



LEAF REMOVAL MANAGEMENT AND ITS EFFECT ON THE QUALITY OF 'BORDÔ' VINE CULTIVATED IN THE NORTHERN PLATEAU OF SANTA CATARINA

Alcemir Nabir Kowal¹, Thalia Aparecida Silva Maciel¹, Thuany Aparecida Levandoski Jansen¹, Eduarda Schmidt¹, Rabechl Stange Almeida¹, Eduardo Virmond Souza Farias¹, Otávio Frederico Tschoeke Steidel¹, Rodrigo Palinguer¹, Kelly Eduarda Demetrio¹, Caroline de Souza Wisniewski¹, Sabrina de Cassia Senen¹, Douglas André Wurz^{1*},

¹Instituto Federal de Santa Catarina, Campus Canoinhas, Avenida Expedicionários 2150, Canoinhas/SC, Brasil.

*Corresponding author: Email: douglas.wurz@ifsc.edu.br;

ABSTRACT: Brazilian viticulture has a wide range of varieties and producing regions. The 'Bordô' variety stands out in national production due to its destination for the production of red table wines and natural juices, which are more appreciated by Brazilians. The Northern Plateau region of the state of Santa Catarina has favorable soil and climate conditions for viticulture, however, it lacks information about the necessary management in the region. Thus, the present study sought to evaluate the effect of defoliation management on the agronomic performance of 'Bordô' vine cultivated in the northern plateau of Santa Catarina. For this, five treatments were carried out, determined in randomized blocks, which consisted of different defoliation times, namely, T1 = Full bloom, T2 = Chumbinho grain, T3 = Pea grain, T4 = Color change and T5 = Control. The work was carried out in the municipality of Canoinhas/SC, in a commercial vineyard of the 'Bordô' variety under "VR 043-43" rootstock, with 3.0 x 1.5 m spacing, conducted in manger and mixed pruning system, in the 2022/2023 harvest. Variables bunch mass, bunch length, number of berries per bunch, berry diameter, compaction index, mass of 50 berries, soluble solids, total titratable acidity and pH were evaluated. Among analyzed variables, T5 treatment presented higher bunch mass and pH; the mass of 50 berries obtained lower values in T2 and T3, while T3 and T4 treatments presented higher total acidity values. Thus, it appears that defoliation management in conjunction with standard pruning results in excessive reduction in leaf area, causing little or no interference in the variables analyzed. Thus, new defoliation trials associated or not with other vegetative canopy management should be carried out in the region.

KEY WORDS: *Vitis labrusca*, vegetative canopy, chemical composition.

MANEJO DA DESFOLHA E SEU EFEITO NA QUALIDADE DA VIDEIRA 'BORDÔ' CULTIVADA NO PLANALTO NORTE CATARINENSE

RESUMO: A viticultura brasileira apresenta uma enorme gama de variedades e de regiões produtoras. A variedade 'Bordô' possui destaque na produção nacional dada a sua destinação para a produção de vinhos de mesa tintos e sucos naturais, que possuem mais apreço pelos brasileiros. A região do Planalto Norte Catarinense possui condições edafoclimáticas favoráveis para a viticultura, entretanto, carece de informações sobre o manejo necessário na região. Com isso, o presente ensaio buscou avaliar o efeito do manejo da desfolha da no desempenho agrônomo da videira 'Bordô' cultivada no planalto norte catarinense. Para isso foram realizados cinco tratamentos, determinados em blocos ao acaso, que consistiam em diferentes épocas de desfolha, sendo eles, T1 = Plena florada, T2 = Grão chumbinho, T3 = Grão ervilha, T4 = Mudança de cor e T5 = Testemunha. O trabalho foi realizado no município de Canoinhas/SC, em vinhedo comercial de variedade Bordô sob porta enxerto "VR 043-43", com espaçamento 3,0 x 1,5 m, conduzidas em manjedoura, em sistema de poda mista, no ciclo

2022/2023. Foram avaliadas as variáveis massa de cacho, comprimento do cacho, número de bagas por cacho, o diâmetro de baga, índice de compactação, massa de 50 bagas, sólidos solúveis, acidez total titulável e pH. Dentre as variáveis analisadas, o tratamento T5 apresentou maior massa de cacho e pH, a massa de 50 bagas obteve menores valores em grão chumbinho e grão ervilha, enquanto os tratamentos T3 e T4 apresentaram maior acidez total. Com isso, verifica-se que o manejo da desfolha em conjunto com o desponje padrão resulta em uma redução excessiva da área foliar, ocasionando pouca ou nenhuma interferência nas variáveis analisadas. Dessa forma, novos ensaios de desfolha associados ou não a outros manejos do dossel vegetativo devem ser realizados na região.

PALAVRAS-CHAVE: *Vitis labrusca*, dossel vegetativo, composição química.

Aceito para publicação em 26/08/2024

Publicado em: 11/12/2024

INTRODUCTION

In Brazil, viticulture has a wide genetic variety and producing regions, including the Northern Plateau of the state of Santa Catarina, which has great potential for viticulture given its favorable soil and climate conditions, presenting itself as an alternative source of income for small producers in the region. On the other hand, there are few studies on the crop in the region, in order to obtain and disseminate information to producers about appropriate management for vines under local conditions (Kowal et al., 2022).

Würz et al. (2018) point out that vine is demanding in cultural treatments, which must be adapted for each cultivar and each region. Maciel et al. (2020) report the low productivity of the 'Bordô' vine cultivar in the municipality of Canoinhas, located in the Northern Plateau of Santa Catarina. As a result, the activity may become unsustainable in the long term, which is why different forms of crop management must be evaluated in order to increase its productivity and quality and, consequently, producers' income.

When seeking to improve grape quality, the vine's vegetative canopy management is extremely important for the crop. According to Radünz et al. (2013), the different types of green pruning are among the various forms of management, which can be performed in different ways, at different phenological stages and for different purposes. The vegetative canopy management aims to provide greater sunlight, aeration and heat in the canopy, and to improve the quality of the final product. In the region, a widely used technique is pruning. Brighenti et al.

(2010) emphasize that this technique consists of removing the terminal areas of branches and is applied when the plant vigor has not been controlled with other forms of management.

Among the green pruning management practices, defoliation stands out, which consists of eliminating leaves to promote aeration in the region of inflorescences and grape bunches, providing better ripening conditions (Miele and Mandelli, 2012). This management is carried out in all wine-growing regions and is normally applied between fruiting and color-changing phases of berries (Diago et al., 2010). However, misinformation leads producers to remove leaves from the region of bunches indiscriminately (Mandelli et al., 2008; Anzanello et al., 2011).

Defoliation can alter the composition of grapes, improving their quality at harvest, with increased levels of sugars, anthocyanins and phenolic compounds and lower levels of titratable acidity, when compared to shaded fruits (Diago et al., 2012; Silvilotti et al., 2016; Ivanisevic et al., 2020).

The 'Bordeaux' grape variety is considered *Vitis labrusca*, which is why several wine-producing countries do not cultivate it. However, it has a large share in the Brazilian wine and juice production (Tecchio et al., 2007). This occurs because the 'Bordeaux' grape produces wines characterized as table wines, which are not appreciated by consumers in these wine-producing countries, who choose fine wines. The profile of Brazilian wine consumers shows high demand for table wines, especially red ones. Among grape varieties used to produce table

wines, 'Bordô' variety stands out, which also plays a fundamental role in the production of juices (Würz, 2018; Würz et al., 2020).

Corroborating this finding, Vieira et al. (2022) found that more than 76% of grape producers in the Northern Plateau of Santa Catarina grow the 'Bordô' variety. However, when asked about cultivation and management techniques, such as spacing and conduction system, it was found that there is no standard, so that producers follow their own technique. Thus, there is a clear need for further studies and technical training so that producers can become professionals and improve the quality of grapes, such as those already being carried out by the Federal Institute of Santa Catarina – Canoinhas Campus, according to the Best Juices and Wines of the Northern Plateau of Santa Catarina Contest.

Most management techniques used in vineyards, including defoliation, were based on the experiences of producers and research results from other wine regions already established in the sector, without considering local soil and climate conditions. In this context, the present study aims to evaluate the effects of defoliation on the agronomic performance of 'Bordô' grapevine cultivated in the Northern Plateau of Santa Catarina.

MATERIAL AND METHODS

The experiment was carried out in the 2022/2023 harvest, in a commercial vineyard, on a plot of the 'Bordô' variety, located in the municipality of Canoinhas, Santa Catarina (26°12'49.0" S 50°26'37.6" W; altitude of 870 m a.s.l.). The region is characterized by presenting average annual temperature between 17°C and 18°C, average rainfall of 1,500 to 1,700 mm, flat to undulating relief and soils of medium fertility (Wrege et al., 2012).

The vineyard is composed of the 'Bordô' variety grafted onto "VR 043-43" rootstock, implemented in 2013. The spacing used was 3.0 x 1.5 m, in rows arranged in the N-S direction, conducted in manger and mixed pruning system, with height of 1.5 m. Crop treatments of sprouting, pruning and phytosanitary treatments were carried out by the rural producer according

to recommendations of technical managers in all treatments.

Treatments consisted of five different defoliation periods, namely: Full Bloom, Chumbinho Grain, Pea Grain, Color Change and Control (without defoliation).

Defoliation consisted of removing leaves located close to bunches, aiming to allow the incidence of light in order to evaluate the interference in the production quality.

On the harvest date, random bunch samples were collected for later physicochemical analyses. For the bunch analyses, ten bunches per treatment were collected. Through these bunches, bunch mass (g) was obtained using a semi-analytical scale; also measuring bunch length (cm) with a ruler; number of berries per bunch; berry diameter (cm), with digital caliper; compaction index and mass of 50 berries (g).

After physical analysis, all berries from each treatment were mixed and then 50 berries were randomly collected per treatment to determine technological ripeness. The must for analyses was obtained by macerating the pulp, and soluble solids (°Brix), total titratable acidity (meq L⁻¹) and pH were determined, according to methodology proposed by the Office International de la Vigne et du Vin (Oiv, 2012).

Randomized block experimental design was used, with four blocks and ten plants per block. Data were submitted to analysis of variance (ANOVA) and, when statistically significant differences were observed, means were compared using the Tukey test, with 5% error probability.

RESULTS AND DISCUSSION

The values observed in the evaluation of variables bunch mass, bunch length, number of berries, berry diameter and compaction index are described in Table 1. It is possible to observe that, of these, only variable bunch mass presented statistical difference, where the control treatment was the only one to differ, obtaining higher value in relation to the others. The values obtained in this variable for treatments varied between 104.3 g and 141.4 g on average per bunch.

Table 1: Effect of different defoliation times on variables bunch mass (g bunch⁻¹), bunch length (cm bunch⁻¹), number of berries (berries bunch⁻¹), berry diameter (cm berry⁻¹) and compaction index of the ‘Bordô’ vine cultivated in the Northern Plateau of Santa Catarina, 2022/2023 harvest.

Treatments	Bunch mass	Bunch length	Number of berries	Berry diameter	Compaction index
	(g bunch ⁻¹)	(cm bunch ⁻¹)	(berries bunch ⁻¹)	(cm berry ⁻¹)	
T1	113.3 b	11.9 ns	46 ns	1.5 ns	0.81 ns
T2	119.9 b	12.3	52	1.4	0.82
T3	117.3 b	11.6	50	1.5	0.79
T4	104.3 b	11.3	53	1.5	0.81
T5	141.4 a	12.9	56	1.4	0.86
CV (%)	15.5	16.5	12.3	5.1	16.5

*Averages followed by the same letter, in the row, do not differ from each other by the Tukey test at 5% error probability.

For bunch length, the values obtained varied between 11.3 cm and 12.9 cm on average per bunch, while the number of berries per bunch varied between 46 and 56. The berry diameter was between 1.4 cm and 1.5 cm per berry and the compaction index between 0.79 and 0.86. Radünz et al. (2015) carried out trials in Rio Grande do Sul, evaluating different defoliation times in the ‘Bordô’ grapevine variety, and observed, in comparison to control, that treatments resulted in increased bunch mass and reduced number of berries, differing from this study in both analyses.

On the other hand, when evaluating the effects of defoliation intensity on the ‘Syrah’ grapevine in the Brazilian semiarid region,

Almeida and Ono (2016) observed significant differences in bunch mass and berry mass, while bunch length, soluble solids content and titratable acidity did not differ among treatments. These results were very similar to those observed in this study, where only titratable acidity showed result different from that observed by the authors.

Table 2 shows data related to variables mass of 50 berries (g), soluble solids (°Brix), total acidity (meq.L⁻¹) and pH. Of these, only soluble solids did not differ statistically among treatments, which obtained values between 13.5°Brix and 13.8°Brix. For variable mass of 50 berries, values ranged from 125.8 g to 149.9 g, with Chumbinho grain and Pea grain defoliation treatments obtaining the lowest results.

Table 2: Effect of different defoliation times on variables weight of 50 berries (g), soluble solids (°Brix), total acidity (meq L⁻¹) and pH of ‘Bordô’ vine cultivated in the Northern Plateau of Santa Catarina, 2022/2023 harvest.

Treatments	Mass of 50 berries	Soluble solids	Total acidity	pH
	(g)	(°Brix)	(meq L ⁻¹)	
T1	145.5 a	13.5 ns	109.6 b	3.26 ab
T2	126.8 b	13.8	107.6 b	3.25 ab
T3	125.8 b	13.7	114.6 a	3.13 c
T4	149.9 a	13.7	116.6 a	3.2 b
T5	140.4 a	13.7	107.9 b	3.33 a
CV (%)	8.1	4.2	3.9	2.1

*Averages followed by the same letter, in the row, do not differ from each other by the Tukey test at 5% error probability.

Regarding total acidity, the values obtained in treatments varied between 107.6 meq.L⁻¹ and 116.6 meq.L⁻¹, with pea grain and color change treatments obtaining the highest values. Finally, for variable pH, values ranged from 3.13 to 3.33, with plants not submitted to

defoliation management presenting the highest value, while the lowest value was observed for pea grain defoliation treatment.

In the evaluation carried out by Pötter et al. (2010) on the ‘Cabernet Sauvignon’ grapevine cultivated in the state of Rio Grande do Sul, it was

found that defoliation provides reduction in pH and total solids content, as well as increase in total acidity, results consistent with those obtained in this study, with the exception of the soluble solids content, which did not differ.

Anzanello et al. (2011), in an experiment evaluating the effects caused by defoliation at different times on 'Niagara Branca', 'Concord', 'Cabernet Sauvignon' and 'Merlot' varieties, found reduction in variables bunch mass, soluble solids and pH, while total acidity increased compared to control. For the other varieties, defoliation did not interfere in any of variables. A certain similarity was observed in the first two varieties when compared with this study.

Souza et al. (2012) evaluated different defoliation intensities in the 'Superior Seedless' variety in the state of Pernambuco and did not observe statistical differences in variables soluble solids, total acidity and berry diameter. However, Würz et al. (2018) pointed out statistical differences among defoliation treatments for variables soluble solids and total acidity, as well as differences in the same treatments. There are discrepancies found in comparison with several other tests found in literature, which may have occurred due to the time in which the experiment was carried out, as well as the defoliation intensity, location where the experiment was carried out and/or variety used.

Based on observed data, it is clear that the reduction in the leaf area/fruit ratio caused a decrease in the supply of carbohydrates to berries (Parker et al. 2015). In addition, it is possible to consider the hypothesis that the remaining leaves were not capable of increasing the photosynthetic activity of defoliated plants (Vasconcelos and Castagnoli, 2000), and therefore the defoliation management did not result in increase in the levels of soluble solids or reduction in total acidity.

It could be concluded that the defoliation management of the 'Bordô' grapevine, under the soil and climate conditions of the Northern Plateau of Santa Catarina, resulted in little or no effect on the architecture of bunches, as well as on the chemical variables of berries when combined with the pruning treatment, widely used by regional producers.

Therefore, further studies on the subject should be carried out in the region, in order to obtain a better understanding of the effect of defoliation management on the 'Bordô' grapevine, and thus determine the best time and intensity of implementation, as well as the other management techniques that may or may not be carried out together.

REFERENCES

Almeida, M. B.; Ono, E. O. Efeitos de diferentes níveis de desfolha sobre a fisiologia, a produção e a qualidade das uvas e dos vinhos da variedade Syrah em condições tropicais semiáridas brasileiras. *Revista Semiárido de Visu*, **2016**, 4, 160-175.

Anzanello, R.; Souza, P. V. D.; Coelho, P. F. Desfolha em videiras americanas e viníferas na fase de pré-maturação dos frutos. *Ciência Rural*, **2011**, 41, 1132-1135.

Brighenti, A. F.; Rufato, L.; Kretschmar, A. A.; Madeira, F. C. Desponte dos ramos da videira e seu efeito na qualidade dos frutos de 'Merlot' sobre os porta-enxertos 'Paulsen 1103' e 'Couderc 3309'. *Revista Brasileira de Fruticultura*, **2010**, 32,19-26.

Diago, M.; Vilanova, M.; Tardaguila, J. Effects of Timing of Manual and Mechanical Early Defoliation on the Aroma of *Vitis vinifera* L. Tempranillo Wine. *American Journal of Enology and Viticulture*, **2010**, 610, 382-391.

Diago, M. P.; Ayestaran, B.; Gaudalupe, Z.; Garrido, A.; Tardaguila, J. Phenolic composition of Tempranillo wines following early defoliation of the vines. *Journal Science Food Agriculture*, **2012**, 92, 925-934.

Ivanisevic, D.; Kaladjdzic, M.; Deanjacevic, M.; Puskas, V.; Korac, N. The impact of cluster thinning and leaf removal timing on the grape quality and concentration of monomeric anthocyanins in Cabernet-Sauvignon and Probus (*Vitis vinifera* L.) wines. *OENO One*. **2020**, 54, 63-74.

- Kowal, A. N.; Demetrio, K. E.; Krauss, N. M.; Vieira, L. C.; Regina, M.; Wurz, D. A. Principais entraves para o cultivo da videira identificados pelos produtores rurais na região do Planalto Norte Catarinense. In: Simpósio de fruticultura da Região Sul, 3., 2022, Evento. Anais [...]. On-Line: Frusul, **2022**. Disponível em: <https://portaleventos.uffs.edu.br/index.php/FRUSUL/article/view/16294>. Acesso em: 10 jul. 2023.
- Maciel, T. A. S.; Kowal, A. N.; Wurz, D. A.; Almeida, R. S.; Ribeiro, D. M. Poda curta x poda mista: efeito no desempenho produtivo da variedade 'bordô' no Planalto Norte Catarinense. In: Simpósio de integração científica e tecnológica do Sul Catarinense, 9., 2020, Evento Virtual. Anais [...]. Santa Rosa do Sul: IFC, **2020**. p. 895-895. Disponível em: <http://criciuma.ifsc.edu.br/sict-sul/images/Anais2020.pdf>. Acesso em: 10 jul. 2023
- Mandelli, F.; Mieli, A.; Rizzon, L. A.; Zanús, M. C. Efeito da poda verde na composição físico-química do mosto da uva Merlot. *Revista Brasileira de Fruticultura*, **2008**, 30, 667-674.
- Miele, A.; Mandelli, F. Manejo do dossel vegetativo e seu efeito nos componentes de produção da videira Merlot. *Revista Brasileira de Fruticultura*, **2012**. 34, 964-973.
- Oiv – Office International de la Vigne et du Vin. Recueil des Méthodes Internationales d'Analyse des Vins et des Moûts. Office International de la Vigne et du Vin: Paris, **2012**.
- Parker, A. K; Hofmann, R. W.; Van Leeuwen, C.; McLachlan, A. G. R.; Trought, M. C. T. Manipulating the leaf area to fruit mass ratio alters the synchrony of total soluble solids accumulation and titratable acidity of grape berries. *Australian Journal of Grape and Wine Research*. **2015**, 21, 266-276.
- Pötter, G. H.; Daudt, C. E.; Brackmann, A.; Leite, T. T.; Penna, N. G. Desfolha parcial em videiras e seus efeitos em uvas e vinhos Cabernet Sauvignon da região da Campanha do Rio Grande do Sul, Brasil. *Ciência Rural*, **2010**, 40, 2011-2016.
- Radünz, A. L.; Schoffel, E. R.; Hallal, M. O. C.; Brixner, G. F. Efeito da época de poda e da desfolha na interceptação de radiação solar na videira Bordô. *Bragantia*, **2013**, 72, 403-407.
- Radünz, A. L.; Schoffel, E. R.; Borges, C. T.; Radunz, A. F. O. Influência da poda sobre características produtivas e de qualidade em videiras na região de Pelotas/RS. *Pesquisa Agropecuária Gaúcha*, **2015**, 21, 72-78.
- Silvilotti, P.; Herrera, J.C.; Lisjak, K.; Hesnik, H.B.; Sabbatini, P.; Peterlunger, E.; Castellarin, S.D.; Impact of Leaf Removal, Applied Before and After Flowering, on Anthocyanin, Tannin, and Methoxypyrazine Concentrations in 'Merlot' (*Vitis vinifera* L.) Grapes and Wines. *Journal of Agricultural and Food Chemistry*, **2016**, 64, 4487-4496.
- Souza, E. R.; Ribeiro, V. G.; Pionório, J. A. A. Intensidades de desfolha para qualidade de cachos da videira. *Revista Brasileira de Tecnologia Aplicada nas Ciências Agrárias*, **2012**, 5, 87-98.
- Tecchio, F.M.; Miele, A.; Rizzon, L. A. Características sensoriais do vinho Bordô. *Pesquisa Agropecuária Brasileira*, **2007**, 42, 897-899.
- Vasconcelos, M. C.; Castagnoli, S. Leaf canopy structure and vine performance. *American Journal of Enology and Viticulture*, **2000**, 51, 90-396.
- Vieira, L. C.; Kowal, A. N.; Maciel, T. A.; Regina, M.; Wurz, D. A. Caracterização do sistema de cultivo da videira no Planalto Norte Catarinense. In: Simpósio de fruticultura da Região Sul, 3., 2022, Evento. Anais [...]. On-Line: Frusul, **2022**. Disponível em: <https://portaleventos.uffs.edu.br/index.php/FRUSUL/article/view/16249>. Acesso em: 05 jul. 2023.
- Wrege, M. S.; Steinmetz, S.; Reisser Junior,

C.; Almeida, I. R. Atlas climático da região sul do Brasil: estados do Paraná, Santa Catarina e Rio Grande do Sul. 2. ed. Brasília DF: Embrapa Informação Tecnológica, **2012**. 334 p.

Würz, D. A. Análise da comercialização de vinhos finos e de mesa no Brasil. *Journal of Agronomic Sciences*, **2018**, 8, 43-49.

Würz, D. A.; Allebrandt, R.; Marcon Filho, J. L.; Bem, B. P.; Brighenti, A. F.; Rufato, L.; Kretschmar, A. A. Época de desfolha e sua

influência no desempenho vitícola da uva 'Sauvignon Blanc' em região de elevada altitude. *Revista de Ciências Agroveterinárias*, **2018**, 17, 91-99.

Würz, D. A.; Pinto, M. A.; Kowal, A. N.; Maciel, T. A.; Oliveira, S.; Almeida, R. S.; Ribeiro, R. M.; Ribeiro, D. M. Avaliação da fertilidade de gemas de variedades de uvas americanas e híbridas cultivadas no Planalto Norte Catarinense. *Revista de Ciências Agroveterinárias*, **2020**, 19, 502-505.