Phenological characterization and thermal demand of 'BRS Vitoria' seedless grape grown in subtropical area

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ABSTRACT

The 'BRS Vitoria' is a black hybrid seedless grape with a raspberry-like taste. These characteristics meet the main demands of the grape industry in Brazil, and also this cultivar show good tolerance to downy mildew. However, there is no information available on the phenological characteristics and thermal demand of this grapevine in subtropical area. The objective of this work was to characterize the phenological behavior and determine the thermal demands in degree-days of this grapevine in the Northern region of the Paraná State. The trials were conducted during two consecutive seasons (regular crop of 2013 and off-season crop of 2014). The study verified the phenological behavior and the thermal demands of 20 representative grapevines trained in a over-head trellis system, spaced at 2.5 x 5.0 m. For the characterization of the phenological stadia, two canes of each grapevine were marked. These canes were evaluated according to the duration in number of days of the following stadia, starting from winter pruning: a) cotton swell, b) sprouting, c) inflorescence emergence, d) flowering, e) veraison f) ripening. The thermal demand was calculated by the total degree-day (DD) from pruning to ripening, as well as for each of the phenological subperiods, considering 10 °C and 12 °C as base temperatures. Results showed that the duration of the pruning to ripening was 130 days, and thermal demand was 1,679.96 DD for the regular crop and 134 days and 1,831.84 DD for off-season crop, being the temperature-base of 10oC the most adequate to calculate this demand.

Key words: *Vitis* spp, hybrid, degrees-day, table grape.

INTRODUCTION

In the last years, there have been some changes in the grapevine production systems in Brazil, with the introduction of new cultivars, specially for seedless grapes (Yamamoto et al., 2012). In 1997, Embrapa Grape and Wine started a table grape genetic breeding program for the creation of seedless cultivars. Six years later, the following first cultivars were released: BRS Morena, BRS Clara and BRS Linda (Nachtigal 2005), and most recently, in 2012, BRS Vitoria (Maia et al., 2012), which is a hybrid seeless with black color and a raspberry-like taste. These characteristics meet the main demands of the grape industry in Brazil, and also this cultivar show tolerance to downy mildew (*Plasmopara viticola*), the main grapevine disease under the humid tropical conditions. This is an interesting cultivar, since the absence of seeds and tolerance to downy mildew are importante, especially for the off-season crops, during which the disease is more severe (Maia et al., 2012).

However, no information is available on the phenological characteristics and thermal demand of this grapevine in subtropical area. To implememt a new cultivar in a region where its cultivation is unknown, studies on its phenological behavior and thermal demand in function of local edaphoclimatic condition are needed.

The phenological characterization and the quantification of the thermal units needed for the grapevive to complete the different phases of the production cycle provide the vine grower knowledge on probable harvesting dates, indicating the climate potential of the grapevine growing regions (Pedro Júnior et al., 1993).

The main advantages of this grapevine phenological stages are: reduction in phytosanitary treatments, which start to be realized more rationally, according to the appearance of the main pests and diseases, within the current development phase of the crop; better fruit quality; input savings; and the possibility of an off-season crop (Murakami et al., 2002).

Taking into account all these aspects, the objective of this work was to characterize the phenological behavior and determine the thermal demands in degree-days of the 'BRS Vitoria seedless grape in subtropical area during the regular and off-season crops.

MATERIAL AND METHODS

The experiment was conducted in a three-year-old commercial vineyard of 'BRS Vitoria' (*Vitis* sp.) grafted on 'IAC 766 Campinas', located in Marialva-PR, Brazil, whose geographical coordinates are 23º29'52,8" S and 51º47'58,0" O, with 570 m of altitude, average annual rainfall of 1,600 mm, average annual temperature of 20.7 °C and average

relative humidity of 73%. According to the Köppen classification, the local climate is of the Cfa.

The study verified the phenological behavior and thermal demands of 20 representative vines trained in an overhead trellis system, spaced at 2.5 m x 5 m. The experiment was conducted during the regular crop of 2013 (August-December) and during the off season crop of 2015 (January-June).

Pruning was performed on August 12, 2013 and January 22, 2014, and the trials were harvested in December 20, 2013 during the regular crop and in June 5, 2014, during the off season crop. In each pruning, three to four buds per branch were left, followed by the application of hydrogenated cyanamide at 3% on the two apical buds for budbreak.

Habitual crop and phytosanitary treatments and phytosantitary for the region were realized during the assays in regards to nutrition, weeds control and pests and diseases management.

To characterize phenological stadia, two canes of each vine were labelled. Duration of the following stadia of these two canes, starting from pruning (PR), were assessed through visual observations, according to the classification of Baggiolini (1952) and Baillod and Baggiolini (1993):

a) Cotton-swell (CS): when 50% of the bolls reaches the vine's second stadium of development, i.e., when the scale breaks up and the plumage appears.

b) Sprouting (SP): when 50% of the bolls reaches the fourth stadia , i.e., during leaves emergence.

c) Inflorescence emergence (IE): when 50% of the branches shows inflorescence, with visible berry bunches, though rudimentary.

d) Flowering (FL): when 50% of the flowere are open (flowering with visible flowers).

e) Veraison (VE): when 50% of the berries change to a reddish color and start softening.

f) Ripening (RI): when 100% of the berries are soft, with an intense coloration and stable total soluble solids content.

Then, diagrams were developed from these data, representing in a scale the duration of each one the phenological phases as well as the total grapevine cycle.

To characterize the thermal demands of 'BRS Vitoria' seedless grape, the degrees-day (DD) sum from pruning to ripening was used as well as for each of the phenological subperiods, using climate data from the INMET – National Institute of Metrology, according to the following equations proposed by Villa Nova et al. (1972):

a) DD = (Tm - Tb) + (TM - Tm)/2, for Tm>Tb;

b) DD = (TM - Tb)2 / 2(TM - Tm), for Tm<Tb; and

c) DD = 0, for Tb>TM

where:

DD = degrees-day;

MT = maximum daily temperature (ºC);

mT = Minimum daily temperature (ºC);

bT = base temperature.

Degree-days were then calculated for the two base-temperatures (10 and 12 ºC), to establish the lowest standard deviation for days, according to the following equation proposed by Arnold (1959):

Sd = Sdd/xt – bt

where:

Sd = standard deviation in days;

Sdd = standard deviation in degrees-day;

xt = average air temperature in the period under consideration (ºC); and

bt = base temperature (ºC).

RESULTS AND DISCUSSION

Figure 1 shows the number of days of the phenological stages for the 'BRS Vitoria' seedless grape, as well as its cycle duration. It shows that this grapevine cycle (PR-RI) in the regular crop was 130 days, and the duration of pruning to cotton swell (P-CS), pruning to sprouting (PR-SP), pruning to emergence of inflorescence (PR-EI), pruning to flowering (PR-FL) and pruning to ripening (PR-RI) was 16, 21, 25, 46 and 95 days, respectively.

For the off season crop, the cycle was longer, totaling 134 days, while the duration of the PR-CS, PR-SP, PR-EI, PR-FL and PR-RI subperiods was of 9, 14, 20, 38 and 93 days, respectively (Figure 1). Considering the two crops assessed, the average duration of the PR-RI period for the 'BRS Vitoria' grape was 132 days.

Similar results were found with the 'Cabernet Sauvignon' and Tannat' grapevines, which showed total cycle in the region, with an average duration of 130.3 and 131.3 days, respectively (Sato et al., 2011).

Information on this grapevine phenological characteristics are scarce. The 'BRS Vitoria' is a vigorous cultivar, which contributed to the good plant development in the first year. It shows a wide climate adaptation expressed by the excellent agronomic behavior in the several in which it was tested. This grapevine may show, depending on the climate conditions, a total cycle of 90 to 135 days, depending of the area where it is cultivated (Maia et al., 2012).

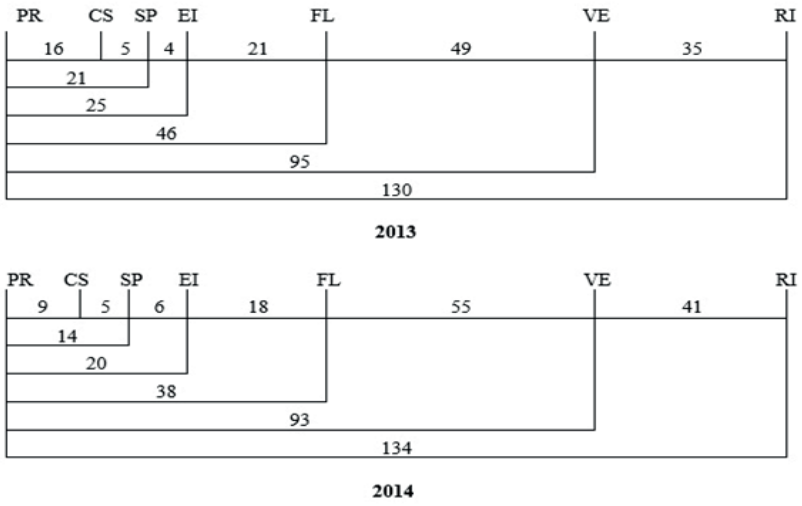

Figure 1: Duration in number of days for the phenological subperiods of the 'BRS Vitoria' seedless grape (regular crop of 2013 and off-season crop of 2014). Pruning (PR); Cotton-swell (CS); Sprouting (SP); Inflorescence emergence (IE); Flowering (FL); Veraison (VE); Ripening (RI).

According to the results here obtained, it was possible to obtain two annual crops of 'BRS Vitoria' in this subtropical area, since, by performing the pruning in late winter, the harvest is obtained in December, leaving enough time for the realization of a summer pruning (January) and to obtain a harvest in the early fall.

Table 1 shows the termal demands in degrees-day (DD) for each phenological subperiod and total cycle of the 'BRS Vitoria' seedless grape for the base temperatures at 10 and 12 °C.

Table 1: Thermal demand in degrees-day (DD), calculated for base temperatures at 10 and 12 °C, and standard deviation (Sd) in days for each subperiod for the 'BRS Vitoria' seedless grape (regular crop of 2013 and off-season crop 2014).

Subperiods	2013 regular crop				2014 off-season crop			
	10 °C		12 °C		10 °C		12 °C	
	DD	Sd	DD	Sd	DD	Sd	DD	Sd
PR-CS[1]	127.25	±0.66	104.34	±0.78	172.60	±0.08	152.60	±0.09
CS-SP	61.15	±0.29	51.15	±0.35	100.50	±0.04	90.60	±0.04
SP-EI	42.42	±0.07	42.42	±0.09	113.85	±0.06	101.85	±0.06
EI-FL	266.58	±0.38	224.58	±0.45	265.70	±0.11	229.70	±0.12
FL-VE	656.51	±0.20	558.51	±0.23	778.75	±0.16	668.75	±0.19
VE-RI	526.04	±0.10	456.04	±0.11	400.54	±0.38	328.10	±0.42
PO-RI	1679.96	±0.30	1437.04	±0.34	1831.84	±0.29	1571.50	±0.33

[1]Pruning (PR); Cotton-swell (CS); Sprouting (SP); Inflorescence emergence (IE); Flowering (FL); Veraison (VE); and Ripening (RI).

Thermal demand for the total cycle (PR-RI), in the regular crop of the 'BRS Vitoria' was 1679.96 GD and 1437.04 DD, considering base temperatures at 10 and 12°C. For the evaluated phenological subperiods: the demand was of 127.25; 61.15; 42.42; 266.58; 656.51 and 526.04 DD and 104.34; 51.15; 42.42; 224.58; 558.51 and 456.04 DD, respectively.

In the off season crop, thermal demand for the total cycle was 1,831.84 and 1,571.50 DD, considering base temperatures at 10 and 12°C. For the evaluated following phenological subperiods, the demand was 172.60; 100.50; 113.85; 265.70; 778.75 and 400.54 DD and 152.60; 90.60; 101.85; 229.70; 668.75 and 328.10 DD, respectively (Table 1).

The lowest standard deviations (Sd) in days were obtained at the base temperature of 10°C for te subperiods and grapevine total cycle, when compared to the base temperature at 12°C. Other authors have reported that the most adequate temperature for therma demand determination is 10°C for several grapevine cultivars in Brazil (Nagata et al., 2000; Roberto et al., 2005).

Besides the temperature, other climate factors, rootstock use, fertilization, pests and diseasses and the genotype can also affect grapevine cycle duration (Leão and Silva 2004; Kishino and Marur 2007).

Based on these findings, the knowledge of the duration of each phenological subperiod of the 'BRS Vitoria' seedless grape and its thermal demand will help grapegrowers with crop treatments programming, optimizing the work power and allowing for the rationalization of the phytosanitary treatments and harvest programming.

CONCLUSIONS

'BRS Vitoria' seedless grape cycle duration, from pruning to ripening is 130 days, and its thermal demand is 1,679.96 DD for regular crop, and 134 days and 1,831.84 DD for off-season crop, being the temperature-base of 10 °C the most adequate for the calculation of this demand during the two crops.

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