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Research Article

Performance of 'BRS Magna' vines grown under different training systems, rootstocks and production cycles

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ABSTRACT: Over the past decade, the business of producing juice from grapes (*Vitis labrusca* L. and hybrids) has been expanding in response to increasing consumption encouraged by campaigns promoting the benefits grape juice can have on health. This study aimed to determine the effect of the production cycle, vine training system, and rootstock on the yield and physical and physical-chemical characteristics of 'BRS Magna' grapes grown in the Vale do Submédio São Francisco in the northeastern region of Brazil. The study was conducted in Petrolina, Pernambuco, over eight production cycles (2017 to 2020). The grapevines were trained in three vine training trellis systems: espalier, lyre, and pergola; and grafted onto two rootstocks: IAC 572 and IAC 766. The production cycle, training system, and rootstocks affected the yield components, vigor, and physical characteristics of the BRS Magna grapes. The combination of the pergola training system and rootstock IAC 766 stood out from the others, providing mean yields estimated at 26 t ha^{-1} per production cycle. The soluble solids content (SS), titratable acidity (TA), and SS TA^{-1} ratio were affected neither by the training system nor the rootstock, and higher values for SS and lower values for TA were obtained in the first, second, fourth and eighth production cycles. Thus, the pergola training system and rootstock IAC 766 are recommended for promoting yield gains in the 'BRS Magna' grape in the Vale do Submédio São Francisco.

Keywords: grapevine, grape juice, crop management, tropical viticulture

Introduction

The production and consumption of grape juice have been on the rise in Brazil, with an increase of 372 % in sales of grape juice over this past decade alone, according to information from the Instituto Brasileiro do Vinho (Ibravin). The Vale do Submédio São Francisco stands out as the new emergent production region of high-quality grape juices produced from Brazilian cultivars, such as 'Isabel Precoce', 'BRS Magna', 'BRS Violeta', 'BRS Cora', and 'BRS Carmem' (Lima et al., 2014). The BRS Magna has yielded prodigiously in the Vale do Submédio São Francisco (Leão et al., 2018) and is rich in phenolic compounds and antioxidant activity (Lima et al., 2014).

In grape growing, the spatial distribution of the canopy, trunk, cordons, shoots, and the support system constitute the grapevine training system, which, in turn, regulates canopy growth and exposure of leaves and fruit to sunlight, wind, and moisture, modifying the microclimate within the vineyard (Rodrigues et al., 2016).

Over time, the evolution of the types of training systems has improved the microclimate through increases in the interception and distribution of solar energy and the exposed leaf surface (Reynolds and Vanden Heuvel, 2009). In addition to modifying the microclimate, the training system also affects vegetative development, yield, and grape characteristics and quality (Reynolds and Vanden Heuvel, 2009).

In Brazil, studies relating to training systems have been conducted mainly on the cultivar Niágara Rosada in the southeastern region. The 'Niágara Rosada' cultivar showed an increase in the number of branches and spurs per plant, leaf area index, the number of clusters per plant, cluster fresh weight, and yield when grown in the double cordon 'Y' type training system compared to the espalier (Hernandes et al., 2013; Pedro Júnior et al., 2011) but there was no effect on the total soluble solids content (Sanchez-Rodriguez et al., 2016). Pedro Júnior et al. (2018) studied the effect of the training system on different cultivars producing juice in Jundiaí, SP, observing that the double cordon system ('Y' or 'V' type) led to an increase in yield compared to the espalier system.

References have not been found in the literature regarding 'BRS Magna' grapevines grown in different training systems, rootstocks and production cycles under tropical conditions. Therefore, the present study aimed to determine the effect of the production cycle, training system, and rootstock on the yield and characteristics of 'BRS Magna' grapes grown in the Vale do Submédio São Francisco.

Materials and Methods

Experimental location and growing conditions

An experimental vineyard from the grape juice producing cultivar BRS Magna was set up in 2015 in Petrolina, Pernambuco, in the northeastern region of Brazil (09°09′ S, 40°22′ W, altitude 365.5 m). According to the Köppen classification, the climate in this region is Bswh, which corresponds to a scorching semi-arid region (Alvares et al., 2014). The mean, maximum, and minimum air temperatures (°C), global solar radiation (MJ m^{-2}), and rainfall (mm) were recorded at the Automatic Agrometeorological Station, and the mean monthly values during the period of experimenting are shown in Figure 1.

The experiment was conducted over eight production cycles from 2017 to 2020. The pruning and harvest dates for each production cycle are shown in Table 1.

Treatments and experimental design

The treatments were represented by three training systems (pergola, lyre, and espalier), two rootstocks (IAC 572 and IAC 766), and eight production cycles in split-split plots, where the main plots were the production cycles, the split plots the training systems, and the split-split plots the rootstocks. The rootstocks studied are very common in Brazilian viticulture and were developed by the Instituto Agronômico de Campinas (IAC) adapted to the tropical climate and of moderate to high vigor. A randomized block experimental design was used with four replications and plots consisting of five plants, identifying two plants to be used for yield evaluation and collection of fruit samples.

Vineyard management

The grapevines were planted at a spacing of 3.0 × 1.0 m (3,333 plants ha^{-1}) and trained in a unilateral cordon, with six main lateral branches in all training systems. Two production prunings were carried out per year on spurs at the base of the branches and canes with 6 to 7 buds. Hydrogen cyanamide (5 %) was sprayed on after pruning to buds break.

A drip irrigation system was used, with two emitters per plant, one emitter every 0.50 m, and a mean flow of 2.10 L h^{-1}. The crude water depth values

Table 1 – Pruning and harvest dates of BRS Magna grapevines over eight production cycles, Petrolina, PE, Brazil.

Production cycle	Pruning date	Harvest date
1st	12 Jan 2017	19 Apr 2017
2nd	28 Jun 2017	16 Oct 2017
3rd	17 Jan 2018	25 Apr 2018
4th	18 Jun 2018	05 Oct 2018
5th	18 Dec 2018	25 Mar 2019
6th	18 May 2019	23 Aug 2019
7th	16 Oct 2019	24 Jan 2020
8th	05 Oct 2020	15 Jan 2021

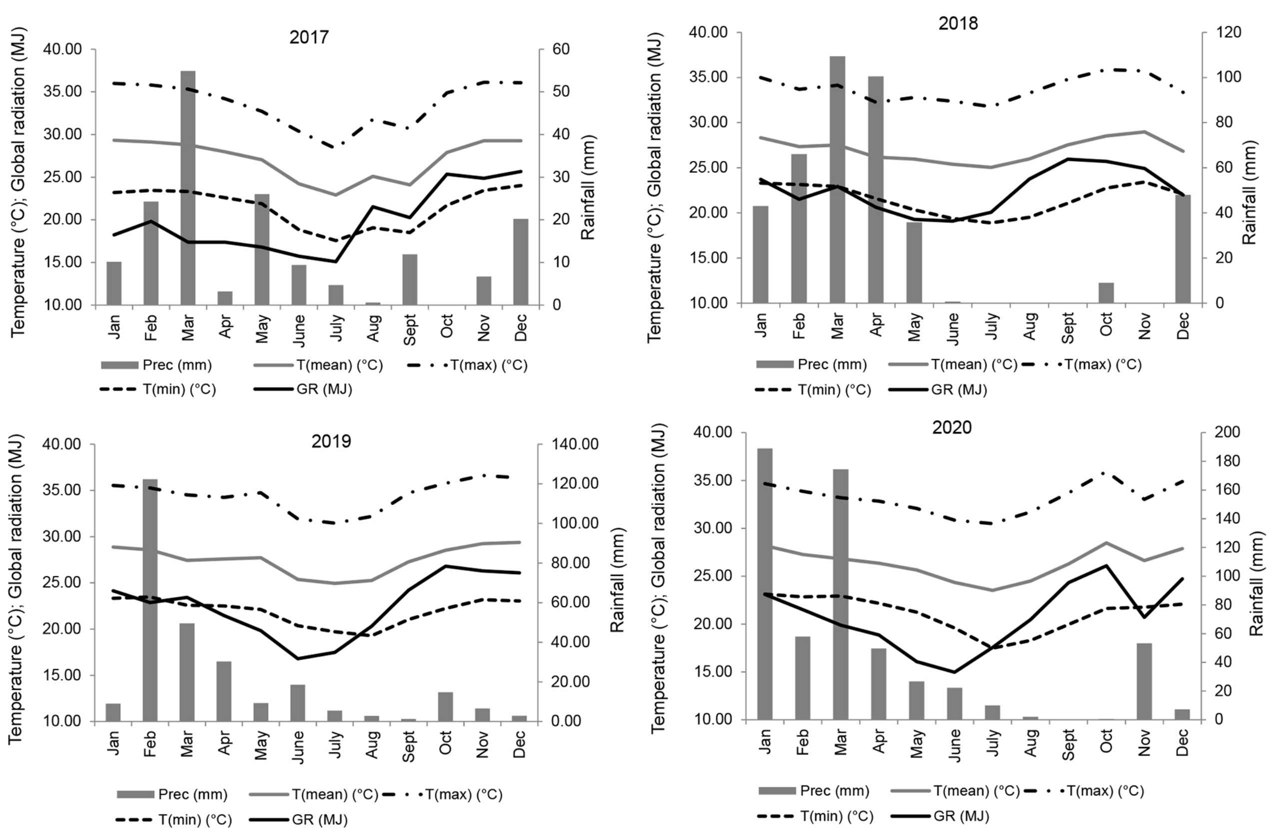

Figure 1 – Seasonal variations of rainfall (mm); mean, maximum, and minimum air temperature (°C); and global solar radiation (MJ m^{-2}) in the period 2017-2020, Petrolina, PE, Brazil.

were calculated dai using evapotranspiration (ETo) as determined by the Class A pan method (Allen et al., 1998).

Crop treatments on the canopy included shoot thinning, tying branches and shoots, shoot topping, and leaf removal near the clusters. Weeds were controlled by applying herbicide, mowing between rows, and possible weeding. Pests and diseases were controlled through weekly spraying with chemical products registered for the grape crop. Fertilization was applied according to the need for nutrients recommended by soil and plant tissue analysis and was dispensed through fertigation.

Evaluations and fruit analysis

The vegetative vigor of the grapevines was determined by the weight of the branches and leaves eliminated by pruning as determined by a digital electronic balance in kg per plant.

The sprouting percentage (%) and fertility index of buds were calculated approximately twenty days after pruning during the phenological phase of bud break, before thinning, counting the total number of buds, sprouts, and clusters on all the canes and spurs. The sprouting and bud fertility values were determined according to the following equations: sprouting (%) = (no. of sprouts) (no. of buds)$^{-1}$ × 100; and fertility (index) = (no. of clusters) (no. of sprouts)$^{-1}$.

Yield and number of clusters per plant were evaluated during harvest by the total weight of clusters of the two plants used for the data collection on a digital electronic balance and expressed in kg per plant.

The physical and physical-chemical characteristics of the 'BRS Magna' grapes were evaluated by the following variables: cluster weight, derived from the ratio of total weight of the clusters (g) number of clusters per plant, in grams (g); cluster length and width: determined in a sample of five clusters per plot, with the aid of a ruler, in centimeters (cm); berry weight: using a sample composed of 10 berries collected in five clusters per plant and weighed on a digital electronic balance, in grams (g); berry length and diameter: using the previous sample of berries with the aid of a ruler, in millimeters (mm); soluble solids content (SS): obtained from the must extracted from 50 berries collected from the five clusters harvested in the field, from a reading taken by a digital refractometer with automatic temperature adjustment and values ranging from 0 to 69 °Brix; titratable acidity (TA): from a dilution of 5 mL of grape pulp in 50 mL of distilled water, together with a 0.1 N NaOH solution, using an automatic titrator in g tartaric acid 100 mL^{-1} (AOAC, 2010) and SS TA^{-1} ratio.

Statistical analysis

The Shapiro-Wilk normality test was used on the mean values of all the variables. Where the data fulfilled the requirement of normal distribution, analysis of variance was carried out (F test, $p < 0.05$), considering the production cycles, training systems, and rootstocks as sources of variation, and means were compared by Tukey's test at 5 % probability.

Results and Discussion

The yield per plant showed significant interactions between the training system and the production cycle and between the training system and the rootstock from the decomposition of the mean values obtained in the three vine training systems in each cycle (Table 2) and of the rootstocks in each training system (Table 3). Higher yields were observed in the fifth production cycle in all the training systems, which is related to the age of the plant and increased photosynthetically active leaf area, resulting in greater carbohydrate reserve storage capacity.

The yield response to the training system varied according to the production cycle, with no significant differences between the young plants in the first two production cycles and the sixth cycle (2019) (Table 2). The pergola training system resulted in a greater yield in the 'BRS Magna' grapevines in most of the cycles; however, these differences were significant in comparison to the espalier system in the third and fourth production cycles (2018) and comparison to the lyre system in the fourth (2018), seventh and eighth, (2020)

Table 2 – Mean values for yield of 'BRS Magna' grapevines considering the production cycle × training system interaction, Petrolina, PE, Brazil.

Production cycle	Training system			Mean
	Espalier	Pergola	Lyre	
1st	2.77[1] Ad	2.57 Ad	2.05 Ad	2.46
2nd	3.09 Acd	4.40 Acd	4.02 Acd	3.83
3rd	5.90 Bb	7.62 Aab	6.10 ABabc	6.56
4th	5.02 Bbc	7.33 Ab	4.68 Bbc	5.73
5th	8.45Aa	7.92 ABab	6.62 Bab	7.66
6th	6.96 Aab	6.30 Abc	7.26 Aa	6.84
7th	8.23 ABa	9.53 Aa	7.14 Ba	8.30
8th	8.22 ABa	9.63 Aa	7.28 Ba	8.37
Mean	6.10	6.90	5.69	6.24

[1]Means followed by the same uppercase letters in the row and lowercase letters in the columns do not differ by Tukey's test at 5 % probability.

Table 3 – Mean values for yield of 'BRS Magna' grapevines considering the training system × rootstock interaction, Petrolina, PE, Brazil.

Training system	Rootstock		Mean
	IAC 572	IAC 766	
Espalier	5.72[1] Ba	6.46 Ab	6.10
Pergola	6.01 Ba	7.77 Aa	6.90
Lyre	5.46 Aa	5.91 Ab	5.69
Mean	5.74	6.73	6.24

[1]Means followed by the same uppercase letters in the row and lowercase letters in the columns do not differ by Tukey's test at 5 % probability.

production cycles. Maximum yield values were found in the pergola training system during the eighth production cycle, achieving 9.63 kg per plant, corresponding to an estimated yield of 32 t ha^{-1} per production cycle. The yield achieved by 'BRS Magna' trained in the pergola system during the eighth production cycle represented an increase of 41 % in comparison to the mean yield of the grapevine in the Vale do Submédio São Francisco in 2020 (IBGE, 2021). It was also superior to the yields obtained in 'Isabel Precoce', 'Bordô', 'BRS Violeta', 'Isabel', and 'Concord' for the production of juice under three different training systems in Jundiaí, São Paulo (Pedro Júnior et al., 2018). In contrast, the grapevines grown in the lyre and espalier systems did not show significant differences in yield, except for the fifth cycle, when yield in the espalier was higher than under the lyre system. The Y type training system, which is similar to the lyre, favored yield increases in the cultivar Niágara Rosada compared to the espalier system in different studies conducted in the state of São Paulo (Pedro Júnior et al., 2011; Hernandez et al., 2013). These results differ from the ones found in this study. However, similar results were found by Mota et al. (2010) in the cultivar Niágara Rosada, when the pergola system produced an increase in yield compared to the espalier system. Therefore, the yield performance can vary under different training systems since they are affected by other factors, such as the cultivar, the climate conditions, and vineyard management, which are characteristics of the production cycle and, moreover, of each grape and wine-growing region (vine- and site-dependent). According to Reynolds and Vanden Heuvel (2009), training systems, like the pergola, that promote division of the canopy increase grapevine yield as compared to training systems that do not divide the canopy, similar to the espalier, since they increase light interception and retain more significant number of buds per unit of length of the main branch or of the plant row.

The effect of the rootstock on the yield of 'BRS Magna' grapevines varied according to the training system: the pergola increased the yield in both rootstocks, but significant differences were not observed between the training systems when the grapevines were grafted on 'IAC 572' (Table 3). On the rootstock IAC 766, yield in the pergola system was higher than under the lyre and espalier systems. The rootstock IAC 766 increased the yield of 'BRS Magna' grapevines in the espalier and pergola training systems, and the maximum value was obtained from the grapevines trained in the pergola system and grafted on IAC 766, which was 7.77 kg per plant or 26 t ha^{-1} per production cycle, representing an increase of 27 % in mean yield of the grapevine in this region in 2020 (IBGE, 2021). These results are in agreement with Silva et al. (2018), who observed yield increases in four grape juice grapes in Votuporanga, São Paulo, on the rootstock IAC 766 compared to IAC 572; however, they differ from the results noted by Mota et al. (2010) with 'Niágara Rosada' in Caldas, Minas Gerais, where a higher yield was found on 'IAC 572' in relation to 'IAC 766'. Therefore, growing 'BRS Magna' grapes under the pergola training system and on the rootstock IAC 766 is recommended for promoting yield gains in the Vale do Submédio São Francisco.

Significant interaction between production cycles and the training system was found for the number of clusters per plant (Table 4), but there was no effect of the rootstock on this variable. The most significant number of clusters per plant was obtained in the seventh production cycle in all the training systems, obtaining a mean of 70 clusters per plant. The high number of clusters is under genetic control since 'BRS Magna' is characterized by high bud fertility, around 2.0 clusters per sprout (Ritschel et al., 2014). However, it is considerably affected by climate conditions, especially solar radiation and temperatures that occur during the floral differentiation phase and that define the fertility of buds in the following cycle, which explains the variations in the number of clusters observed in the production cycles.

The pergola system produced a more significant number of clusters than espalier during the second production cycle and the lyre and espalier systems in the fourth cycle. However, the number of clusters in the plants trained according to the espalier system was higher than in the lyre, but did not differ from the pergola during the fifth and the seventh production cycles, obtaining maximum values of 79 clusters per plant in the 'BRS Magna' grapevines trained under the espalier system during the seventh production cycle.

Vegetative development and vigor were evaluated by the fresh weight of branches and leaves eliminated during pruning, considering the effect of climate conditions and management practices employed in each production cycle. The fifth cycle promoted the development of more vigorous grapevines with more significant branch and leaf weight, whereas the grapevines had the lowest vigor in the first and seventh

Table 4 – Mean values for number of clusters per plant of 'BRS Magna' grapevines considering the production cycle × training system interaction, Petrolina, PE, Brazil.

Production Cycle	Training System			Mean
	Espalier	Pergola	Lyre	
1st	23.31[1] Aef	16.44 Ae	15.06 Ad	18.27
2nd	22.06 Bf	34.56 Ad	31.07 ABc	29.15
3rd	45.75 Ad	53.06 Abc	43.21 Abc	47.52
4th	37.00 Bde	49.64 Ac	33.17 Bc	40.28
5th	67.69 Aab	65.00 ABab	56.56 Bab	63.08
6th	50.88 Acd	50.75 Ac	52.31 Aab	51.31
7th	78.56 Aa	70.88 ABa	62.13 Ba	70.52
8th	61.31 Abc	66.06 Aab	55.44 Aab	60.94
Mean	48.50	50.82	44.18	47.89

[1]Means followed by the same uppercase letters in the row and lowercase letters in the columns do not differ by Tukey's test at 5 % probability.

cycles (Table 5). The plants were young in the first production cycle, with a smaller leaf area, resulting in lower canopy vigor. However, in the seventh cycle, the low vigor could be the consequence of a lack of adequate recomposition of carbohydrate reserves during the resting phase, associated with the high yield obtained in this production cycle (28 t ha^{-1} per production cycle).

The pergola system favored the development of more vigorous grapevines with more significant branch and leaf weight than the espalier system but did not differ significantly from the lyre system (Table 5). The pergola and lyre systems better intercept solar radiation as they have more leaf surface exposed than vertical systems, such as the espalier, favoring photosynthesis (Norberto et al., 2008). In addition, no difference was observed in the branch weight of 'Niágara Rosada' and 'Folha de Figo' grapevines trained in the pergola, lyre, and espalier systems (Norberto et al., 2008).

The training system did not affect cluster weight, differing from the results obtained in the same experimental area by Ferreira et al. (2019), who found that the lyra system favored clusters heavier than those from the pergola system. The weight of the 'Niágara Rosada' grape clusters was higher in the Y with plastic covering (Hernandes et al., 2013; Pedro Júnior et al., 2011) or pergola (Mota et al., 2010) training systems than in the espalier system, but cluster weight did not differ between the IAC 572 and IAC 766 rootstocks (Tecchio et al., 2019).

The production cycle and the rootstock effected cluster weight, obtaining a maximum value of 197 g during the sixth production cycle, which differed significantly from the values found in the first, second, fifth, and eighth production cycles and was superior to the values for 'BRS Magna' obtained in the same region and experimental area by Ferreira et al. (2019). The grapevines grafted on 'IAC 766' had heavier clusters than those on 'IAC 572' (Table 6) and are in agreement with the results obtained by Silva et al. (2018) in 'Isabel Precoce', 'BRS Carmem', 'BRS Cora', and 'IAC 138-22 Máximo', which also exhibited heavier clusters on IAC 766. The 'BRS Magna' clusters exhibited a mean of 165 g when grafted onto the IAC 766 rootstock, near the values obtained by Leão et al. (2018) in previous studies with the same cultivar in the Vale do Submédio São Francisco.

The variables related to cluster size and berry weight and size, as well as total soluble solids content (SS), titratable acidity (TA), and SS TA^{-1} ratio, were affected by all the factors studied, but there was no interaction between them. The production cycle affected the physical characteristics of the cluster and the berry differently. Clusters with greater length were observed in the eighth cycle, differing from the length of the clusters harvested in the fifth production cycle. However, in that cycle, the clusters had greater length than in the other production cycles (Table 7). The 'BRS Magna' grape clusters showed greater length in the pergola training system (13.11 cm) than in the espalier system, but there was no effect of the training system on cluster width. The IAC 766 rootstock favored the production of clusters with greater length and width.

Berry weight and size were affected by the production cycle and rootstock but not by the training system (Table 7). The IAC 766 rootstock increased berry weight and size, unlike the results obtained in cv. Niágara Rosada, no differences were observed in berry weight between the rootstocks (Tecchio et al., 2019).

There was no effect of the training system and rootstock on the chemical composition of the 'BRS Magna' grapes, which differs from those reported by Ferreira et al. (2019) in this same cultivar and experimental area, who found a significant interaction between the training system, rootstock, and production cycle. The soluble solids content and titratable acidity

Table 5 – Mean values of fresh weight of branches and leaves of 'BRS Magna' grapevines in different production cycles and training systems in Petrolina, PE, Brazil.

Variable	Branch and leaf weight (kg per plant)[2]
Production Cycles	
1st	0.837 d[1]
2nd	1.755 bc
4th	1.395 c
5th	2.362 a
6th	1.770 b
7th	0.807 d
Training systems	
Espalier	1.353 b
Pergola	1.653 a
Lyre	1.457 ab
Mean	1.488

[1]Means followed by the same lowercase letter do not differ from each other by Tukey's test at 5 % probability; [2]Data transformed into square root of x + 1.

Table 6 – Mean values of cluster weight of 'BRS Magna' grapes in different production cycles and rootstocks in Petrolina, PE, Brazil.

Variable	Cluster weight (g)
Production Cycles	
1st	138.03[1] bc
2nd	130.68 c
3rd	182.52 a
4th	179.59 a
5th	132.23 c
6th	197.11 a
7th	168.62 ab
8th	136.92 c
Rootstocks	
IAC 572	150.58 b
IAC 766	164.66 a
Mean	157.77

[1]Means followed by the same lowercase letter in the column do not differ from each other by Tukey's test at 5 % probability.

Table 7 – Mean values of the physical-chemical characteristics of 'BRS Magna' grapes harvested in different production cycles, training systems, and rootstocks in Petrolina, PE, Brazil.

Variable	CL[3]	CW	BW	BL	BD	SS[4]	TA	SS/TA
				Production cycles				
1st	12.48 ab[1]	7.73 b	2.53 b	17.76 ab	15.70 bc	22.58 a	0.30 e	75.37 a
2nd	12.77 ab	7.39 bc	2.31 c	17.40 b	15.29 c	22.58 a	0.44 d	54.07 b
3rd	12.44 ab	8.74 a	2.68 ab	18.17 a	16.19 a	18.78 b	0.63 ab	30.48 c
4th	12.68 ab	7.92 b	2.69 ab	17.68 ab	15.68 bc	22.16 a	0.36 e	66.32 ab
5th	12.16 b	7.41 bc	2.70 ab	17.40 b	15.96 ab	18.08 b	0.52 c	35.36 c
6th	12.71 ab	6.82 c	2.74 a	17.46 b	15.61 bc	17.92 b	0.66 a	35.73 c
7th	13.01 ab	7.62 bc	2.56 ab	15.69 c	16.16 a	18.67 b	0.59 bc	32.83 c
8th	13.42 a	7.88 b	2.67 ab	18.21 a	15.91 ab	20.69 ab	0.53 c	39.49 c
				Training systems				
Espalier	12.33 b	7.78 ns[2]	2.62 ns	17.51 ns	15.77 ns	19.64 ns	0.51 ns	45.48 ns
Pergola	13.11 a	7.75	2.56	17.39	15.80	20.33	0.49	47.81
Lyre	12.68 ab	7.54	2.65	17.52	15.87	19.94	0.51	45.33
				Rootstocks				
IAC 572	12.43 b	7.48 b	2.58 b	17.35 b	15.71 b	20.16 ns	0.50 ns	48.13 ns
IAC 766	12.99 a	7.89 a	2.64 a	17.59 a	15.91 a	19.79	0.51	44.28
Mean	12.71	7.69	2.61	17.47	15.81	19.98	0.50	46.21

[1]Means followed by the same lowercase letter in the column do not differ from each other by Tukey's test at 5 % probability; [2]ns = non-significant; [3]CL = cluster length (cm), CW = cluster width (cm), BW = berry weight (g), BL = berry length (mm), BD = berry diameter (mm), SS = total soluble solids content (°Brix), TA = titratable acidity (% tartaric acid), SS/TA = °Brix/acidity ratio; [4]Data on SS, TA, and SS/TA for production cycles were transformed into square root of x + 1.

are mainly affected by the climate that characterizes each production cycle. Therefore, divergent results were found in the literature for these variables in 'Niágara Rosada' and 'Folha de Figo' grapevines in the region of Caldas, Minas Gerais, with higher values for soluble solids content either in the lyre and espalier training systems (Mota et al., 2010) or in the pergola training system (Norberto et al., 2008). Tecchio et al. (2019) report that the rootstock IAC 766 led to greater soluble solids content than IAC 572 in cv. Niágara Rosada.

The most outstanding soluble solids contents were achieved in the first, second, fourth, and eighth production cycles (22.58, 22.58, 22.16, and 20.69 °Brix, respectively), which were associated with lower mean values of titratable acidity. The grapes had titratable acidity (TA) of 0.50 g 100 mL^{-1}, ranging from 0.30 in the first cycle to 0.66 g 100 mL^{-1} in the sixth production cycle. The SS TA^{-1} ratio of the grapes also showed significant differences between the production cycles, with the highest values obtained in the first and fourth cycles (Table 7). These results agree with those presented by Ferreira et al. (2019). The authors highlight the effect of climate, especially from high solar radiation and temperatures during the maturation phase, which increases photosynthetic efficiency, favoring the synthesis of carbohydrates and accumulation of sugars, but also degrading organic acids and other compounds associated with grape quality. Therefore, the greater soluble solids content and reduction in titratable acidity observed during the first, second, fourth, and eighth production cycles can be explained by the high temperatures and solar radiation observed in the months corresponding to the maturation phase of the grape in these production cycles (Figure 1).

High SS TA^{-1} ratios were obtained in all the production cycles, regardless of the training system and rootstock used, which shows the potential of the 'BRS Magna' grapes for producing high quality juices in consecutive harvests and different periods of the year in the Vale do Submédio São Francisco.

Conclusions

Yield, vigor, and physical characteristics of the BRS Magna grapes were affected by the production cycle, training system, and rootstocks.

Combination of the pergola training system and rootstock IAC 766 improved the agronomic performance of the 'BRS Magna' vines grown in the Vale do Submédio São Francisco.

Soluble solids content (SS), titratable acidity (TA), and SS TA^{-1} ratio were not affected by the training system and rootstock.

Seasonal variations between production cycles affected the performance of BRS Magna vines under tropical conditions.

Authors' Contributions

Conceptualization: Leão, P.C. de S. **Project administration**: Leão, P.C. de S. **Methodology**: Leão, P.C. de S. **Investigation**: Leão, P.C. de S.; Cunha, M.A.C.; Souza, E.R. **Data curation**: Leão, P.C. de S.; Cunha, M.A.C.; Souza, E.R. **Writing-original draft**: Leão, P.C. de S. **Writing-review & editing**: Leão, P.C. de S.

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