Brazilian Grape Breeding Program

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Abstract

Since 1977, Embrapa Uva e Vinho has been leading a breeding program, aiming to develop grape cultivars for different purposes as table grapes and also for wine and juice. The objectives of this program can be summarized as the development of grape cultivars adapted to different production regions, including tropical ones, presenting tolerance to the main grape diseases and pests occurring in Brazil and quality for different purposes. About 3,000 hybrids from crossings between several *Vitis* species, including wild tropical ones, are evaluated each year. Selected individuals are multiplied and evaluated for 3-4 years. Then, promising materials are propagated and evaluated in larger plots for more 3-4 years. This step can include sensory analysis of table grapes, juice or microvinifications, depending on the goal. Advanced selections are then tested on commercial fields, for about 2 years. New cultivars are released only when this decision is also supported by growers. As results, 14 new Brazilian grape cultivars were released in recent years, contributing to several segments of the grape production chain. Currently, about 300 table and processing grape selections are under evaluation and five new advanced selections are under validation. These point toward the perspective of development and release of new Brazilian grapes in the next few years.

INTRODUCTION

The first grape cultivars grown in Brazil were *Vitis vinifera* brought by the Portuguese soon after the discovery of the country in the XVI century. However, biotic, abiotic and also economic factors caused the stagnation of Brazilian viticulture until the XIX century. The introduction of the American hybrid 'Isabela' (*V. vinifera* × *V. labrusca*) took place in this period and it was spread by the Italian immigrants in the Brazilian South and Southeast, resulting in the fast substitution of European vineyards. With the American grapes, came the introduction in the country of new pests and diseases such as phylloxera (*Phylloxera vitifoliae*), downy mildew (*Plasmopara viticola*) and powdery mildew (*Uncinula necator*). A new level of technology was established, aiming at the prevention of pests and diseases as the development of more tolerant cultivars, the use chemical control and the adoption of rootstocks (Souza, 1996). A hundred years later, the implementation and evolution of these and other techniques would contribute to the success of Brazilian tropical viticulture, which today experiences a big expansion in the country (Leão and Possídio, 2000; Protas et al., 2006). As a result, today viticulture is practiced from the very South (parallel 30°) to the Northeast (parallel 10°) of Brazil.

Tropical viticulture can be defined as the one practiced where temperatures are not low enough to interrupt vine growing (Camargo, 2003). The manipulation of irrigation associated to pruning management can simulate the conditions to start this process, enabling a succession of vegetative cycles and the programming of the harvest date during the year (Camargo, 2005). However, in these conditions, the physiological and the phytosanitary behavior of commercial cultivars is completely different from their behavior in temperate conditions (Camargo, 2003).

Genetic breeding has been one of the approaches used to solve the problems resulting from the lack of adaptation of grape cultivars introduced from traditional temperate regions to the Brazilian climate. The outcome of the development of grape

cultivars adapted to Brazilian conditions is a set of more sustainable production technologies, which meet modern consumer demands. Cultivars with greater natural fertility and more resistant to the main grape diseases and pests result in reduction of chemicals in the production system, such as bud burst hormones or products to control pests and diseases.

The first reports of grape genetic breeding in Brazil are private initiatives from the end of the XIX century (Paz, 1898; Sousa, 1959). Only in the '40s the grape genetic breeding started in public institutions, first in São Paulo and later in Rio Grande do Sul (Sousa, 1959; Pommer, 1993; Santos Neto, 1971, 1990; Camargo, 2000). The grape breeding program maintained by "Instituto Agronômico de Campinas" (IAC), in São Paulo, marked the beginning of genetic program focusing on production in Brazilian tropical regions, resulting in several wine grapes and tropical table grapes such as 'Piratininga' and 'Patricia'. However, its main contributions were tropical rootstocks such as 'IAC 313', 'IAC 572' and 'IAC 766' (Santos Neto, 1971).

In Rio Grande do Sul, after the initiatives of Caxias do Sul Experimental Station, Embrapa Uva e Vinho has been leading a breeding program since 1977, aiming the development of new grape cultivars for different purposes: table grapes, juice and wine.

MATERIALS AND METHODS

Two methods have been used for the development of new Brazilian grape cultivars (Camargo, 2000).

Clonal Selection

Clonal selection aims to identify, select and propagate superior clones originated from somatic variations of standard cultivars (Becker, 1978; Huglin, 1986). This traditional method is widespread mainly in Europe and also in countries where grape growing for wine making is long-established. The efficiency depends on the amount of variability of the population under selection, which is a function of the origin of the cuttings used to form the vineyard and of how long a cultivar has been planted in the area. The main steps of the method can be resumed as: i. Prospection of mutated plants in commercial vineyards; ii. Clonal collection evaluations; iii. Validation tests made in growers's areas (Camargo, 2000).

Hybridization

Through hybridization, it is possible to use and combine all *Vitis* germplasm since its species are interfertiles. This method has been used since the XIX century in Europe and in the United States (Huglin, 1986). Although these first hybrids showed higher yields and resistance, they are also characterized by poor quality. Besides, the dissemination of information regarding the negative consequences of consumption of hybrid wines to the human health contributed to avoid their popularization (Camargo, 2000). Today, new concepts are emerging as the concern with the effect of widespread use of chemicals in agriculture on human health and environment, together with the development of high quality hybrid products (Alleweldt and Possingham, 1988). Thus, grape breeding programs are making large use of hybridization again as a means to develop new resistant grapes with quality.

Basic germplasm used includes *V. vinifera* and *V. labrusca*, besides tropical species as *V. caribaea*, *V. gigas*, *V. smalliana* and *V. shuttleworthii*. Complex interspecific hybrids created in Europe after phylloxera dissemination (as 'Seibel' and 'Seyve Villard', for instance), resulting from crosses betwen *V. vinifera* and several American species as *V. rupestris*, *V. riparia*, *V. aestivalis*, *V. cinerea*, *V. berlandieri*, *V. bourquiniana* and *V. labrusca* are also used by the Brazilian breeding program mainly as resistant source to the main pests and diseases (Camargo, 1998; Embrapa, 2010a, b).

The basic steps of the method are: i. Parental selection; ii. Hybridizations; iii. Preparation of seeds and bed seeds; iv. Seedling evaluation; v. Selection evaluation; vi. Advanced selection evaluation; vii. Validation tests made in private vineyards (Camargo, 2000). The development of seedless table grapes involves a step of embryo rescue

(Amaral et al., 2000). Each year, about 3,000 new hybrids are evaluated and about 300 intermediate and 30 advanced selections are re-evaluated.

RESULTS AND DISCUSSION

Fourteen new Brazilian grape cultivars were released in recent years, contributing to several segments of the grape production chain (Camargo et al., 2010; Embrapa, 2010a).

– 'Dona Zilá': *labrusca* table grape, medium compact clusters, medium pink round, split flesh, fox flavor. It is a late grape, recommended for the South of Brazil.
– 'Tardia de Caxias': Very similar to 'Dona Zilá', but with larger clusters and berries; with less intense pink color. Sensitive to cracking in the rainy season
– 'Moscato Embrapa': first cultivar for wine making releases by Embrapa Uva e Vinho. Initially recommended to the South of Brazil, it is now also recommended for tropical areas. It's a white hybrid grape, muscat flavor, 17°Brix, yields of 35 t/ha and resistant to bunch rot (*Botrytis cinerea*). The wine is aromatic with moderate acidity, very appreciated by Brazilian consumers. It has 76% of *V. vinifera* in its pedigree.
– 'BRS Rúbea': typical "teinturier" or dyer red which results in juices and wines with a very strong color, very appreciated by Brazilian consumers. Vines are tolerant to anthracnose, powdery and downy mildew. It was initially recommended for the South of Brazil and its area tends to grow.
– 'Concord clone 30': earlier clone of traditional juice cultivar 'Concord' which presents its general features regarding to yield, agronomic behavior and grape quality. However, the harvest period is anticipated in two weeks. It is indicated as an alternative to enlarge the period of grape juice processing in the South of Brazil.
– 'BRS Lorena': initially recommended for the South of Brazil, it is a hybrid with high yields and tolerance to the main grape diseases. It can be used to make a muscat sparkling wine, mainly because of the high sugar level (more than 20°Brix) and acidity (90-100 meq/L). It results in a muscat wine or in muscat sparkling wine with foam and persistent perlage. It presents about 80% of *V. vinifera* in its pedigree. It has good performance in tropical regions (Fig. 1A).
– 'Isabel Precoce': it is a clone from the traditional cultivar 'Isabela', recommended for juice and wine making. Its harvest period is anticipated in 30 days, comparing to standard 'Isabela'. It can be grown in tropical areas.
– 'BRS Cora': is a high yield red cultivar which produces grape juice with excellent color associated with high levels of sugar. Recommended for tropical climates.
– 'BRS Violeta': recommended for tropical, subtropical and temperate areas, for juice and wine making. It presents high yields, high sugar contents, strong color and fox flavor. Its use is recommended for juice making in blend with other cultivars such as 'Isabela' (Fig. 1B)
– 'BRS Margot': hybrid, recommended for colored wine making. It presents high yields and tolerance to grape diseases, and high sugar content. Its pedigree is 70% from *V. vinifera*.
– 'BRS Carmem': late grape, with strong color and very pleasant fox flavor. Recommended for the South of Brazil, for juice and wine making.
– 'BRS Morena': black seedless grape cultivar for tropical conditions in Brazil. High yields, large loose clusters, with crunchy berries, 20 mm with the use of AG3, it has a crunchy texture and a pleasant taste with 19°Brix. Adequate packaging is required since berries are easily detached from pedicels. Its behavior in respect to fungal diseases is similar to that of the cultivar 'Italia'.
– 'BRS Clara': yellow seedless grape cultivar for growing in tropical regions. It is characterized by high natural fertility, high yields and sugar potential, easily reaching 20°Brix. Large and loose clusters with crunch berries, mild muscat-flavor, 17 mm diameter using gibberellic acid. Its behavior in relation to fungal diseases is similar to that of the cultivar 'Italia' (Fig. 1C).

– ‘BRS Linda’: green seedless grapes for tropical climates in Brazil. High yields; large clusters, naturally loose, with large crunchy berries, neutral taste, 22 mm diameter with gibberellic acid, neutral taste and greenish color. The sugar content is low, 14 to 15°Brix, however the taste is pleasant due to low acidity. It has high resistance to berry drop as well as an excellent post-harvest storage. Concerning to fungal diseases it behaves similarly to the cultivar ‘Italia’, but is more susceptible to powdery mildew.

CONCLUSIONS

Currently, about 300 table and processing grape selections are under evaluation and five new advanced selections are under validation. That points toward the perspective of development and release of new Brazilian grapes in the next years.

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Figures

(A)

(B)

(C)

Fig. 1. (A) ‘BRS Lorena’, a white grape for wine making; (B) ‘BRS Violeta’, a colored grape for juice and wine grape; (C) ‘BRS Clara’, a seedless table grape.