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# Influence of brassinosteroids on fruit yield and quality of table grape 'Alphonse Lavallée'

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## Summary

**This research was carried out to determine the effects of a brassinosteroid compound (22S-, 23S-homobrassinolide) on yield and quality attributes of a field-grown table grape cultivar 'Alphonse Lavallée'. The vines were sprayed at anthesis (first week of May) with the compound over two growing seasons. The solutions were prepared at the concentrations of control, $10^{-3}$ and $10^{-4}$ mg·L$^{-1}$. Clusters were harvested when those of the control vines reached 16 °Brix. Yield and quality parameters were analyzed. There were no clear effects of the compound on yield and quality, except for the cluster length. The low concentration resulted in longer clusters. High concentration increased the tensile strength of the pedicel to some degree. Seasonal differences were observed in most of the parameters studied.**

K e y w o r d s : brassinosteroid, homobrassinolide, grape, yield, quality.

## Introduction

Applications of growth regulators in viticulture aim to improve fruit yield and quality. Literature is abundant with the studies that involve hormones such as gibberellins, ethylene or auxin in grape growing. Brassinosteroids are a group of plant hormones that have various effects on plant growth and development. Physiological functions they exert in a plant have not been yet fully documented. It is known that they are very low in a plant tissue.

Effects of exogenous brassinosteroid applications have been studied in many fruit and vegetable crops, such as tomatoes (Nunez *et al.* 1995), pepper (Serna *et al.* 2012), cucumber (Yu *et al.* 2004), and passion fruit (Gomes *et al.* 2006) with varying results. The researchers have concluded that brassinosteroids could play a significant role in plant growth and development. Studies on grapes, on the other hand, are very limited (Watanabe *et al.* 1997, Tambe 2002, Symons *et al.* 2006, Warusavitharana *et al.* 2008, Bhat *et al.* 2011). This research was undertaken to assess possible effects of exogenously applied brassinosteroid on yield and quality attributes of a table grape cultivar. It was also conducted to set up a time frame, concentration and mode for the BR application in a vineyard.

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## Material and Methods

*Vitis vinifera* L. table grape 'Alphonse Lavallée' was grafted on 41B rootstock in 2005. Implementations were carried out at the experimental vineyard located in Bornova, İzmir. The vineyard is on sandy and silt soil 2.0 x 3.0 m spacing. Guyot-trained vines were drip irrigated. During winters of 2011 and 2012, Bordeaux mix was applied following pruning, and wettable powder sulphur was used when the summer shoots were 10 cm long.

In order to determine effects of brassinosteroid on fruit yield and quality, the inflorescences were encased from three sides at anthesis and sprayed with different concentrations of 22S-, 23S-homobrassinolide solutions (control, $10^{-3}$ and $10^{-4}$ mg·L$^{-1}$) obtained from Sigma (St. Louis, MO, USA). The substance was first dissolved in ethanol and then diluted with distilled water to the proper concentration. The solution was used straight after the preparation. There were no other manipulations on the clusters. Control vines were sprayed with distilled water. During the course of development the vines were followed and harvested when the control vines reached 16 °Brix.

After harvest, some quality and yield components were measured and recorded under lab conditions. Tensile strength of the pedicel (Newton, N) was measured with a penetrometer (Somyftec, France) on 30 berries taken from the clusters. The external berry color was measured at the equatorial area of each side of 30 berries using a colorimeter (CR-300, Minolta Co, Osaka, Japan), Average scores were recorded in terms of CIE-L* a* b* values. The colorimeter had an 8 mm diameter viewing area and was calibrated with a white tile (L* = 97.26, a* = +0.13, b* = +1.71). The total soluble solids (°Brix) content in the juice was determined with a digital refractometer (PR-1, Atago, Tokyo, Japan) and expressed as percentage. Titratable acidity was measured by titration with 0.1 N NaOH to pH 8.1, and the results were expressed as g tartaric acid·100 mL$^{-1}$ fruit juice.

Statistical analysis was performed on completely randomized design with 3 replications that composed of four vines each. The data were analyzed by repetitive measures analysis of variance using SPSS (Chicago, IL, USA: v. 15.1; year: repetition, factor: concentrations) and means were compared by Tukey's multiple range test at $p \leq 0.05$.

## Results and Discussion

This study that was conducted in order to assess the effects of 22S-, 23S-homobrassinolide on the fruit yield and quality of 'Alphonse Lavallée' grapes revealed that differences among the concentrations used were not distinguish-

Table 1

Effects of 22S-, 23S-homobrassinolide on the yield and physical parameters of table grape 'Alphonse Lavallée'

| | Pruning weight (kg) | | | Yield (kg·vine$^{-1}$) | | | Cluster weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | mean | 2011 | 2012 | mean | 2011 | 2012 | mean |
| $10^{-3}$ mgL$^{-1}$ | 10.62 | 11.82 | 11.22 | 19.13 | 19.35 | 19.24 | 468.80 | 443.22 | 456.01 |
| $10^{-4}$ mgL$^{-1}$ | 13.36 | 12.60 | 12.98 | 19.13 | 19.32 | 19.23 | 432.08 | 427.44 | 429.76 |
| control | 12.22 | 12.97 | 12.60 | 21.33 | 20.43 | 20.88 | 447.37 | 430.34 | 438.85 |
| mean | 12.07 | 12.46 | | 19.86 | 19.70 | | 449.41A | 433.67B | |
| | Cluster width (cm) | | | Cluster length (cm) | | | Berry weight (g) | | |
| | 2011 | 2012 | mean | 2011 | 2012 | mean | 2011 | 2012 | mean |
| $10^{-3}$ mgL$^{-1}$ | 22.00 | 21.33 | 21.67 | 22.67 | 27.00 | 24.8b | 6.24 | 6.29 | 6.27 |
| $10^{-4}$ mgL$^{-1}$ | 22.33 | 23.33 | 23.33 | 28.00 | 30.00 | 29.0a | 6.40 | 6.61 | 6.40 |
| control | 19.00 | 18.33 | 18.33 | 24.00 | 24.33 | 24.2b | 6.21 | 6.53 | 6.37 |
| mean | 21.11 | 21.00 | | 24.89 | 27.11 | | 6.28 | 6.41 | |

Capital letters denote the significant differences between the seasons and the small letters denote the significant differences among the concentrations of the chemical used ($p \leq 0.05$).

Table 2

Effects of 22S, 23S- homobrassinolide on the chemical parameters of table grape 'Alphonse Lavallee'

| | °Brix | | | pH | | | Titratable acidity (g·100 mL$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | mean | 2011 | 2012 | mean | 2011 | 2012 | mean |
| $10^{-3}$ mgL$^{-1}$ | 16.13 | 15.70 | 15.92 | 3.67 | 3.90 | 3.79 | 6.60 | 5.76 | 6.18 |
| $10^{-4}$ mgL$^{-1}$ | 15.67 | 15.07 | 15.37 | 3.60 | 4.30 | 3.95 | 7.30 | 5.50 | 6.40 |
| control | 16.47 | 16.23 | 16.35 | 3.66 | 3.96 | 3.81 | 7.12 | 5.56 | 6.34 |
| mean | 16.09 | 15.67 | | 3.64B | 4.05A | | 7.01A | 5.61B | |
| | Maturity index | | | Tensile strength of the pedicel (N) | | | Chroma (C) | | |
| | 2011 | 2012 | mean | 2011 | 2012 | mean | 2011 | 2012 | mean |
| $10^{-3}$ mgL$^{-1}$ | 24.76 | 27.55 | 26.15 | 400.7 | 408.3 | 404.50 | 5.47 | 2.96 | 4.22 |
| $10^{-4}$ mgL$^{-1}$ | 21.69 | 28.56 | 25.12 | 311.7 | 321.0 | 316.33 | 4.81 | 3.11 | 3.96 |
| control | 23.58 | 29.33 | 26.46 | 360.3 | 366.5 | 363.50 | 4.55 | 2.50 | 3.52 |
| mean | 23.34B | 28.48A | | 357.6A | 356.3B | | 4.94A | 2.86B | |

Capital letters denote the significant differences between the seasons and the small letters denote the significant differences among the concentrations of the chemical used ($p \leq 0.05$).

able for most of the parameters studied (Tabs 1 and 2). The only significant effect of the 22S, 23S-homobrassinolide was observed on cluster length. Application of $10^{-4}$ mg·L$^{-1}$ 22S-, 23S-homobrassinolide resulted in considerably longer clusters (29.0 cm) compared to the $10^{-3}$ mg·L$^{-1}$ and control clusters (Tab. 1). Seasonal variations exerted significant effects on cluster weight, pH, titratable acidity, maturity index, chroma values and tensile strength of the pedicel (Tab. 2). In general, the second-year application resulted in lower titratable acidity, less coloration, and lighter clusters (3.5 %). Maturity index and pH, on the other hand, were higher in the second year. Attachment strength of the pedicel to the stalk was also greater in the first year. Berries lost more color in the second year. At low concentration, the color was darker.

Use of brassinosteroids in agricultural production as a plant growth regulator only dates back to the early nineties. Since then, due to their physiological effects on growth, germination, rooting, flowering, abscission and maturation (Swamy and Rao 2008), they have been widely experimented with under field, greenhouse and laboratory conditions.

In this study, 22S-, 23S-homobrassinolide was applied at anthesis to the clusters by spraying at two different concentrations. There were no clear effects of the compound on either yield or quality, except for the cluster length. Clouse *et al.* (1996) and Haubrick and Assmann (2006) reported that brassinosteroids promote stem elongation by regulating cell growth. Lower concentrations seemed to increase the length of the stalk. Furthermore, although not supported by the statistical analysis here, 22S-, 23S-homobrassinolide applied at high concentration resulted in stronger attachment between the pedicel and the stalk. This was also observed in persimmons (Suzuki *et al.* 1988) and oranges (Sugiyama and Kuraishi 1989) sprayed with brassinolide (0.01 mg·L$^{-1}$) at anthesis.

It is reported that brassinosteroids degrade quickly (Symons *et al.* 2006, Janeczko *et al.* 2010) and applying more than once could ensure their lasting action. The not-so-clear effects of the compound applied in this study might have been worn off during the comparably long growing season. Although Symons *et al.* (2006) reported that epibrassinolide accelerated the veraison; it was not observed in the present study. Having no effect on the soluble solids content of the treated fruit was supported with the findings of Gomes *et al.* (2006) and Symons *et al.* (2006) by spraying passion fruit and grapes, respectively. It contradicted the results of Vardhini and Rao in tomato (2002) and groundnut (1998) and of Yu *et al.* (2004) in cucumber, who reported increases in sugars in fruits.

In the studies on grapes, Bhat *et al.* (2011), Tambe (2002) and Warusavitharana *et al.* (2008) combined brassinosteroids with other growth regulators, such as gibberellins and cytokinins. Bhat *et al.* (2011) concluded that twice application of CPPU and 0.4 $mg \cdot L^{-1}$ brassinosteroid resulted in better berry and cluster weights and berry numbers. Tambe (2002) and Warusavitharana *et al.* (2008) used brassinosteroid with $GA_3$ at 3-4 mm berry stage and concluded that they both increased cell elongation and division. Watanabe *et al.* (1997) stated flowering time as the best time for application in 'Kyoho' grapes. The authors also reported increases in berry and cluster weights and no change in acidity, sugar accumulation, and color. In this present study, we have not found any significant differences in the berry and cluster weights and other chemical composition parameters. This might be due to the comparably lower concentrations used.

In conclusion, manifestation of the effects of brassinosteroids on fruit growth and quality largely depends on the type and concentration of the compound, the length of plant exposure, application time, frequency and mode. This present study is one of the few studies that have investigated the effect of brassinosteroids on field-grown grapevines and provides new information for future studies.

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