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DISEASES INCIDENCE AND FUNGICIDE COST REDUCTION WITH OVERHEAD COVERED GRAPES[1]

MARCUS ANDRÉ KURTZ ALMANÇA[2], NATÁLIA SARTORI FRIGHETTO[3], JÚLIO CÉSAR TONELLO[4], SABRINA LERIN[5]

ABSTRACT - An alternative to control diseases on the grapevine is the use of plastic overhead cover. The cost of developing a vineyard is a relevant factor in the use of plastic overhead cover and will be directly linked to the cost of pest control. The aim of this study was to establish criteria for the use of fungicides in vine plants with plastic overhead cover compared to conventional farming in order to reduce the number and cost of application. The experiment was conducted in the 2010/2011 crop year in Viamão - RS, using the Cabernet Sauvignon cultivar grafted on Paulsen 1103 in "Y Shape" trained, with 1.80 x 2.50 m spacing. The following treatments were evaluated: Treatment 1: plastic overhead cover: phytosanitary treatment applied when leaf wetting was observed; Treatment 2: plastic overhead cover: curative treatment, when there were symptoms of disease in shoots; Treatment 3: plastic overhead cover: conventional calendar treatment every 15 days, with reapplication after leaf wetting and Treatment 4: without plastic overhead cover: conventional calendar treatment every 15 days, with reapplication after leaf wetting. The lowest number of applications was observed in treatment where the criteria for fungicide applications was only when symptoms were visualized and the greater number of applications was in the area without plastic overhead cover with conventional treatment, affecting the application cost, but without reflecting in higher productivity. The highest incidence of downy mildew was observed in treatment 4. It was concluded that it is possible to reduce the number of applications and the fungicide cost for disease control using plastic overhead cover. Moreover, this management may provide less contact with chemicals during crop and reduce chemical wastes in the environment and in the harvested product.
Index Terms: Plasticulture, *Vitis vinifera*, fungal diseases.

INCIDÊNCIA DE DOENÇAS E REDUÇÃO DE CUSTOS COM FUNGICIDAS UTILIZANDO COBERTURA PLÁSTICA EM VIDEIRA

RESUMO - Uma das alternativas para o controle de doenças da parte aérea na videira é a utilização de cobertura plástica. O custo de implantação de um vinhedo é um fator relevante na utilização de cobertura plástica e estará diretamente associado ao custo do controle fitossanitário. Assim, o objetivo do trabalho foi estabelecer critério para uso de fungicidas em plantas de videira com cobertura plástica em comparação ao cultivo convencional a fim de reduzir o número e o custo de aplicação. O experimento foi realizado no ciclo vegetativo de 2010/2011, em Viamão – RS, com a cultivar Cabernet Sauvignon enxertada Paulsen 1103, em sistema de sustentação ípsilon "Y" com espaçamento 1,80x2,50 m. Foram avaliados os seguintes tratamentos: Tratamento 1: com cobertura plástica: tratamento fitossanitário aplicado quando houvesse molhamento foliar; Tratamento 2: com cobertura plástica: tratamento fitossanitário curativo, ou seja, quando houvesse sintoma de doenças na parte aérea; Tratamento 3: com cobertura plástica: tratamento fitossanitário convencional de calendário a cada 15 dias, com reaplicação após molhamento foliar e Tratamento 4: sem cobertura plástica: tratamento fitossanitário convencional de calendário a cada 15 dias, com reaplicação após molhamento foliar, O menor número de aplicações foi observado no tratamento em que o critério para aplicação de fungicidas químicos era somente quando se visualizavam sintomas, e o com maior número de aplicações foi na área sem cobertura plástica com tratamento convencional, afetando o custo com produtos, porém sem refletir em maior produtividade. A maior incidência de míldio foi observada no Tratamento 4. Concluiu-se que é possível fazer uma redução do número de aplicações e do custo com fungicidas para o controle de doenças utilizando cobertura plástica. Além disso, este manejo pode proporcionar um menor contato com produtos químicos durante a safra e auxiliar na redução dos resíduos químicos no ambiente e no produto colhido.
Termos para indexação: Plasticultura, *Vitis vinifera*, doenças fúngicas.

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[2]Agronomist. PhD. Professor of Plant Pathology, IFRS/*Campus* Bento Gonçalves. Cx. Postal 540, 95700-206. Bento Gonçalves-RS. E-mail:marcus.almanca@bento.ifrs.edu.br
[3]Technician. IFRS. E-mail: nataliafriguetto@hotmail.com
[4]Technician. IFRS. E-mail: julio.c.tonello@gmail.com. Bolsista CNPq.
[5]Technician. M. Sc. PhD student, UFPel. Department of Fruticulture. E-mail: sabrinalerin@gmail.com. Bolsista Capes.

INTRODUCTION

The cultivation of vines in Brazil occupies approximately 83.7 thousand hectares and Rio Grande do Sul is the Brazilian state with the largest wine production. In 2014, wine companies in Rio Grande do Sul processed 606.1 million kilograms, approximately 89.11% of this amount of American and hybrid grapes (IBRAVIN, 2015). Fungal diseases are one of the main problems of the vine crop and phytosanitary treatments are responsible for about 30% of the production cost (GRIGOLETTI JÚNIOR; SÔNEGO, 1993). The main strategy used to control shoot diseases in grapevines is the use of fungicides and up to 14 sprays are usually carried out in open-grown *Vitis vinifera* grapes (FREIRE et al., 1992) and from eight to ten applications are made for the control of downy mildew (MENDES, 2002). There are regions of Brazil, as in the State of Paraná, where up to 60 sprays are made in *Vitis vinifera* grapes (CHAVARRIA et al., 2009). Often, chemical control is carried out on the basis of a calendar with weekly applications, which may lead to unnecessary applications (CHAVARRIA et al., 2007a) and to the selection of resistant genotypes, such as the resistance of *Botrytis cinerea* and *Plasmopara viticola* in Italy (ANGELINI et al, 2014; TOFFOLATTI et al, 2015).

An alternative strategy for the control of shoot diseases is the use of plastic overhead cover. In this situation, free water is minimized on leaves and fruits, an essential factor for the onset of fungal infections (GRIGOLETTI JÚNIOR; SÔNEGO, 1993). Chavarria et al. (2007) observed drastic reduction of free water on leaves, no establishment of downy mildew, reduction of incidence and severity of bunch rot and increase of residual fungicide captan under cultivation conditions with grapevine cover of Moscato Giallo cultivar. An important factor for the use of plastic overhead cover is related to the implementation cost, which will be directly related to the cost of phytosanitary control. Thus, the aim of this study was to search strategies for the reduction of the use of phytosanitary products and production costs, with the aid of the plastic overhead cover in grapevines.

MATERIAL AND METHODS

The experiment was carried out in the 2010/2011 crop year at "Silveira" farm, located in Viamão - RS, Passo do Garcia, 30º08'51''S and 51º00'33''W, using Cabernet Sauvignon cultivar (Clone R5) grafted on Paulsen 1103 rootstock. This vineyard was implanted in 2004 in "Y" support system with 1.80 x 2.50 m spacing. The uncovered area presented the same implantation characteristics.

In all treatments, mixed pruning was carried out, with six production shoots with six buds and ten to twelve spurs of two buds per plant, and was performed on August 26, 2010. After pruning, dormancy breaking was performed with application of growth regulator based on hydrogenated cyanamide. Throughout the cycle, vegetative canopy management occurred in all treatments, such as sprouting, defoliation and shoot topping, which were performed according to the need for covered vineyard to avoid branches from touching the canvas or being exposed outside the canvas. In the uncovered vineyard, vegetative canopy management was also carried out.

The vineyard area under study was divided into four treatments, with 516 plants each, namely: Treatment 1: plastic overhead cover: phytosanitary treatment applied when leaf wetting was observed; Treatment 2: plastic overhead cover: curative treatment, when there were symptoms of disease in shoots; Treatment 3: plastic overhead cover: conventional calendar treatment every 15 days, with reapplication after leaf wetting and Treatment 4: without plastic overhead cover: conventional calendar treatment every 15 days, with reapplication after leaf wetting, treatment corresponding to control.

The active principles used in this study were captan (240g / 100L, 2L syrup per plant), cymoxanil (600g / ha, 1000L syrup / ha), dithianone (125g / 100L, 1000L syrup / ha), mancozeb (300g / 100L, 1200L syrup / ha), mancozeb + cymoxanil (3kg / ha, 1000L syrup / ha), procymidone (200g / 100L, 1000L syrup / ha), copper sulfate (700g / 100L syrup / ha), and methyl thiophanate + chlorothalonil (200mL / 100L, 900L syrup / ha) to control downy mildew, difeconazole (12mL / 100L, 600L syrup / ha), tebuconazole (100mL / 100L, 900L syrup / ha), methyl thiophanate (70g / 100L, 800L of syrup / ha) to control powdery mildew and potassium phosphite 30% P_2O_5 and 20% K_2O (190mL / 100L). All active principles used have registration for disease control in grape crops. The variation in the use of active principles in the experiment occurred due to the environmental differences of treatments and techniques (plastic damage) between cultivation condition with and without the presence of plastic overhead cover.

Shoot diseases were visually monitored for incidence on leaves and bunches of 10 treatment-tagged plants at the beginning of the experiment, randomly before the onset of any disease symptom. Monitoring took place throughout the productive

cycle, from sprout to harvest, at frequency of once a week to carry out the application of fungicides according to criterion for each treatment. The presence / absence of free water on leaves (leaf wetting) was visually monitored after the occurrence of rainfalls.

The incidence of downy mildew and powdery mildew was calculated based on the number of plants with symptoms (leaves and bunches) on the total number of plants evaluated at the end of the crop cycle. Productivity was evaluated after harvest. Data were submitted to analysis of variance and later to the Tukey test at significance level of 5%. In addition, comparison between treatments was performed, the total cost with phytosanitary products and productivity in each area.

RESULTS AND DISCUSSION

As for the sum of the number of applications of active principles, comparing treatments 1, 2 and 3 with treatment 4, without the use of plastic overhead cover, it was observed that in treatment 3, using calendar and plastic overhead cover, there was a reduction of three applications of active principles (14.29%). In treatment 1, application when there was leaf wetting, a reduction of 17 applications (80.95%) was observed. In treatment 2, there was a reduction of 18 applications (85.71%), the largest reduction observed (Table 1).

The tendency to decrease the number of applications of phytosanitary products with the use of plastic overhead cover, as approached by Santos (2005) and Chavarria et al. (2007a), has been proven. Based on these results, the potential for the use of plastic overhead cover as an alternative for organic grape production was observed (CHAVARRIA et al., 2007b). Moreover, with a reduction in the frequency of applications, the possibility of selection of genotypes resistant to the frequent use of one or more active principles is reduced (BRENT; HOLLOMON, 2007), which has been observed in successive crop years and, in many cases, leads to an increase in the number of sprays and active principles used (GRIGOLETTI JÚNIOR; SÔNEGO, 1993).

Another explanation is based on the residual accumulation of active principles applied in the crop. According to Chavarria et al. (2007a) in work conducted with Moscato Gialo cultivar, active principle captan was higher in bunches grown under plastic overhead cover in 18.26%, in the evaluation performed two days after the first application and in 33.1% and 27.52% in evaluations performed two and seven days after the second application, respectively.

In relation to the costs of fungicides used, it was verified that in the comparison between treatments 1, 2 and 3 and treatment 4, the reduction percentages were higher than those observed in the number of applications. Treatments 1, 2 and 3 provided respectively cost reductions of 91.62%, 94.72% and 60.76%, and increased productivity by approximately 20% (Table 2).

The results corroborate results obtained by Chavarria et al, (2007a), who observed a reduction from 17 to two applications in vineyard with plastic overhead cover and Genta et al. (2010), who observed differences between types of cover, verifying that it is possible to perform 75% less sprays for the control of downy mildew in plastic overhead cover compared to the anti-hail screen.

Regarding the occurrence of fungal diseases, the incidence of Botrytis bunch rot (*Botrytis cinerea*) and rip rot (*Glomerella cingulata*) was not observed. The incidence of downy mildew was observed only in leaves and it was observed that in the three treatments under plastic overhead cover, the incidence was significantly lower (Figure 1). The lower incidence of downy mildew in the covered environment is due to the lower occurrence of leaf wetting, an essential factor for the infection of *Plasmopara viticola* (Berk. & Curt.) Berlese & de Toni (GUBLER, 2013), (CHAVARRIA et al. 2007a). In the uncovered environment, leaf wetting occurs mainly with rainfall, as can be observed in table 3.

The opposite was verified for powdery mildew, where the incidence of this disease was observed only in treatments with plastic overhead cover. In the case of the occurrence of powdery mildew, the foliar wetting factor is not favorable to the infection and growth of *Uncinula necator* on the plant surface, therefore, a covered environment with reduction of leaf wetting favors the occurrence of the disease. Temperature and relative humidity conditions (Table 3) that occurred during the cycle, in general, were favorable to the occurrence of these diseases.

TABELA 1 - Comparison of active principles, number of applications of each principle and total number of applications used in vineyards with and without plastic overhead cover, and different criteria for the use of chemical fungicides in Cabernet Sauvignon cultivar in Viamão-RS.

Treatment	Active principles applied (Number of applications)	Sum of the number of application of active principles
1	Mancozeb (1) Tebuconazole (1) Potassium Phosphite (2)	4
2	Tebuconazole (1) Potassium Phosphite (2)	3
3	Mancozeb (1) Tebuconazole (3) Potassium Phosphite (7) Methyl thiophanate (1) Cymoxanil (2) Methyl thiophanate + Cymoxanil (2) Difeconazole (1) Cymoxanil + Mancozeb (1)	18
4	Dithianone (4) Captan (1) Procymidone ((2) Potassium Phosphite (2) Cymoxanil (3) Cymoxanil + Mancozeb (2) 1% Copper sulfate (7)	21

TABLE 2 - Comparison of the cost of phytosanitary products and productivity in vineyards with and without plastic overhead cover, and different criteria for the use of chemical fungicides in the Cabernet Sauvignon cultivar in Viamão-RS.

Treatment	Cost of the phytosanitary product (R$/ha)	Productivity (Kg/ha)
1	174,06	14.930 a*
2	109,66	14.850 a
3	815,24	15.000 a
4	2077,8	12.000 b

* Averages followed by the same letter do not differ by the Tukey test at 5% level.

TABLE 3 - Meteorological data recorded during the development of the work.

Year	Month	Rainfall (mm)	Maximum temperature (°C)	Minimum temperature (°C)	Average temperature (°C)	RH (%)
2010	September	180.8	21.0	16.5	18.8	77
	October	57.8	24.5	13.5	19.0	72
	November	72.1	28.5	16.1	22.3	70
	December	92.9	29.5	20.3	24.9	73
2011	January	135.7	31.5	22.8	27.2	79
	February	119.5	30.2	24.0	27.1	79
	March	83.1	26.8	18.9	22.9	84

RH: Relative Humidity. Source: Adapted from INMET.

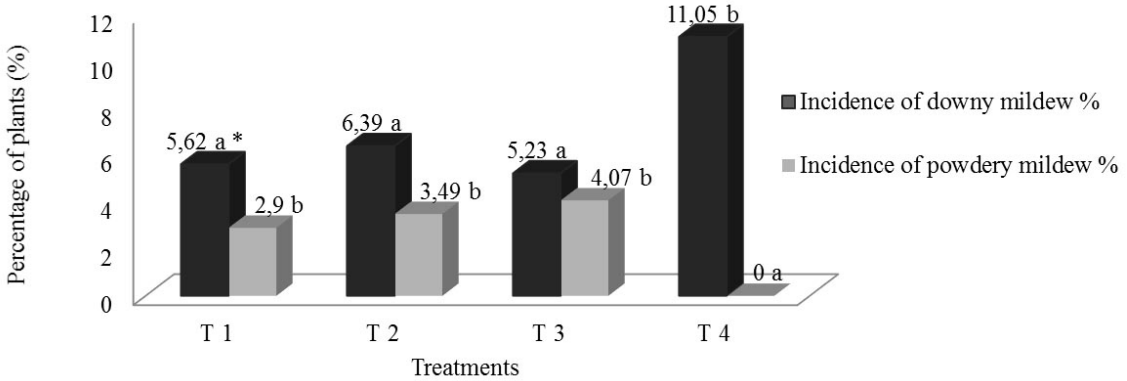

FIGURE 1 - Incidence of downy mildew and powdery mildew in Cabernet Sauvignon plants with and without plastic overhead cover and different criteria for the use of chemical fungicides in Viamão-RS.

* Means followed by the same letter, in each treatment, do not differ by the Tukey test at 5% level.

CONCLUSIONS

It was concluded that the criteria "leaf wetting" and "observation of presence of symptoms" are efficient for the decision-making for the application of fungicides in vineyards with plastic overhead cover which, consequently, impact on the cost reduction.

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