breeding wine varieties.

These are the main achievements of grape breeding in China. Research is continuing in many Chinese institutions. Results of such research will be published in different pomological or horticultural journals. Any suggestion will be appreciated.

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