Using Foliar Applications of Amino Acid Chelate (Colouring Powder) to Improve Colour and Quality Attributes of Crimson Seedless Grapes

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Abstract

Inadequate colour development is a major issue associated with the Crimson Seedless table grapes variety, which can cause an economic loss due to the poor quality of grapes and uneven colouring. The red colour in grapes is associated with anthocyanin biosynthesis and accumulation. The use of potassium and amino acid chelate products during veraison can improve the synthesis of anthocyanins in grapes skin. The aim of the study was to evaluate the effects of foliar applied amino acid chelate during the verasion to assist in improving colour development and other quality attributes of Crimson Seedless grapes. Vines were treated with 2% amino acid chelate and biologically active organic molecules - BAOM (patented product) at the rate of 1 ml/10L water at the beginning of verasion and repeated after two weeks. Applications of amino acid chelate treatment significantly increased the pH and iron concentration levels in the grape's berries. In addition, grapes collected from treated vines showed an increase in free anthocyanins of 18.75% and brix level by 2.78% while no concurrent impact on total phenolics and titratable acids.

Keywords: Amino acid chelate, anthocyanins, pH, colour, *Vitis vinifera*

1. Introduction

Crimson seedless is one of the most popular table grapes (*Vitis vinifera*) varieties in the world. However, due to it being a red table grape variety, growers often experience issues related to colour development. This issue is associated with a lack of red colour pigment development and causes issues with the evenness of red colour development on the grapes under specific environmental conditions such as hot weather. The colour and quality of grape skins is one of the key visual quality attributes which consumers first consider when purchasing grapes. When red grapes are not adequately and evenly coloured, purchasing and repeated purchasing can result causing in less return on investments for growers. Due to inadequate colour development, at least 30% of Crimson grapes are kept on the vine unharvested as growers understand the negative sales effects inadequate colouring entails. This is a big issue all over the world where grapes are grown as it leads to large economic losses as a result of poor grape colouring (Olivares et al., 2017).

The red colour observed in red grapes is associated with the biosynthesis and accumulation of anthocyanins in the berry skin and it depends on several internal and external factors such as variety, environmental conditions and cultural practices. High temperature summers and cool night temperatures are not favorable for anthocyanin accumulation in grapes. Anthocyanin accumulation in red grape varieties starts at the beginning of the verasion (Ferrara et al., 2014; Olivares et al., 2017).

Amino acid chelate (coloring powder) is a product with potassium chelate (10%), calcium chelate (5%), magnesium chelate (2%), free amino acids (41%) and trace amounts of zinc, boron, molybdenum, and iron chelates. This study was therefore conducted to test the effect of amino chelate foliar application during verasion on colour development and other quality attributes of Crimson Seedless grapes.

2. Objectives

The specific objectives of this study were to:

- Study the effect of amino acid chelate (colouring powder) foliar applications on colour development in Crimson Seedless grapes.
- To assess the effectiveness of amino acid colouring powder on ripeness and quality parameters associated with Crimson Seedless grapes.
- To study the impact of colouring powder on berry nutrient accumulation.

3. Materials and Methods

Site Selection and Trial design

This trial was conducted in Robinvale, Victoria. A Crimson Seedless block in the vineyard was selected as the trial site. Four panels with 12 vines were selected for treatment application and another 12 vines were selected to keep as control vines. Foliar applications of colouring powder were applied at the beginning of verasion and again 2 weeks later. Vines were treated with a mixture of 2% amino acid chelate and biologically active organic molecules (patented product) at a rate of 1 ml/10L water. At harvesting time, berry samples were collected to assess color development and ripeness parameters. The trial design was randomized complete block design with three replicates for each treatment.

Red colouring in grapes is associated with the biosynthesis and accumulation of anthocyanins in the berry skin, and it depends on several internal and external factors such as variety, environmental conditions, and cultural practices. Hot summertime and narrow day or night temperatures are not favorable for anthocyanin accumulation in grapes. Anthocyanin accumulation in red grapes varieties starts at the beginning of the verasion (Ferrara et al., 2014; Olivares et al., 2017).

Evaluation Method

Acid, Colour and Grape Ripeness Analysis

At harvesting time, three samples were collected from three replicate panels in the treated and control areas, and each sample consisted with 400g of berries. These samples were then carefully packaged straight away and the samples were express posted to the Australian Wine Research Institute (AWRI) in South Australia for the analysis of pH, brix, free anthocyanins, total phenolics and total tannin.

Berry Nutrient Analysis

For the berry nutrient analysis, three samples were collected from three replicate panels in the treated and control areas. Each sample had 200g of berries and these samples were packages and express posted to Analytical Laboratories & Technical Services Australia (ALTSA) in Mildura for a full nutrient concertation analysis between the treated and control grapes.

Statistical Analysis

Statistical analysis was done by using Prism 7 (Graph Pad Software) and t-test used to evaluate the significant difference between treated and control vines. Significant difference was calculated as a P value less than 0.05.

4. Results

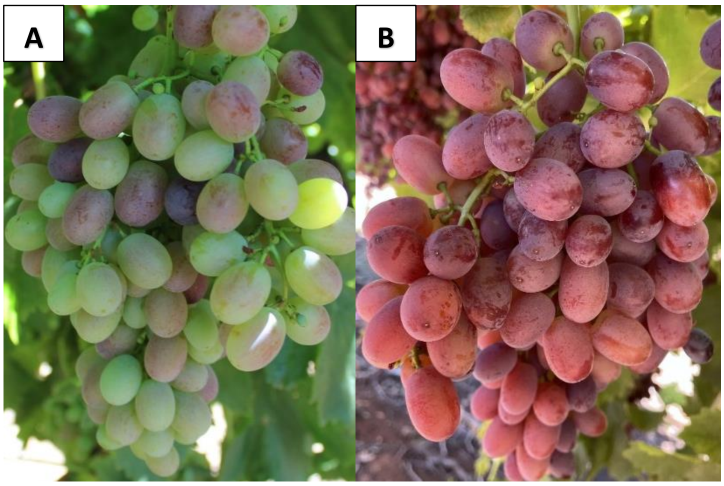

Figure 1: Crimson Seedless grapes at the beginning of verasion (A) and again at harvest (B).

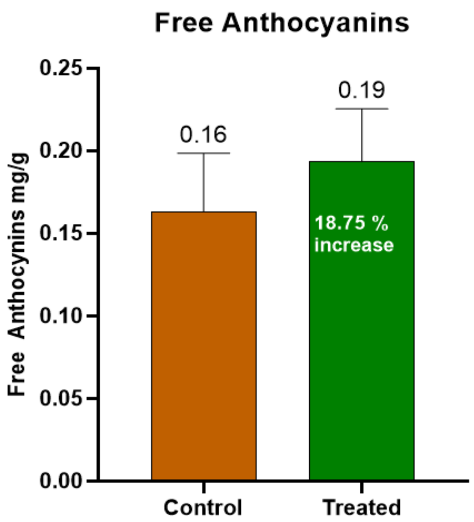

Figure 2: Free anthocyanins in treated and control Crimson Seedless grapes after colouring powder application

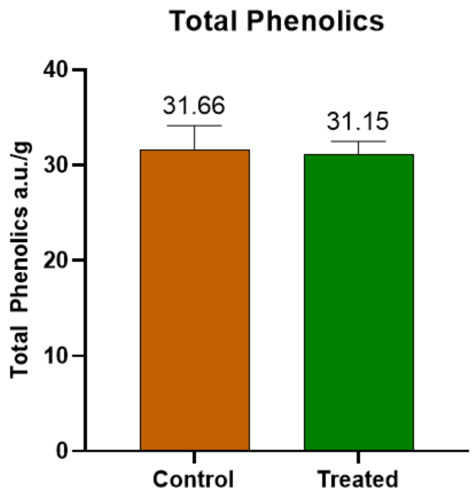

Figure 3: Total phenolics in treated and control Crimson Seedless grapes after colouring powder application

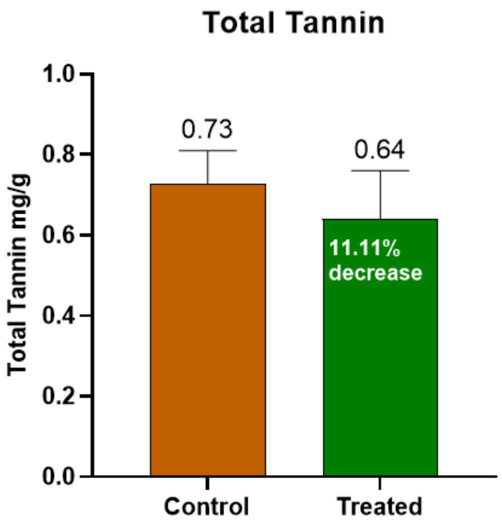

Figure 4: Total tannins in treated and control Crimson Seedless grapes after colouring powder application

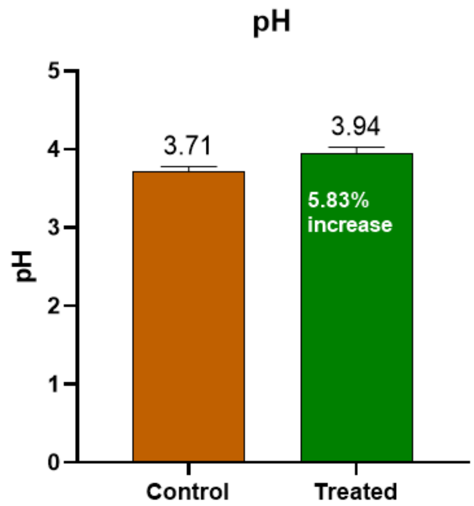

Figure 5: pH analysis of treated and control Crimson Seedless grapes after colouring powder application. Significant difference ($P<0.05$).

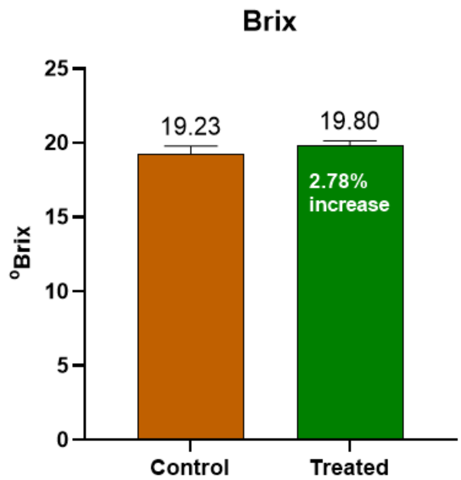

Figure 6: Brix differences between treated and control Crimson Seedless grapes after colouring powder application

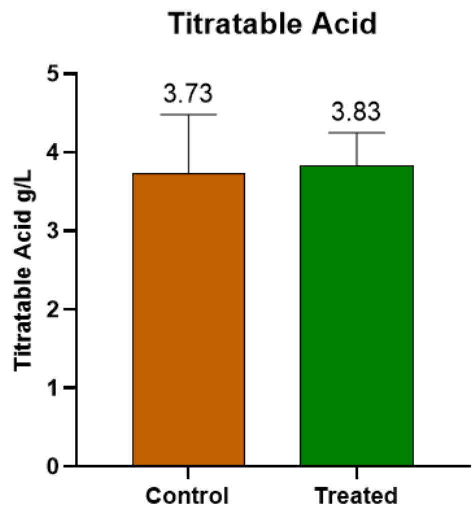

Figure 7: Titratable acidity between treated and control Crimson Seedless grapes after colouring powder application

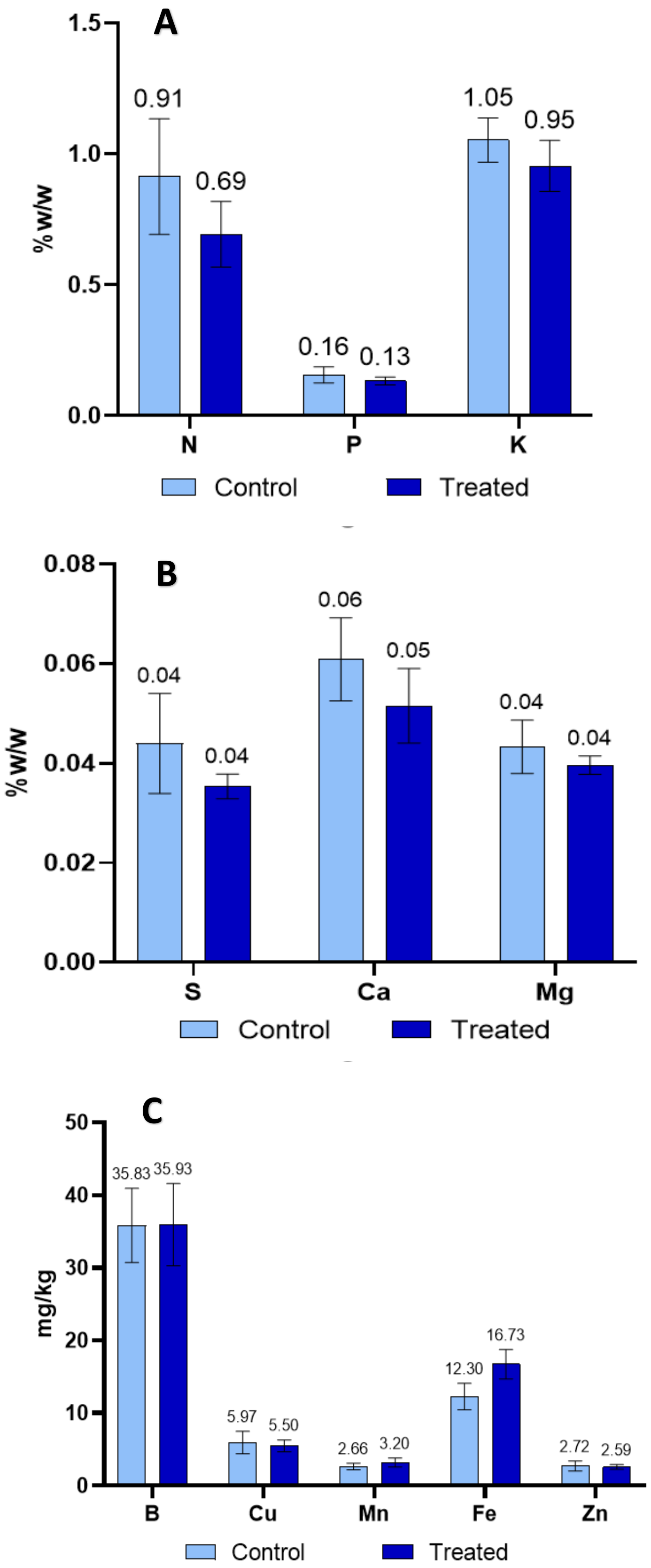

Figure 8 A, B, C: Nutrient levels in the berries with reference to colouring powder treatment vs control (A, B and C). Analysis done at ALTSA Laboratories.

5. Discussion

Figure 2 shows the free anthocyanin analysis between the treated and control Crimson Seedless grapes. It was calculated that there was an 18.75% increase in free anthocyanins in grape vines treated with colouring powder compared to the control vines. Free anthocyanins are responsible for the red colour of grapes which is located in the berry skin (Conde, et al., 2006).

Figure 3 shows the total phenolics analysis between the treated and control Crimson Seedless grapes. When looking at this graph, there was very little difference observed between both treatments.

Figure 4 shows the total tannin analysis between the treated and control Crimson Seedless grapes. It was calculated that there was an 11.11% decrease of total tannins in grape vines treated with applications of the colouring powder compared to the control grape vines. Tannins are polyphenols which are predominantly located in the skin and seeds of grapes. Although tannins have been researched to have good antioxidant properties, it also is related to the bitterness of fruit (Conde, et al., 2006, Soares et al., 2020). According to Conde, et al., 2006 tannins in berries starts to decline after the colour variation.

Grapes collected from colouring powder treated vines showed significantly higher ($P<0.05$) pH levels compared to control grapes (Figure 5). pH is an important measure and a good indicator to determine the ripeness of grapes. It is associated with the acidity of grapes and affects the flavour and colour of wines (Godden, Wilkes & Johnson, 2015). Berry pH is highly dependent on three factors including total amount of acids, malic acid to tartaric acid ratio and the concentration of potassium in grapes. When grapes are ripening, malic acid begins to metabolize and hence the pH begins to rise reducing the acidity of the grapes an making them more palatable for consumers. This makes it a good indicator when determining the ripeness of grapes. As stated earlier, pH is strongly associated with the acidity of grapes and affects the flavour and colour of wines (Godden, Wilkes & Johnson, 2015).

Figure 6 shows the Brix (total soluble solids) differences observed between the treated and control grapes vines. It was calculated that there was a 2.78% increase in Brix level in grapes treated with the colouring powder in comparison to the control. Although there is no significant difference, a 2.78% increase in Brix has a significant effect on the sweetness of grapes. Brix level is measured by a refractometer and brix levels will rapidly increase with berry ripening. It has been researched that one degree of brix is equal to one gram of sugar per 100g of grape juice ("Brix – Grapes", 2021). As Brix levels increase due to ripening, the titratable acid decreases which is why the pH of sweeter grapes is higher and more palatable (Godden, Wilkes & Johnson, 2015).

Figure 8 A, B and C all show the difference in nutrient concentration between colouring powder treated vines and control vines. Figure 8 C shows that vines treated with colouring powder had a significantly higher concentration of iron in grapes compared to the control grapes. This is most likely due to the iron contained in the colouring powder product. Treated grapes also had higher concentrations of boron and manganese compared to the control grapes, however these differences were not significant. Amino acid chelation within the colouring powder product can increase the uptake and translocation of elements through the plant and move nutrient to where they are in highest demand.

There was no significant difference in macro and micro nutrient concentrations in grapes berries, but all analyzed macronutrients were low in coloring powder treated berries compared to control (Figure 8 A, B, C).

Potassium is an essential macronutrient for the growth and development of grapes. Although the potassium is mostly accumulated in leaves at the beginning of the season, as ripening and verasion begins, potassium is redistributed from leaves to grapes. However, excessive potassium levels in berries can cause a reduction in the quality of grapes (Conde, et al., 2006). In addition to potassium, excessive nitrogen is harmful for sugar accumulation in grapes during the ripening stage (Delgado, Martín, delÁlamo & González, 2004). According to Conde, *et al* calcium is an important macronutrient in grapes, and it is at its highest concentration during the verasion and then decreases constant during maturation.

6. Conclusion

The results of this study show that Amino Acid Chelate or Colouring Powder has a great impact on colour development in Crimson Seedless grape berries by stimulating anthocyanin synthesis in berry skin during the ripening stage. In addition, colouring powder can affect the quality parameters of Crimson Seedless grapes such as free anthocyanins, total tannin, pH, and brix level. This study revealed that colour development and quality parameters of crimson seedless grapes can be improved by the foliar applications of colouring powder at the verasion.

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