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New Approaches in Viticulture: Different Rates of Net Shadow Applications to Yield, Must, Color and Wine Quality

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Abstract: This study was conducted on the Sinceri grape variety in 2023. Three applications (35%, 55% and 75% net shadows) and a control were applied in the experiment. The shading materials were covered over the vines when the grapes were at veraison. The effects of the applied net shadows on the grape yield, color parameters of the berry skin and physicochemical analyses in the must were examined. In addition, some chemical analyses [such as pH, ethyl alcohol (%), volatile acidity (mg/L), reducing sugar (g/L), density and total acidity (g/L)], secondary metabolites, color parameters and sensory analyses were performed in wines produced spontaneously by the microvinification method. In terms of the yield parameters, the 55% net shadow application provided a 61.93% increase in grape yield, 37.83% increase in cluster weight and 35.76% increase in 100-berries weight compared to the control. While the L* value and Hue angle increased, the a* value, b* value and Chroma value decreased as the proportion of shading material increased. In the must, the must yield and total acidity increased while the TSSC, maturity index and density decreased. In terms of the physicochemical wine analysis (ethyl alcohol, density, total phenolic compound and antioxidant amount) and sensory evaluations, the best result was given by 75% net shadow and, in terms of wine color parameters, by 55% net shadow application.

Keywords: vine; chroma; hue angle; ethyl alcohol; reducing sugar; phenolic compound; antioxidant; organoleptic analyses

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1. Introduction

In recent years, especially in gardens where horticultural products are grown, shading materials (nets) are used to protect the products (clusters and leaves) from the burning effects of sun and hail damage. Covers called nets or photo-selective nets have found use in grapevine seedling cultivation and vineyards.

The three most important climatic factors (temperature, light and water) have different effects on grapevines in different life stages, depending on time, place and variety. Temperature has a significant effect on bud formation, flowering and must quality. The water factor is effective on shoot growth, cluster formation and berry growth. Light plays a role in flowering, acid and sugar accumulation in the berry and has a great effect on the final stage of berry growth and shoot growth [1].

Photosynthesis is affected by the intensity, quality and duration of light exposure, and photosynthesis generally increases as the light intensity per unit leaf area increases [2]. It is reported that 150–200 W/m^2 radiant energy is required for maximum assimilation in vines and that a medium-thick vine leaf receiving direct sunlight absorbs 90–95% of the 400–700 nm wavelength sunlight coming in vertically [3].

Light intensity has an effect on the productivity of buds of grapevines, independent of temperature. It has been determined that 10 h of daily sunlight is required for sufficient productivity in the Sultani Cekirdeksiz grape variety [4].

It is reported that in grapes grown in an environment where the temperature is constant (25 °C) and the light intensity changes, cluster formation increases as the light intensity increases, although it varies according to the variety [5]. In cluster formation, temperature is the dominant factor, light has a limited effect, and a suitable combination of high temperature and high light intensity is needed [1].

It has been determined that shading with two types of plastic covers (light transmission ratio 21–30%) from mid-July to mid-September in the Riesling and Sauvignon Blanch grape varieties delays grape ripening by 1–5 weeks. No statistical difference was found in terms of ripening time and berry content in vines covered during veraison and 2 weeks before veraison. In fresh grapes, berry weight was similar in vines exposed to 100% and 30% sunlight [6].

In a study conducted in Chile, it was determined that using polyethylene covering material against pre-harvest rainfall in the Thompson Seedless grape variety reduced the rate of cracked and rotten berries in grapes in measurements taken at 30–50-day intervals during harvest and storage [7].

In a study conducted on the Cabernet Sauvignon variety, vines shaded with a three-layered cover with a transmittance of 44% and control vines were exposed to 660 nm red light under fluorescent light. It is reported that shading delays ripening, reduces the amount of sugar, phenol and anthocyanin, and increases the amount of acid [8].

In viticulture, completely covering the vines with plastic covers is performed to advance the ripening of early varieties, to delay the harvest of medium and late ripening varieties, and to protect the vines from the negative effects of climatic factors such as rain, hail, snow and storm, as well as diseases and pests [9–13].

For high-quality wines' grape production, canopy growth should be managed, and in-season management practices should be used in combination with indirect methods that influence canopy size and vigor. Managing the canopy with vine balance in mind will both create a vine microclimate and improve cluster composition.

Once the basic vineyard management techniques such as soil moisture management, nutrient management or vineyard floor management have been identified, it is possible to fine-tune the canopy management methods for the vineyard and production objectives (to achieve the right balance). It is important to remember that no combination of management techniques will provide the best balance or fruit quality in all cases. A customized plan should be developed for each vineyard [14].

The aim of this study is to determine the most optimal net shadow for growing a high-quality Sinceri grape variety for both table and wine.

2. Materials and Methods

2.1. Material

2.1.1. Characteristics of the Experimental Vineyard

The coordinates of the vineyard where the experiment was conducted are 37°57′33.5″ N latitude, 41°58′36.2″ E longitude and 1117 m altitude (Figure 1).



Figure 1. Satellite image of the experimental vineyard (Google Earth, 2023).

The monthly average highest temperature of the trial vineyard was 30.12 °C in July, while the monthly average lowest temperature was 8.16 °C in March. The minimum temperature was −0.26 °C in March, while the maximum temperature was 42.15 °C in July. The monthly average highest humidity was 65.08% in March, while the monthly average lowest humidity was 21.28% in August. The minimum humidity was 7.94% in June, while the maximum humidity was 99.76% in March.

2.1.2. General Characteristics of Plant Material

Sinceri grape variety is a white grape variety widely grown in the Southeastern Anatolia Region of Turkey. It is a local variety with short and mixed pruning, is medium late and has a variety-specific aroma grown for centuries both for table and wine.

2.1.3. Characteristics of Net Shadow Used in the Experiment

Nets made of polyethylene with 3 different shading rates (35, 55 and 75%) provided shade for the vines in the experimental vineyard on 19 June 2023 (during veraison).

2.2. Method

The grapes were harvested (on 31 August 2023) when total soluble solid contents (TSSC) reached 22% or when biotic and abiotic stress factors made harvest difficult.

2.2.1. Data Taken on Clusters and Berries

It was performed on 10 clusters randomly taken from 5 vines in each replication. Grape yield (kg/vine), number of clusters (pcs), cluster weight (g), 100-berries weight (g) and number of berries per 100 g (pcs) were given.

2.2.2. Wine Process

Grapes harvested during the maturity period for each application and replication were processed into wine separately on the same day spontaneously with the microvinification method. After the stem separation, bursting and pressing processes, the must obtained was filled to 80% in a 3 L Erlenmeyer flask, and 30 ppm SO_2 (sulfur dioxide) was added to the must and left to ferment at 18 °C (Figure 2). Temperature and density measurements were made every day that the fermentation continued. When the density value of the wines fell below 1 g/cm^3, fermentation was stopped and 3 transfers were made at 10-day intervals.

Then, after the maturation and clarification processes, the bottling process was carried out. Wine analyses were carried out approximately 3 months after the bottling process.



Figure 2. Microvinification process in laboratory conditions.

2.2.3. Analyses Made on Must and Wines

Grapes were crushed by hand, and must was extracted.

In must samples, pH [15], total soluble solid contents (TSSC) (%) [16], maturity index [17,18], must yield (%) [19], density and total acidity (g/L) [15] parameters were examined. In wines, pH [15], ethyl alcohol (% *v*/*v*) [20], volatile acid (mg/L) [15], reducing sugar (g/L) [21], density and total acidity (g/L) [15] parameters were examined. In addition, in wines, total phenolic compound (mg/mL) was determined as gallic acid at a wavelength of 760 nm (Figure 3) [22,23]. Total antioxidant (mg/mL) was determined as trolox at a wavelength of 734 nm (Figure 4) with ABTS [2,2′-Azino-bis (3-Etilbenzotiazolin-Sulfonik asit)] method [24] and at a wavelength 517 nm (Figure 5) with DPPH (1,1-Difenil-2-Pikril Hidrazil) method [25].

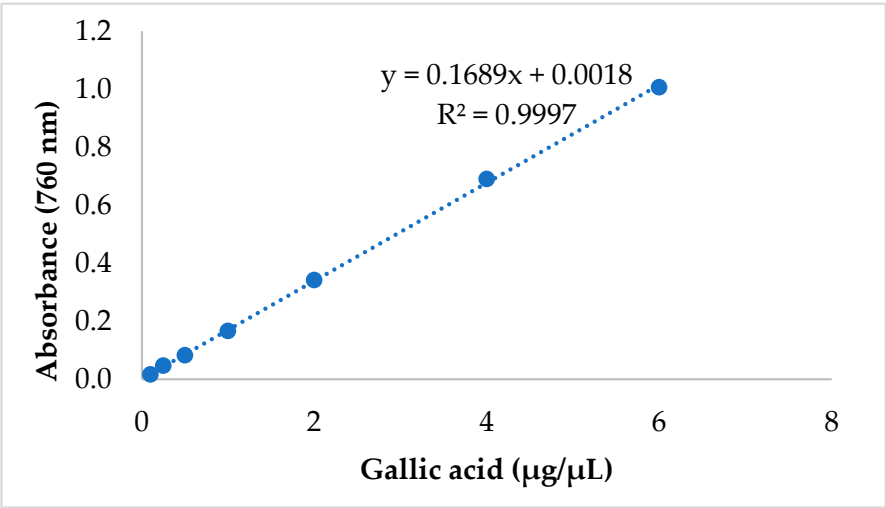

Figure 3. Gallic acid standard graph.

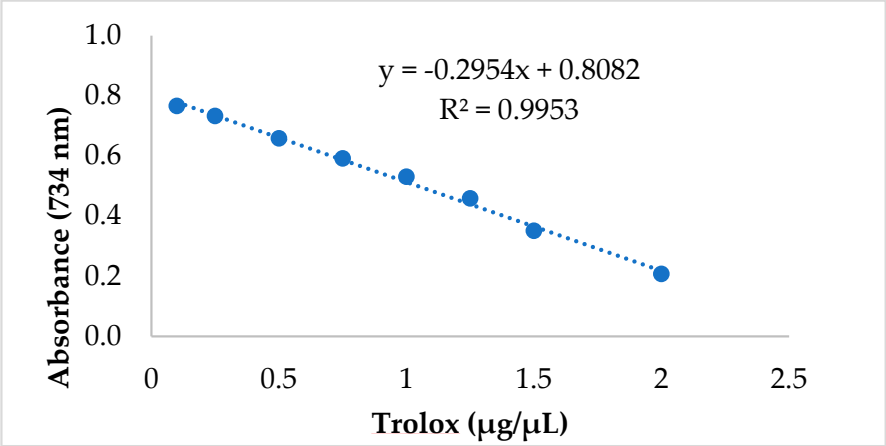

Figure 4. Trolox standard graph (ABTS method).

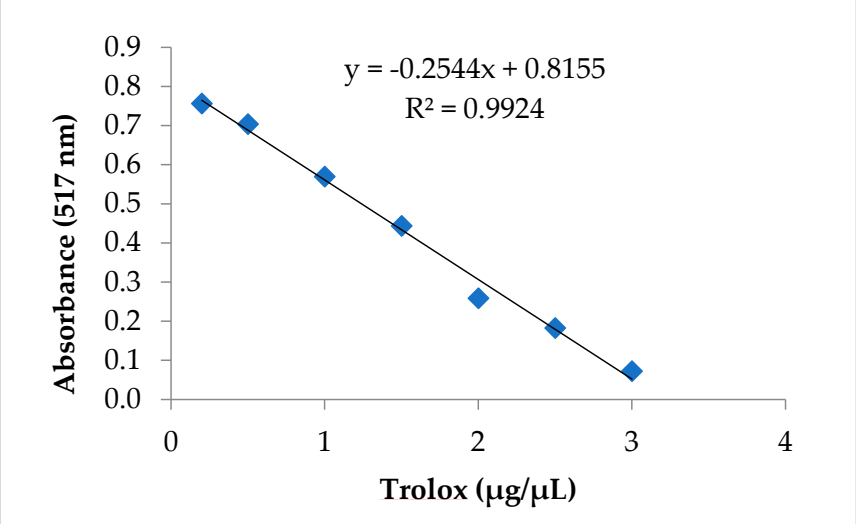

Figure 5. Trolox standard graph (DPPH method).

2.2.4. Color Determination

It was determined by measuring the values (L*, a* and b*) in both the berry skin and wine samples in the Hunter color measurement system [26]. In addition, Chroma (C*) and Hue angle (h°) were calculated using L*, a* and b* values [27].

2.2.5. Organoleptic (Sensory) Analysis

Sensory analysis of wines was performed by 13 (7 female + 6 male) panelists using the scoring method out of 20 points determined b they International Organisation of Vine and Wine (OIV) [28].

Color: 0–2 (0: bad, 2: very good);

Clarity: 0–2 (0: bad, 2: very good);

Bouquet: 0–4 (0: bad, 4: very good);

Taste and general impression: 0–12 (0: bad, 12: very good).

Here, 1–12 points represent poor-quality wines, 13–15 points represent good-quality wines, 16–18 points represent high-quality wines and 18–20 points represent excellent-quality wines.

2.2.6. Statistical Analysis

The experiment was carried out on a total of 60 vines, with 3 applications (35%, 55% and 75% shading rate polyethylene nets) and a control and 3 replications with 5 vines in each

replication, according to the randomized-plot experimental design. The data obtained from the applications were subjected to variance analysis using the SAS JMP 8 statistical software package based on "Completely Randomized Design". Differences between application groups were determined using the "LSD (Least Significant Difference) multiple comparison test" [29]. The reliability of the experiment was evaluated by calculating the coefficients of variation.

3. Results

3.1. Effects of Applications on Yield, Cluster and Berry Parameters

According to the applications, some yield parameters such as grape yield (kg/vine), the number of clusters (pcs), cluster weight (g), 100-berries weight (g) and the number of berries per 100 g (pcs) are presented in Table 1.

Table 1. Yield, cluster and berry parameters.

Application	Grape Yield (kg/vine)	Number of Clusters (pcs)	Cluster Weight (g)	100-Berries Weight (g)	Number of Berries per 100 g (pcs)
Control	3.52 ± 0.13 c	16.17 ± 0.27	231.39 ± 1.43 c	241.70 ± 18.07 b	41.82 ± 2.98 a
35% net shadow	3.79 ± 0.24 bc	17.19 ± 0.10	238.38 ± 2.37 c	253.57 ± 15.74 b	39.73 ± 2.33 a
55% net shadow	5.70 ± 0.27 a	17.18 ± 0.53	318.93 ± 3.84 a	328.13 ± 10.88 a	30.54 ± 1.00 b
75% net shadow	4.31 ± 0.13 b	17.07 ± 0.30	259.17 ± 8.80 b	307.80 ± 12.97 a	32.60 ± 1.32 b
LSD	0.655 ***	1.091	16.292 ***	47.847 **	6.741 *
VC	8.03	3.43	3.30	8.99	9.90

* $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$. VC: variation co-efficient. The differences between the averages were indicated by separate letters. ± shows the standard error.

When the yield parameters presented in Table 1 were compared according to the applications, the highest value in terms of both cluster weight and 100-berries weight and grape yield per vine was determined in the 55% net shadow application. In terms of the yield parameters, 35%, 55% and 75% net shadow applications provided, respectively, a 7.67%, 61.93% and 22.44% increase in grape yield compared to the control. Also, the 55% net shadow application provided a 37.83% increase in cluster weight and 35.76% increase in 100-berry weight compared to the control. All values except the number of clusters were found to be statistically significant.

3.2. Effects of Applications on Color Parametrers in Berry Skin

According to the applications, the color parameters in the berry skin are given in Figure 6.

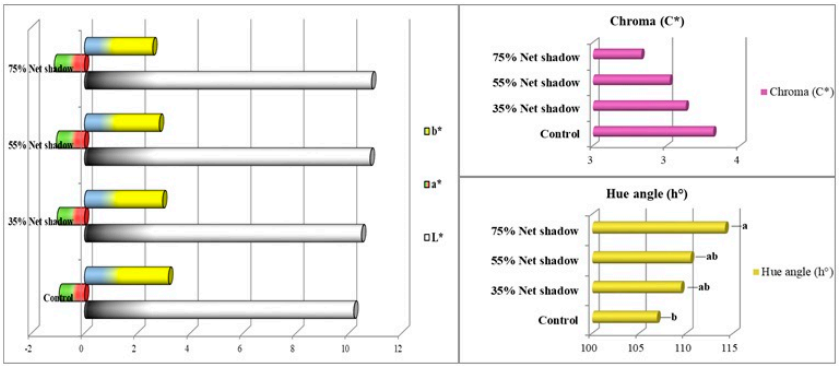

Figure 6. Effects of nets on L*, a*, b*, C* and Hue angle values in berry skin. The differences between the averages were indicated by separate letters. LSDL *: 1.689; VCL *: 8.48; LSDa ***: 0.234; VCa *: 11.87; LSDb **: 0.701; VCb *: 12.90; LSDC *: 0.663; VCC *: 11.46; LSDh°: 6.342 *; VCh°: 3.06. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$.

When the color parameters in the berry skin presented in Figure 6 are compared according to the applications, the other values except the Hue angle were not found to be statistically significant. However, the L* value expressing brightness and the a* value expressing greenness were found to be the highest in the 75% net shadow (10.85 and −1.14, respectively), and the b* value expressing yellowness was found to be the highest in the control (3.18). The C* value expressing the saturation of the color was calculated to be the highest in the control (3.32), and the Hue angle expressing the tone of color was calculated to be the highest in the 75% net shadow (114.15).

3.3. Effects of Applications on Must Parameters

Chemical analyses such as pH, TSSC (%), maturity index, must yield (%), density and total acidity (g/L) were made and calculated in accordance with the method, separately for each application. The effects of the net shadow applications on the must parameters are presented in Table 2.

Table 2. Must parameters.

Application	pH	TSSC (%)	Maturity İndex	Must Yield (%)	Density	Total Acidity (g/L)
Control	4.26 ± 0.07	24.77 ± 0.96	72.17 ± 4.20 a	75.23 ± 0.92	1.1325 ± 0.0078 a	3.44 ± 0.07 b
35% net shadow	4.19 ± 0.02	24.23 ± 1.06	69.77 ± 1.38 a	75.77 ± 1.11	1.1210 ± 0.0029 ab	3.47 ± 0.08 b
55% net shadow	4.17 ± 0.03	23.90 ± 0.15	64.10 ± 0.73 ab	76.10 ± 0.17	1.1109 ± 0.0083 b	3.73 ± 0.06 ab
75% net shadow	3.86 ± 0.35	23.67 ± 0.98	61.27 ± 2.29 b	76.33 ± 0.94	1.1081 ± 0.0020 b	3.87 ± 0.15 a
LSD	0.589	2.838	8.204 *	2.838	0.019 ***	0.321 **
VC	7.60	6.24	6.52	1.99	0.92	4.71

* $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$. VC: variation co-efficient, TSSC: total soluble solid content (%), Density: calculated by pycnometric method, Total Acidity (g/L): determined as tartaric acid. The differences between the averages were indicated by separate letters. ± shows the standard error.

When the must parameters presented in Table 2 were compared according to the applications, the highest value of pH, TSSC, maturity index and density was determined in the control application. All values except pH, TSSC and must yield were found to be statistically significant.

3.4. Effects of Applications on Wine Parameters

Some chemical analyses performed on wines such as pH, ethyl alcohol (%), volatile acidity (mg/L), reducing sugar (g/L), density and total acidity (g/L) were calculated according to the method separately for each application. The effects of the net shadow applications on wine parameters are presented in Table 3. The secondary metabolites of wines are presented in Figure 7.

Table 3. Wine parameters.

Application	pH	Ethyl Alcohol (% *v/v*)	Volatile Acid (mg/L)	Reducing Sugar (g/L)	Density	Total Acidity (g/L)
Control	4.30 ± 0.03 a	13.93 ± 0.24 ab	0.12 ± 0.01	3.80 ± 0.40 a	0.9926 ± 0.0004 b	7.05 ± 0.10 a
35% net shadow	4.24 ± 0.02 ab	13.27 ± 0.47 b	0.10 ± 0.00	0.73 ± 0.26 b	0.9914 ± 0.0003 b	7.43 ± 0.07 a
55% net shadow	4.08 ± 0.02 c	13.80 ± 0.31 ab	0.13 ± 0.02	1.20 ± 0.21 b	0.9920 ± 0.0003 b	6.02 ± 0.08 b
75% net shadow	4.18 ± 0.02 b	14.40 ± 0.32 a	0.12 ± 0.01	3.20 ± 0.17 a	0.9946 ± 0.0006 a	6.41 ± 0.25 b
LSD	0.064 ***	1.124 *	0.045	0.900 ***	0.001 ***	0.475 **
VC	0.81	4.31	20.10	21.40	0.08	3.75

* $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$. VC: variation co-efficient, Volatile Acid (mg/L): determined as sulfuric acid, Density: calculated by pycnometric method, Total Acidity (g/L): determined as tartaric acid. The differences between the averages were indicated by separate letters. ± shows the standard error.

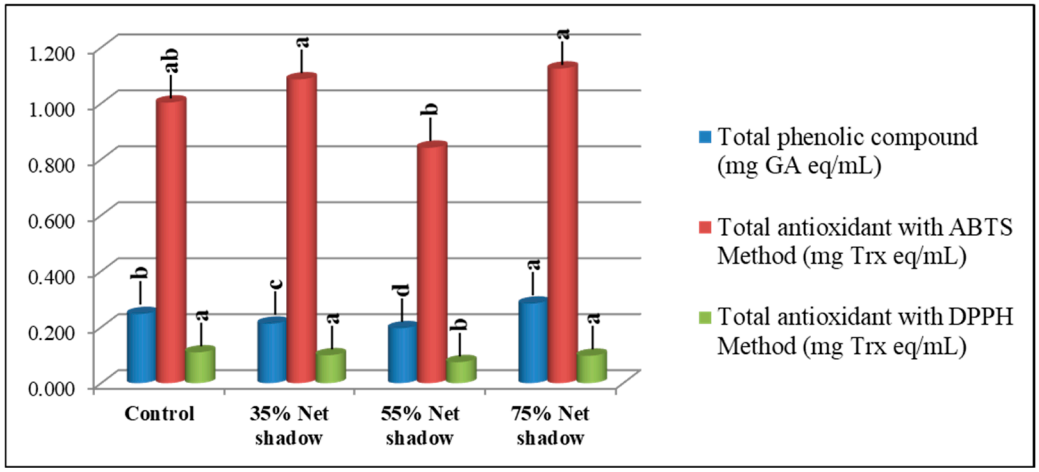

Figure 7. Effects of net shadows on total phenolic compound and total antioxidant amounts in wine. The differences between the averages were indicated by separate letters. LSDtotal phenolic compound: 0.009 ***; VCtotal phenolic compound: 2.03; LSDtotal antioxidant with ABTS Method: 0.171 **; VCtotal antioxidant with ABTS Method: 8.94; LSDTotal Antioxidant with DPPH Method: 0.018 *; VCTotal Antioxidant with DPPH Method: 9.80. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$.

When the wine parameters presented in Table 3 were compared according to the applications, the highest value in terms of both ethyl alcohol and density was determined in the 75% net shadow application. All values except the volatile acid were found to be statistically significant.

When total phenolic compound and total antioxidant amounts in wine presented in Figure 6 are compared according to the applications, all values were found to be statistically significant. The highest total phenolic compound and total antioxidant amounts (with ABTS method) were determined in the 75% net shadow (0.284 mg/mL; 1.125 mg/mL, respectively). The highest total antioxidant amount (with DPPH method) was determined in the control (0.110 mg/mL).

3.5. Effects of Applications on Color Parametrers in Wine

According to the applications, the color parameters in wine are given in Figure 8.

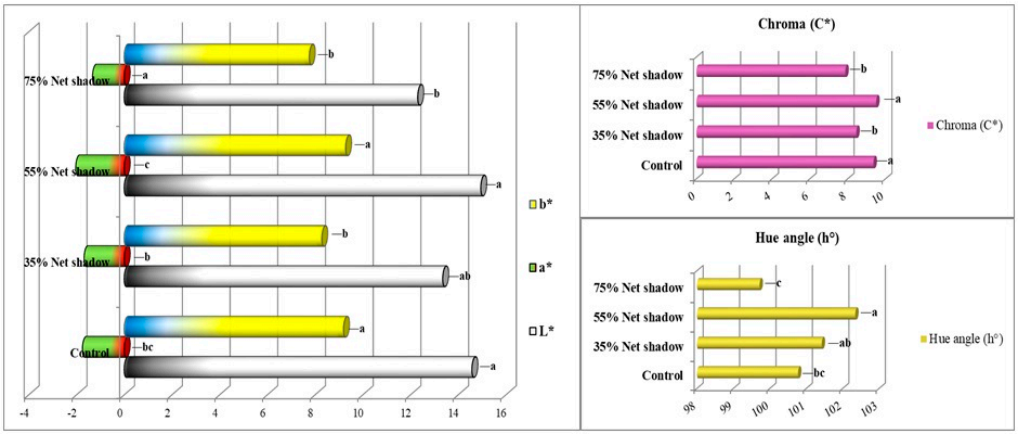

Figure 8. Effects of net shadows on L*, a*, b*, C* and Hue angle values in wine. The differences between the averages were indicated by separate letters. Lines on columns were standard deviations. LSDL *: 1.857 *; VCL *: 7.15; LSDa *: 0.283 ***; VCa *: 8.85; LSDb *: 0.677 **; VCb *: 4.17; LSDC *: 0.704 **; VCC *: 4.25; LSDh°: 1.363; VC h°: 0.72. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$.

When the color parameters in the wine presented in Figure 8 are compared according to the applications, all values were found to be statistically significant. The L* value expressing

brightness, the a* value expressing greenness and the b* value expressing yellowness were found to be the highest in the 55% net shadow (14.95, −2.03 and 9.50, respectively). The C* value expressing the saturation of the color and the Hue angle expressing the tone of color were calculated to be the highest in the 55% net shadow (9.50 and 102.35, respectively).

3.6. Effects of Applications on Organoleptic Analysis in Wine

According to the applications, the sensory parameters in wine are given in Figure 9.

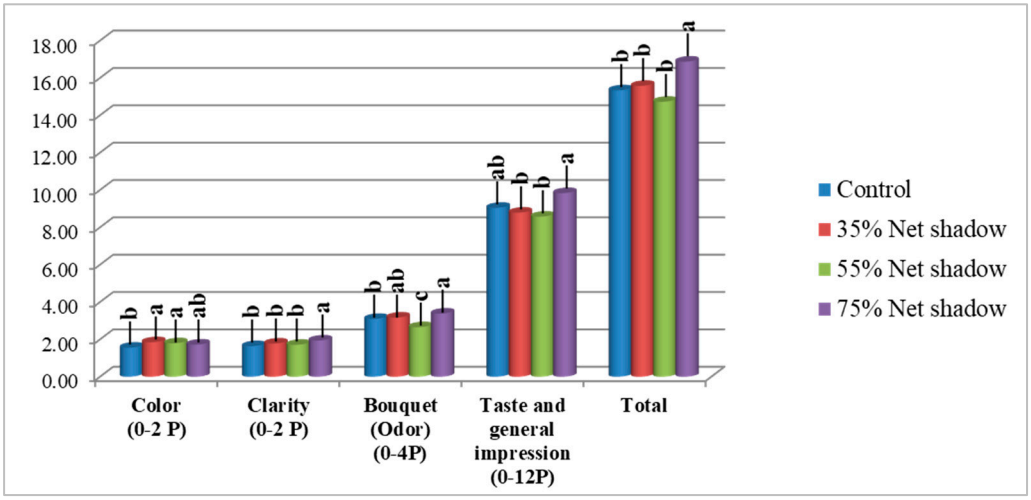

Figure 9. Effects of net shadows on organoleptic (sensory) analysis of wines. The differences between the averages were indicated by separate letters. LSDColor: 0.230 *; VCColor: 7.06; LSDClarity: 0.151 **; VCClarity: 4.55; LSDBouquet: 0.263 ***; VCBouquet: 4.54; LSDTaste and general impression: 0.899 *; VCTaste and general impression: 5.27; LSDTotal: 1.025 **; VCTotal: 3.48. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$.

When the organoleptic analyses in the wine presented in Figure 9 are compared according to the applications, all values were found to be statistically significant. The highest color score was obtained from wines with the 35% net shadow (1.85 points), while the highest score in terms of clarity, bouquet, taste and general impression was obtained from wines with the 75% net shadow (1.94, 3.38 and 9.83 points, respectively). According to the total score, the highest value was obtained from wines obtained with 75% net shadow application (16.87 points).

4. Discussion

4.1. Effects on Yield, Cluster and Berry Parameters

Kısaca and Gazioglu Şensoy [30] determined the 100-berries weight of the Sinceri grape variety as 241 g in their study. In another study conducted on the Sinceri grape variety, grape yield was determined as 6.60 kg/vine, cluster weight as 323.05 g and 100-berries weight as 278 g [31]. Koç [32], in his study, which was conducted to determine the ampelographic characteristics of local grape varieties in Muş province, determined the cluster weight of Sinceri grape variety as 138.77 g, berries weight as 7.9 g and grape yield as 5.16 kg/vine. Ünal and Yurtgül [33] reported the 100-berries weight of the Sinceri grape variety as 310 g in their study conducted in the Güçlükonak/Şırnak region. As can be seen, when comparing both the previous studies conducted with the same variety and these previous studies with the control values of our study, quite different results were obtained in terms of yield parameters. This shows that grape varieties grown in different ecologies differ according to climate conditions, soil properties and vineyard management practices.

4.2. Effects on Color Parametrers in Berry Skin

The L* value indicates brightness (between 0 and 100; approaching 100 indicates that the color becomes whiter, that is, the brightness increases, and approaching 0 indicates that the black color increases); the a* value indicates green–red colors (between +60 and –60; increasing + values indicates that the red color increases, and increasing–values indicates that the green color increases); the b* value indicates blue–yellow colors (between +60 and –60; increasing + values indicates that the yellow color increases, and increasing–values indicates that the blue color increases) [34]. In the CIE L* a* b* scale, the Chroma value (C*) expresses the saturation of the color (0° = matte, 60° = saturated), and the Hue value (h°) is the angle coordinate [27].

In a study investigating berry skin color in the Narince grape variety, which has similar characteristics with the Sinceri grape, it was determined that the L* value varied between 33,3 and 37.41; the a* value between −5.01 and −1.57; and the b* value between 12.13 and 13.91 [35].

In the study conducted on the Sultani Cekirdeksiz grape variety in the Denizli province, it was determined that the L* value, which is a brightness indicator in terms of grain color parameters, was highest in the second treatment, the most dominant green color was in the third treatment and the yellowish green color was in the control group. They also determined that the Chroma (C*) value was higher in the control [36].

It can be seen that as the rates of net shadow increases, the brightness and greenness of the berry skin increase and the yellowness decreases.

The color of grapes is one of the main quality indicators, which significantly affects the selection process and commercial value of the product due to their visual appearance. Therefore, clusters with intense and uniform colors are more accepted in the market [37,38].

4.3. Effects on Must Parameters

Anthocyanin accumulation in berries is started during veraison. When several physiological processes take place, the berries begin to soften and change color, and the total soluble solids content begins to increase [39].

In a study conducted on the Sinceri grape varieties, total acidity was determined 1.38%; TSSC as 19.20%; pH as 4.08; maturity index as 14.24 [30]. In another study on Sinceri grapes, pH was determined as 4.59; total acidity as 5.03 g/L; TSSC as 18.85% [31]. Ünal and Yurtgül [33] reported in their ampelographic study of the Sinceri grape variety the must yield as 54.2%; TSSC as 19.80; total acidity as 5 g/L; pH as 4.10; maturity index as 29.30. In terms of wort parameters, pH values obtained in this study showed similar results with previous studies. However, since the grapes in this study were harvested when they reached wine quality, parameters such as TSSC, maturity index and total acidity were different from the results obtained in other studies.

4.4. Effects on Wine Parameters

The total acidity of the wine should be at least 3.5 g/L in terms of tartaric acid, and the amount of reducing sugar should be at most 4 g/L in dry wines [40]. When yeasts have suitable conditions, they can continue their activities in wines containing sugar and cause spoilage in wines [41]. When the alcohol levels and reducing sugar levels in the study are examined, it is seen that fermentation is completed in all applications, and they are included in the scope of dry wines.

Alcohol is one of the important components affecting the characteristic taste and smell of wines [42]. It has been stated that the amount of alcohol in wines depends on the amount of sugar, that the amount of alcohol can vary between 8 and 17% by volume, that this rate varies between 11 and 14% in red wines and that the amount of alcohol in wines

should not be below 10% in terms of durability [15]. According to Turkish Food Codex Wine Communique, the alcohol content by the volume of wine should be at least 9% and at most 15% [40]. In a study conducted on the Emir variety, the ethyl alcohol content in spontaneously produced wines was found to be 10.87% [43]. Bozoğlu [44] determined the density of white wines obtained from İznik grapes to be between 0.9919–0.9891 g/mL. The alcohol content and density of the wines produced in the study are in accordance with the literature data. Recamales et al. [45] studied wines obtained from the "Zalema" white grape variety grown in the southwest of Spain and reported pH to be 3.06; density 0.9906 g/cm^3; ethanol 11.1% *v*/*v*; reducing sugars 1.0 g/L. They reported total acidity as 5.2 g tartaric acid/L and volatile acidity as 0.23 g acetic acid/L.

Phenolic compounds are the most complex chemical structures found in grapes. Plants produce many different organic compounds as long as they continue their vital activities. These are secondary metabolites and secondary products [46]. The amount of phenolic compounds in grapes varies according to variety, maturity, environmental factors (climate, soil, etc.) and cultural treatments [47].

Phenolic compounds found in grapes and wines can be grouped under four categories: phenolic acids, flavonoids, anthocyanins and tannins. Red varieties contain more phenolic compounds than white varieties [48]. The main reason for this is thought to be the contribution of anthocyanins to the total amount of phenolic compounds [49].

Soleas et al. [50] stated that the total phenolic compound content in white wines varies between 50 and 2000 mg/L in terms of gallic acid. Şen and Tokatli [51] determined in their study that the total phenolic compound amount in Narince wines varies between 236 and 416 mg/L. Chircu Brad et al. [52] determined that the total phenolic compound amount in wines produced from the Chardonay grape variety was between 307.21 and 454.13 mg GAE/L. In another study, the total phenolic compound amount in Muscatel wines was determined as 1090 mg GAE/L on average [53].

In the study, it was determined that the total phenolic compound amount investigated in the wines was consistent with some of the literature but different from some other literature findings. It was also seen that the amount of phenolic compounds increased as the rates of the net shadow increased. It is thought that the reason for this is due to the "terroir". In other words, it is due to the fact that the grape acquires different characteristics according to the soil structure, topographic features, the level of exposure to sunlight and the water–soil relationship in the region where it is grown. For this reason, if the same grape variety is grown in different regions or in the same region but under different net shadows, the wines produced will be different from each other.

4.5. Effects on Color Parametrers in Wine

Color can indicate to some extent the quality of the food, and the expected aroma and taste, and can even influence the acceptance and preference of the food [54]. Similarly, wine color is an important aspect of wine quality and roughly refers to information such as year, variety, region and even possible defects throughout the production, aging and storage periods [55].

Recamales et al. [45] stored the wines obtained from the "Zalema" white grape variety for 12 months and examined the color parameters every two months. They reported that increases in Chroma and decreases in Hue angle are characteristic changes in wines during storage, with a* values showing a decrease from 0.86 at the beginning to −1.47, while b* values remained constant until the 10th month, resulting in a change in the color of the wine from pale yellow to yellow-brown.

4.6. Effects on Organoleptic Analysis in Wine

Wine tasting usually follows the typical sequence of viewing, smelling and tasting to determine in detail various general aspects and levels of a wine product. Systematic wine sensory analysis procedures usually start with the evaluation of color and other visual characteristics such as transparency, clarity and brightness [56]. Thus, it is evident that wine color can provide the most direct and intuitive first sensory impression and, in particular, influence preliminary and initial predictions about the style and quality of the wine product [57]. Moreover, wine color strongly indicates the type of wine, which is inextricably related to related aroma descriptors. For example, red wine is often described as having aromas of black currant, blueberry and other ripe black fruits; rose wine is associated with the aroma of strawberry and rose flower; and white wine offers notes of honey, white flower, peach, pear and other white fruits. Even under certain experimental conditions, stained white wines were blended with red wines and associated with odor descriptors that identify the type of red wine [58]. Consequently, wine color can set expectations for tasters and even signal descriptions of wine aroma, flavor and overall quality and influence their preferences and acceptability [59,60]. In other words, a negative initial judgment based on the visual perception of the wine product is difficult to balance with subsequent positive aromas and flavors [61]. Therefore, a systematic and scientific assessment of wine color is crucial, especially considering the important role and profound influence of visual perception on the overall perceived quality of the wine product [60].

The sensory analysis of wines was performed using the scoring method out of 20 points determined by International Organisation of Vine and Wine [28]. Here, 1–12 points represent poor-quality wines, 13–15 points represent good-quality wines, 16–18 points represent high-quality wines and 18–20 points represent excellent-quality wines.

When evaluated according to the total score, wines with control (15.34 points) and 55% net shadow (14.72 points) were included in the "good-quality wines" category, while wines with 35% net shadow (15.58 points) and 75% net shadow (16.87 points) were included in the "high-quality wines" category.

5. Conclusions

In premium wine grape cultivation, the management of vine growth under shade material is one of the important factors affecting the vitality of the vine and should be used together with other cultural methods. Managing net shadow rates with vine balance in mind will improve both the microclimate in the cluster zone and the shoot and leaf development.

Once the basic vineyard management techniques, such as soil moisture management, nutrient management or vine base management, have been determined, the net shadow rates need to be fine-tuned to achieve the right balance for your production goals.

The fact that the grapes obtained from control vines and the wines produced from these grapes are generally not of good quality shows that the Sinceri variety is sensitive to excessive exposure to sunlight. Therefore, cultivation under a net shadow is ideal in terms of both yield and quality criteria. When all the results obtained in the study are evaluated, it is concluded that the application of 55% net shadow is the best application.

It is important to remember that no combination of management techniques will provide the best balance or fruit quality in every situation. A customized plan needs to be developed for each vineyard. When all the results obtained in the study are evaluated, it was concluded that the best application was the 55% net shadow application.

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