Ciência e Agrotecnologia
SCIENCE AND AGROTECHNOLOGY

Ciência e Agrotecnologia, 47:e008023, 2023
http://dx.doi.org/10.1590/1413-7054202347008023

Agricultural Sciences
eISSN 1981-1829

Yield components and physical attributes of the 'BRS Magna' grapevine on different rootstocks

Componentes de rendimento e atributos físicos da videira 'BRS Magna' sobre diferentes porta-enxertos

Chaiane Renata Grigolo[1*], Idemir Citadin[1], Edimir Andrade Pereira[2], Laise de Souza de Oliveira[1], Renata Caroline Rossoni Gobetti[1], Nelson Pires Feldberg[3]

[1]Universidade Tecnológica Federal do Paraná/UTFPR, Programa de Pós Graduação em Agronomia, Pato Branco, PR, Brasil
[2]Universidade Tecnológica Federal do Paraná/UTFPR, Programa de Pós Graduação em Tecnologia de Processos Químicos e Bioquímicos, Pato Branco, PR, Brasil
[3]Empresa Brasileira de Pesquisa Agropecuária/EMBRAPA, Canoinhas, SC, Brasil
*Corresponding author: chaigrigolo@hotmail.com
Received in June 1, 2023 and approved in October 11, 2023

ABSTRACT

'BRS Magna' was released with the aim of improving the colour, sweetness, and flavour of Brazilian grape juice. Therefore, it is necessary to test this cultivar on different rootstocks in order to identify the canopy/rootstock combinations that best contribute to the purpose of the enterprise under cultivation conditions. Thus, the objective of this study was to evaluate the influence of different rootstocks on the yield components and physical characteristics of the bunch and berry of the 'BRS Magna' grapevine. The research was conducted in the vineyard established in the experimental area of the Universidade Tecnológica Federal do Paraná (UTFPR), located in the municipality of Pato Branco, Paraná. The 'BRS Magna' was grafted onto 10 rootstocks: 'Kober 5BB', 'SO4', 'IAC 766 Campinas', 'Harmony', 'Paulsen 1103', '420A', 'IAC 572 Jales', 'Freedom', 'IAC 313 Tropical', and '101-14 MGT'. For three agricultural years, production, productivity, vegetative vigor, number of bunches, and average bunch weight per plant, length and width of bunch and berry, as well as average berry weight were evaluated. Analysis of variance showed a interaction between rootstocks and production years for all variables. 'BRS Magna' showed alternation in yield components, vegetative vigor and physical characteristics of bunch and berry between the evaluated crops. Under the cultivation conditions studied, the recommended rootstock for the 'BRS Magna' cultivar is 'IAC 572 Jales'. On the other hand, '101-14 MGT' and '420 A' are not recommended as rootstock for this cultivar.

Index terms: *Vitis* sp.; grafting; productivity.

RESUMO

'BRS Magna' foi lançada com o objetivo de melhorar a cor, doçura e sabor do suco de uva brasileiro. Portanto, é necessário testar esta cultivar em diferentes porta-enxertos, a fim de identificar as combinações copa/porta-enxerto que melhor contribuam para o objetivo do empreendimento nas condições de cultivo. Assim, o objetivo deste trabalho foi avaliar a influência de diferentes porta-enxertos nos componentes de produção e nas características físicas do cacho e da baga da videira 'BRS Magna'. A pesquisa foi conduzida no vinhedo implantado na área experimental da Universidade Tecnológica Federal do Paraná (UTFPR), localizada no município de Pato Branco, Paraná. A 'BRS Magna' foi enxertada em 10 porta-enxertos: 'Kober 5BB', 'SO4', 'IAC 766 Campinas', 'Harmony', 'Paulsen 1103', '420A', 'IAC 572 Jales', 'Freedom', ' IAC 313 Tropical' e '101-14 MGT'. Durante três anos agrícolas foram avaliados a produção, a produtividade, vigor vegetativo, o número de cachos, o peso médio do cacho por planta, o comprimento e a largura do cacho e da baga, bem como o peso médio da baga. A análise de variância mostrou interação entre porta-enxertos e anos de produção para todas as variáveis. 'BRS Magna' apresentou alternância nos componentes de produção, vigor vegetativo e nas características físicas de cacho e baga entre as culturas avaliadas. Nas condições de cultivo estudadas, o porta-enxerto recomendado para a cultivar 'BRS Magna' é o 'IAC 572 Jales'. Por outro lado, '101-14 MGT' e '420 A' não são recomendados como porta-enxerto para esta cultivar.

Termos para indexação*:* *Vitis* sp.; enxertia; produtividade.

INTRODUCTION

Brazilian grape juices are mainly produced from *Vitis labrusca* grapes and account for more than 80% of the national production (Da Silva et al., 2022). 'BRS Magna' was launched with the proposal of improving the colour, sweetness, and flavour of Brazilian grape juice. It is a red grape cultivar, with wide climatic adaptation, recommended for cultivation in regions with tropical and temperate climates (Ritschel et al., 2014).

Success in grape production is linked to the management practices adopted, from vineyard establishment, formation, and harvest (Vedoato et al., 2020). The use of rootstock has become an indispensable practice, as the interaction between it and the scion cultivar, climate, and soil of each producing region allows for satisfactory results in grape production (Souza et al., 2015). Furthermore, the use of rootstocks represents a strategy for adaptation to abiotic stresses, such as saline, dry, humid, acidic, alkaline, shallow, compacted, or low-fertility soils, as well as biotic stresses, such as pests and diseases (Leão; Chaves, 2019).

Due to their different performances under cultivation conditions, the rootstock promotes differential effects on the scion cultivar, influencing vigour, yield components, and fruit quality, as well as the quality of derived products (Da Silva et al., 2017; Ferreira et al., 2019; Loureiro et al., 2016; Villanova et al., 2021). However, this influence is dependent on the specific affinity of the scion-rootstock interaction (Callili et al., 2022; Tecchio et al., 2022).

The choice of rootstock requires careful consideration and should take into account the particularities of the production regions and the cultivars used as scion, since there is no universal rootstock and no material shows superiority for all cultivation regions (Li et al., 2019). Thus, each material must be tested before a decision is made to use it, given that its efficiency may vary depending on the scion and planting location (Klimek et al., 2022).

For the implementation of the vineyard in which the present work was effective, the choice of rootstocks was based on the results obtained in the previously carried out experiment, in which the compatibility and initial development of 'BRS Magna' grafted on 17 rootstocks were evaluated different grafts (Grigolo et al., 2021). Of these, ten materials were selected for the field phase, these being the most used in southern Brazil.

The introduction of *Vitis* sp. varieties, such as 'BRS Magna', for the production of grape juice requires more research to evaluate the interactions in scion-rootstock combinations (Da Silva et al., 2022). Therefore, the objective of this study was to evaluate the influence of rootstocks on yield components and physical characteristics of the bunch and berry of the 'BRS Magna' grapevine.

MATERIAL AND METHODS

The study was conducted in a vineyard established in the experimental area of the Universidade Tecnológica Federal do Paraná (UTFPR), located in the municipality of Pato Branco, Paraná, at an altitude of 764 m, latitude 26°10'38" S and longitude 52°41'24" W. The climate in the area is classified as Cfa and the soil is classified as Dystroferric Red Latosol.

The vineyard was established in January 2019, with the cultivar 'BRS Magna' grafted onto different rootstocks and trained on a trellis system. The crop rows were spaced four meter apart and arranged on contour lines in a north-south direction, each with a length of 90 metres. The experimental units were nine metres long by four metres wide, totalling 36 m^2.

The treatments consisted of the use of ten rootstocks: 'Kober 5BB', 'SO4', 'IAC 766 Campinas', 'Harmony', 'Paulsen 1103', '420A', 'IAC 572 Jales', 'Freedom', 'IAC 313 Tropical', and '101-14 MGT', and three production cycles (2020, 2021, and 2022/23). The experiment was conducted in a randomized complete block design, in a factorial scheme (rootstocks x production cycles), with four replicates, with nine plants per plot, spaced one metre apart, seven of which were used for analysis and two as border plants.

The area of soil destined for the experiment received, prior to planting, the application of calcitic limestone, 695 kg ha^{-1} NPK chemical fertilizer (8:25:16) and 7.0 ton ha^{-1} poultry litter, both in coverage. Annually, with the exception of the third year, with the beginning of sprouting, replacement fertilization was carried out on the surface using organic fertilizer from bird waste, approximately four kg per plant, in coverage. In addition to fertilization, all experimental units were cultivated with a mix of black oats, turnip and vetch, during the vineyard's rest period.

The short pruning system was used, carried out in August of each year, maintaining two buds per spur, totaling 24 buds per plant. Of these, 12 branches per plant were selected, taken to the last wire of the espalier (3.10 m from the ground), and then removed. In both cycles, 3% Dormex (hydrogen cyanamide 520 g L^{1-})(Dormex®) was applied to ensure uniform sprouting of the vines.

During both cycles, the practices of weeding and mowing weeds, control of leaf-cutter ants through the distribution of ant killer baits on the trails and application of Formifuu® anti-ant sticky paste on the trunks, summer pruning (sprouting, topping, leaf removal) and branch staking were carried out. In addition to these activities, phytosanitary treatments were carried out to prevent mildew and anthracnose with three applications of Dithane® (Mancozeb) during the budding period using a knapsack sprayer and eight applications interspersed with Amistar Top® (Azoxystrobin 200 g L^{-1} + Difenoconazole

125 mg L^{-1}) and Bravonil® (Chlorothalonil 500 g L^{-1}) using a remotely piloted helicopter.

The agronomic variables evaluated were: a) yield per plant: evaluated at harvest by weighing all the bunches harvested from each vine on a digital electronic scale, expressed in kilograms (Kg); b) productivity: estimated by multiplying the production obtained by the plant density per hectare, according to the adopted spacing (1m x 4m), in tons per hectare (t ha^{-1}); c) vegetative vigor: two branches of the year were selected from each plant, totalizing 14 branches per plot. The total length (cm) was determined from these with a measuring tape; d) number of bunches per plant: obtained by counting all the bunches; e) bunch weight: determined by dividing the total bunch weight of each plant by the number of bunches, in grams (g); f) bunch length and width: obtained by measuring a representative sample of 10 bunches per plot, using a digital caliper, in centimetres (cm); g) berry weight: determined in a sample of 30 berries collected randomly per plot, weighed on a precision scale, expressed in grams (g); h) berry length and width: determined from the same representative sample collected for berry weight, using a digital caliper, in millimetres (mm).

The results were subjected to Shapiro-Wilk's test of residual normality and Levene's test of variance homogeneity, both at a significance level of 5%. The variables that met the ANOVA assumptions were subjected to Scott-Knott mean grouping test ($p \leq 0.05$). The yield and productivity variables did not have a normal distribution and were transformed using the square root ($\sqrt{x+1}$). All statistical analyses were performed using the R language.

RESULTS AND DISCUSSION

The analysis of variance showed a interaction between rootstocks and production years for all variables. 'BRS Magna' exhibited production fluctuations among the evaluated crops, a result of the interaction between rootstocks and agricultural years (Table 1). Overall, the highest yields and productivities were observed in the 2022/23 agricultural season for most rootstocks. In all evaluated cycles, the rootstocks differed from each other, with plants grafted onto 'IAC 572 Jales' showing superiority for both variables. In contrast, on '101-14 MGT', '420A', 'IAC 313 Tropical', and 'Harmony', the productivity of the canopy decreased with the progression of plant age, especially in the third evaluated cycle.

Although the 'SO4' rootstock showed similar planned behavior to 'IAC 572 Jales' in the 2022/23 agricultural harvest, there has been progressive plant death caused by Yuong Vine Decline (YVD) in the vineyard, an occurrence that is being investigated and, soon, a scientific note will be issued on the topic. Therefore, this problem prevents us from including 'SO4' as a recommended rootstock for 'BRS Magna' in the study region.

Table 1: Mean production and productivity of 'BRS Magna' grapevine on ten rootstocks in three production years.

Rootstock	*Production (kg $plant^{-1}$)		
	2020	2021	2022/23
'Kober 5BB'	1.383 cC**	1.906 cB	2.900 bA
'SO4'	1.939 bC	2.234 bB	3.298 aA
'IAC 766 Campinas'	1.343 cA	1.611 dA	1.391 eA
'Harmony'	1.964 bA	1.665 dB	0.562 fC
'Paulsen 1103'	2.047 bA	1.803 dA	1.993 dA
'420A'	1.886 bA	0.134 eB	0.203 gC
'IAC 572 Jales'	2.392 aB	3.183 aA	3.262 aA
'Freedom'	1.933 bB	1.791 dB	2.365 cA
'IAC 313 Tropical'	2.538 aA	1.959 cB	0.375 fC
'101-14 MGT'	2.104 bA	0.253 eB	0.000 hC
CV (%)	11.44		
Mean	1.721		
	*Productivity (t ha^{-1})		
	2020	2021	2022/23
'Kober 5BB'	3.46 cC	4.76 cB	7.25 bA
'SO4'	4.85 bC	5.58 bB	8.23 aA
'IAC 766 Campinas'	3.36 cB	4.03 dA	3.48 eB
'Harmony'	4.91 bA	4.16 dB	1.40 fC
'Paulsen 1103'	5.12 bA	4.51 dA	4.98 dA
'420A'	4.72 bA	0.34 eB	0.51 hC
'IAC 572 Jales'	5.98 aB	7.96 aA	8.16 aA
'Freedom'	4.83 bB	4.48 dB	5.92 cA
'IAC 313 Tropical'	6.34 aA	4.90 cB	0.94 gC
'101-14 MGT'	5.26 bA	0.63 eB	0.00 iC
***CV(%)	11.44		
Mean	4.30		

*Variable transformed by $\sqrt{x+1}$. **Means followed by different lowercase letters in the column and uppercase letters in the row differ by the Scott-Knott test ($p \leq 0.05$). *** C.V.: Coefficient of variation.

The higher vigour expressed by 'IAC 572 Jales' in 'BRS Magna' may explain the higher yields obtained on this rootstock (Table 2). In another study, the IAC 572 rootstock promoted a 61% increase in the productivity of 'BRS Magna', with significant responses in the other production components (Leão; Cunha; Souza, 2022), and was also superior for 'Moscato Embrapa' (Dalbó; Feldberg, 2019) and 'Isabel' (Sato et al., 2009).

The results obtained are in accordance with those reported in the cultivar 'Bordô' and 'Niagara Rosada' grown in trellis system (Mota et al., 2009) and 'Niagara Rosada' (Tecchio et al., 2014) and 'Vênus' (Tecchio et al, 2019) in pergola system, in which higher yields were observed on the 'IAC 572 Jales' rootstock.

The branch length was greater for the IACs '572 Jales' and '313 Tropical' in the three years evaluated (Table 2). The high scion vigor induced by IAC series rootstocks has already been observed in other studies (Feldberg et al., 2007; Dalbó; Schuck; Basso, 2011; Dalbó; Feldberg, 2019). In this case, excessive vigor requires differentiated management aimed at controlling the growth of productive branches, such as intensive pruning and control of fertilization in the crop cycle (Dalbó; Feldberg, 2019).

Although the two rootstocks induced greater vigor in the scion, 'IAC 313 Tropical' resulted in a greater number of infertile basal buds, resulting in a lower number of bunches (Table 3) and, consequently, lower productivity (Table 1) in the pruning system adopted. In general, '101-14 MGT' and '420 A' expressed low vigor to 'BRS Magna', since they induced the smallest branch lengths. A similar result was observed for the table cultivar 'Sugraone', which expressed less vigor when grafted onto '420 A' (Leão; Brandão; Gonçalves, 2011).

More vigorous rootstocks provide better conditions for the crop to produce a greater number and mass of bunches, while materials that restrict it, such as '420 A', can limit plant production (Sato et al., 2009), results that are consistent with the findings in this study (Table 2 and Table 3). In the Folha de Figo (Bordô) cultivar, the production obtained with '420 A' rootstock was 50% lower compared to 'IAC 572' (Mota et al., 2009).

The productivity obtained in the experiment, even in the best evaluated combinations, was inferior to the values described for the cultivar, which has the potential to achieve 25-30 t ha^{-1} of harvested grapes in a trellis system (Ritschel et al., 2014). Plant age, vineyard spacing, and pruning and training systems are factors that contribute to differences in productivity.

In the early productive cycles, not all the vine's organs, such as roots, trunks, and arms, are fully developed (Sato et al., 2009). In addition, the vine training system and pruning system can also influence bud fertility, reflecting variations in vine productivity, depending on the cultivar and growing region (Botelho; Pires; Terra, 2006; Meneguzzi et al., 2020; Würz et al., 2019).

Table 2: Mean for branch length (cm) of 'BRS Magna' grapevine on ten rootstocks in three production years.

Rootstock	Branch length (cm)		
	2020	2021	2022/23
'Kober 5BB'	70.10 cC*	76.90 cB	104.90 cA
'SO4'	67.00 dC	74.00 dB	105.60 cA
'IAC 766 Campinas'	66.60 dB	67.10 eB	114.10 bA
'Harmony'	66.90 dB	54.10 gC	75.00 eA
'Paulsen 1103'	71.00 cC	83.40 bB	112.70 bA
'420A'	62.10 eA	17.00 hC	52.30 fB
'IAC 572 Jales'	90.10 aC	96.90 aB	131.10 aA
'Freedom'	53.00 fC	59.40 fB	95.30 dA
'IAC 313 Tropical'	93.50 aB	89.60 aC	133.60 aA
'101-14 MGT'	59.00 eA	20.10 hC	54.90 fB
**CV (%)		2.89	
Mean		77.24	

*Means followed by different lowercase letters in the column and uppercase letters in the row differ by the Scott-Knott test ($p \leq 0.05$). **C.V.: Coefficient of variation.

BRS Magna is characterized by having lower fertility in basal buds (Ritschel et al., 2014). Thus, these factors may explain the productive performance found in this study for the cultivar, since it is in its third year of production and has not yet reached full and stable productivity. In addition, the plants were trained in a trellis system, spaced at 4 m x 1m, with short pruning (one or two buds per spur), which favoured the retention of only basal buds on the plants.

Regarding the number of bunches, comparing the production cycles associated with rootstocks, it was observed that in the 2022/23 cycle, 'Kober 5BB' showed superiority, differing from the other treatments (Table 3). In terms of average bunch weight, better results were obtained in plants grafted onto 'IAC 572 Jales', 'SO4' and 'Freedom', in the third year of production.

The plants grafted onto '420 A' and '101-14 MGT', in the second and third evaluated cycles, and 'IAC 313 Tropical' and 'Harmony', in the third year, showed poor performance both for the number of bunches and bunch weight, resulting in lower production per plant and, consequently, inferior productivity compared to the other treatments (Table 1). Other studies have also shown that '420 A' and '101-14 MGT' provide the lowest bunch weight of 'Concord' clones, inducing lower production and productivity for all evaluated treatments (Anzanello; Souza; Coelho, 2010; Borges et al., 2014).

Table 3: Means of number of bunches per plant and bunch weight of the grapevine 'BRS Magna' on ten rootstocks in three production years.

Rootstock	Number of bunches per plant		
	2020	2021	2022/23
'Kober 5BB'	11.13 cC*	15.3 bB	23.35 aA
'SO4'	15.69 bB	13.40 bC	20.80 bA
'IAC 766 Campinas'	12.78 cA	13.68 bA	14.44 cA
'Harmony'	15.92 bA	14.39 bA	5.17 dB
'Paulsen 1103'	17.06 aA	14.54 bB	15.04 cB
'420A'	18.43 aA	3.70 dB	3.22 dB
'IAC 572 Jales'	15.06 bB	17.75 aA	19.08 bA
'Freedom'	17.61 aA	13.45 bC	15.83 cB
'IAC 313 Tropical'	19.19 aA	13.59 bB	4.45 dC
'101-14 MGT'	18.16 aA	8.76 cB	0.00 eC
CV (%)	8.84	---	---
Mean	13.70	---	---
	Bunch Weight (g)		
	2020	2021	2022/23
'Kober 5BB'	124.70 bA	124.50 eA	124.00 bA
'SO4'	124.00 bB	166.8 bA	158.90 aA
'IAC 766 Campinas'	105.30 cB	117.80 eA	96.40 dB
'Harmony'	123.20 bA	114.80 eB	108.90 cB
'Paulsen 1103'	119.90 bB	124.20 eB	132.20 bA
'420A'	102.50 cA	36.20 fC	63.70 fB
'IAC 572 Jales'	158.70 aB	179.30 aA	171.00 aA
'Freedom'	109.80 cC	133.30 dB	149.30 aA
'IAC 313 Tropical'	132.30 bB	144.40 cA	84.30 eC
'101-14 MGT'	115.50 cA	29.00 fB	0.00 gC
**CV (%)	6.01	---	---
Mean	114.46	---	---

*Means followed by different lowercase letters in the column, and uppercase letters in the row, differ by the Scott-Knott test ($p \leq 0.05$). **CV: Coefficient of variation.

Bunch weight depends on several factors such as mineral absorption, Ravaz index, number of berries per bunch, leaf area, factors that can be influenced by the rootstock (Ferreira et al., 2020; Guilpart; Metay; Gary, 2014; Santos; Pereira; Moreira, 2015), which may explain the variations obtained in this study.

In relation to bunch size, in the second year of production, bunches of 'BRS Magna' showed a larger size compared to the 2020 and 2022/23 cycles, except for those on '420 A' and '101-14 MGT'. In this variable, the highlight was for 'IAC 572 Jales' and 'SO4', which differed from the others in all years of evaluation (Table 4). Considering the three cycles, bunches from '420 A', '101-14 MGT', and 'IAC 313 Tropical' were the smallest (Table 4). These results are in line with those found for the Isabel cultivar, since 'IAC 572 Jales' conferred greater bunch mass (155 g) and length (12.2 cm), being superior to '420 A' (95.2 g and 10.7 cm, respectively) (Sato et al., 2009).

Thus, it is possible to infer that the good performance of 'IAC 572 Jales' for both evaluated variables may be due to the interaction with the scion cultivar, while in '101-14 MGT' and '420 A' the degree of affinity is possibly lower, which justifies the low performance in most of the variables evaluated in this experiment.

The characteristics related to berry size showed differences among all rootstocks and cycles, with the third year, in general, being the best. Greater mass, length, and width were observed in berries from plants grafted onto 'IAC 572 Jales' in all evaluated harvests (Table 5). On the other hand, '420 A' and '101-14 MGT', in the second and '420 A' in the third cycle, showed inferior behaviour for the variables in question. A similar result was observed for the 'Sugraone' grapevine when grafted onto '420 A' (Leão; Brandão; Gonçalves, 2011).

The 'BRS Magna' berry is considered small, with a size of 18 mm x 20 mm (Ritschel et al., 2014). Therefore, the results presented in this study are inferior to those described for the cultivar, since the average size obtained was 14.59 mm x 13.84 mm. Some studies indicate that the rootstock has little effect on berry size characteristics, justified by the little expressive increase in mass, length, and diameter (Colombo et al., 2011; Leão; Brandão; Gonçalves, 2011; Sato et al., 2009). However, based on the results obtained so far, it is believed that 'BRS Magna' behaves differently depending on the rootstock used, since there was variation among the combinations.

Table 4: Means of length and width of the 'BRS Magna' grape bunch on ten rootstocks in three years of production.

Rootstock	Length of the bunch (cm)		
	2020	2021	2022/23
'Kober 5BB'	12.22 aA*	12.36 cA	12.30 bA
'SO4'	12.25 aC	14.31 aA	13.67 aB
'IAC 766 Campinas'	10.47 cC	13.46 bA	11.39 cB
'Harmony'	12.20 aB	13.30 bA	10.89 dC
'Paulsen 1103'	10.63 cC	12.06 cA	11.41 cB
'420A'	11.38 bA	6.98 eC	9.46 eB
'IAC 572 Jales'	12.47 aB	14.48 aA	13.94 aA
'Freedom'	11.07 bC	13.40 bA	12.54 bB
'IAC 313 Tropical'	11.17 bB	13.60 bA	9.76 eC
'101-14 MGT'	11.44 bA	8.31 dB	0.00 fC
CV (%)	2.08		
Mean	11.38		
	Width of the bunch (cm)		
	2020	2021	2022/23
'Kober 5BB'	5.75 bB	6.39 cA	5.50 cB
'SO4'	5.41 cB	7.45 aA	5.67 cB
'IAC 766 Campinas'	5.41 cB	5.78 dA	5.17 cB
'Harmony'	5.07 dB	6.38 cA	5.29 cB
'Paulsen 1103'	4.98 dB	6.54 cA	6.19 bA
'420A'	4.95 dA	3.35 fC	4.27 eB
'IAC 572 Jales'	6.59 aB	7.56 aA	5.40 cC
'Freedom'	5.32 cC	6.45 cB	8.78 aA
'IAC 313 Tropical'	5.30 cB	6.95 bA	4.77 dC
'101-14 MGT'	5.60 bA	4.69 eB	0.00 fC
**CV(%)	4.47		
Mean	5.56		

* Means followed by different lowercase letters in the column and uppercase letters in the row differ according to the Scott-Knott test ($p \leq 0.05$). **CV: Coefficient of variation.

Table 5: Means of berry weight, length and width of grapevine 'BRS Magna' on ten rootstocks in three years of production.

Porta-enxerto	Berry weight (g)		
	2020	2021	2022/23
'Kober 5BB'	2.38 bA*	2.52 bA	2.66 dA
'SO4'	2.36 bB	2.49 bB	2.92 cA
'IAC 766 Campinas'	2.38 bB	2.52 bB	3.19 bA
'Harmony'	2.60 aA	2.39 bA	2.56 dA
'Paulsen 1103'	2.53 aB	2.43 bB	3.18 bA
'420A'	2.18 bB	1.89 cC	2.55 dA
'IAC 572 Jales'	2.60 aC	2.93 aB	3.42 aA
'Freedom'	2.50 aB	2.57 bB	2.88 cA
'IAC 313 Tropical'	2.62 aB	2.61 bB	3.60 aA
'101-14 MGT'	2.37 bA	1.38 dB	---
CV (%)		7.57	
Mean		2.51	
	Berry length (mm)		
	2020	2021	2022/23
'Kober 5BB'	14.50 aB	14.10 aB	16.00 bA
'SO4'	14.60 aB	14.50 aB	16.90 aA
'IAC 766 Campinas'	14.20 aB	14.80 aB	17.00 aA
'Harmony'	14.90 aB	14.30 aB	16.50 aA
'Paulsen 1103'	15.10 aB	14.10 aB	16.60 aA
'420A'	13.90 aB	13.30 bB	14.80 bA
'IAC 572 Jales'	14.90 aB	15.60 aB	17.30 aA
'Freedom'	14.60 aB	14.80 aB	16.90 aA
'IAC 313 Tropical'	14.80 aB	15.20 aB	17.70 aA
'101-14 MGT'	14.00 aA	11.80 cB	---
CV(%)		5.58	
Mean		14.59	
	Berry width (mm)		
	2020	2021	2022/23
'Kober 5BB'	13.30 aB	14.10 aA	14.90 cA
'SO4'	13.70 aB	13.90 aB	16.00 bA
'IAC 766 Campinas'	13.30 aB	14.20 aB	16.20 bA
'Harmony'	13.70 aB	13.70 aB	15.60 bA
'Paulsen 1103'	13.80 aB	13.70 aB	15.90 bA
'420A'	13.00 aB	12.90 aB	14.30 cA
'IAC 572 Jales'	14.10 aB	14.80 aB	16.60 aA
'Freedom'	13.40 aB	14.00 aB	16.10 bA
'IAC 313 Tropical'	13.80 aB	14.60 aB	17.10 aA
'101-14 MGT'	13.30 aA	11.30 bB	---
*CV(%)		4.75	
Mean		13.84	

Continue...

* Means followed by different lowercase letters in the column and uppercase letters in the row differ by the Scott-Knott test ($p \leq 0.05$). **CV: Coefficient of variation.

CONCLUSIONS

Under the cultivation conditions studied, the recommended rootstock for the 'BRS Magna' scion cultivar is 'IAC 572 Jales'. On the other hand, '101-14 MGT' and '420 A' are not recommended as rootstock for this cultivar.

AUTHOR CONTRIBUTION

Conceptual idea: Grigolo, C.R.; Citadin, I.; Pereira, E.A; Feldberg, N.P.; Methodology design: Grigolo, C.R.; Citadin, I.; Pereira, E.A.; Feldberg, N.P.; Data collection: Grigolo, C.R.; De Oliveira, L. de S.; Gobetti, R.C.R.; Data analysis and interpretation: Grigolo, C.R.; Citadin, I.; Pereira, E.A.; Writing and editing: Grigolo, C.R.; Citadin, I.; Pereira, E.A.

ACKNOWLEDGMENTS

The authors would like to thank UTFPR, Pato Branco campus, for providing the physical structure, as well as MAPA and CAPES for financial support to students Chaiane Renata Grigolo and Laise de Souza de Oliveira.

REFERENCES

ANZANELLO, R.; SOUZA, P. V. D.; COELHO, P. F. Uso da poda seca e da poda verde para obtenção de duas safras por ciclo vegetativo em três cultivares de videira. Revista Brasileira de Fruticultura, 32(1):196-203, 2010.

BORGES, R. S. et al. Produção e qualidade de frutos de clones de videira 'Concord' sobre diferentes porta-enxertos. Pesquisa Agropecuária Tropical, 44(2):198-204, 2014.

BOTELHO, R. V.; PIRES, E. J. P.; TERRA, M. M. Bud fertility in vines: Physiology and factors involved. Ambiência, 2(1):129-144, 2006.

CALLILI, D. et al. Rootstock and potassium fertilization, in terms of phenology, thermal demand and chemical evolution, of berries on Niagara Rosada grapevine under subtropical conditions. Bragantia, 81:e2022, 2022.

COLOMBO, L. A. et al. Produção fora de época da videira 'BRS Clara' sob cultivo protegido. Ciência Rural, 41(2):212-218, 2011.

DA SILVA, M. J. R. et al. Phenolic compounds and antioxidant activity of red and white grapes on different rootstocks. African Journal of Biotechnology,16(13):664-671, 2017.

DA SILVA, M. J. R. et al. Phytochemical profile of Brazilian grapes (*Vitis labrusca* and hybrids) grown on different rootstocks. PLoS ONE, 17(10):e0275489, 2022.

DALBÓ, M. A.; SCHUCK, E.; BASSO, C. Influence of rootstock on nutrient content in grape petioles. Revista Brasileira de Fruticultura, 33(3):941-947, 2011.

DALBÓ, M. A.; FELDBERG, N. P. Agronomic behavior of grape rootstocks resistant to young vine decline in the conditions of the state of Santa Catarina Brazil. Agropecuária Catarinense, 32(2):68-72, 2019.

FELDBERG, N. P. Desempenho agronômico das videiras 'Crimson Seedless' e 'Superior Seedless' no norte de Minas Gerais. Pesquisa Agropecuária Brasileira, 42(6):77-783, 2007.

FERREIRA, T. O. et al. Quality and antioxidant potential of 'BRS Magna' grapes harvested in the first half of the year under different training systems and rootstocks in a tropical region. Ciência e Agrotecnologia, 43:e029518, 2019.

FERREIRA, T. O. et al. Rootstock for the 'BRS Magna' grapevine grown in a tropical region affects the quality of the stored juice. Revista Ciência Agronômica, 51(3):e20186562, 2020.

GRIGOLO, C. R. et al. Compatibility and initial development of grapevines 'BRS Magna' grafted on different rootstocks. Ciência Rural, 57(7):e20190939, 2021.

GUILPART, N.; METAY, A.; GARY, C. Grapevine bud fertility and number of berries per bunch are determined by water and nitrogen stress around flowering in the previous year. European Journal of Agronomy, 54:9-20, 2014.

KLIMEK, K. et al. Evaluation of the influence of rootstock type on the yield parameters of vines using a mathematical model in nontraditional wine-growing conditions. Applied Sciences, 12(14):7293, 2022.

LEÃO, P. C. S.; BRANDÃO, E. O.; GONÇALVES, N. P. S. Production and quality of table grapes 'Sugraone' on different rootstocks in the São Francisco River Valley. Ciência Rural, 41(9):1526-1531, 2011.

LEÃO, P. C. D. S.; CHAVES, A. R. D. M. Training systems and rootstocks on yield and agronomic performance of 'Syrah'grapevine in the Brazilian semiarid. Ciência e Agrotecnologia, 43:e005719, 2019.

LEÃO, P. C. S.; CUNHA, M. A. C.; SOUZA, E. R. Agronomic performance of rootstocks on the juice grape 'BRS Magna' grown in a Brazilian semi-arid region. Revista Brasileira de Fruticultura, 44(1):e-832, 2022.

LI, M. et al. Evaluation of eight rootstocks on the growth and berry quality of 'Marselan' grapevines. Scientia Horticulturae, 248:58-61, 2019.

LOUREIRO, M. D. et al. Influence of rootstock on the performance of the Albarín Negro minority grapevine cultivar. Scientia Horticulturae, 201:145-152, 2016.

MENEGUZZI, A. et al. Fertility of buds and pruning recommendation of different grapevine varieties grown in altitude regions of Santa Catarina State, Brazil. Revista Ceres, 67(1):30-34, 2020.

MOTA, R. V. et al. Productivity and physicochemical composition of berries of grapevine cultivars grafted onto different rootstocks. Pesquisa Agropecuária Brasileira, 44(6):576-582, 2009.

RITSCHEL, P. et al. 'BRS MAGNA' - a novel grape cultivar for juice making, with wide climatic adaptation. Crop Breeding and Applied Biotechnology, 14(4):266-269, 2014.

SANTOS, A. O.; PEREIRA, S. E.; MOREIRA, C. A. Physico-chemical quality of grapes and wine sensory profile for different varieties of vine subjected to mechanical pruning. Revista Brasileira de Fruticultura, 37(2):432-441, 2015.

SATO, A. J. et al. Ripening evolution and physico-chemical characteristics of 'Isabel' grape on differents rootstocks in North of Paraná. Semina: Ciências Agrárias, 30(1):11-20, 2009.

SOUZA, C. R. et al. Cabernet Sauvignon grapevine grafted onto rootstocks during the autumn-winter season in southeastern Brazilian. Scientia Agricola, 72(2):138-146, 2015.

TECCHIO, M. A. et al. Influence of rootstocks and pruning times on yield and on nutrient content and extraction in "Niagara Rosada" grapevine. Pesquisa Agropecuária Brasileira, 49(5):340-348, 2014.

TECCHIO, M. A. et al. Phenological, physicochemical, and productive characteristics of 'Vênus' grapevine onto rootstocks. Pesquisa Agropecuária Brasileira, 54:e00335, 2019.

TECCHIO, M. A. et al. Yield performance and quality of wine grapes (*Vitis vinifera*) grafted onto different rootstocks under subtropical conditions. Bragantia, 81:e1622, 2022.

VEDOATO, B. T. F. et al. Production, physicochemical quality and antioxidant capacity of 'Niagara Rosada' grape grafted on different rootstocks. Bioscience Journal, 36(6):1879-1889, 2020.

VILANOVA, M. et al. Rootstock effect on volatile composition of Albariño Wines. Applied Sciences, 11(5):2135, 2021.

WÜRZ, D. A. et al. Evaluation of bud fertility from grapevine varieties cultivated in high altitude region of Santa Catarina. Revista de Ciências Agroveterinárias, 18(1):81-86, 2019.