



# Phenology, thermal requirements and maturation of the SR 0.501-17 white wine grape hybrid cultivated in contrasting climatic conditions

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## ABSTRACT

The SR 0.501-17 grape hybrid developed for wine making purposes, is characterized for producing white and small berries with seeds. The purpose of this study was to characterize the phenology, thermal requirements and must physicochemical characteristics of the hybrid, in contrasting climatic conditions due to altitude at Jundiaí (715 m) and Votuporanga (483 m) respectively located at east and northwest of the São Paulo State-Brazil. Evaluations were performed from 2012 to 2016 and observations during the vine growth period and data of phenology and must soluble solids content and acidity measurements at harvest were taken. Average duration of the pruning-harvest period was 146 and 131 days and grape maturation period was 29 and 27 days, respectively for Jundiaí and Votuporanga. Thermal requirement expressed in degree days for the hybrid growth cycle was 1663 and 1923, respectively for Jundiaí and Votuporanga. Rainfall during the maturation period showed negative correlation with total soluble solids and maturation index and positive correlation with titratable acidity. The effect of temperature on vine growth cycle were more pronounced in Jundiaí in comparison to Votuporanga while the effect of rainfall on the maturation characteristics were more effective in Votuporanga when compared to Jundiaí.

**Keywords:** degree days; soluble solids; titratable acidity.

## INTRODUCTION

Grape growers are increasing the demand for different grape cultivars aiming at elaborating high quality wine due to agrotourism expansion and the possibility of producing white grape wines has been emerging in the State of São Paulo to meet the consumer needs. But, in the climatic conditions of Brazilian south and southwest grape growing regions, high rainfall rates occur during the maturation period, and sugar berry accumulation may be impaired (Mota *et al.*, 2010; Regina *et al.*, 2011; Favero *et al.*, 2011; Dias *et al.*, 2017).

According to Regina *et al.* (2010) this rainy condition allows a better balance between grape sugars and acids, a factor that benefits the production of white wines, as evaluated by sensorial analysis. In addition, Tonietto *et*

*al.* (2006) reported that humid climate favors obtaining suitable grapes for white and sparkling wines elaboration once they show levels of acidity that valorize the product.

However, these climatic conditions promote increase of disease occurrence and grape hybrids arise as a solution for sustainable viticulture regions (Lloreda, 2018). Winegrowers in different regions of the country have already used some white hybrid grapes. Among the hybrids obtained by the Instituto Agrônômico (IAC) stand out: 'Rainha'. This hybrid is cultivated on a small scale in the State of São Paulo and when introduced in Santa Catarina it was among the hybrids destined to the elaboration of white wines, with grapes considered of high quality. 'Madalena' a hybrid with muscat flavor and used for sparkling wines (Sousa & Martins, 2002) shows in the grape

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growing region of Jundiaí-SP soluble solids content around 16° Brix (Hernandes *et al.*, 2010). ‘Moscatel de Jundiaí’ used for white liqueur wines can also be consumed as table grapes (Sousa & Martins, 2002) show sugar content between 16 and 18° Brix during the summer growing season (Hernandes *et al.*, 2010).

Embrapa also provided to grape growers white grape hybrids like the ‘BRS Lorena’ and ‘Moscatel Embrapa’. ‘BRS Lorena has been cultivated in the southern region of the country, as well as in tropical regions (Camargo, Maia & Ritschel, 2010) and eastern of São Paulo State (Pedro Júnior *et al.*, 2013) showing must physicochemical characteristics compatible for white wines.

In spite of the existence of different white grape hybrids for wine purposes, the demand for new hybrids promoted the evaluation and selection of genetic crosses, in the IAC grape-breeding program, which need agronomic characterization in different climatic conditions, as well as the evaluation of its winemaking performance. Thus, the selection made at the IAC highlighted the hybrid ‘SR 0.501-17’ for the winemaking purposes, due to cluster quality, vine rusticity and sugar accumulation characteristics. This hybrid, developed at the former Experimental Station of São Roque (São Paulo, Brazil), is a white grape, with small round seeded berries and medium maturity cycle.

When a grape cultivar is introduced in a new growing region, the knowledge of phenology plays a major role in the success of the production system since the characterization of the phenological stages duration and thermal requirements of the vines in different climatic regions provide information for management (Bertoletti-Barros *et al.*, 2015). Also allows the cropping system planning in similar climatic conditions aiming at determining the harvesting season (Nunes *et al.*, 2016).

Among the several factors that may influence grapevine phenology and maturation process, stands out the genetics of cultivar and the region of production. It has been reported the influence of the air temperature on duration of different phenological stages and reproductive vine cycle (Parker *et al.*, 2011; Santibáñez *et al.*, 2014). In addition, the occurrence of low temperatures and high rainfall rates during the maturation period may be detrimental to berry sugar accumulation (Mota *et al.*, 2010; Favero *et al.* 2011).

Protas, Camargo & Mello (2006) reported that viticulture activities are traditional in temperate climate regions, and at the eastern region of the State of São Paulo, is found with altitudes varying between 700 and 900 m, annual rainfall of 1400 mm and temperature of 19.5 °C, where the altitude compensates the effect of latitude. Currently the northwest region of the state emerges as a pole of tropical viticulture, where altitudes range from 450 to 550 m, total annual rainfall of 1300 mm and the average temperature of 23 °C.

These climatic differences between the east and northwest region may influence both phenology and maturation process of grape cultivars. Therefore, the objective of this study was to evaluate and compare the performance of SR 0.501-17 white grape hybrid in contrasting climatic conditions, represented by municipalities of the eastern and northwestern regions of the state of São Paulo, aiming at characterizing the different phenological stages duration; thermal requirements and the influence of temperature and rain occurrence on must physicochemical characteristics.

## MATERIAL AND METHODS

The evaluation of the phenological and maturation performance of the SR 0.501-17 white grape hybrid, in contrasting climates, was done in experimental vineyards with 240 m<sup>2</sup> of the Centro de Frutas, located in Jundiaí-SP (Latitude: 23° 12’S; Longitude: 46° 53’W; Altitude: 715m), and 300 m<sup>2</sup> of the Centro de Seringueira e Recursos Agroflorestais, in Votuporanga-SP (Latitude: 20°15’S; Longitude: 50°30’W; Altitude: 483m) of the Instituto Agrônomico de Campinas from Agência Paulista de Tecnologia do Agronegócio – Secretaria de Agricultura e Abastecimento (IAC/APTA/SAA). The climate according to Koeppen is classified as Aw in Votuporanga and Cfb in the region of Jundiaí. The vines were grafted on the IAC 766 ‘Campinas’ rootstock and trained on vertical shoot position trellis with three wires to support the shoots. The spacing was 2 x 1m and 2 x 1.5m, respectively in Jundiaí and Votuporanga. Grapevine irrigation from budburst to beginning of maturation was performed, when necessary, with micro sprinkler system, as described by Conceição *et al.* (2017) to avoid water deficit.

In each experimental area, the evaluations were taken during the grape growing seasons from 2012 to 2016 and for maintenance of the experiments were adopted cultivation techniques recommended for the grape growers of each region. The planting of the rootstocks was carried out in November 2008 and the grafting in June 2009. Short pruning, leaving two buds per shoot, was carried out during July in Votuporanga and early August in Jundiaí. Harvest occurred during early December in Votuporanga and late December in Jundiaí. Dormex® at 3.5% was used to stimulate budburst.

At harvest, when the pH of the must reached values between 3.3 and 3.5, 100 berries were randomly harvested in the vineyard and subdivided into four samples of 25 berries each. The berries were manually smashed and the must used to determine soluble solids (SS) content (°Brix) with digital refractometer (Atago Pal-3) and titratable acidity (TA) using a semi-automatic pHmeter - Digimed DM-22 (0.1N NaOH solution and titration endpoint pH = 8.2) and

the result being expressed as  $\text{mEqL}^{-1}$  and % of tartaric acid (TAc). The maturation index was calculated by the ratio between the soluble solids and the tartaric acid content.

Vine phenology was characterized evaluating weekly the grape phenological stages, using the scale developed by Lorenz *et al.* (1995) to determine the occurrence of budburst, flowering, beginning of maturation (berry softening) and harvesting. The duration, in days, of the phenological stages was determined as follows P-B: Pruning-Budburst; B-F: Budburst-Flowering; F-M: Flowering-Beginning of maturation; M-H: Beginning of maturation-Harvest.

Maximum and minimum temperatures and rainfall data were collected in automatic standard weather stations, managed by CIIAGRO (IAC/APTA/SAA), at the experimental sites. The calculation of the thermal requirements was done through the accumulation of growing degree days (GDD) obtained by the averages between the maximum and minimum temperatures, subtracting the base temperature, considered as  $10\text{ }^{\circ}\text{C}$  (Sato *et al.*, 2011; Radünz *et al.*, 2015).

The relation between the values of cycle duration and air temperature was done by linear regression analysis using the least square method while the comparison between must physicochemical characteristics and total rainfall in the maturation period was evaluated by the correlation coefficient. The comparison of mean values of the physicochemical characteristics of the grapes in the different localities was done, as suggested by Silvestre (2016) using the “U” test of Mann-Whitney at 5% probability level.

## RESULTS AND DISCUSSION

Average air temperature and total rainfall values obtained during the vine growth cycle (Pruning-Harvest) and grape maturation period (Beginning of Maturation-Harvest), for the evaluated growing seasons, in Jundiaí and Votuporanga, are shown in Table 1.

During the grapevine growth cycle, temperature, on average, was  $3.3\text{ }^{\circ}\text{C}$  higher in Votuporanga when compared to Jundiaí, while the total rainfall was 164 mm lower. Taking in consideration the maturation period of the grapes, it was verified that temperature was, on average,  $2.7\text{ }^{\circ}\text{C}$  higher in Votuporanga, whereas for rainfall, although being 30 mm less than in Jundiaí, no difference was observed comparing the localities. The growing seasons with less occurrence of rainfall in Votuporanga were 2014 and 2016, while in Jundiaí were 2013 and 2014. The occurrence of lower rainfall levels during the maturation period usually enhances berry grape sugar accumulation, favoring obtainment of high quality product for wine making purposes.

### *Phenological subperiod duration and air temperature relationship*

The duration of different phenological subperiods and mean air temperature for the SR.0.501-17 grape hybrid cultivated under the contrasting climatic conditions of Jundiaí and Votuporanga during the growing seasons from 2012 to 2016 are shown in Figure 1.

The Pruning-Budburst phenological stage had an average duration of 16 days in both Jundiaí and Votuporanga, varying from 12 to 20 days depending on the growing season. The Budburst-Flowering stage was longer in Jundiaí (35 days) when compared to Votuporanga (31 days). Also for the Flowering-Beginning of maturation subperiod, it was observed a longer duration in Jundiaí, being the average values 66 and 57 days, respectively, for Jundiaí and Votuporanga. The maturation period of the grapes, represented by the duration of the phenological subperiod: Beginning of maturation (berry softening) – Harvest, was similar in both localities evaluated varying between 27 and 29 days.

The obtained values of the duration of the maturation period for SR.0.501-17 was similar to that reported by Hernandez *et al.* (2010) for ‘Moscatel de Jundiaí’ and ‘Madalena’. Both are white grape cultivars for wine purposes that, when grown in the region of Jundiaí, showed a duration of the phenological stage of the 30 days. In addition, for ‘Cabernet Sauvignon’ was reported a duration of maturation period of 33 days, in the subtropical northwest region of Paraná (Roberto *et al.*, 2005). On the other hand, the duration of the maturation period for SR.0.501-17 was lower than the values reported by Pedro Júnior *et al.* (2013) for ‘BRS Lorena’ grape grown in São Roque-SP, which averaged 57 days. It was also lower than the results obtained by Brighenti *et al.* (2014) for the cultivars Chardonnay and Sauvignon Blanc grown in São Joaquim-SC. The obtained values were respectively, 44 and 41 days and for the cultivars Proseco, Vermentino and Verdichio whose duration of the maturation varied between 53 and 62 days, probably due to the regional climatic condition, due to existing low temperatures as a function of high altitude, and the genetic characteristics of the cultivar. The characteristic of having a short maturation period demonstrated by SR.0.501-17 is of high concernment for the grape growers because it allows two crop cycles in one producing year (Moura *et al.*, 2017).

Regarding the vine growth cycle duration (Pruning-Harvest), it was found to be about 15 days longer in Jundiaí when compared to Votuporanga, being the observed average values 146 days for Jundiaí and 131 days for Votuporanga. Cultivars of grapes for high quality wine, such as the ‘Sauvignon Blanc’ grown in the Cam-

panha region of the Rio Grande do Sul state, also had a similar cycle duration, that is, 147 days (Radünz *et al.*, 2015). While Brighenti *et al.* (2014) evaluating Italian autochthonous varieties reported for São Joaquim, in Santa Catarina state, cycle durations ranging from 217 to 246 days as a function of the cultivar and low temperatures in the region.

In Figure 1 is shown the influence of the average air temperature on vine growth cycle duration. For the 2013 growing season, lower temperatures were observed in Votuporanga and the growth cycle duration was longer, with 137 days. While in the growing season of 2015 when higher temperatures occurred, the cycle was shortened and it was obtained, respectively, for Jundiaí and Votuporanga, 136 and 126 days.

The effect of air temperature on the SR 0.501-17 cycle duration is shown in Figure 2 by means of regression analysis used to verify the relationship between cycle duration and air temperature.

The obtained regression coefficients were 0.84 and 0.76, respectively for Jundiaí and Votuporanga. The angular coefficient of the regression equation for Jundiaí was -10.29 indicating a more pronounced effect of temperature in the cycle length compared to Votuporanga, whose angular coefficient was -4.9. That can be interpreted as, for each degree of temperature rise in Jundiaí the cycle shortens in approximately 10 days, while in Votuporanga it diminishes 5 days on average. The high temperatures observed in Votuporanga for all the growing seasons allow verifying graphically the effect in shortening vine cycle duration when compared to Jundiaí.

### Thermal requirements

The thermal requirements, expressed in terms of accumulated degree days, considering the base temperature of 10 °C, are shown in Table 2 for different growing seasons and phenological subperiods of SR 0.501-17 in the evaluated localities.

The thermal requirement for the subperiod: Pruning-Budburst was, on average, 129 and 168 GDD, respectively for Jundiaí and Votuporanga, while for the Budburst-Flowering subperiod was, respectively 342 and 400 GDD.

During the vine vegetative development, represented by the subperiod: Flowering-Beginning of maturation, it was required 791 and 870 GDD, respectively for the localities of Jundiaí and Votuporanga. For grape maturation, characterized by the subperiod: Beginning of maturation-Harvest, it was required 390 and 485 GDD for Jundiaí and Votuporanga. The thermal requirement for the vine growth cycle observed, considering: Pruning to Harvest, was 1653 and 1923 GDD, respectively for Jundiaí and Votuporanga. Table 2 shows that standard deviation for the cycle duration in Jundiaí was 12.1 GDD, while in Votuporanga it was 28.4 GDD. These values, considering the average temperatures of the different evaluated localities, represent a variation on cycle duration of about 1 day for Jundiaí and 2 days for Votuporanga.

In Votuporanga and Jundiaí different thermal requirement values were observed for the hybrid SR 0.501-17 to complete the growth cycle. The difference between obtained values of thermal requirement found when comparing different localities was reported by Santibáñez *et al.* (2014) associating this variation to the effect of climatic

**Table 1:** Temperature and rainfall during the grapevine cycle and maturation period of the white grape hybrid SR 0.501-17 grown in Jundiaí and Votuporanga counties, São Paulo State, Brazil, during the growing seasons from 2012 to 2016

Locality	Growing season	Grapevine cycle		Maturation period	
		Temperature (°C)	Rainfall (mm)	Temperature (°C)	Rainfall (mm)
Jundiaí	2012	21.6	501	24.2	200
	2013	20.6	407	23.7	100
	2014	21.3	312	23.0	118
	2015	22.1	342	24.1	245
	2016	21.0	545	23.2	166
	Mean	21.3b	481a	23.6b	166a
	SD	0.57	127	0.51	59
Votuporanga	2012	24.7	253	27.7	158
	2013	23.5	301	26.2	151
	2014	24.6	312	25.9	115
	2015	25.6	370	26.0	159
	2016	24.4	351	25.9	98
	Mean	24.6a	317b	26.3a	136a
	SD	0.75	46	0.77	28

SD: Standard Deviation. Means followed by the same letter, in the comparison of variables between localities in the same phenological stage, do not differ statistically by the Mann-Whitney 'U' test at 5% of probability. Grapevine cycle: Pruning to Harvest; Maturation period: Beginning of maturation to Harvest.

variables such as temperature and high atmospheric demand causing the closure of stomata around midday. Another factor that occurs in Votuporanga, besides allowing faster accumulation of growing degree days due to elevated temperatures, is the high evapotranspiration rate that could submit the plants to periods of water stress interfering in the duration of the phenological subperiods and consequently accumulation of degree days (Massignam & Angelocci, 1993).

Chavarria *et al.* (2009) obtained an average thermal requirement value of 1750 GDD for 'Moscato Giallo' grapevines grown in Flores da Cunha-RS region. Ricce *et al.* (2013) observed thermal requirement values similar to that obtained for SR 0.501-17 in Jundiá for the cultivars Moscato Embrapa, Moscato Giallo and Trebbiano in the state of Paraná.

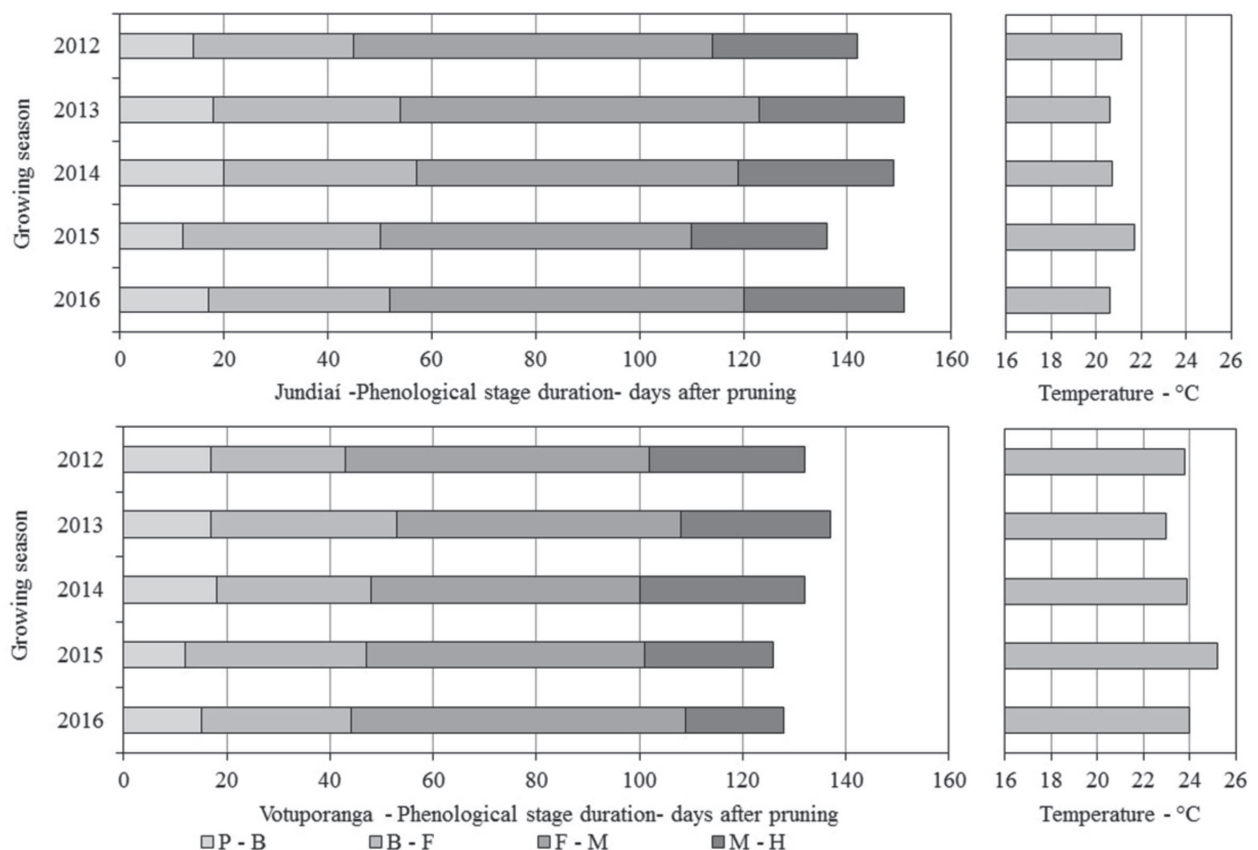
### ***Must physicochemical characteristics and rain at maturation period***

Table 3 shows the mean values of must physicochemical characteristics of SR 0.501-17 and Figure 3 the relationship between soluble solids (SS) content, total titratable acidity (TA) and maturation index (MI) and total rainfall during the grape maturation period.

For both localities, Jundiá and Votuporanga, it was observed a variation in SS values for the different growing seasons, probably related to rainfall observed during the maturation period of the grapes, since there is a decreasing effect on berry sugar content related to rainfall occurrence. Santos *et al.* (2010) also reported that it is usually expected variations on must physicochemical characteristics when comparing growing seasons, once they are influenced by the climatic conditions, mainly rainfall occurrence.

The observed SS values in Jundiá varied from 16.8 to 20.5° Brix for the different growing seasons (Table 3). These values were higher than reported by Hernandez *et al.* (2010) for hybrid grapes ('Moscatel de Jundiá' and 'Madalena') whose SS values averaged 16.7° Brix. Pedro Júnior *et al.* (2013) obtained similar values of soluble solids content (18.7 to 20.3° Brix) for 'BRS Lorena' grapevine in the wine-growing region of São Roque (SP).

In Votuporanga, SS values variation for different growing seasons was also observed, ranging from 16.6 to 20.5° Brix (Table 3). This difference in SS values, as in Jundiá, was probably due to the occurrence of rain during grape maturation. Obtained average SS values were 18.2° Brix and 18.9° Brix, respectively in Votuporanga and Jundiá. Although the observed rainfall amounts during the grape



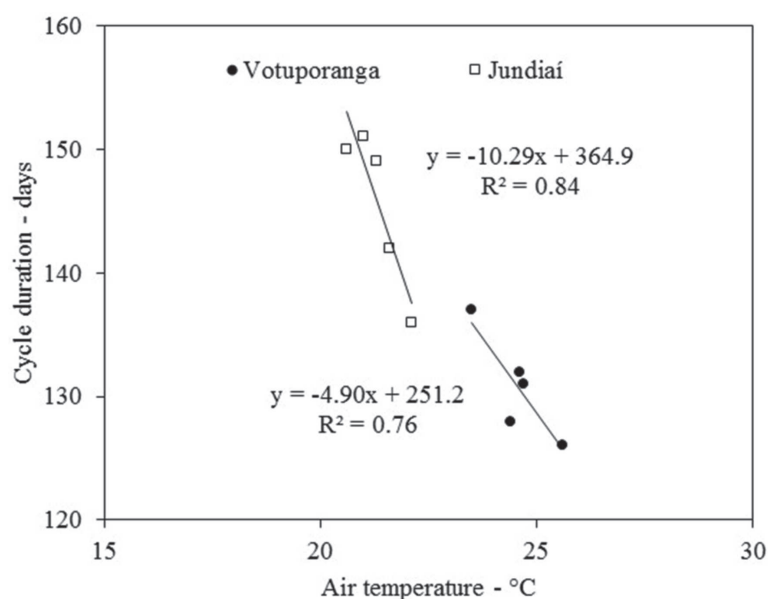
**Figure 1:** Phenological subperiods duration of the white grape hybrid SR 0.501-17 and average temperature for different growing seasons at Jundiá and Votuporanga counties, São Paulo State, Brazil. P-B: Pruning-Budburst; B-F: Budburst-Flowering; F-M: Flowering-Beginning of maturation (*veraison*); M-H: Beginning of maturation-Harvest.

ripening period were lower in Votuporanga compared to Jundiaí, no influence was observed on the average value of SS considering all evaluated growing seasons, and no statistical difference between localities was found for total rainfall during grape maturation (Table 1).

The occurrence of rainfall during maturation has been evaluated as detrimental to sugar accumulation in grapes and in this experiment, high SS values were observed, for the growing seasons with low rainfall occurrence during the maturation period. In Jundiaí lower rates of rainfall occurred during 2013 and 2014 and in

Votuporanga during 2014 and 2016 (Table 1), being SS above 18.5° Brix (Table 3). For the growing seasons of 2012 and 2015, when rainfall occurrence was high during grape maturation period for both localities, low values soluble solids were observed.

The correlation (Figure 3) between the soluble solids content and rain accumulated during grape maturation period was negative, indicating that high rainfall amounts influence the dilution of berry soluble solids. The obtained correlation coefficients values were 0.76 and 0.77, respectively, for the Votuporanga and Jundiaí. Araújo *et*



**Figure 2:** Relation between cycle (y) duration (pruning to harvest) of the white grape hybrid SR 0.501-17 and mean air temperature (x) for Jundiaí and Votuporanga counties, São Paulo State, Brazil.

**Table 2:** Thermal requirements (growing degree days) for different phenological subperiods of the white grape hybrid SR 0.501-17 cultivated in Jundiaí and Votuporanga counties, São Paulo State, Brazil during the growing seasons from 2012 to 2016

Locality	Growing season	Phenological subperiod				
		P - B	B - F	F - M	M - C	P - H
Jundiaí	2012	113	318	824	396	1651
	2013	131	331	756	395	1613
	2014	148	362	786	391	1687
	2015	116	369	804	364	1653
	2016	137	332	784	407	1660
	Mean	129	342	791	391	1653
	SD	14,0	20,3	14,5	16,0	12,1
Votuporanga	2012	140	357	907	532	1936
	2013	151	417	815	469	1852
	2014	181	405	837	509	1932
	2015	167	474	932	399	1972
	2016	201	346	860	514	1923
	Mean	168	400	870	485	1923
	SD	18,4	38,6	39,4	40,5	28,4

P-B: Pruning – Budburst; B-F: Budburst - Flowering; F-M: Flowering- Beginning of maturation; M-C: Beginning of maturation – Harvest; P-C: Pruning – Harvest; SD: Standard Deviation

*al.* (2016) also verified that rainfall, occurring 30 days before harvesting, corresponding to the maturation period of the grapes, negatively influenced the soluble solids content of *Vitis labrusca* cultivars in the grape growing region of Bento Gonçalves and Flores da Cunha in Rio Grande do Sul state.

Regarding total titratable acidity, the obtained mean value was 91 mEqL<sup>-1</sup> both for Votuporanga and for Jundiaí (Table 3). These values were lower than reported by Pedro Júnior *et al.* (2013) for the cultivar BRS Lorena cultivated in the region of São Roque-SP and those observed by Silva *et al.* (2015) for the cultivars Rainha and BRS Lorena cultivated in Jundiaí-SP, which ranged between 110 and 115 mEqL<sup>-1</sup>.

Rainfall occurrence during grape maturation period, in both Jundiaí and Votuporanga, influenced increasing titratable acidity values. In Votuporanga rainfall values of 150 mm allowed to obtain must with titratable acidity around 110 mEqL<sup>-1</sup>, while in Jundiaí, the values did not exceed 100 mEqL<sup>-1</sup> even under conditions of high rainfall. According to Felippeto *et al.* (2016), total acidity levels between 90 and 120 mEqL<sup>-1</sup> are acceptable for grapes considering winemaking purposes. The correlation coefficient was positive for both localities indicating that the occurrence of rain influences in order to increase grape must titratable acidity.

The values of tartaric acid content, expressed as a percentage, varied between 0.52 and 0.78, in Votuporanga, and between 0.65 and 0.75, in Jundiaí (Table 3). The average value for the different growing seasons was 0.69%, being

the same in both locations, and there was no statistical difference between localities. The obtained value was similar to those reported for 'SR 0.501-17' and 'Madalena' and lower than those obtained for cultivars Moscatel de Jundiaí and BRS Lorena in the region of Jundiaí-SP (Moura *et al.*, 2017).

In general, no difference was found in the evaluated must physicochemical characteristics when comparing Jundiaí and Votuporanga besides the climatic differences between localities. On the other hand, Regina *et al.* (2010) reported differences on soluble solids and acidity values for 'Chardonnay' and 'Pinot Noir' grown in Minas Gerais state due the effect of altitude. Probably because the difference in altitude for the localities evaluated at Minas Gerais were greater than the difference in the comparison of sites in this experiment.

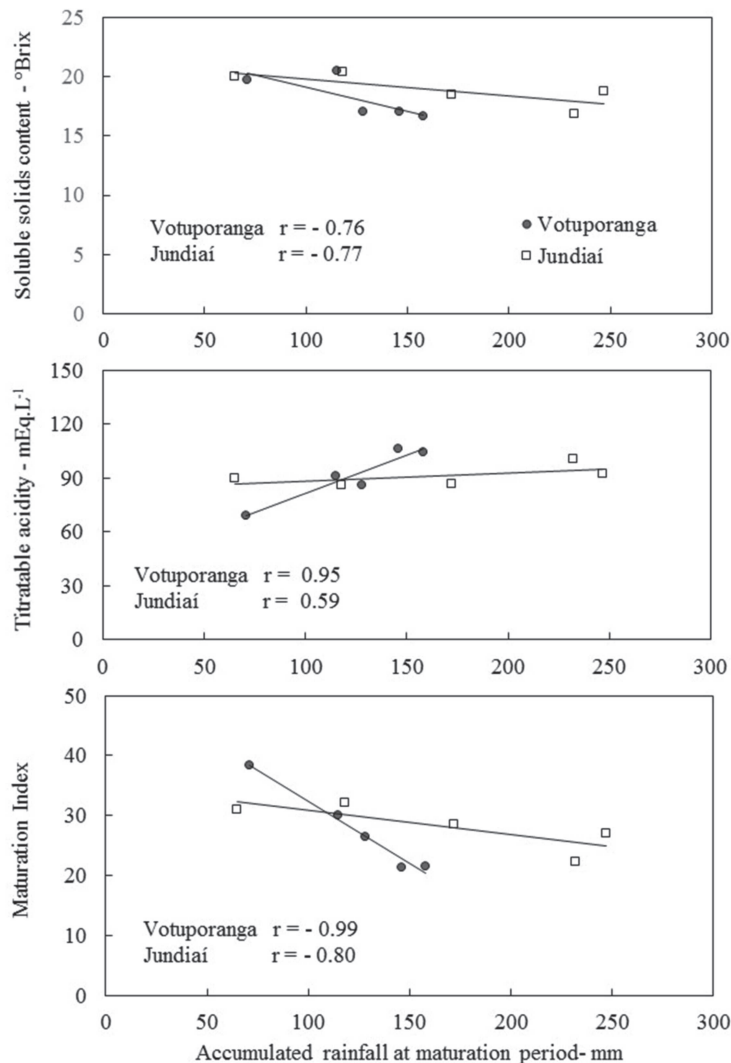
The maturation index (MI) was 27.6 in Votuporanga and 28.2 in Jundiaí (Table 3) and no difference was found when comparing localities. According to Sato *et al.* (2009) the MI seems to be an option to determine the ideal grape harvest point because it represents the balance between sugar content and acidity of the must.

In Figure 3, it is possible to verify the negative influence of rainfall on MI, more pronounced in Votuporanga, probably due to the short vine cycle and high temperatures in the region. Similar MI values were reported for the 'BRS Lorena' in the region of São Roque - SP (Pedro Júnior *et al.*, 2013). Still, and according to Rizzon & Miele (2002) values of MI between 30 and 32 are appropriate for the wine purpose.

**Table 3:** Soluble solids content (SS), tartaric acid content (TAc), titratable acidity (TA), maturation index (MI) and rainfall during the maturation period for the white grape hybrid SR 0.501-17 grown in Jundiaí and Votuporanga counties, São Paulo State, Brazil, during the growing seasons from 2012 to 2016

Locality	Growing season	SS	TAc	TA	MI
		°Brix	%	mEqL <sup>-1</sup>	
Jundiaí	2012	18.8	0.69	93	27.1
	2013	20.0	0.65	90	31.0
	2014	20.5	0.65	86	32.2
	2015	16.8	0.75	101	22.4
	2016	18.5	0.65	87	28.5
	Mean	18.9a	0.69a	91a	28.2a
	SD	1.4	0.05	5.9	3.9
Votuporanga	2012	16.6	0.78	105	21.5
	2013	17.1	0.68	86	26.6
	2014	20.5	0.68	91	30.1
	2015	17.0	0.80	106	21.5
	2016	19.7	0.52	69	38.4
	Mean	18.2a	0.68a	91a	27.6a
	SD	1.8	0.11	15.2	7.0

SD: Standard Deviation. Means followed by the same letter, in the comparison of variables between localities, do not differ by the Mann-Whitney 'U' test at 5% of probability.



**Figure 3:** Correlation between must physicochemical characteristics of the white grape hybrid SR 0.501-17 and accumulated rainfall during the maturation period for Jundiaí and Votuporanga counties, São Paulo State, Brazil.

## CONCLUSIONS

The SR 0.501-17 cycle duration is higher in Jundiaí when compared to Votuporanga being respectively, 146 and 131 days. The angular coefficient of the regression lines allowed verifying that in Jundiaí the effect of the air temperature on the cycle duration is more pronounced in comparison to Votuporanga.

The thermal requirement expressed in degree days for the SR 0.501-17 cycle is higher in Votuporanga (1923 GDD) compared to Jundiaí (1653 GDD).

SR 0.501-17 must physicochemical characteristics do not differ when comparing Jundiaí and Votuporanga.

The correlation coefficient between must physicochemical characteristics and rainfall during the maturation period is negative for soluble solids content and maturation index and positive for titratable acidity in both locations.

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