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# THE INFLUENCES OF DIFFERENT SEAWEED DOSES ON TABLE QUALITY CHARACTERISTICS OF CV. TRAKYA ILKEREN (*VITIS VINIFERA* L.)

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## Abstract

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Trakya Ilkeren is an early maturing table grape cultivar for some regions of Turkey. Sometimes, quality characteristics of early maturing of table grapes, which is desired by grower can’t adequately occur. Recently, seaweed extracts have been used for different purposes in agriculture. In present study, different doses of a seaweed extract were used for enhancing table quality characteristics of cv. Trakya Ilkeren.

As a result, although different doses of seaweed extract represented varying effects on grapevine yield and table grape quality of cv. Trakya Ilkeren; 1000 and 3000 ppm seaweed treatments particularly gave the best results for the table grape quality.

*Key words: Vitis vinifera* L., table grape, seaweed, quality characteristics

## Introduction

Viticulture is an agricultural activity extensively performed in Turkey and grape is the first most important fruit crop in Turkish fresh fruit trade. Total fresh grape production of Turkey is approximately 3.923.040 tones and total planted area of grapevine is 540.000 ha (Anonymous, 2007).

Berry quality plays important role for marketing table grapes. In table grape, quality can be found out different ways such as seediness, appearance, eating quality characteristics like sweetness, firmness, texture and flavor (Clingeleffer, 1985). In our day, grapes with large and seedless berries are mostly preferable by consumers, which in some markets are more important than flavor and taste (Downing, 1994).

In commercial grape growing, quality attributes of grapes are improved using some management techniques such as girdling, topping, pinching, cluster thinning, trimming, sprinkler cooling and spraying of different growth regulators (Winkler et al., 1974).

Nowadays, there is growing interest in researching ways to improve agricultural yields in both developed and undeveloped countries. With an increasing of energy prices and an elevated awareness of environmental issues such as excessive fertilizer, herbicide, and pesticide use, it is important to improve fertilizer and chemical efficiency and to find alternative methods to improve crop yields (Metting et al., 1990).

Algae have been used for many years as a valu-

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able source of organic matter for various soil types and many different fruit and vegetable crops in especially coastal regions of world. Seaweed extracts are also used as liquid fertilizers, sprayed on various crops in today and advantageous effects of spraying seaweed extracts on crop plants have been reported (Norrie, 2008).

The algal species, most commonly used in Europe for this aim, is *Ascophyllum nodosum.* A broad range of useful effects has been observed, including increased crop yield, nutrient uptake, resistance to frost and stress conditions, crop quality, longer shelf life of fruit, improved seed germination, and reduced incidence of fungal and insect attack (Abetz, 1980; Metting et al., 1990; Jolivet et al., 1991).

More than 15 million metric tons of seaweed products are used annually as nutrient supplements and biostimulants in agriculture and horticultural crop production (Anonymous, 2006).

As a result, utilization from algae as biofertilizers seems hopeful in agriculture and treatment of seaweed extract as an organic biostimulant is fast becoming an accepted practice in horticulture (Verkleij, 1992) and also viticulture (Mancuso et al., 2006; Turan and Kose, 2004) due to its beneficial effects.

The objective of present study is to search the effects of different seaweed doses on improving of table grape quality of cv. Trakya Ilkeren

## Material and Methods

### *Vineyard site and plant material*

This study was carried out in a 13-year-old vineyard situated in a research field of Tekirdag Viticulture Research Institute, Thrace Region of Turkey (40°58' N; 27°28' E; elevation 4 m a.s.l.) during the vegetation period of 2007. In the study, cv. Trakya Ilkeren (hybrid of Alphonse Lavalleè x Perlette) that is early maturing grape cultivar was used. Grapevines were trained to a double-guyot system grafted to 5BB rootstock and spaced at 3.0 x 1.5m. During the winter pruning, all grapevines were uniformly pruned, with a bud charge of 22±2 buds per grapevine before the starting time of research. In vegetation period, standard canopy management operations were carried out including side and top trimming and suckering in vineyard.

### *Climate and soil properties of vineyard region*

In research area, the climate is generally mild and means of annual temperature, sunshine duration per day, relative humidity, total annual rainfall were respectively 15.2 °C, 84.1%, 7.0 h and 546.5 mm for 2007 year.

The soil type of vineyard is respectively clay-loamy with soil pH, total lime content and organic matter content averaging about 7.74, 7.46% and 1.16%.

### *Treatments of seaweed extract*

In this study, a liquid seaweed extract (*Ascophyllum nodosum)* that content was given in Table 1 was applied to grapevines as foliar way.

For this aim, four different doses of seaweed extract (control, 1000, 3000, 5000 ppm) based on organic matter were used for three times and sprayed at 15 days intervals (at different phonological stages of grapevine; shoots having 15-20 cm length, pre-bloom and berries having huge pea size).

### *Measurement and analysis*

At the commercial harvesting time (in early August), quality and yield components in terms of total soluble solids (TSS, °B), total acidity (expressed as tartaric acid, %), content of total phenolic compound (expressed as gallic acid, mg/100g), tannin content (mg/100g), color intensity (hunter colour L*, a*, b* values), yield per grapevine (kg), cluster weight (g), berry weight (g), 100 berry weight (g) were determined for cv. Trakya Ilkeren.

**Table 1**
**Chemical properties of liquid seaweed extract used for experiment**

| Properties | Values |
|---|---|
| Organic matter, % | 19.0 |
| Free amino acids, ppm | 20.4 |
| pH | 9.0-11.0 |

***Standard measurements***

Measurements of TSS, total acidity, yield per grapevine, cluster weight, berry weight, 100 berry weight were performed as standard procedure.

***Determination of contents of total phenolic compound and total tannin***

In order to determine contents of total phenolic compound and total tannin, it was utilized from spectrophotometric methods. The content of total phenolic compound in grapes of seaweed treated grapevines was determined according to the Folin-Ciocalteu procedure (Singleton and Rossi, 1965) and tannin contents of same samples were found out according to standard methods (Anonymous, 1990).

***Determination of color intensity***

In order to determine grape skin color data, a HunterLab DP 9000, D25 Tristimulus Colorimeter was used. Standard white plate, with reflectance values of X = 82.32, Y = 84.49, Z = 97.93 was used as reference. For this aim, grape pulps from grapevines treated with different doses of seaweed extract was placed on the light port using a 5 cm diameter plastic dish with cover. L* a* b* color parameters were recorded as L* (lightness), a* (redness) and b* (yellowness) (Ancos et al., 1999). The parameters that define the space of color, CIELab, that represent the different chromatic characteristics are; a* (red/green values), b* (yellow/blue values) and L* (lightness), from which the psychophysical parameters correlated with the perception of color by human observers are obtained.

***Experimental design and statistics***

Study was arranged in a completely randomized blocks factorial test design with 5 replicates, each consisting 3 grapevines.

All data were submitted to analysis of variance by TARIST statistical software package. In order to analyze difference between means, LSD test was applied at P<0.01.

## Results

In current research, significant differences among seaweed extract doses in terms of berry weight, total acidity and tannin content were statistically observed (P<0.01).

***Total yield per grapevine, kg***

Despite the fact that non significant differences at P>0.01 level were examined among different doses of seaweed, 1000 ppm and 3000 ppm seaweed treatments caused increases in total yield per grapevine compared to control and 5000 ppm seaweed treatment was lower than control (Figure 1).

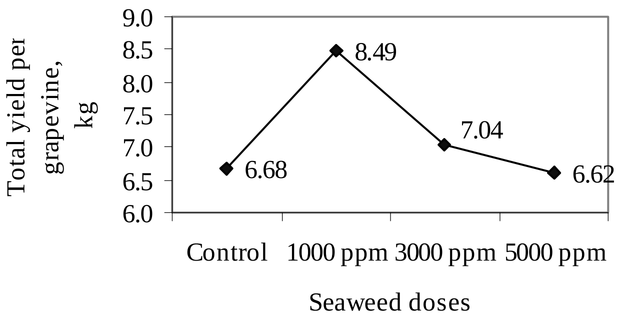


**Fig. 1. The effects of seaweed doses on total yield per grapevine (kg) of cv. Trakya Ilkeren**

***Cluster weight, g***

Cluster weights of cv. Trakya Ilkeren were affected by seaweed treatments and means of all treatments were higher than control but, these increases were not found statistically significant at P>0.01 level (Figure 2).

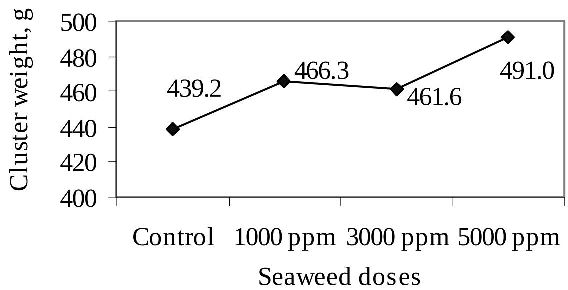


**Fig. 2. The effects of seaweed doses on cluster weight (g) of cv. Trakya Ilkeren**

***Berry weight, g***

Among the seaweed treatments, 1000 ppm led to significantly higher berry weight at $P<0.01$ level. Other treatment values were lower than control (Figure 3).

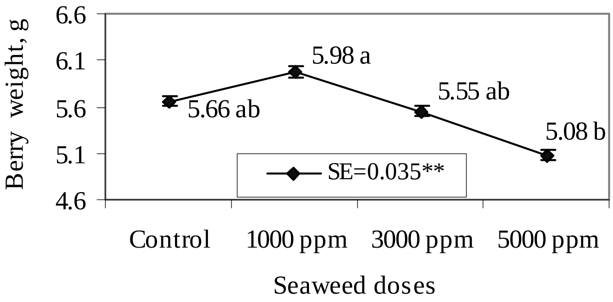


**Fig. 3. The effects of seaweed doses on berry weight (g) of cv. Trakya Ilkeren**

Vertical bars represent ±SE; $^{**}P<0.01$

***100 berry weight, g***

In terms of 100 berry weight, there were no statistically differences in means of 100 berry weight at $P>0.01$ level and higher values were respectively obtained from seaweed treatments of 1000 ppm, control, 5000 ppm and 3000 ppm (Figure 4).

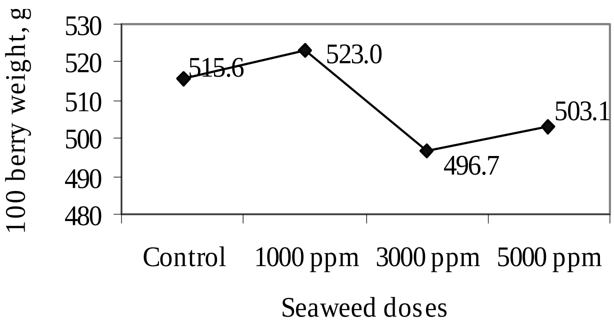


**Fig. 4. The effects of seaweed doses on 100 berry weight (g) of cv. Trakya Ilkeren**

***TSS, °B***

Despite being statistically insignificant at $P>0.01$ level, compared to treatments of 1000, 5000 ppm and control; 3000 ppm seaweed treatment resulted in the highest TSS mean as shown in Figure 5.

***Total acidity, %***

Means of total acidity were statistically found to

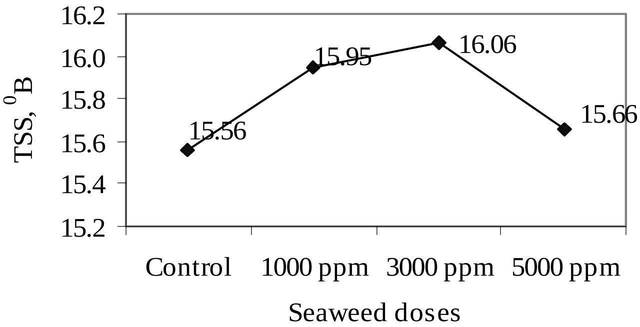


**Fig. 5. The effects of seaweed doses on TSS (°B) of cv. Trakya Ilkeren**

be significant among the treatments at $P<0.01$ level. All seaweed treatments increased total acidity than control (Figure 6).

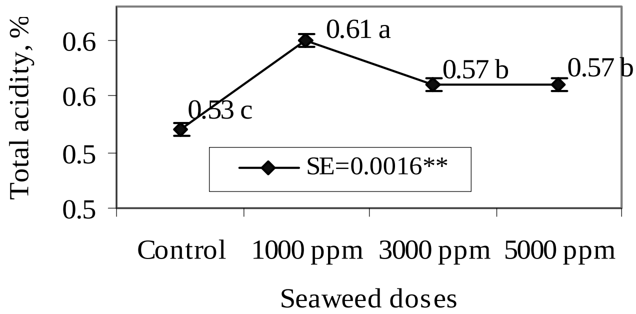


**Fig. 6. The effects of seaweed doses on total acidity (%) of cv. Trakya Ilkeren**

Vertical bars represent ±SE; $^{**}P<0.01$

***Total phenolic compound content, mg/100g***

Total phenolic compound content was affected by seaweed doses ($P>0.01$) and 1000 ppm, 3000 ppm, control, 5000 ppm seaweed treatments contributed to higher total phenolic compound content, respectively (Figure 7).

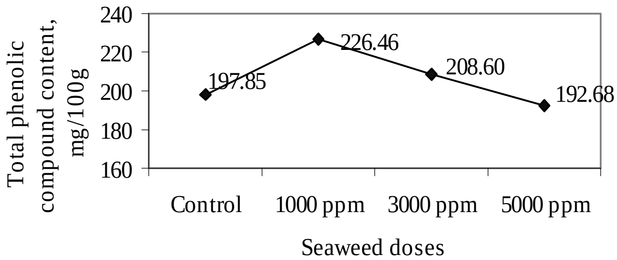


**Fig. 7. The effects of seaweed doses on total phenolic compound content (mg/100g) of cv. Trakya Ilkeren**

***Tannin content, mg/100g***

In the study, seaweed treatments statistically increased tannin content of cv. Trakya Ilkeren at P<0.01 level; the higher means were respectively obtained from 1000, 3000, 5000 ppm seaweed treatments and control (Figure 8).

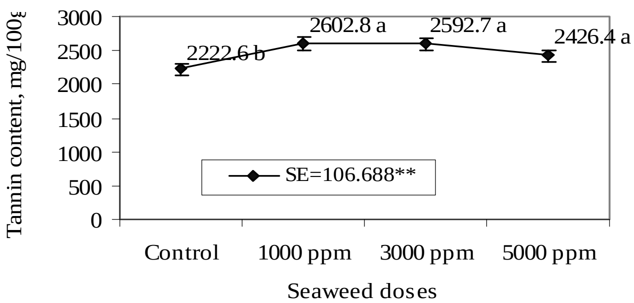


**Fig. 8. The effects of seaweed doses on tannin content (mg/100g) of cv. Trakya Ilkeren**
Vertical bars represent ±SE; **P<0.01

***Color intensity (Hunter colour L*, a*, b* values)***

Instrumental color data were provided as CIE L*a*b* scale, which define the color in a three-dimensional space as shown in Table 2. In terms of L means, higher values were respectively obtained from 3000, 5000, 1000 ppm seaweed treatments and control. With respect to a, b values, higher means were measured for 5000, 3000, control and 1000 ppm for a color scale; were also respectively obtained from 5000, 1000, 3000 ppm and control for b color scale.

**Table 2**

**Hunter colour L*, a*, b* values of cv. Trakya Ilkeren grape**

| Seaweed doses | L* | a* | b* |
|---|---|---|---|
| Control | 16.11 | 2.00 | -0.12 |
| 1000 ppm | 16.35 | 1.95 | 0.18 |
| 3000 ppm | 17.08 | 2.42 | 0.15 |
| 5000 ppm | 16.71 | 2.71 | 0.22 |

## Discussion

The using of seaweed extracts have a wide range of useful effects including increased crop growth, yield and quality and decreased incidences of pest and disease and increased resistance to environmental stress conditions (Featonby-Smith and Van Staden, 1987; Crouch, 1990).

In current study, seaweed treatments were found to be effective on grapevine yield and in enhancing table grape quality.

Confirming study results of Berlyn and Russo (1990), regarding some doses of seaweed treatments can increase crop yield in different plant species. Figure 1 shows results of yield per grapevine after seaweed treatments. Mean values were found as 8.49 kg for 1000 ppm, 7.04 kg for 3000 ppm, 6.68 kg for control and 6.62 kg for 5000 ppm. Grapevines treated with 1000 and 3000 ppm seaweed had higher total yield (P>0.01)

Although insignificant differences among the cluster weight means of cv. Trakya Ilkeren treated with different seaweed doses were statistically observed; cluster weights were affected by different ways (P>0.01). Especially, as compared with that of the control (439.2 g), higher means of cluster weight were respectively obtained from seaweed treatments of 5000 ppm (491.0 g), 1000 ppm (466.3 g), 3000 ppm (461.6 g) (Figure 2).

Berry weight and size are important quality parameters for table grapes. The mean values of berry weight in seaweed treated grapevines according to different doses are displayed in Figure 3. From the results of statistical analysis emerged, that there is a significant difference in berry weights of grapevines among the seaweed doses (P<0.01). 1000 ppm seaweed treatment significantly increased berry weight (5.98 g) compared to control (5.66 g), 3000 ppm (5.55 g) and 5000 ppm (5.08 g).

The variations in 100 berry weight of grapevines treated with different doses of seaweed are represented in Figure 4. In spite of the fact that 100 berry weights in seaweed treated grapevines were not statistically different from each other (P>0.01); higher means of 100 berry weight were respectively obtained from 1000 ppm (523.0 g), control (515.6 g), 5000 ppm (503.1 g) and 3000 ppm seaweed treatment (496.7 g).

In table grapes, TSS content of early maturing grape varieties become low. Although there were statistically non significant differences (P>0.01), TSS content in grapes of all grapevines treated with seaweed increased compared to control in the period to the end of harvest time. Data in Figure 5 revealed that TSS content of berries of grapevines treated with 3000 ppm seaweed were higher (16.06°B) than 1000 ppm (15.95°B), 5000 ppm (15.66°B) and control (15.56°B).

Grape ripening is not only determined by the rate of TSS accumulation, but also characterized by the rate of decline in organic acids. Table grapes freshly consuming require lower acidity than wine grapes and grapes to be consumed fresh should be chosen for balanced TSS and acid content. In current study, the lowest total acidity means were obtained from control (0.53%) and 3000 ppm (0.57%), 5000 ppm (0.57%) and 1000 ppm (0.61%) (P<0.01) (Figure 6).

Phenolic compounds are responsible for many important properties of grapes, especially wine grapes including wine color, bitterness, astringency and antioxidant capacity. Phenolics are viewed as a parameter beyond sugar and acid by which to judge the quality of grapes and it is widely recognized that phenolics are a fundamental component for either wine grape quality (Harbertson and Spayd, 2005) or certainly rate for table grapes for eating quality. As shown in Figure 7, total phenolic compound contents of cv. Trakya Ilkeren were not significantly affected by seaweed doses (P>0.01). In the study, 1000 ppm seaweed treatment resulted in the content of the highest total phenolic compound (226.46 mg/100g) and 3000 ppm (208.60 mg/100g), control (197.85 mg/100g) and 5000 ppm seaweed treatments (192.68 mg/100g) were respectively followed it.

Tannin plays a pivotal role on grape composition in especially wine grape quality contributes to the astringency, bitterness, color and aging potential of red wine (Glories, 1988) and certainly rate for table grapes for eating quality. In terms of tannin content in berries of seaweed treated grapevines, statistically significant variations were observed among the seaweed doses (P<0.01). Compared to the control (2222.6 mg/100g), berries of grapevines treated with various doses of seaweed extract exhibited higher tannin contents for 1000 ppm (2602.8 mg/100g), 3000 ppm (2592.7 mg/100g), 5000 ppm (2426.4 mg/100g) (Figure 8).

The L*a*b* color space is one of the most popular color space for measuring object color and is frequently utilized in virtually all fields. Instrumental color data were provided as CIE L*a*b* scale, which define the color in a three-dimensional space**.** This represents the effects of different seaweed doses on the lightness (L*), redness (a*), yellowness (b) of cv. Trakya Ilkeren. Under the light of research findings, it was seen that grapevine treated with 3000 ppm seaweed had the brightest berries (L*=17.08) than 5000 ppm (L*=16.71), 1000 ppm (L*=16.35) and control (L*=16.11). Concerning a scale means (a*), the highest values were respectively obtained from 5000 ppm (2.71), 3000 ppm (2.42), control (2.00) and 1000 ppm (1.95). Finally, effects of seaweed treatments on b scale means (b*) were 0.22 for 5000 ppm, 0.18 for 1000 ppm, 0.15 for 3000 ppm and -0.12 for control (Table 2).

## Conclusions

Nowadays, seaweed products are increasingly used in crop production and also viticulture for different purposes. Growing of early maturing table grapes is important for viticulture and sometimes these cultivars have low quality characteristics. In current study indicates that seaweed treatments can be a valid alternative to viticulture management techniques of early maturing table grapes.

However, different doses of seaweed had various effects on grapevine yield and table grape quality; 1000 and 3000 ppm seaweed treatments especially caused significant improvements for table grape quality of cv. Trakya Ilkeren.

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