African Journal of Biotechnology Vol. 10(29), pp. 5593-5600, 22 June, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.210

Full Length Research Paper

Effects of cluster reduction, herbagreen and humic acid applications on grape yield and quality of Horoz Karasi and Gök üzüm grape cultivars

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Accepted 6 May, 2011

This study was carried out in 5 BB rootstock grafted on Horoz Karasi and Gök üzüm grape varieties (*Vitis vinifera* L.) during the 2010 growth season. Effects of 1/3 cluster reduction (CR), 1/3 CR + herbagreen (HG) and 1/3 CR + humic acid (HA) applications on grape yield and quality of cultivars were examined. The results showed that 1/3 CR + HA application increased grape yield, berry weight, berry red and blue color intensity values of Horoz Karasi grape variety and 1/3 CR application increased grape yield and maturity index values of Gök üzüm grape variety.

Key words: *Vitis vinifera* L., grape yield, quality, cluster reduction, humic acid, herbagreen.

INTRODUCTION

Turkey is the most suitable location for viticulture. It is the 4^{th} with 479,024 ha viticulture area, and the 6^{th} with 4,264,720 tons production in the world (FAO, 2009). It produces 57,609 tons of grape from 13,375 ha vineyard area in the province of Konya. Hadim district is the first place with 7,000 ha viticulture area and 30,000 tons production in terms of area and production among the districts of Konya (TÜİK, 2009). Horoz Karasi and Gök üzüm grape varieties are the most commonly grown varieties in Hadim district.

Herbagreen as a foliar fertilizer is a unique, patented technology of calcite, the "tribomekanik activation" and the processing of a product made of 100% natural minerals. Plants are more vibrant and more prominent as a result of herbagreen. Herbagreen enters the leaves from stomata with an application of the leaf, allowing the formation of CO_2 within the cell. It enhances the efficiency of plant photosynthesis and enzyme activity, and increases the immune system, improves plant health and productivity (Anonymous, 2010).

Plant growth-stimulating effect of humic substances is associated with increased macro-nutrient intake (De Kock, 1955). The statement about the effect of humic acid on plant growth by Vaughan and Mc Donald (1976), is that humic substances affect the ion exchange of plant nutrients that are useful in microbial activity by increasing conversions directly as well as indirectly as a result of the stimulating plant growth hormones. According to Lobartini et al. (1997), humic acid in nutrition of the plants plays an important role directly and indirectly. In the full bloom period of humic acid application, berry weight, titratable acidity and maturity index values of Italy grape cultivar increased significantly (Ferrara and Brunetti, 2010).

Çelik et al. (1995) found that in Narince grape vine cultivar, the increasing doses of N, yield, soluble solids (%), acid (g/100 cc) and bunch weight decreased, while shoot growth rate and shoot length increased very significantly. They determined early bud burst, bud failure and delayed maturation due to increased doses of nitrogen. Çoban et al. (2005) showed that Fetrilon-13 was implemented in round seedless grape cultivar leaves. By spraying only water as the control, it was realized that yield, 100 berry weight and ^{0}Brix values increased. Cantin et al. (2007), in Crimson Seedless grape cultivar, showed that 0, 150, 300 ABA, or 250 μlL^{-1} Ethephon were applied, while 300 μlL^{-1} ABA application resulted in 30 days earliness, fruit color development and preservation progress in the end of the harvest. ABA has been recommended to be used as an alternative instead of Ethephon.

Yener et al. (2008) carried out a study of foliar potassium (K) applications on Sultani Çekirdeksiz (*Vitis vinifera* L.) grape variety. The highest increase in grape yield by 13% have been achieved by 2% KNO_3 application. In Carignane and Colombard wine grapes, 1 and 2% doses of potassium nitrate applications increased productivity (Altindişli et al., 1999). In round seedless grape variety, mono ammonium phosphate (MKP), potassium nitrate (KNO_3) and TZF have been used with different combinations as foliar fertilizers and the highest yield was obtained by 24.0 to 25.6 kg with applications, while the lowest yield was obtained by control application with 14.7 kg (Akyüz, 2000). In round seedless grape cultivar, the highest grape yield was obtained with foliar application of 1% KNO_3, while the highest total soluble solids and titratable acidity values were obtained with 2% KNO_3 application (Aydın et al., 2005).

A yield increase with 39% in Sultani Çekirdeksiz grape cultivar was reported by zinc fertilization (Yağmur et al., 2002). In Sultani Çekirdeksiz grape cultivar, zinc fertilizer in the form of $ZnSO_4.7H_2O$ chelate with 0.50 and 0.25% dose levels increased the grape yield and quality characteristics (Akgül et al., 2007). Round seedless grape cultivars were increased by fresh grape yield per vine in the soil and foliar zinc sulfate ($ZnSO_4.7H_2O$) applications (Şenay et al., 2007). Bybordi and Shbanov (2010) applied $MgSO_4xH_2O$ $ZnSO_4.7H_2O$ to the leaves of Saheb, Soltani and Ghezel grape varieties and the highest increase in product was obtained from Ghezel variety. The 1% increase of the level of water soluble dry matter content was significant. The highest pH value was obtained from leaf application with 0.80% of the magnesium sulphate and 0.40% of zinc sulphate. TARIŞ-ZF foliar fertilizer applied on leaves of Horoz Karasi (Ermenek) grape cultivar, fresh grape yield, cluster weight, 100 berry weight, berry stalk connection force, must yield and pruning waste weight values were increased. However, berry width, berry length, berry length/ berry width ratio, total sugar, total acid, maturity index and the number of bud burst values were decreased (Akin, 2003).

Reducing cluster number application in Amasya and Cardinal grape cultivars decreased the amount of titratable acid and fresh grape yield per vine, while it increased the index of maturity value (Dardeniz and Kismali, 2002). Leaf collection and implementation of cluster thinning in Crimson seedless grape cultivar resulted in increases of cluster weight, cluster size, berry size, berry color, ^{0}Brix and fruit juice values and decreases in accelerating the maturation process and the acidity values (Abd El-Razek et al., 2010).

The objective of this study, therefore,was to determine the effects of Horoz Karasi and Gök üzüm grape varieties of 1/3 CR, 1/3 CR + HG and 1/3 CR + HA foliar applications on grape yield and its quality.

MATERIALS AND METHODS

This study was carried out in the Horoz Karasi and Gök üzüm grape varieties grafted on 5 BB rootstock in the district of Hadim, Konya province, during the 2010 growth season. The varieties are among the most widely grown grape cultivars in Hadim district. The cultivars are consumed as table grape in Horoz Karasi (black color), as table grape or raisin in Gök üzüm (yellow-green). As Gök üzüm keeps its pure greenish color when dried in the shade, the flower type of both Horoz Karasi and Gök üzüm cvs. has hermaphrodite. In this study, 20 years old Horoz Karasi grape variety and 8 years old Gök üzüm grape variety grafted on 5 BB rootstock, the 1/3 cluster reduction (CR), 1/3 CR + herbagreen (HG) (100 lt/50 g, 40% CaO, 1% MgO, 1% Fe_2O_3, SiO_2, 4%) and 1/3 CR + humic acid (HA) (150 cc / da; humic acid + fulvic acid: 15%, organic matter, 5%, water-soluble potassium, 1.5%) were conducted with 3 different applications as 3 replications. The 1/3 cluster reduction (berry thinning) was applied by cutting the tips of the cluster at the point of one third of the cluster length, while the 1/3 cluster reduction of all clusters outside the control in the fruit set (FS) period (05/31/2010) was conducted. In the form of foliar spray applications, the liquid form of HA and HG was started in the FS period and the implementation of the 15 day intervals was continued until harvest. Harvests of 24.08.2010 in Horoz Karasi grape variety and 18.09.2010 in Gök üzüm grape variety were made for the necessary measurements and analysis.

Fresh grape yield (kg/vine) was calculated by weighing all the yields from the vines in the parcels and dividing it with the number of vines. The cluster weight (g) was found by dividing the total grape yield with the number of grape cluster obtained from each parcel, while the berry weight (g) was calculated by dividing the total weight with the number of berries collected using the Amerine and Cruess (1960) method. ^{0}Brix (total soluble solid substance) (%) was determined by squeezing the grapes (berries) collected from the vines using the Amerine and Cruess (1960) method and keeping the resulting juice at 20°C in a digital refractometer device (Atago RX 7000 Alpha). TA (titratable acidity) (g/l) was calculated using the titration method from the juice squeezed from the same grapes. The maturity index (°Brix /TA) was determined with the division of °Brix to TA. The must yield (grape juice yield) was determined as the amount of juice obtained by squeezing the grapes that were picked. Color densities were determined using a colorimeter device (CR-400 Minolta Co., Osaka, Japan). Color intensity values were provided as CIEL* (Commision Internationele de l'E Clairage) a* b* coordinates, which defined the color in a three-dimensional space. However, L* indicated lightness, while a* and b* were the chromaticity coordinates, green-red and blue-yellow coordinates, respectively. L* is an approximate measurement of luminosity, which is the property according to which each color can be considered as equivalent to a member of the gray scale, between black and white, taking values within the range of 0 to 100. Thus, a* takes positive values for reddish colors and negative values for the greenish ones, whereas b* takes positive values for yellowish colors and negative values for the bluish ones (Minolta, 1994). For the color measurement, 10 grapes per cluster were selected from two opposite sides of the cluster and at 5 different heights. In this way, the color datum was the mean of 10 grapes for each application. The research was planned in a completely randomized block design as a simple factorial experiment and variance analyses and multiple comparison tests were done by JMP statistical package program (version 7.0; SAS Institute, Cary, NC, USA).

RESULTS AND DISCUSSION

It was found that the effects of berry with 1/3 CR+HA application in Horoz Karasi on grape yield, berry weight, red and blue color intensity values, and the maturity index values with 1/3 CR application in Gök üzüm on grape yield were statistically significant. However, the effects of the applications of Horoz Karasi on cluster weight, and the values of a and b color in Gök üzüm were not found

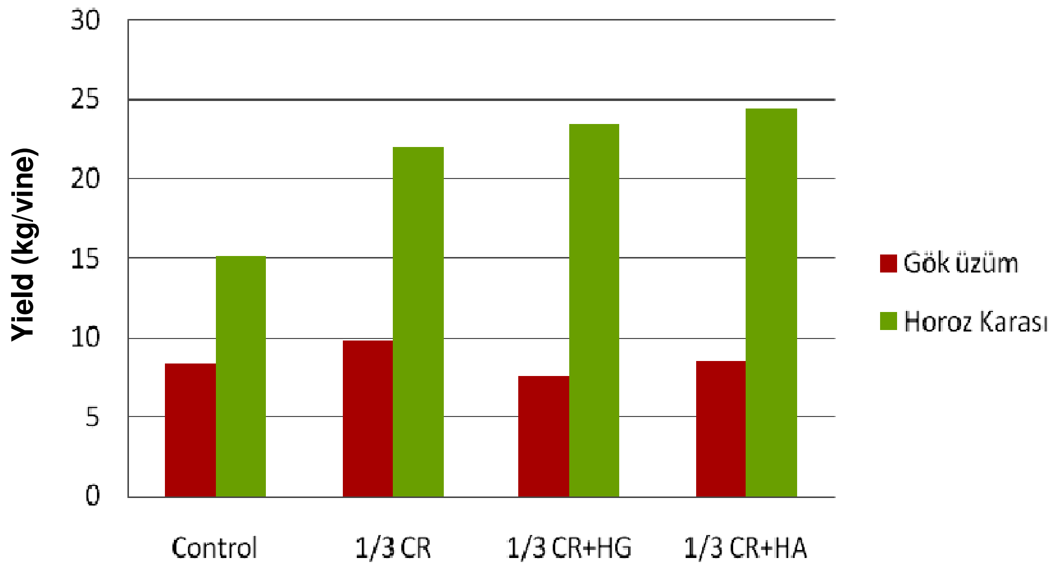

Figure 1. Effects of applications on yield.

to be statistically significant.

Effect of applications on grape yield

Grape varieties have given a different response according to applications in terms of grape yield. The maximum grape yield was taken with 24.39 kg/vine from 1/3 CR + HA application in Horoz Karasi. However, 1/3 CR + HG (23.44 kg/vine), 1/3 CR (21.92 kg/vine) and the control (15.07 kg/vine) followed it respectively. The maximum grape yield was taken with 9.82 kg/vine from 1/3 CR application in Gök üzüm, while 1/3 CR + HA (8.48 kg/vine), the control (8.37 kg/vine) and 1/3 CR + HG (7.54 kg/vine) followed it respectively (Figure 1).

Maximum grape yield was obtained from 1/3 CR+HA application with an increase of 62% in Horoz Karasi and from 1/3 CR application with an increase of 17% in Gök üzüm. However, a lot of research was carried out to improve the grape yield. While Taris-ZF foliar fertilizer application did not increase fresh grape yield of Hesap Ali and Ekşi Kara varieties, it increased that of Ermenek grape variety (Akin, 2003). It was reported that the bunch reduction application (Dardeniz and Kismali, 2002), nitrogen application (Çelik et al., 1995), potassium application (Yener et al., 2008), potassium nitrate application (Altindişli et al., 1999; Aydin et al., 2005), zinc, chelates and manganese applications (Bacha et al., 1997), zinc fertilization application (Yağmur et al., 2002), chelate form of zinc fertilizer application (Akgül et al., 2007), zinc sulfate ($ZnSO_4.7H_2O$) application (Şenay et al., 2007), application of Fetrilon-13 (Çoban et al., 2005), and application of $MgSO_4xH_2O$ and $ZnSO_4.7H_2O$ (Bybordi and Shbanov, 2010) increased grape yield.

Effect of applications on cluster weight

The effect of applications on cluster weight varied between the cultivars. There was no significant effect for the applications of cluster weight in Horoz Karasi. The highest cluster weight was taken with 369.63 g from 1/3 CR + HA application in Gök üzüm. It was followed by the control (348.63 g), 1/3 CR (338.46 g) and 1/3 CR + HG (331.31 g), respectively (Figure 2). However, the maximum cluster weight was obtained from 1/3 CR + HA application with an increase of 6% in Gök üzüm. In similar studies, while Taris-ZF foliar fertilizer application did not increase the cluster weight of Hesap Ali and Ekşi Kara varieties, it did increase in Ermenek variety (Akin, 2003), with nitrogen application (Çelik et al., 1995), leaf collection and cluster reduction applications (Abd El-Razek et al., 2010). As such, increases in cluster weight were determined.

Effect of applications on berry weight

Grape varieties have given a different response according to applications in terms of berry weight. The highest berry weight was taken with 7.85 g from 1/3 CR + HA application in Horoz Karasi, and was followed by 1/3 CR (7.80 g), 1/3 CR+HG (7.53 g) and the control (6.20 g), respectively; whereas, the highest berry weight was taken with 3.89 g from 1/3 CR+HA application in Gök üzüm, and was followed by 1/3 CR+HG (3.84 g), 1/3 CR (3.74 g) and the control (3.63 g), respectively, (Figure 3). Maximum berry weight increase was obtained from 1/3 CR+HA application in Horoz Karasi and Gök üzüm grape cultivars with 26.6 and 7.2%, respectively. Other studies

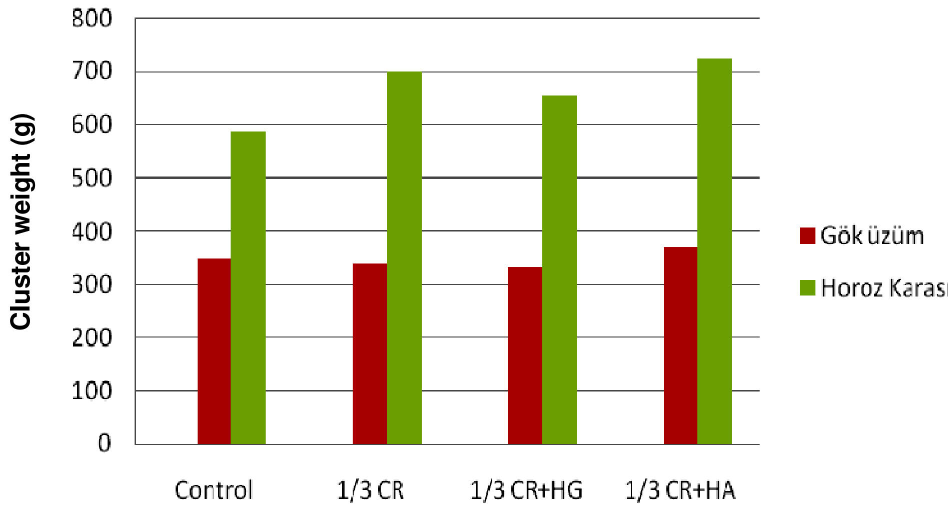

Figure 2. Effects of applications on cluster weight.

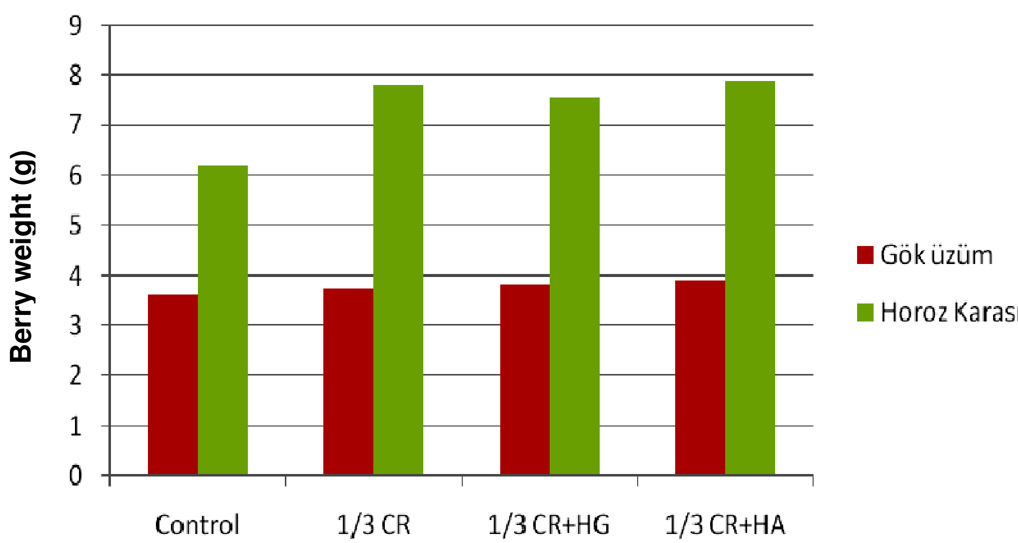

Figure 3. Effects of applications on berry weight.

on this subject showed that while Taris-ZF foliar fertilizer application increased berry weight of Ekşi Kara and Ermenek varieties, increase in Hesap Ali variety was not found to be significant (Akin, 2003) with zinc, chelates and manganese (Bacha et al., 1997), as well as Fetrilon-13 application (Çoban et al., 2005). However, increases in berry weight were suggested.

Effect of applications on °Brix

The effect of applications on °Brix varied between the cultivars. The most °Brix was taken with 18.43% from the control in Horoz Karasi, and it was followed by 1/3 CR (16.06%), 1/3 CR + HG (15.99%) and 1/3 CR + HA application (14.99%), respectively; whereas, the highest °Brix was taken with 19.15% from 1/3 CR + HA in Gök üzüm. It was followed by 1/3 CR (19.06%), the control (18.60%) and 1/3 CR + HG application (17.63%), respectively (Figure 4). The maximum °Brix was obtained from 1/3 CR + HA application with an increase of 18.31% in Gök üzüm. °Brix value of Horoz Karasi was not increased with applications, but the highest °Brix was obtained from the control application (18.43%). According to the results of researches, while Taris-ZF foliar fertilizer application increased the must yield of Hesap Ali and Ekşi Kara varieties, increase in Ermenek variety was not found to be significant (Akin, 2003) with nitrogen application (Çelik et al., 1995), Fetrilon-13 application (Çoban et al., 2005), application of potassium nitrate (Aydin et al., 2005), leaf

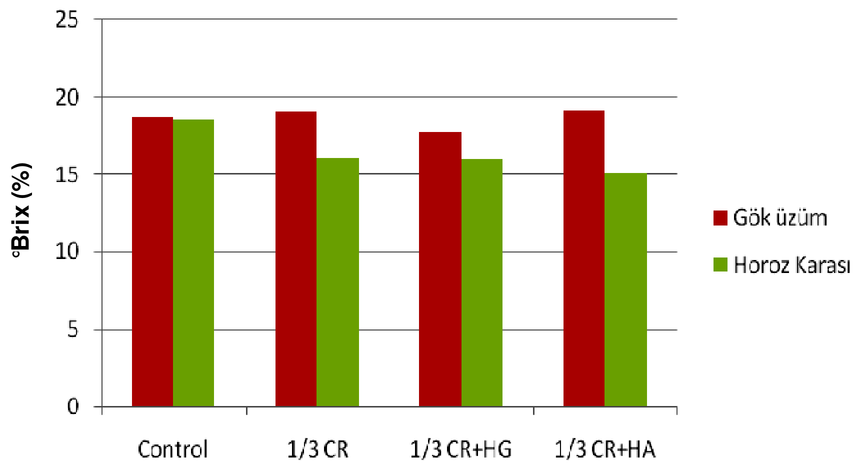

Figure 4. Effects of applications on °Brix.

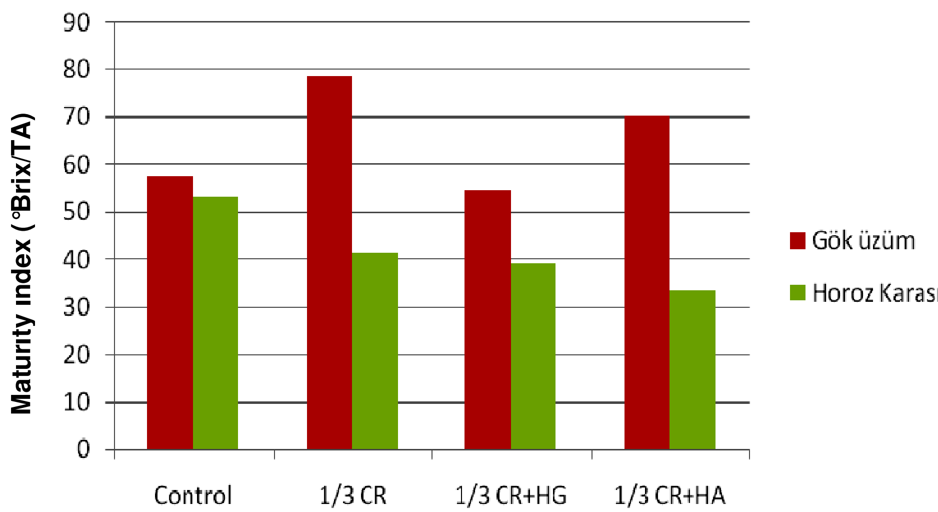

Figure 5. Effects of applications on maturity index.

collection and cluster reduction application (Abd El-Razek et al., 2010). Nonetheless, increases in °Brix value were reported.

Effect of applications on maturity index

Grape varieties were given a different response according to applications in terms of maturity index. The highest maturity index was taken with 53.17 from the control in Horoz Karasi and was followed by 1/3 CR (41.19), 1/3 CR+HG (39.33) and 1/3 CR+HA application (33.32), respectively; whereas the highest maturity index was taken with 78.35 from 1/3 CR in Gök üzüm and was followed by 1/3 CR+HA (70.09), the control (57.53) and 1/3 CR+HG application (54.53), respectively (Figure 5). As the maximum maturity index increase was obtained with 36.19% from 1/3 CR application in Gök üzüm, the maturity index value of Horoz Karasi was not increased with applications. In similar studies, while Taris-ZF foliar fertilizer application increased the maturity index of Hesap Ali and Ekşi Kara varieties, increase in Ermenek grape variety was not found to be significant (Akin, 2003), although the bunch reduction application (Dardeniz and Kısmali, 2002), which increased the maturity index value, was determined.

Effect of applications on must yield

The effect of applications on must yield varied between the cultivars. The highest must yield was taken with 782 ml from 1/3 CR + HA application in Horoz Karasi and was followed by 1/3 CR + HG (770 ml), 1/3 CR (735 ml) and

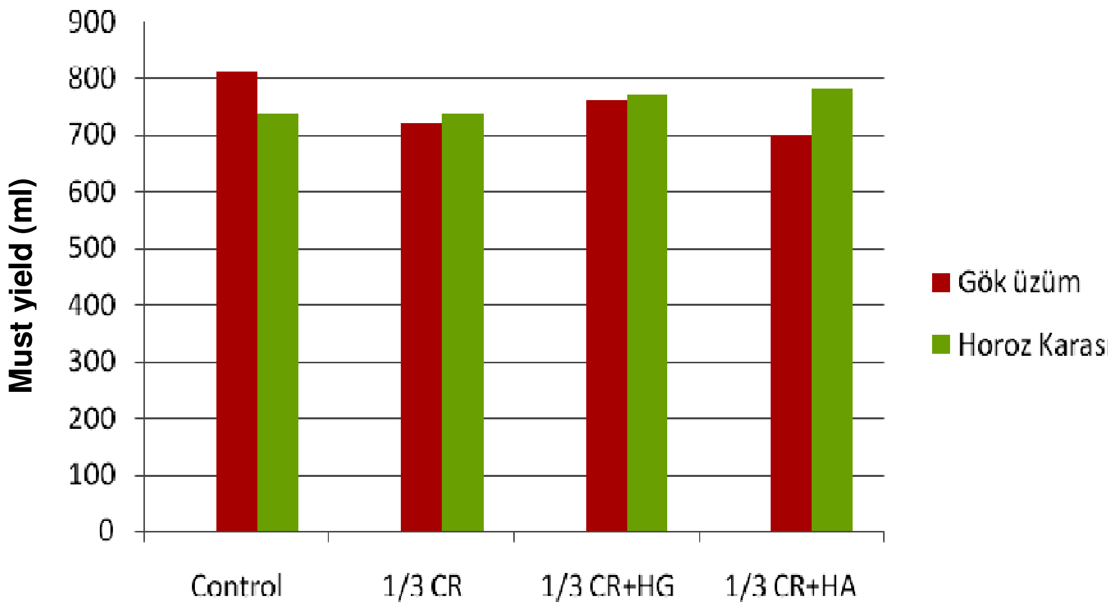

Figure 6. Effects of applications on must yield.

the control application (735 ml), respectively; whereas, the highest must yield was taken with 810 ml from the control in Gök üzüm variety and was followed by 1/3 CR + HG (760 ml), 1/3 CR (720 ml) and 1/3 CR + HA applications (700 ml), respectively (Figure 6). While the maximum must yield increase was obtained with 4.76% from 1/3 CR + HA application in Horoz Karasi, the must yield value of Gök üzüm was not increased with applications. In similar studies, as Taris-ZF foliar fertilizer application increased the must yield of Ekşi Kara and Ermenek varieties, increase in Hesap Ali was not found to be significant (Akin, 2003) with leaf collection and cluster reduction application (Abd El-Razek et al., 2010). However, increases in berry weight were suggested.

Effect of applications on color intensity

Grape varieties have given a different response according to applications in terms of color intensity. While there was no statistically significant effect on the brightness of berry applications in Horoz Karasi, the berries with the highest brightness were obtained from the control application. The highest effect of applications on the a* and b* colors was determined from 1/3 CR + HA in Horoz Karasi. As the berries with the highest brightness were obtained from 1/3 CR + HA and 1/3 CR + HG applications in Gök üzüm, a and b color intensity values were not significantly influenced by applications (Figure 7).

[L* = 0 black (dark), L* = 100 white (brightness); a* = +60 red, a* = -60 green; b* = +60 yellow, b* = -60 blue].

Effect of applications on L* color intensity

The highest effect on brightness of applications was obtained with 40.35 from 1/3 CR + HA and 40.09 from 1/3 CR + HG in Gök üzüm, and with 37.49 from the control application in Horoz Karasi.

Effect of applications on a* color intensity

While there was no significant effect on a* color intensity of applications in Gök üzüm, the effect was obtained with 5.24 from1/3 CR + HA application in Horoz Karasi.

Effect of applications on b* color intensity

As there was no significant effect on b* color intensity of applications in Gök üzüm, -3.74 was obtained from 1/3 CR + HA application in Horoz Karasi. However, the bluish color intensity with 1/3 CR + HA application in Horoz Karasi was increased.

Fundamentally, 1/3 cluster reduction application was carried out during the fruit set period in grape varieties. 1/3 CR + HA and 1/3 CR + HG applications were started in the fruit set period, while different practices continued with 15 day intervals until harvest. Effects on grape yield and quality of applications were determined by an examination of the harvested grapes. As berry weight, red and blue color increase were obtained from 1/3 CR + HA application in Horoz Karasi, °Brix and maturity index values were reduced with this application. Although, it was not statistically significant, grape yield was mostly

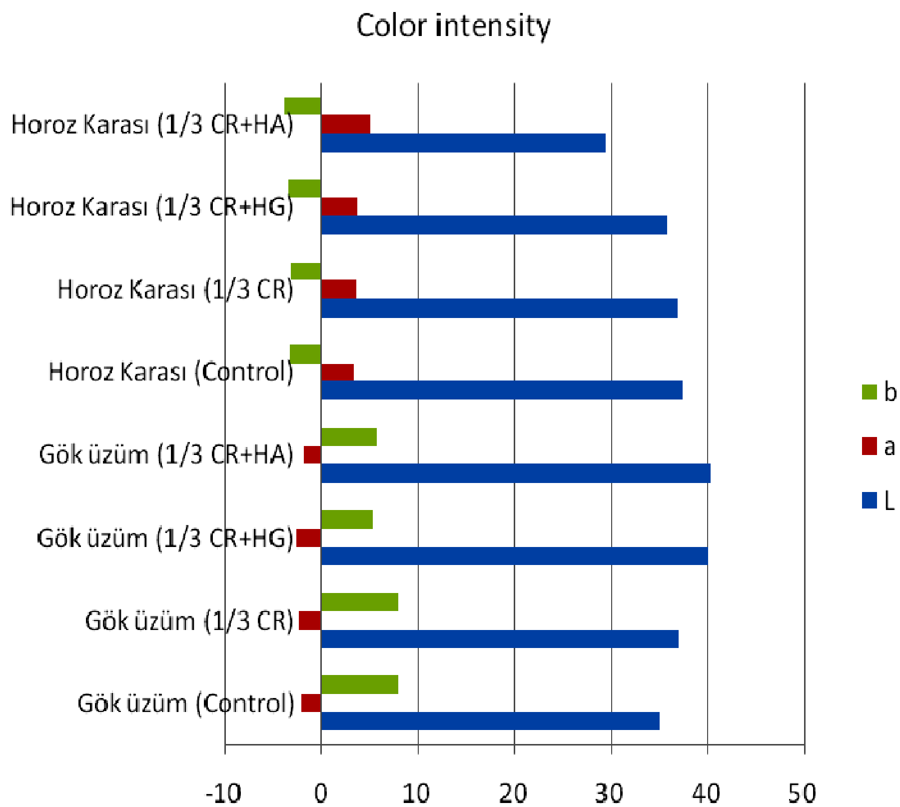

Figure 7. Effects of applications on color intensity [L* = 0 black (dark), L* = 100 white (brightness); a* = +60 red, a* = -60 green; b* = +60 yellow, b* = -60 blue].

increased with 1/3 CR + HA application in Horoz Karasi. Nevertheless, grape yield and maturity index increase were determined from 1/3 CR application in Gök üzüm.

Consequently, to increase production, it can be advised that 1/3 CR + HA application should be used in Horoz Karasi, while 1/3 CR application should be used in Gök üzüm.

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