Novel Brazilian Grape Cultivars

1Embrapa Grape and Wine, Bento Gonçalves, RS, Brazil
2Embrapa Grape and Wine, Tropical Viticulture Experimental Station, Jales, SP, Brazil
3Vino Vitis Consulting, Bento Gonçalves, RS, Brazil

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Abstract

In Brazil, genetic breeding aiming at the development of novel grapevine cultivars is based on the diversity maintained in the Grapevine Germplasm Bank. It consists of approximately 1500 accessions; 1000 of them have been characterized and evaluated for the most important agronomical and industrial traits, such as disease responses and must features. The program employs mainly sexual hybridizations, followed by screening and field selection cycles. During the final stages of developing novel cultivars, advanced selections are tested under semi-commercial scale, in real production conditions. The agronomical characteristics and the features of the grapes, of the juice or of the wine from the potential cultivar, are evaluated in collaboration with growers. As a result, 18 grapevine cultivars were developed in the last years, contributing to several segments of the Brazilian grape productive chain. In 2012/2013, four novel grapevine cultivars were released; three are table grapes and the fourth, for juice making. ‘BRS Magna’ is a new juice cultivar with intermediate productive cycle and wide climatic adaptation, released as an alternative for color, sugar contents and the flavor improvement. ‘BRS Vitória’ is a novel black seedless table grape cultivar presenting excellent agronomic behavior, high bud fertility and tolerance to downy mildew, the main grapevine disease in Brazil. ‘BRS Isis’ is a red seedless table grape, also tolerant to downy mildew, presenting high yields, naturally large berries and uniform color, in the absence of chemical treatments. ‘BRS Nubia’ is a seeded table grape, with good black color and neutral flavor. It is high yielding and presents large berries (24x34 mm, no gibberellin) with crisp flesh. The three novel table grapes are recommended to Brazilian subtropical and tropical areas.

INTRODUCTION

In Brazil, the first V. vinifera vineyards were established around 1530 by the Portuguese, where currently is the state of São Paulo (Fig. 1A) (Sousa, 1969). However, the warm and humid Brazilian coast was not favorable for European cultivars. Incorporation of other Vitis species, native of North America, into commercial production contributed to overcoming these problems. These grapevine species are hardier than the European cultivars and started to be used from the 19th century on, with the development of the first hybrid cultivars, such as; ‘Catawba’, ‘Isabella’, ‘Norton’, ‘Ives’ and ‘Concord’ (Hedrick, 1908, 1919; Pinney, 1989). The spread of American grapes in Brazil gained momentum with the arrival of Italian immigrants, from 1875 on, but brought along fungal diseases, from 1875 on, but brought along fungal diseases, such as; downy mildew [Plasmopara viticola (Berk e Curt) Berl] and powdery mildew [Uncinula necator (Schw.) Burr.]. New technological goals had to be established for Brazilian viticulture in order to prevent the occurrence of fungal diseases, including the use of chemical control and the development of cultivars with increased tolerance (Souza, 1969).

Presently, Brazil is at the 13th position in the world rank of grape growers (FAO, 2013). Despite the expansion tendency, Brazilian viticulture is still concentrated in the central and southern regions of the country. The state of Rio Grande do Sul is the main

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*patricia.ritschel@embrapa.br

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producer, followed by Pernambuco, São Paulo, Paraná, Santa Catarina, Bahia and Minas Gerais (Fig. 1B). In 2012, 830,915 t, equivalent to approximately 57% of the national grape production, were industrialized to wine (257,980,767 L), juice (70,066,733 L) and other products, such as; sparkling wine, dessert wine, concentrated must, among others (100,757,101 L). Table grapes correspond to 43% of the Brazilian grape production (Mello and Machado, 2014).

The first notes on grapevine genetic breeding in Brazil were on private initiatives from the late 19th century (Paz, 1898; Souza, 1969). Only in the 1940s public institutions began to undertake these activities, initially, in the state of São Paulo, and later in Rio Grande do Sul (Santos Neto, 1971; Camargo et al., 2009). The grapevine Breeding Program maintained by “Instituto Agronômico de Campinas” (IAC) is a landmark for the beginning of the development of cultivars adapted to tropical climates. Several table grape cultivars, such as; ‘Piratininga’ and ‘Patricia’, and wine grapes, such as; cultivars ‘Rainha’ (IAC 116-31) and ‘Máximo’ (IAC 138-22), were developed by the program. The main results of the program were the development of rootstocks adapted to tropical conditions, such as; ‘IAC 766’ (synonym: ‘Campinas’) and ‘IAC 572’ (synonym: ‘Jales’) (Santos Neto, 1971). Those genotypes are widely used in tropical viticulture with V. vinifera and American scions (Soares and Leão, 2009).

Currently, Embrapa Grape and Wine conducts a grape breeding program mainly focused on hybridization, aiming to develop novel grape cultivars for in natura consumption and processing for wine and juice industries (Ritschel and Maia, 2014). Despite the existence of specific lines of interest for each usage, the program has common goals, such as the development of novel cultivars with greater fecundity in warm conditions and/or increased tolerance to the major grapevine pests and diseases. Specific objectives for each product are also pursued.

MATERIAL AND METHODS

At Embrapa Grape and Wine, genetic breeding aiming to develop novel grape cultivars is based on the diversity maintained in the Grapevine Germplasm Bank, constituted of approximately 1500 accessions. The majority of the collection has been characterized and evaluated for the most important agronomical and industrial traits, such as; agronomic traits, disease responses, and must features.

Basic germplasm used by the program includes V. vinifera and hybrids from V. labrusca, along with tropical wild species such as V. caribaea, V. gigas, V. smalliana and V. schuttleworthii. Complex interspecific hybrids obtained in Europe after phylloxera dissemination (for example, ‘Seibel’ and ‘Seyve Villard’, among others) and the results from crosses between V. vinifera and several American species such as V. rupestris, V. riparia, V. aestivalis, V. cinerea, V. berlandieri, V. bourquina and V. labrusca, are also used by the program, mainly as source of resistance genes for the most important diseases and pests (Camargo, 1998).

Evaluations are performed at the Tropical Viticulture Experimental Station (TVES) located in Jales, in the northwest of the state of São Paulo. During initial selection, the most carefully considered features include resistance to the main diseases, especially downy mildew (Plasmopara viticola), flower bud fecundity, yield, sugar content, acidity, and flavor. Color hue is also taken into consideration on selections of grapes for juice making.

About 2,500 hybrids, resulting from crosses between the fore mentioned species and hybrids, with the purpose of developing novel grape cultivars, are evaluated each year. Chosen individuals are propagated to selection fields where they are evaluated for 2-3 years. Promising selections are then propagated to validation fields, where their performances are evaluated further, for 3-4 years. The evaluation stage includes sensory analysis of the final product (table, juice or wine). Advanced selections are subsequently assayed on grower’s fields for about two years. Novel cultivars are released in accordance to the grower’s evaluations. Development of seedless table grapes includes an additional step of embryo rescue.
RESULTS AND DISCUSSION

Eighteen novel grapevine cultivars were developed in the past years, contributing to the several segments of the Brazilian grape productive chain. In 2012/2013, four novel grapevine cultivars were released; three are table grapes and the fourth, for juice making (Ritschel and Maia, 2014).

‘BRS Magna’

‘BRS Magna’ resulted from the crossing between ‘BRS Rúbea’ × ‘IAC 1398-21’ (‘Traviú’), made in 1999, at Embrapa Grape and Wine, in the City of Bento Gonçalves, (Ritschel and Maia, 2014). 336 plants were obtained and grafted to the vineyards at TVES. The first evaluation occurred in September 2006. The original plant was selected due to its good fertility, raspberry flavor, high sugar content and proper color. ‘BRS Magna’ was successfully evaluated in tropical and temperate regions. It presents intermediate productive cycle and its potential yield reaches 25 to 30 t ha⁻¹. The estimated thermal requirements of ‘BRS Magna’ are of 1442 degree-day, from pruning to the end of maturation, and of 1330 degree-day, from sprouting to the end of maturation. ‘BRS Magna’ presents medium tolerance to leaf blight, whose etiological agent has not been identified. During the evaluations, symptoms of downy mildew [Plasmopara viticola (Berk e Curt) Berl], powdery mildew [Uncinula necator (Schw.) Burr.], bunch rot (Botrytis cinerea Pers.), anthracnosis [Elsinoe ampelina (De Bary) Shear], grape ripe rot (Glomerella cingulata (Ston.) Sapulda & Schrenk) and leaf rust (Phakopsora euvitis Ono) were also evaluated. ‘BRS Magna’ presented good agronomic performance when grafted to the rootstocks ‘Paulsen 1103’, in Southern Brazil, and ‘IAC 572’, in tropical areas. The fully ripe grape presents pleasant raspberry flavor, typical of V. labrusca. The chemical traits of the must are sugar content of 17-19°Brix, average total acidity of 90 meq L⁻¹, and pH of 3.60. The juice made with ‘BRS Magna’ displays an intense violet color, and can be consumed alone or in blends with other juices, where it can help to improve the color, sweetness, and flavor. In comparison with the juice made from other cultivars released by the Grape Breeding Program anthocyanin and phenolic compounds contents from ‘BRS Magna’ were distinguished, with smaller values only when compared to those from ‘BRS Violeta’ juice (Fig. 2).

‘BRS Vitória’

‘BRS Vitória’ was selected from the cross between ‘CNPV 681-29’ [‘Arkansas 1976’ × ‘CNPV 147-3’ (‘White Niagra’ × ‘Venus’)] × ‘BRS Linda’, made in 2004, at TVES. 399 embryos were rescued from the cross, giving rise to 158 plants, which were grafted to the vineyards of TVES (Ritschel and Maia, 2014). The first harvest took place in August 2007, where the original plant was selected due to its good bud fecundity, raspberry flavor, high sugar content and absence of seeds. Subsequently, the horticultural and grape quality traits observed in the first harvest were confirmed, along with downy mildew tolerance (Fig. 3). ‘BRS Vitória’ was evaluated under tropical and subtropical climate conditions. It is a vigorous cultivar with wide climate adaptation, expressed by its excellent horticultural performance in several regions where it has been assayed. The clusters are slightly compact. Recommended yields can reach 25 to 30 t ha⁻¹. Due to its high level of acidity, harvest is recommended at 19°Brix or higher (Fig. 4). At this stage, ‘BRS Vitória’ berries present the best balance between sugar levels and acidity, resulting in especially pleasant raspberry flavor without astringency. The thermal requirements for ‘BRS Vitória’ were estimated in 1511 degree-days, from pruning to harvest, and 1375 degree-days, from bud sprouting to the end of maturation. High levels of tolerance to downy mildew and leaf blight were observed. The cultivar is susceptible to leaf rust and anthracnosis during the rainy season and, also, to fruit fly [Anastrepha fraterculus (Wied.) (Diptera: Tephritidae) and Ceratitis capitata (Wied. 1824)] attack. In Marialva, Paraná, the occurrence of grape ripe rot was also observed. The novel cultivar presents good tolerance to berry cracking in the presence of heavy rainfalls during grape maturation.
**‘BRS Isis’**

‘BRS Isis’ was also selected from the cross ‘CNPUV 681-29’ [‘Arkansas 1976’ × ‘CNPUV 147-3’ (‘White Niagara’ × ‘Venus’)] × ‘BRS Linda’. The original plant was selected due to its high bud fecundity, red large berries and neutral flavor. These traits, along with downy mildew tolerance, were confirmed during evaluation essays in tropical and subtropical regions (Fig. 3). It is a vigorous, late cultivar with strong apical dominance and thermal requirements estimated in 1675 degree-days, from pruning to harvest, and 1800 degree-days, from bud sprouting to the end of maturation. It produces 2-3 great clusters per shoot, with natural weight of 375 g, without growth regulator applications. Innate berries are also large, reaching an average of 18.5×28.5 mm. These features make ‘BRS Isis’ a very productive cultivar. In tropical regions, where two annual production cycles are possible, the average productivity in four successive years, was of 26 t/ha/cycle. Besides downy mildew, ‘BRS Isis’ is also tolerant to leaf blight, but susceptible to leaf rust and *Botryodiplodia theobromae* Pat. The incidence of bunch rot, powdery mildew and anthracnosis was not observed during the essays. Fully mature grapes are neutral in flavor with large, soft seed rudiments. Soluble solid contents can reach 16-21°Brix coupled with low total acidity (0.34-0.55 g of tartaric acid 100 ml⁻¹), resulting in SS/AT ratios from 38 to 47.

**‘BRS Núbia’**

‘BRS Nubia’ is a seeded grape cultivar, selected from the cross between ‘Michele Palieri’ × ‘Arkansas 2095’ due to the appearance of the bunch, presence of large, black berries with uniform color, and neutral flavor. These traits were confirmed during evaluation essays in tropical and subtropical regions. It is a vigorous intermediate-cycle cultivar and thermal requirements are estimated in 1500 degree-days, from pruning to harvest. It presents medium bud fertility, with large innate bunches (450 g in average) and berries (24×34 mm), in the absence of growth regulator applications. These features make ‘BRS Núbia’ a productive cultivar, reaching yields of 30 t/ha. It is moderately tolerant to downy mildew, leaf rust and leaf blight, but susceptible to powdery mildew. The incidence of anthracnosis and grape ripe rot were not observed during the essays. Berry cracking may occur in the presence of heavy rainfalls during grape maturation, and damaged berries are susceptible to acid rots. Soluble solid contents of around 16-20°Brix coupled to medium total acidity (0.80 g of tartaric acid 100 ml⁻¹) result in ratios higher than 20 SS/TA.

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**Literature Cited**


Fig. 1. (A) Map of the current viticultural regions in Brazil and locations of Embrapa Grapevine and Wine Headquarters (Bento Gonçalves, RS) and Tropical Viticulture Experimental Station (TVES) (Jales, SP); (B) Grapevine production per state in Brazil. The most representative producing states are shown (Mello and Machado, 2013).
Fig. 2. Mean of total anthocyanin content (mg L⁻¹) (A) and polyphenol index (B) determined in the juices made with cultivars released by the Grape Breeding Program. ‘BRS Violeta’ and ‘BRS Magna’, the novel cultivar, presented the highest values. (Embrapa Uva e Vinho, vintages 2010-11 and 2011-12) (Embrapa Grape and Wine, Bento Gonçalves, RS).

Fig. 3. Downy mildew progress curves in grape cultivars ‘Seyve Villard 12375’ (resistant) and ‘Thompson Seedless’ (susceptible) in comparison to ‘BRS Vitória’ and ‘BRS Isis’, under greenhouse conditions. Response of the novel cultivar is similar to that of the resistant hybrid (‘Seyve Villard 12375’) (Embrapa Grape and Wine, TVES, Jales, SP).
Fig. 4. Total acidity (TA) evolution, expressed as weight of tartaric acid (g) per 100 ml, sugar content, measured as total soluble solids, expressed as °Brix, and soluble solid and acidity ratio (SS/TA) during berry ripening of ‘BRS Vitória’ (Embrapa Grape and Wine, TVES, Jales, SP).