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Plant Protection

Gibberellic acid reduces clusters rot of 'Sauvignon Blanc' grapes

Pricila Santos da Silva[1], Marines Batalha Moreno Kirinus[2], Caroline Farias Barreto[3], Carlos Sebastián Pérez Lamela[4], Marcelo Barbosa Malgarim[5], Paulo Mello-Farias[5]

Abstract - The ripening of grapes is impaired by climatic conditions due to the prolonged rainy season and thus facilitates the proliferation of diseases such as grape clusters rotting, caused by the fungus *Botrytis cinerea*, even before the ideal harvesting point. The aim of the study was to evaluate the effect of gibberellic acid (GA_3) on rot and on physical-chemical quality of 'Sauvignon Blanc' grapevine. The experiment was carried out in the production season of 2016 and 2017 in Campanha region in Rio Grande do Sul, Brazil. The GA_3 treatments were at the doses of 0 (control); 2; 4; 6 and 8 mg L^{-1} of GA_3. The percentage of clusters rotting and maturation index decreased, however, the titratable acidity increased with GA_3 doses. The cluster and rachis length increased with application of GA_3. The cluster width; cluster, rachis and berry mass and the soluble solids were not influenced by application of GA_3. In 'Sauvignon Blanc' grapevine, GA_3 reduced the percentage of clusters rotting and improved the cluster and rachis length characteristics and titrable acidity.

Index terms: Gibberellin. Grapevines. Cluster stretching.

Ácido giberélico reduz a podridão dos cachos de uvas 'Sauvignon Blanc'

Resumo - A maturação das uvas é prejudicada pelas condições climáticas, devido ao prolongado período chuvoso e desta forma, facilita a proliferação de doenças como a podridão dos cachos de uvas, causada pelo fungo *Botrytis cinerea*, antes mesmo do ponto ideal para colheita. O objetivo do trabalho foi avaliar o efeito do ácido giberélico (AG_3) na podridão e na qualidade físico-química dos cachos da videira 'Sauvignon Blanc'. O experimento foi desenvolvido, nas safras produtivas de 2016 e 2017, na região da Campanha no Rio Grande do Sul, Brasil. Os tratamentos com AG_3 foram nas doses de 0 (testemunha); 2; 4; 6 e 8 mg L^{-1} de AG_3. A porcentagem de podridão dos cachos e o índice de maturação diminuíram, no entanto, a acidez titulável aumentou com as doses de AG_3. O comprimento do cacho e engaço aumentaram com aplicação de AG_3. A largura do cacho, massa do cacho, do engaço e da baga e os sólidos solúveis não foram influenciados pela aplicação de AG_3. Em videira 'Sauvignon Blanc', o AG_3 reduziu a porcentagem de podridões dos cachos e melhorou as características de comprimento do cacho e engaço e acidez titulável.

Termos para indexação: Giberelina. Videiras. Alongamento do cacho.

Corresponding author:
pricilassilva@hotmail.com

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[1]Agronomist Engineer, postgraduate student in Plant Production, Department of Biotechnology, Universidade do Estado de Santa Catarina, Lages, Santa Catarina, Brasil E-mail: pricilassilva@hotmail.com (ORCID 0000-0002-4102-1292)

[2]Agronomist Engineer, Doctor in Agronomy, Professor, Instituto Federal Sul-Riograndense, Department of Plant Science, Pelotas, Rio Grande do Sul, Brasil E-mail: marinesfaem@gmail.com (ORCID 0000-0001-9375-5215)

[3]Agronomist Engineer, postgraduate student in Agronomy, Temperate Climate Fruticulture, Department of Plant Science, Universidade Federal de Pelotas, Pelotas, Rio Grande do Sul, Brasil E-mail: carol_fariasb@hotmail (ORCID 0000-0002-5568-5305)

[4]Agronomist Engineer, Doctor of Agronomy, Temperate Climate Fruticulture, Pelotas, Rio Grande do Sul, Brasil E-mail: sebalamela@gmail.com (ORCID 0000-0002-0893-9333)

[5]Professor, Department of Plant Science, Universidade Federal de Pelotas, Pelotas, Rio Grande do Sul, Brasil E-mailS: malgarim@ufpel.edu.br (ORCID 0000-0002-3584-5228); mello.farias@ufpel.edu.br (ORCID 0000-0002-6519-4972)

Introduction

The grapevine (*Vitis vinifera* L.) is one of the most cultivated fruit trees in the world, thus, the excellence of wine quality is directly related to grape quality (MORENO et al., 2011). However, the grapes quality may be affected by the high rainfall volumes, especially during grape maturation, with significant losses due to the occurrence of cluster rot caused by the fungus *Botrytis cinerea* (GIOVANNINI, 2008). This problem is aggravated in grapevines such as the 'Sauvignon Blanc' cultivar because it presents small and compact clusters, as well as causing economic losses and degrading grape and wine quality (KY et al., 2012). The grape clusters compaction provides a maturity that can occur due to the reduction in the incidence of sunlight in the berries, especially in the berries located inside the cluster (OIV, 2007).

Some plant regulators can be used in order to stretch the grapevine cluster and reduce the incidence of cluster rot caused by the fungus *Botrytis cinerea*. Among these plant regulators is the gibberellic acid (GA_3), this endogenous regulator is essential in the growth and development of plants and regulates some processes such as seed germination, stem elongation, leaf expansion, flower and fruit development, and floral transition (DAGAR et al., 2012). Thus the morphological characteristics of grape clusters and berries can be improved with the use of plant regulators, such as GA_3 (BHAT et al., 2011).

Positive effects of GA_3 were observed in 'Sauvignon Blanc', 'Riesling', 'Lemberge' and 'Kadarka' cultivars, in the early ripening of grapes and in the high values of soluble solids, which is an important factor for the production of quality grapes and wines (TESZLAK et al., 2013). The application of GA_3 also promoted the increase of fresh and dry mass of 'Fujiminori' grapes (JUN et al., 2001) and improved the quality of 'Bordô' grapes, causing an increase in soluble solids content and a reduction in titratable acidity (CHIAROTTI et al., 2011). In 'Niagara' the application of GA_3 promotes the increase of berries mass, rachis mass and berry diameter (GUERIOS et al., 2016). GA_3 increased the productivity of seedless grape cultivars, promoting fruit growth and improving the cluster architecture (FERRARA et al., 2014). In seedless grapes such as 'Sunny Rouge', GA_3 improved grapes yield and quality, besides influencing the hardness and elasticity of grape skin (YAMADA et al., 2003).

However, the efficiency of the GA_3 treatment depends on the time of application, its concentration of GA_3 solution and the climatic conditions after the application (KAPŁAN, 2011). Although studies about GA_3 on grapevine have been reported in the literature, there is not enough information about suitable concentrations of GA_3 to control the cluster rot (Kaplan et al., 2017).

Given the above, the purpose of the study was to evaluate the effect of GA_3 in the rot and physical and chemical quality of 'Sauvignon Blanc' grapevine in Campanha region of Rio Grande do Sul, Brazil.

Material and methods

The study was carried out in the production cycles 2015/2016 and 2016/2017, in a commercial vineyard of the Miolo winery, located in Campanha region, municipality of Candiota, Rio Grande do Sul (RS), Brazil, with latitude 31º 33' 29" S, longitude 53º 40' 21" W and altitude of 220 meters. The climate of the region is temperate with hot and dry summers according to the classification of Köppen. The region has an average annual temperature and rainfall of 17.8° C and 1,388 mm, respectively. The soil is classified as Eutrophic Red-Yellow Argilossol (STRECK et al., 2008).

The vineyard used was from the 14-year-old Sauvignon Blanc cultivar grafted on the SO4 rootstock in clone 317 with spacing of 3.0 m between rows and 1.20 m between plants and conducted in Guyot system. The experimental design was randomized blocks with four repetitions for each treatment. The plants used within each block for the pulverization were the three central plants (useful plot/portion), eliminating the border of each treatment and spraying all clusters of the plants. Gibberellic acid (GA_3) was derived from the commercial product Pro-Gibb®, containing 10% active ingredient. Added 0.025% of nonionic adhesive spreader Silwet L-77® in the syrup. Treatments with GA_3 solutions were 0 (control); 2; 4; 6 and 8 mg L^{-1} of GA_3. For the control treatment, water and adhesive spreader were applied.

The pulverizations were performed when 50% of the clusters were in the growth stage developed inflorescence (DI) (EICHHORN and LORENZ, 1984). The applications of GA_3 were made via localized pulverization (manual sprayer) in all clusters of the grapevine until reaching the pour point.

The grapes were harvested, in the final maturation process, to be destined to the elaboration of sparkling wine. The plant yield was counted using the average number of clusters and the average mass of clusters of the useful plot. For the other variables, a uniform sample of five clusters of the useful plot for each treatment was randomly collected. After the harvest, the clusters were conditioned in thermal boxes and transported to the Fruit Laboratory of the Federal University of Pelotas (UFPel) in RS for the quality evaluations of the grape clusters.

The quality evaluations of the grape clusters were as follows: clusters rot caused by the fungus *Botrytis cinerea*, results expressed as percentage (%); plant yield, the results being expressed in kg/plant; length and width of clusters and rachis measured using a digital caliper, expressed in (mm); mass of the clusters, rachis and berries,

quantified with the aid of a digital scale expressed in (g).

For the determination of the berries soluble solids (SS), the digital refractometer was used and the results were expressed in °Brix; titratable acidity (TA) indicated by the titration with 0.1 N of NaOH solution until reaching pH 8.1, and the results expressed in % of tartaric acid, according to the methodology described by AOAC (2007); the maturation index was obtained by the SS/TA ratio

Analyzes of variance were performed by the F test ($p \leq 0.05$), and when the treatments were significant regression analysis was performed.

Results and discussion

The average percentage of 'Sauvignon Blanc' grape clusters caused *Botrytis cinerea* fungus in 2016 and 2017 season decreased on average by 14.88% with GA_3 treatments compared to the control that obtained the average value of 21.34% (Figure 1). We observed in general that for the variable rotting percentage there were no differences between the GA_3 doses applied in the grape clusters, however differences were verified between the control and GA_3 doses. In the 'Vignoles' grapevines when 10 mg L^{-1} of GA_3 was applied before blossom and another two applications of fungicide, the fungus *Botrytis* sp. was controlled (HED et al., 2011).

In 'Sauvignon Blanc' grapevines treated with the 6 mg L^{-1} dose of GA_3, the average plant yield was 3.55 kg / plant, whereas the control resulted in an average of 1.85 kg / plant in both seasons evaluated (Figure 2). The increase in yield of 'Thompson Seedless' grapes with 25 mg L^{-1} of GA_3 after fruiting was also noted (MARZOUK et al., 2011).

The variables such length of cluster and stem in 'Sauvignon Blanc' grapevine presented higher values with the increase of GA_3 doses in the two years of studies (Figures 3A and 3B). The increase of these variables must be due to the gibberellins promote the growth of plant organs, by increasing the volume of existing or newly divided cells (JONG et al., 2009). Sangeetha et al. (2015) also observed increased in the clusters length on 'Israel Blue' grapevine when the 5 mg L^{-1} dose of GA_3 was applied before blossom and at doses of 10 mg L^{-1}, 15 mg L^{-1}, 40 mg L^{-1} and 30 mg L^{-1} of GA_3 at 2, 4, 6 and 8 weeks after blossom.

The GA_3 had no significant effect on the width of 'Sauvignon Blanc' cluster in the 2016 and 2017 seasons. However, for the rachis width, the effect of GA_3 was more significant at 4 mg L^{-1} dose as compared to the control and at doses of 6 and 8 mg L^{-1} (Figure 4). A study developed by Rodrigues et al. (2010) no significant differences were observed for the clusters width after the application of different doses of GA_3 (0, 10, 20 and 30 mg L^{-1}) in the winter and spring cycle on 'Italy' grapevine.

The results of the GA_3 treatments for cluster, rachis and berry mass of 'Sauvignon Blanc' grapevines were not significant in the analysis of variance in the two seasons. However, in the 'BRS Clara' the increase of the clusters mass occurred after the use of 50 mg L^{-1} of GA_3 with one application (berries of 4 to 5 mm in diameter) or two applications (berries of 9 to 10 mm of diameter) (SOUZA et al., 2010). According to Tecchio et al. (2009), the application of GA_3 in the concentration of 60 mg L^{-1}, in the 'Mars' grapevine, increased the fresh rachis mass. In 'Rubi' grapevines the application of gibberellic acid in 3.0 concentration; 100 mg L^{-1} at 30 days after full blossom increased the berries mass (ROBERTO et al., 2002).

In 'Ruby Seedless' and 'Thompson Seedless' grapevines after the application of GA_3 at dose of 40 mgL^{-1} (berries around 15 mm in diameter) and 30 mg L^{-1} (berries between 4 and 5 mm in diameter) did not altered soluble solids values (ZOFFOLI et al., 2009). Titratable acidity increased after application of the GA_3 doses compared to the control in the 'Sauvignon Blanc' grapes or berries (Figure 5A). Özer et al. (2012) studying 'Reçel Üzümü' grapevine after applying 40 mg L^{-1} in berries with 4 to 5 mm in diameter, observed higher values of titratable acidity in the control. However, the maturation index (SS/TA) decreased after application of GA_3 in 'Sauvignon Blanc' grapes (Figure 5B). In 'Perlette' grapes the application of 50 mg L-1 of GA_3, 14 days after full blossom increased ratio (ZAHEDIL et al., 2013).

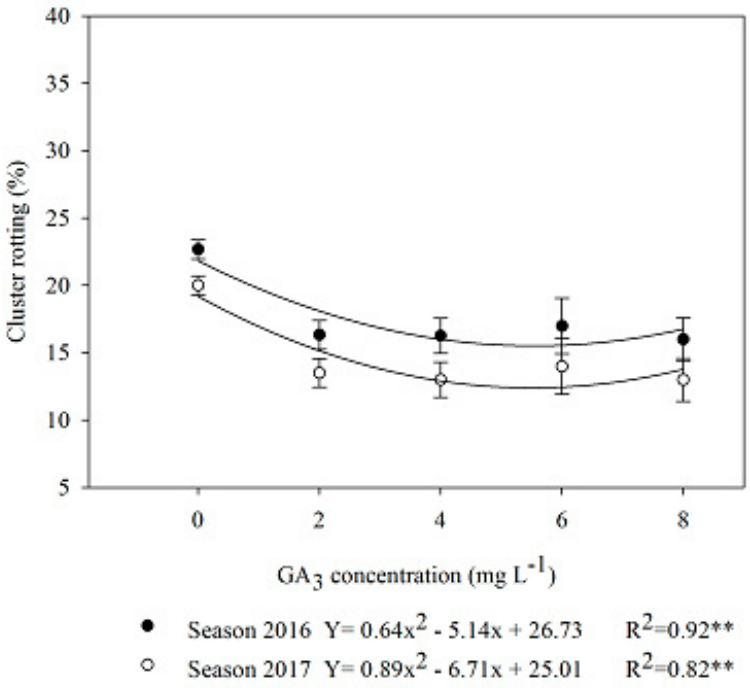


Figure 1. Rotting average percentage in clusters of 'Sauvignon Blanc' grapes treated with gibberellic acid in Campanha region in RS. ** significant at P <0.01 after analysis of variance.

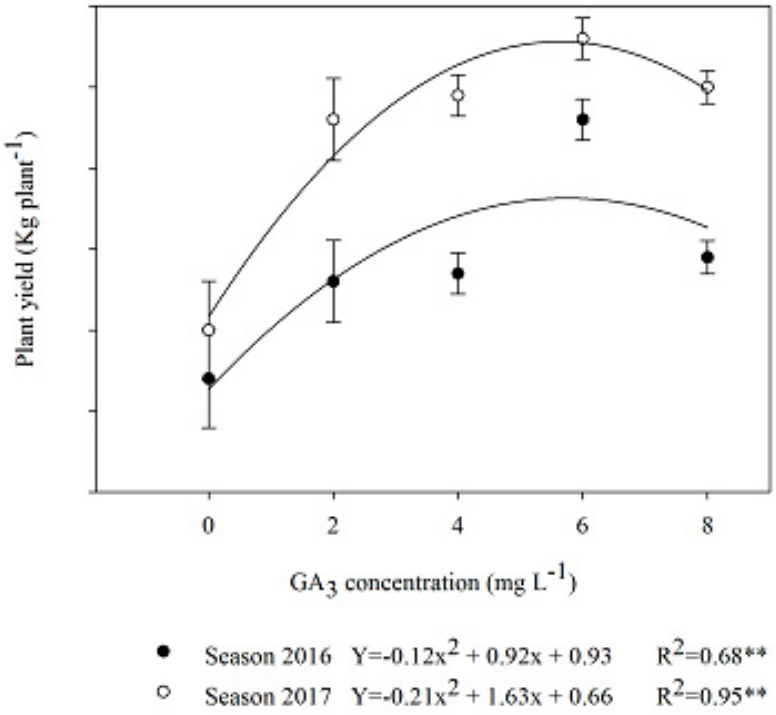
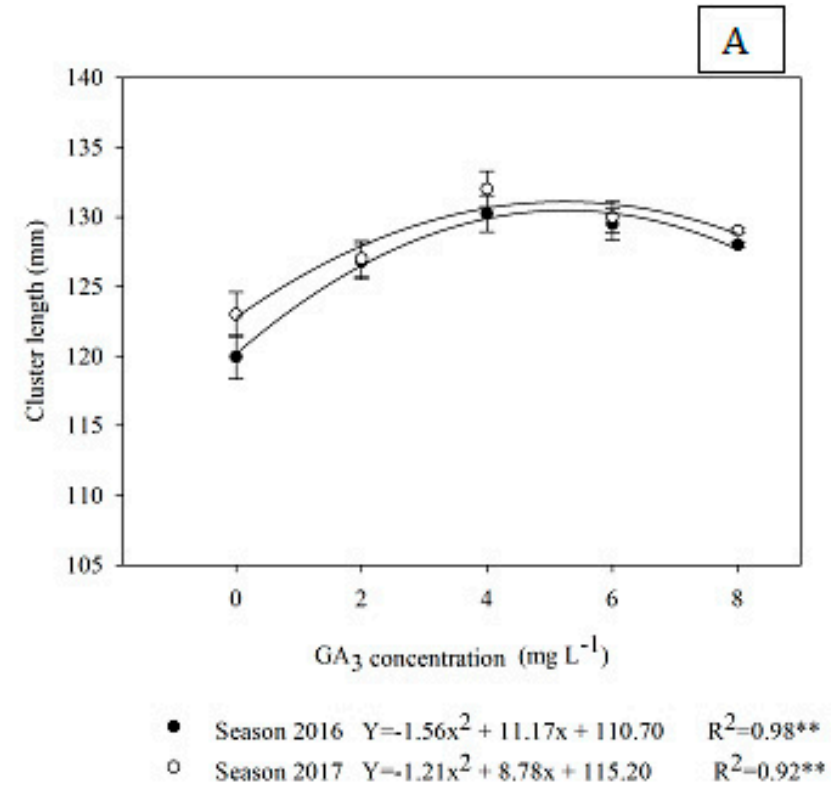


Figure 2. Average plant yield of 'Sauvignon Blanc' grapes treated with gibberellic acid in Campanha region in RS. ** significant at P <0.01, after analysis of variance.



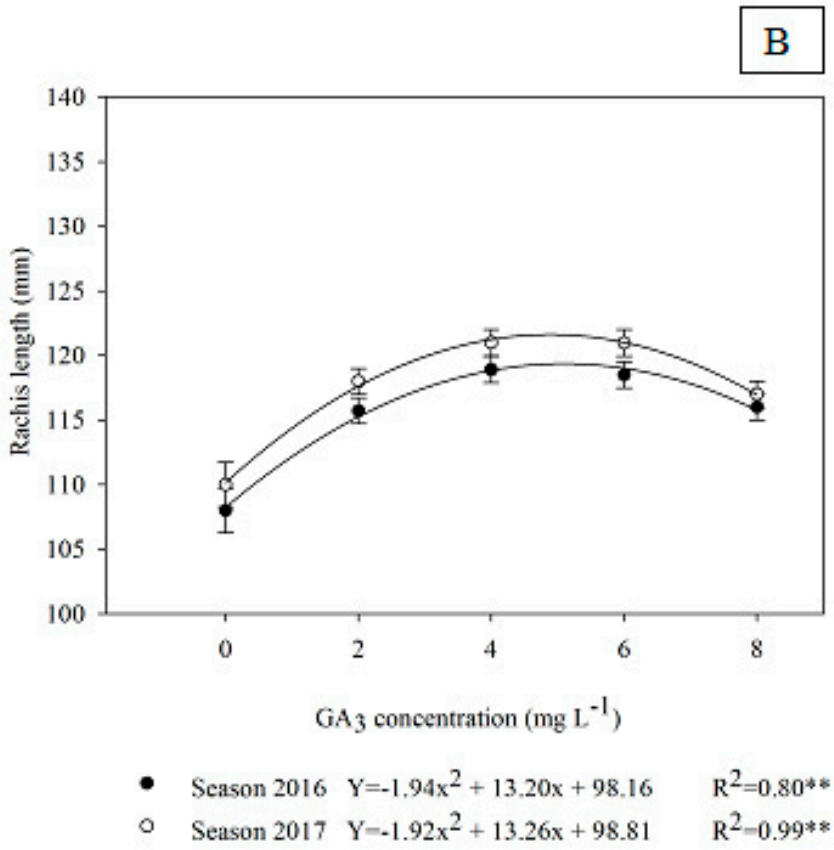


Figure 3- Effect of gibberellic acid (GA_3) application on the inflorescence developed in clusters of 'Sauvignon Blanc' vines. A) Cluster length; B) Rachis length. Candiota-RS, 2016 and 2017 seasons. **, significant at $P < 0.01$ respectively after analysis of variance.

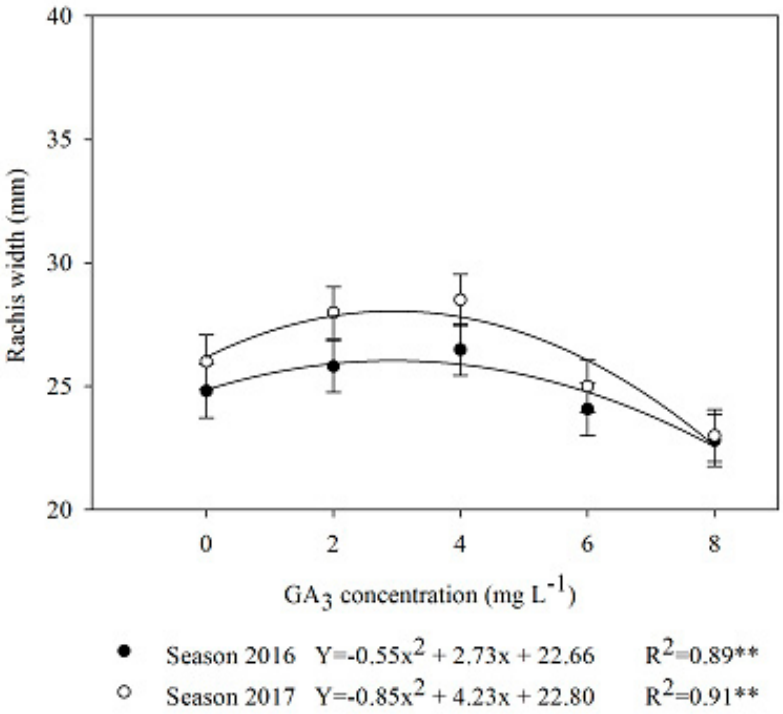


Figure 4: Average rachis width of 'Sauvignon Blanc' grapes treated with gibberellic acid in Campanha region in RS. ** significant at P <0.01 after analysis of variance.

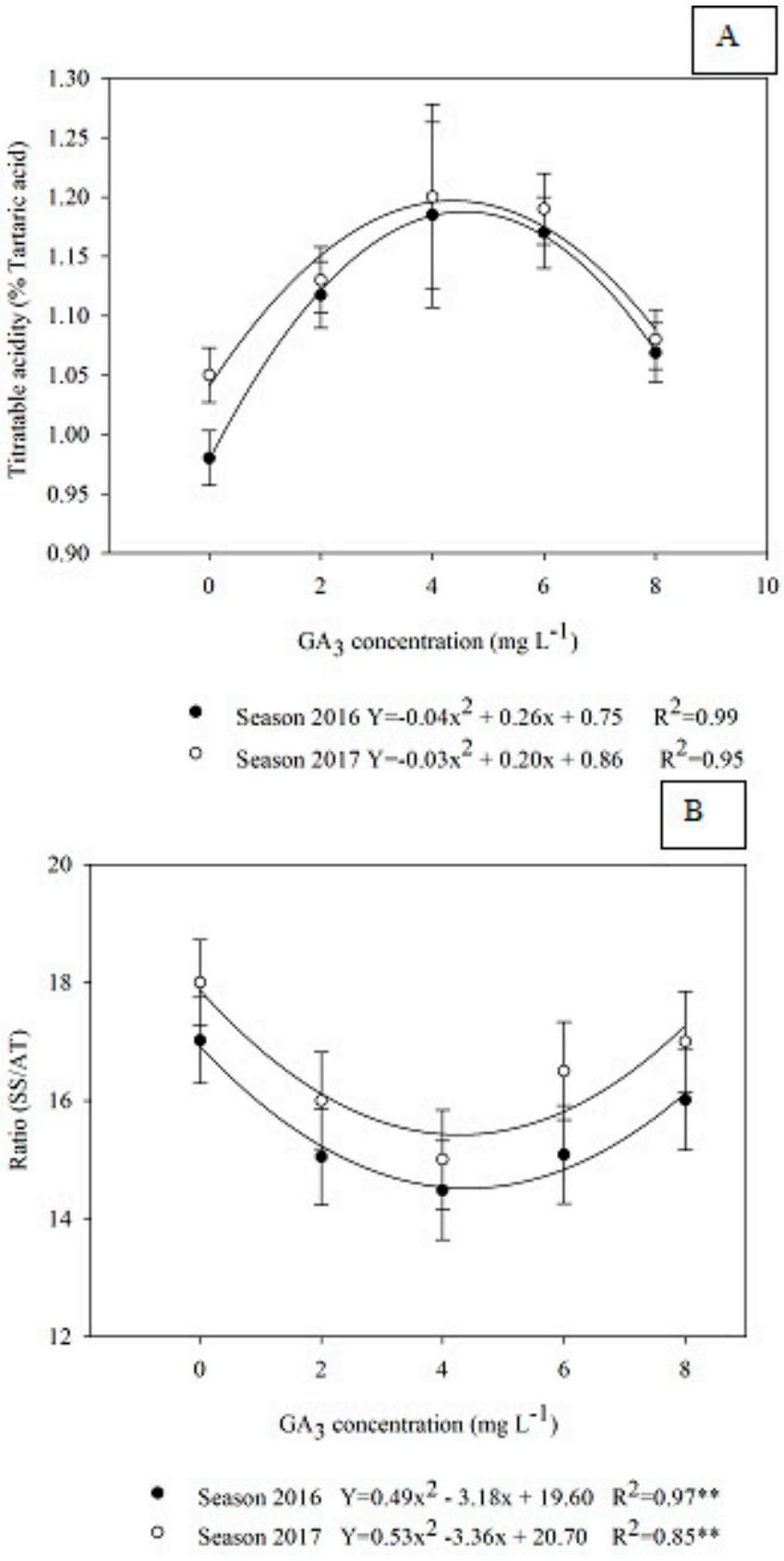


Figure 5: Effect of gibberellic acid (GA_3) application on the inflorescence developed in clusters of 'Sauvignon Blanc' vines. A) Titratable acidity; B) Ratio. Candiota-RS, 2016 and 2017 seasons. **, significant at P <0.01 respectively after analysis of variance.

Conclusions

In 'Sauvignon Blanc' grapevine, the gibberellic acid reduced the percentage of clusters rotting and improved the characteristics such as cluster and stem length, and titratable acidity. The cluster width, cluster, rachis and berry mass, and soluble solids were not influenced by GA_3.

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