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Full Length Research Paper

Effects of some growth regulating applications on leaf yield, raw cellulose and nutrient element content of the Müsküle table grape variety

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The vine leaf is an important dietary product for human nutrition by virtue of its high nutritious value and low calorie. This study was conducted in the Province of Konya in a vineyard belonging to a producer in the 2010 vegetation period. This study investigated the effects of repetitive applications of herbagreen (HG), humic acid (HA), combined foliar fertilizer (CFF) and HG+CFF performed in the Mü□küle grape variety grafted on 5 BB rootstock on fresh or pickled leaf size and leaf raw cellulose content. HA application increased leaf area and leaf water content values whereas HG+CFF application increased leaf raw cellulose values. The effects of the application on leaf weight and leaf volume were found to be insignificant. It was observed that leaf blade samples were efficient in terms of N, P, Fe, Mn and Cu content, but deficient in K, Ca, Mg and Zn content.

Key words: Mü küle grape leaves, herbagreen, humic acid, combined leaf fertilizer, herbagreen + combined leaf fertilizer, yield, crude fiber content, nutrient values.

INTRODUCTION

The vine leaf has a very important place in a healthy human diet by virtue of its high nutritious value, vitamin C and raw fiber content. The Mü küle grape variety, which constitutes the subject of this study, is among the most widely grown varieties in the region due to the suitability of its leaves for pickling.

Herbegreen is incomparable as a foliar fertilizer produced through "tribomechanical activation", which is a calcite patented technology, and a 100% natural mineral product (Anonymous, 2010). It was reported that stimulating effect of humic substances for plant growth is linked to an increase in the intake of macro nutrient elements (De Kock, 1955) and plays an important part directly or indirectly in the nutrition of plants (Lobartini et al., 1997). The original duty of leaves is to perform photo-synthesis and breathing. The vine leaf area has a significant effect on the quality of the grape berry (Drissi et al., 2009). While a positive relationship is established between leaf area/vine and amount of harvest/vine, a negative relationship is reported between the number of bunches/vine (Edson et al., 1995). An increase in leaf area per vinestock is considered to be an increase in photosynthesis and dry matter (Campo et al., 2002).

Narince and Sultani seedless grapes are the most commonly preferred seedless grape varieties in our country in the production and consumption of vine leaves for pickling in terms of the qualities of their leaves such as shape, thickness and hairiness. The leaf is harvested when it reaches 1/3 or 2/3 of its full size. Especially in the area around Tokat, viticulture is conducted extensively and the main goal is production of vine leaves for pickling (Ağaoğlu et al., 1988).

While many researchers investigated the reactions of vine to different plant growth regulators and leaf fertilizer applications (Altındi li et al.,1999; Yener et al., 2008), some other researchers investigated the position of the leaf on the shoot and its quality for pickling (Dalgıç and Akbulut, 1988), salt concentration for pickled vine leaf (Göktürk et al., 1997), appropriateness levels of leaves taken from different grape varieties for pickling (Sat et al., 2002), and the quantity of leaves that can be reduced without creating much difference in yield (Kader and Kısmalı, 2004), and showed that GA and humic acid applications (Demirhan, 2006) increased leaf quantity and size.

In viticulture performed for grape production, since the total assimilation area decreases due to the leaves pulled from the vinestocks in different periods, undesirable drops are observed in yield and quality (Mullins et al., 1992). In vine grown for leaves, the number of bunches negatively affects leaf area and vegetative development of the vinestock (Kaps and Cahoon, 1989); therefore, it is suggested for vineyards to be established for pickled leaf production that the bunches on the vinestocks be pulled when they are still in the flowering stage and a regular fertilizing procedure be implemented (Odaba et al., 1992).

Humic acid applications were performed on Narince and Sultani seedless varieties at dosages of 0.1 and 0.2%. It was reported that while humic acid (HA) application at the dosage of 0.1% increased leaf area and leaf weight in the Narince variety in comparison to the control, it was ineffective with the Sultani seedless variety (Demirhan, 2006). In an extensive survey study also covering the region of Hadim-Aladağ, 59% of the soil in the region was deficient in Iron (Fe), 3% in Copper (Cu); 68% in Zinc (Zn) and 3% in Manganese (Mn) (Bitgi and I ık, 1997).

Yağmur et al. (2005) investigated, on the leaf, the effect of iron applications on leaf nutrient contents in four different levels and in three different periods in the vineyard (fetrilon 13 chelate). They found that generally, iron applications had a positive effect on the nutrient content of the leaf blade and stem in comparison to the control. In the round seedless variety, Fetrilon-13 was sprayed on leaves in four different levels (0, 0.05, 0.10 and 0.15% Fe) and three times, that is in periods of flowering, post-flowering and becoming freckled, until the vinestock surface got wet completely. In the study in which they sprayed only water on the control vines, they found that total Fe content of the leaf (blade and stem) and active Fe content of the leaf blade increased as a result of Fe applications on the leaf (Çoban et al., 2005). In a study conducted on Bobal, Crujidera, Tempranillo and Cabernet Sauvignon grape varieties in the fruit formation period to determine seasonal macro nutrient content in the leaf, the following results were obtained: (% dry weight) N (2.93-3.56), P (0.23-0.35), K (0.56-1.35), Ca (0.89-1.09) and Mg (0.18-0.29) (Navarro et al., 2008).

The nutrient content of the vine leaf is reported as follows in the relevant literature (as ingredients in 100 g): 2.12 g total fat, 1.06 g polyunsaturated fat, 0.08 g mono-unsaturated fat, 5.6 g protein, 17.31 g carbohydrates, 11.00 g diet fiber, 6.3 g sugar, 9 mg sodium, 363.08 mg calcium, 2.63 g iron, 91.02 mg phosphor, 11.10 mg vitamin C and 1376 IU vitamin A (Anonymous, 2006). In their study which they conducted on fresh leaves of Hacitesbihi, Karaerik, Kabuguyufka and Agrazaki grape varieties, Sat et al. (2002) found the raw cellulose content of 7.44, 3.21, 4.40 and 6.95% respectively. The varieties varied between 54.00 and 100.29 mg/100 g in terms of their vitamin C content. Baysal (1993) reported that 100 g vine leaf contained about 120 mg vitamin C and that vine leaf was a very good source of vitamin C. In a study conducted by Ünver et al. (2007) on the vine leaves of Mü küle grape variety, it was found that dry matter was 25.36%, and fresh leaf weight was 2.36 g/per item but it rose to 3.22 g after been processed for pickling. They determined the protein content as 20.20% and energy value as 2.9 kcal/100 g.

It has been reported that fresh vine leaves are good for a variety of diseases. Also, It has been reported that fresh vine leaves stop diarrhea, are effective in the healing of abscesses and sores in the body, strengthens the memory centre and helps the brain work more effi-ciently (Akın, 2010), while raw cellulose found in plant-based foodstuff reduces atherosclerosis, formation of spinal diseases and cancer of the large intestine (Gürses, 1980).

In this study, the effects of repeated applications on leaf of herbagreen, humic acid, combined foliar fertilizer, herbagreen+combined foliar fertilizer in the Mü küle grape variety on the yield, raw cellulose content and nutrient content of the leaf were investigated.

MATERIALS AND METHODS

This study was conducted on 20 old, with goble system Mü küle grape variety grafted on 5 BB rootstock in a producer's vineyard in the village of Gaziler in the Hadim District of the Province of Konya in 2010 vegetation period. Control (C), HG (100 lt/50 g), HA (% 0.15 ml), CFF (100 g/da) and HG+CFF were sprayed on the leaves in five different periods. The first application was immediately before the flowering began (15.05.2010) and after that with an interval of 15 days, four more applications were performed, that is fruit formation and 15, 30, 45 and 60 days after fruit setting (FS).

The first leaf samples were taken in the MP period from the leaves that became suitable for pickling whereas other samples were harvested with an interval of 15 days. Leaf weight was weighed on an assay balance while leaf area was determined through scanning with a "winfolia basic 2003d" camera (Regent Inst. Inc., Canada), and leaf volume was determined by dipping the samples into water. Leaf water content (%): the tare of the dry mass container, which is placed in the desiccator after been kept at 105°C for 1 h, was determined at (a) 2 to 2.5 g of the sample weighed into it (b) it was kept in the drying cabinet at 105°C for 8 h, and then moved to the desiccator. It was weighed after cooling (c) and dry mass percent was calculated using the formula DM (Dry Mass) = c-a x100/amount of sample, and the water content of the leaf was determined in percent by subtracting the value that was obtained from 100. The leaf raw cellulose content was determined through an analysis made according to Soest et al. (1991).

In order to determine the nutritional element content of the leaf blade, the leaves opposite the 1st bunch were picked during the berry formation period and brought to the laboratory, and after initial cleaning, the leaves were separated from the stems. The cleaning procedure was conducted by washing the leaves with pure water and then total N content of the plant samples, which were later dried at 65 to 70°C and ground, was determined using the modified Kjeldahl method (Mills and Jones, 1996). Then, plant extracts were prepared by applying the wet burning method and in these plant extracts, P was determined on the colorimeter, K and Ca on flame photometer and Mg, Fe, Zn, Mn and Cu on atomic absorption spectrophotometer (AAS) (Kacar, 1972; Mills and Jones, 1996).

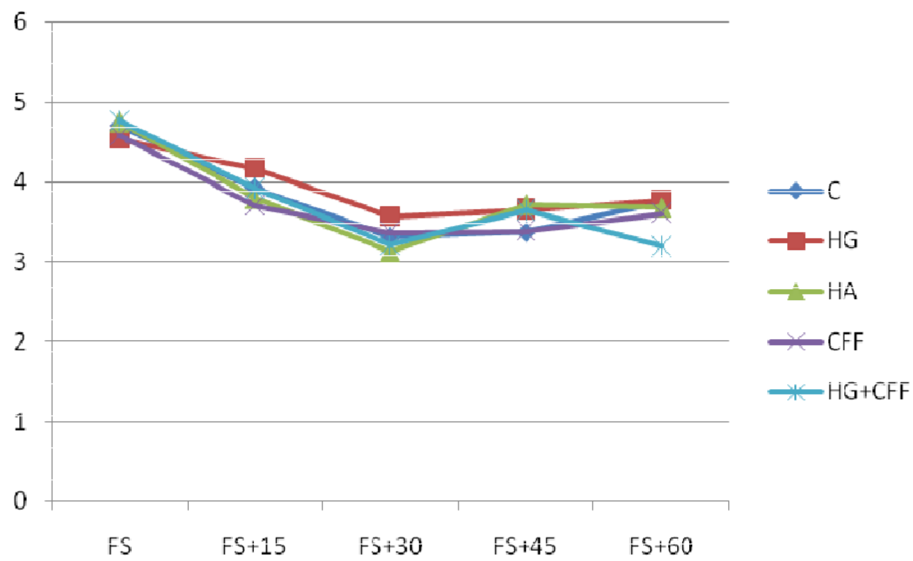

Figure 1. Effects on leaf weight of applications.

Analyses were made on dried leaf blade samples. The study was conducted in three replications according to the random plots experimental design, and the results that were obtained were analyzed using the JMP (7.0 version, SAS Institute, Cary, NC, USA) statistical software.

RESULTS AND DISCUSSION

While the effects of all the applications on leaf weight and leaf volume were found statistically insignificant, their effects on leaf area, leaf width, leaf length and leaf water content (%) and leaf raw cellulose value were significant. It was observed that leaf blade samples were efficient in N, P, Fe, Mn and Cu content but deficient in K, Ca, Mg and Zn content.

Effects of foliar fertilizer applications on leaf weight

The weight values of the vine leaves that were harvested for consumption were at the highest in the FS period, which is the time for picking the first samples, and they exhibited a steady decline until 30 days after FS, when the last sample was taken (31.06.2010) (Figure 1). Of all the harvest periods that were recorded, the leaf weight was lowest in HA application (3.31 g) and was highest in HG+CFF application (4.77 g).

Effects of foliar fertilizer applications on leaf area

In leaf samples that were collected with intervals of 15 days in the fruit set period and until 60 days after that, leaf area was, as in leaf weight, the highest in the FS period; and it was lower with each sample collection. When all the samples were evaluated together, leaf area varied between 148.98 and 198.94 cm^2 in the control group, it varied between 155.64 and 228.30 cm^2 in HG application, between 146.23 and 229.79 cm^2 in HA application, between 140.54 and 203.74 cm^2 in CFF application and varied between 160.36 and 226.84 cm^2 in HG+CFF application (Figure 2). Demirhan (2006) reported that leaf area increased in the Narince variety with HA application at the 0.1% dosage in comparison to the control whereas there was no such increase in the Sultani seedless variety.

Effects of foliar fertilizer applications on leaf volume

Leaf volume was at its highest in the fruit set period and after that decreased gradually. When leaf volume was considered together with all harvest periods, it was observed that it varied between 8.43 and 13.97 cm^3 in the control, whereas it varied between 8.07 and 13.77 cm^3 in the HG application, 8.43 and 14.73 cm^3 in the HA application, 8.20 and 12.57 cm^3 in the CFF application and 8.33 and 13.77 cm^3 in the HG+CFF application (Figure 3).

Effects of foliar fertilizer applications on leaf water content

Leaf water content was at its highest in the fruit set period and after this period, it decreased steadily. While leaf water content varied between 64.39 and 74.40% in the control in all the harvest periods, it varied between 60.58 and 72.44% in the HG application, 62.59 and 76.18% in the HA application, 62.51 and 74.04% in the CFF

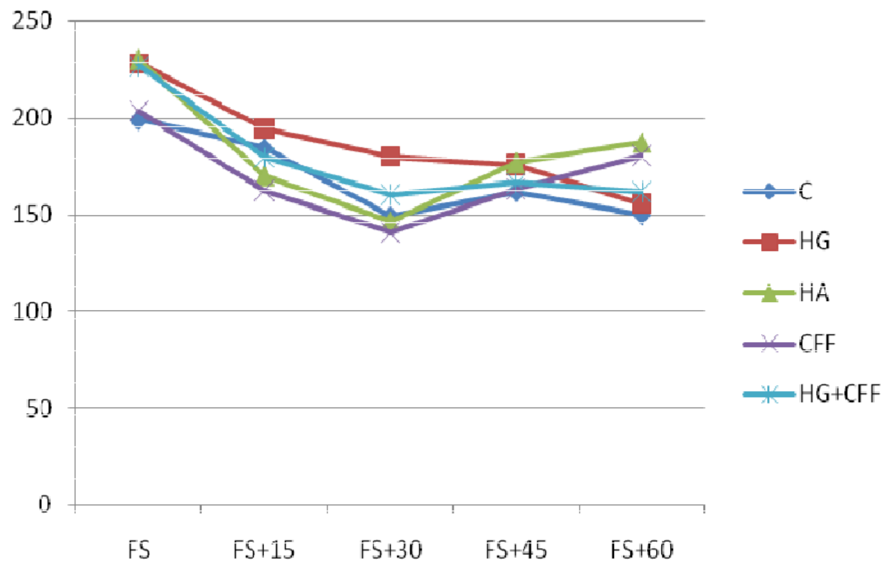

Figure 2. Effects on leaf area of applications.

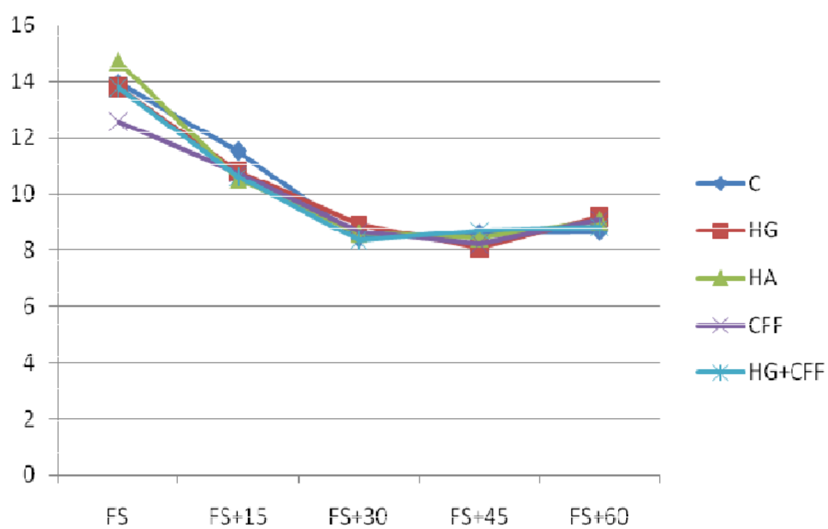

Figure 3. Effects on leaf volume of applications.

application and 59.62 and 74.05% in the HG+CFF application (Figure 4). It is possible to relate the decrease in the leaf size and water content in parallel to the progress in vegetation time to the competition among leaf, shoot and fruit for reserve foodstuff whereas the decrease in the water supply of the vine can be attributed to a decrease in the available nutritional elements in the plant root area.

Effects of foliar fertilizer applications on raw cellulose content of the leaf

When the raw cellulose contents of the leaf samples taken in the FS period and the next four sample collection periods were taken into consideration together, raw cellulose content values of the leaf were the highest in the FS period in the control with 35.52% similar to the changes in leaf size, but this value was the lowest (25.42%) in the second leaf harvest (15.06.2010). Leaf raw cellulose content increased gradually after this date and a value close to the first harvest (34.19) was obtained again in the 5th harvest (31.07.2010). Differences in raw cellulose values were statistically significant. Effects of HG, HA, CFF and HG+CFF applications on the change in raw cellulose were in parallel to the control. However, HG values in the first (35.91%) and the last (38.14%) harvests were above those of the control

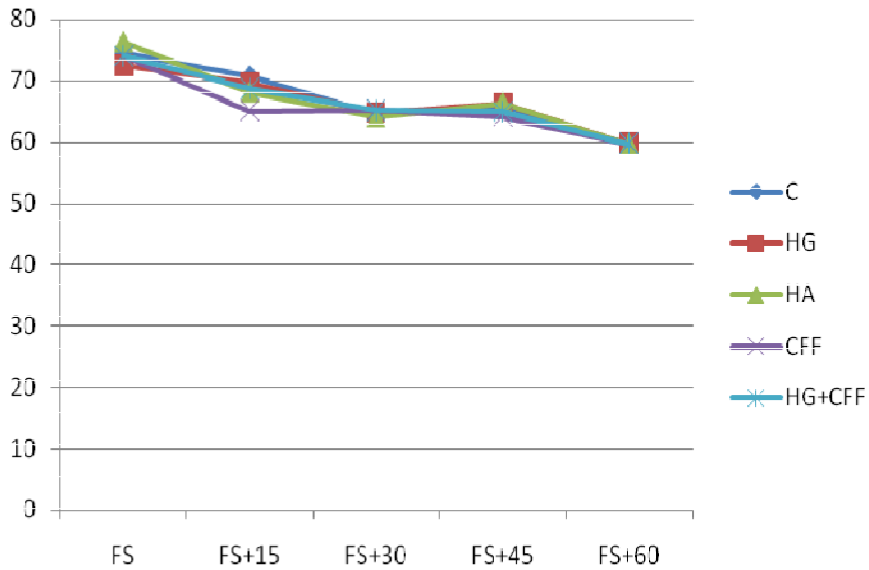

Figure 4. Effects on leaf water content of applications.

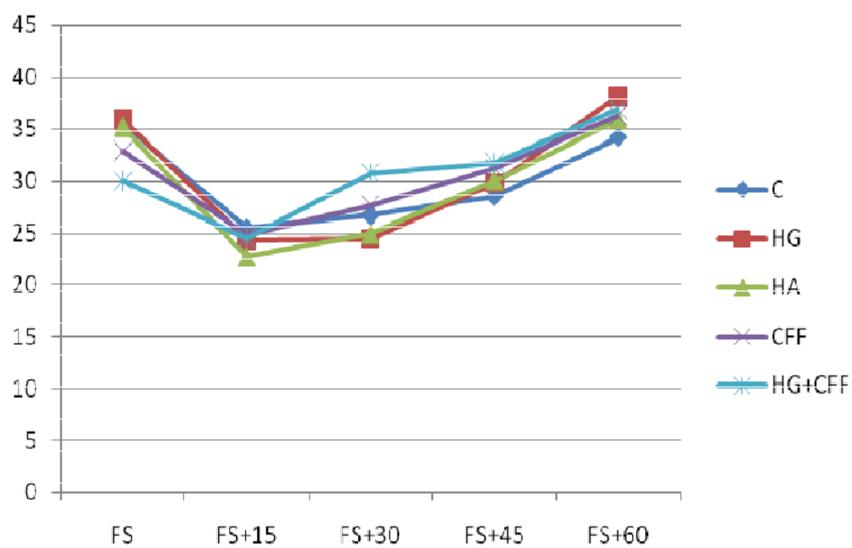

Figure 5. Effects on leaf crude fiber content of applications (in dry matter %).

(Figure 5). Sat et al. (2002) found the raw cellulose content of the fresh leaves of Hacitesbihi, Karaerik, Kabuguyufka and Agrazaki grape varieties as 7. 44, 3.21, 4.40 and 6.95% respectively.

Effects of foliar fertilizer applications on the nutritional element content of the leaf

Plant nutrition elements need to be in optimum levels in a plant for high quality leaf and grape production. The plant will acquire a healthy appearance and the product that is obtained will be of better quality as a result of a balanced diet. The first application of herbagreen, humic acid, combined foliar fertilizer and herbagreen+combined foliar fertilizer was performed on the Mü küle grape variety before flowering. Samples were taken from the leaves opposite the first bunch during the berry formation period. According to the results of the analysis, what nutritional elements the plant needed and the effects of the applications were determined. Macro nutritional element contents such as N, P, K, Ca and Mg (Table 1) and micro nutritional element contents such as Fe, Zn, Mn and Cu (Table 2) were determined in the leaf blade.

Macro nutritional elements were found in the following amounts in the leaf blade during the berry formation

Table 1. Macro element values of Mü küle grape leaf blade in fruit set period.

Applıcatıon	Dry matter (%)				
	N	P	K	Ca	Mg
Control	1.95^{c}	0.19^{c}	1.05^{a}	1.08^{a}	0.19^{b}
HG	2.20^{ab}	0.23^{a}	0.93^{c}	0.85^{d}	0.17^{c}
HA	2.34^{a}	0.22^{b}	0.81^{d}	0.90^{c}	0.19^{ab}
CFF	2.13^{bc}	0.14^{e}	0.77^{e}	0.81^{e}	0.16^{d}
HG+CFF	2.22^{ab}	0.18^{d}	0.97^{b}	1.00^{b}	0.19^{a}
LSD 5%	0.19	0.01	0.00	0.01	0.01

a-e, Values having same letter(s) in a column do not differ significantly at 5% level of probability.

Table 2. Micro element values of Mü küle grape leaf blade in fruit set period.

Applıcatıon	Dry matter (ppm)			
	Fe	Zn	Mn	Cu
Control	61^{c}	19^{c}	57^{a}	5^{c}
HG	47^{d}	17^{c}	$43b^{c}$	5^{c}
HA	64^{c}	21^{c}	58^{a}	7^{b}
CFF	105^{a}	60a	51ab	12^{a}
HG+CFF	76^{b}	33^{b}	41^{c}	12^{a}
LSD 5%	7.93	5.70	8.88	1.63

a-d, Values having same letter(s) in a column do not differ significantly at 5% level of probability.

period: N; 1.95 to 2.34%, P; 0.14 to 0.23%, K; 0.77 to 1.08%, Ca; 0.81 to 1.08%, Mg; 0.16 to 0.19%. The nitrogen content of the plant was at a sufficient level in all the applications except for the control according to the limit values proposed for the leaf blade by Fregoni (1984) "2.0%," and proposed by Mills and Jones (1996) "2.0 to 2.3%". Nitrogen contents were compatible according to the results of similar studies (2.93 to 3.56) (Navarro et al., 2008).

The phosphorus content of the plant was sufficient in all the applications except for the combined foliar fertilizer according to the limit value of 0.15% proposed for leaf blade by Fregoni (1984). Phosphorus contents (0.23 to 0.35%) were compatible according to the results of similar studies (Navarro et al., 2008). The potassium content of the plant was insufficient in all the applications according to the limit values proposed for the leaf blade by Fregoni (1984) "1.20 to 1.40%", by Levy "1.40%" (1970), and by Bergmann "1.20 to 1.60%" (1988). Potassium contents (0.56 to 1.35%) were compatible according to the results of similar studies (Navarro et al., 2008).

According to Fregoni (1984) and Chapmann (1965), the calcium content of the plant was insufficient in all the applications according to the limit values set for the leaf blade by Fregoni (1984) "2.5 to 3.5%", by Chapmann (1965) "1.27 to 3.19%" and Bergmann (1988) "1.00%"; on the other hand, according to Bergmann (1988), it was sufficient in the control and HG+CFF applications but insufficient in the other applications. Calcium contents (0.89 to 1.09%) were compatible according to the results of similar studies (Navarro et al., 2008). The magnesium content of the plant was insufficient in all the applications according to the limit values proposed for the leaf by Levy (1970) "0.20%", by Chapmann (1965) "0.23 to 0.29%" and by Mills and Jones (1996) "0.25 to 0.50%". Magnesium contents (0.18 to 0.29%) were compatible according to the results of similar studies (Navarro et al., 2008).

Nutritional elements such as Fe, Zn, Mn and Cu were found between 47 and 105 ppm, 17 and 60 ppm, 41and 58 ppm and 5 and 12 ppm respectively in the leaf blade in the fruit set period. When compared with the limit values of 60 to 150 ppm according to anonymous (1967), 50 to 300 ppm according to Fregoni (1984), 60 to 175 ppm according to Mills and Jones (1996), the iron content of the plant was at a sufficient level. Bitgi and I ık (1997) determined iron deficiency in 59% of the district soils in their large-scale survey that also covered the Region of Hadim Aladağ. When compared with the limit value of 35 ppm set by Alexander and Woodham (1964), zinc deficiency was determined in all the applications except for the CFF application. Bitgi and I ık (1997) determined zinc deficiency in 68% of the district soils in their large-scale survey that also covered the Region of Hadim Aladağ. When compared with the limit values as suggested by Fregoni (1984) "20 to 400 ppm" and Christensen et al. (1984) "22 ppm", manganese was found at a sufficient level in all the applications. Bitgi and I ık (1997) reported manganese deficiency in 3% of the district soils in their large-scale survey that also covered the Region of Hadim Aladağ.

Copper content was sufficient in allthe applications when compared with the limit values as suggested by Fregoni (1984) “5 to 20 ppm” and Chapmann (1965) “5 to 20 ppm”. Bitgi and I ık (1997) determined copper deficiency in 3% of the district soils in their large-scale survey that also covered the Region of Hadim Aladağ.

In conclusion, Mü küle grape, which is a white, late ripening and table grape variety, has an important market potential thanks to its leaves that are suitable for pickling. The revenue from the leaves meet the costs of labour, pesticide etc. In the this study, the applications that were performed to raise the quality of leaves for pickling did not have an effect on leaf weight and leaf volume. Humic acid increased leaf area and leaf water content values whereas herbagreen+combined foliar fertilizer increased leaf raw cellulose values. According to the results of the analysis, it was shown that the leaf blade was sufficient in N, P, Fe, Mn and Cu contents, but deficient in K, Ca, Mg and Zn. Therefore, nutritional elements that are missing in the plant need to be added.

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