J. Agr. Sci. Tech. (2016) Vol. 18: 245-254

Effects of Shading and Covering on 'Sultana Seedless' Grape Quality and Storability

F. Sen[1*], R. E. Oksar[1], and M. Kesgin[2]

ABSTRACT

This study aimed to determine the effects of different shading ratio and covers on "Sultana Seedless" table grape quality and storability. Grapevines were covered at the veraison stage with 3 shading nets (0, 35, and 75% shading), which were then replaced with covering materials including Polypropylene Cross-stitch (PC), Life Pack (LP) and Mogul (MG), just before harvest. Harvested grapes in all treatments were then kept for 90 days under cold storage (-0.5°C). Postharvest decay development and decreases in sensory quality were observed in unshaded grapes and in those covered with 35% shading net and later covered with life pack. Total soluble solids content, maturity index, and color value (C* and h°) were found lower in 75% shaded grapes compared to unshaded plots. Effects of the tested applications on quality attributes either decreased or vanished during storage. All tested cover materials following shading nets could delay harvest for 50 days. Consequently, in addition to delaying harvest time, PC or MG covers used after 35 % shading allowed higher quality and successful storage of grapes for an additional 90 days.

Keywords: Late harvest, On-vine storage, Photon flux density, Post-harvest decay, Shading nets.

[DOR: 20.1001.1.16807073.2016.18.1.13.1]

INTRODUCTION

Turkey has a grape production of 4,687,922 tons, and ranks the 6th in world grape production (Anonymous, 2014). Grape became the leader in Turkish fruit exportation with 239577 tons in 2011. The Aegean Region ranks the first in grape production and exportation. Within all the exported table grapes cultivars, "Sultana Seedless" is the most important one with 98% share and mostly exported to Russian Federation, followed by Germany and Ukraine (Anonymous, 2011).

In the Aegean Region (western Turkey), *Vitis vinifera* L. *cv*. "Sultana Seedless" (Sultani Çekirdeksiz) variety is being widely cultivated for both fresh and dried production. Sultana Seedless table grape prices rise starting mid-September. Thus, there is a need for supplying "Sultana Seedless" grapes for longer periods both for the export and domestic markets. Harvest can be delayed if grapes are stored on-vine or under cold conditions. Since total capacity of storage rooms are rather limited, excessive amounts of grape cannot be stored under cold conditions. On-vine storage seems to be the most convenient solution. In practicing on-vine storage, climatic and pathological problems may affect storage life, and as a result grape quality may decrease.

Different cover materials and shading nets are widely used in agriculture (Novello and de Palma, 2008). Cover materials are practically used in grape production in order to have an early or late harvesting, rain, hail, snow, and storm protection, and to avoid negative effects of pests and diseases in many countries such as Japan, Thailand, Australia, Chile, USA and Turkey (Ergenoğlu *et al*., 1999; Shrestha *et al.,*

[1] Department of Horticulture, Faculty of Agriculture, Ege University, 35100 İzmir, Turkey.
[2] Manisa Viticulture Research Station, 12 Manisa, Turkey.
*Corresponding author; e-mail: fsenmacar@gmail.com

2000; Kara and Çoban, 2002). Covering grapevines with polypropylene cross-stitch materials to delay harvest is becoming increasingly common in the Aegean Region.

Light influences the growth and composition of a wide variety of fruit, including grapes (Shakak *et al.,* 2004). It has been indicated that the main factor affecting grape quality after veraison is the light conditions (Keller *et al.,* 1998). Shading applications affect ripening period, fruit maturation, and grape quality since reduced light delays fruit maturation (Smart *et al.,* 1988). Artificial shading influences sugar and organic acid concentrations of grapes, as well (Kliewer and Antcliff, 1970; Chorti *et al.,* 2010). It is also reported that shading treatment that reduces the exposure, delays fruit ripening 1 to 5 weeks (Kliewer *et al.,* 1967). Postharvest grape deterioration can be due to physical, physiological, or pathological factors that may occur in the vineyard (pre-harvest) or after harvest (Zoffoli *et al.,* 2009; Crisosto and Mitchell, 2002). Deterioration of grapes during storage is characterized by weight loss, stem browning, softening, shattering and fruit decay (Crisosto *et al.,* 2001; Carvajal-Millan *et al.,* 2001; Crisosto and Mitchell, 2002). There are different covering materials used by producers, however, their effects on grape quality and storage life or impact of different materials are not well known. Producers use covering materials to extend harvest time just before harvest maturity. However, there is insufficient data related to the effects of nets with different shading ratios in combination with covering materials on grape quality and storage life.

The main objective in covering practice is to extend the market period of table Sultana grapes through delaying harvest followed by proper storage. In this research, combined effects of using nets with different shading ratios and covering materials on "Sultana Seedless" grape quality under delayed harvest conditions and during storage period were analyzed.

MATERIALS AND METHODS

Plant Material

This study was conducted on 14-years old vineyard, *Vitis vinifera* L. *cv*. "Sultana Seedless" (seedless grapes), of Manisa Viticulture Research Station in Manisa province of Turkey. The vineyard was established in 2000 on 41B rootstocks with a planting distance of 3.0×2.0 m, and trained on double "Ŧ" trellis system and irrigated by drip irrigation. The recommended table grape management practices developed by Manisa Viticulture Research Institute were applied in all plots.

Shading Nets and Covering Material

Vines were initially covered with shading nets possessing shading ratios 35% (S35) and 75% (S75), at veraison period (13 June, 2012). Polypropylene Cross-stitch (PC), Life Pack (LP), and Mogul (MG) covering materials replaced nets before harvest maturity (28 August 2012). PC, a white fabric covering material, is composed of polypropylene. LP consists of three layers (30 g m^{-1} spunbond+20 mc breathable layer+15 g m^{-1} spunbond) and is water resistant, with an 8% UV additive top layer. MG is a white, 30 g m^{-2}, 0.28 mm thick material, with air permeability of 145 cm^3/sn.cm^2, light transmittance of 70 and 3% UV additive polypropylene. Treatments that were covered with a cover material but without shading nets were considered as the control groups. Inverted "U" type bended anchors (attached to trellis) were used for attaching shading nets and covering materials. Vines were covered with shading nets and covering materials along the rows. Temperature, relative humidity (Hobo U12-013, Onset, USA) and photon flux density (SP 110 pyranometer, Apogee Instruments, Inc., Utah, USA) were measured under nets with data loggers (Figure 1).

[DOR: 20.1001.1.16807073.2016.18.1.13.1]

Sampling and Storage Conditions

Grapes on vines covered with shading nets and/or covering materials were harvested on 18 October, 2012. Grape clusters (total weight of about 5 kg) were put into 30×40×15 cm PolyEthylene (PE) bags placed in boxes. Those boxes were taken into pre-cooling (-0.5°C, 95% RH) for 24 hours and prepared for storage. Dual system SO_2-generating pads (Fresca, Quimetal, Santiago, Chile) were used as 1.2-1.4 g kg^{-1} $Na_2S_2O_5$ according to the supplier's recommendations. SO_2 generation inside the polyethylene bag was fast at the initial stage and then the release rate slowed down and became constant. Grapes were kept for 90 days in storage at -0.5°C and 90% RH. Samples were taken before storage, and on 60th and 90th days. Every box was accepted as a replication during storage.

Decay Development

Distribution of the decays on grape clusters was determined according as to Anonymous (1996) and decay agents were identified at the Department of Plant Protection, Faculty of Agriculture, Ege University.

Quality Attributes

Berry removal force was measured with a penetrometer (Somyf tec, France) on 25 berries taken randomly from different bunches of the replications. The external color was measured at the equatorial level on both sides of the berry, using a colorimeter (CR-300, Minolta Co Osaka, Japan), and average scores were recorded in terms of CIE-L^* a^* b^* values. C^* (chroma) and h^o (hue angle) were calculated by using the following equation: $C^*= (a^{*2}+b^{*2})^{1/2}$, $h^o= arctan\ (b^*/a^*)$. The color of 25 berries was measured for each replication. The Total Soluble Solids (TSS) content of the juice was determined with a digital refractometer (PR-1, Atago, Tokyo, Japan) and expressed as percentage. Titratable Acidity (TA) was measured by titration with 0.1M NaOH to pH 8.1, the results expressed as g tartaric acid 100 mL^{-1} fruit juice. The maturity index was calculated in all samples as the TSS/TA ratio (Karaçalı, 2009).

Sensory Analyses

Eight panelists trained in discriminative evaluation of table grapes conducted the sensory analysis. SO_2 taste and odor were evaluated on a three-point scale (1: None; 2:

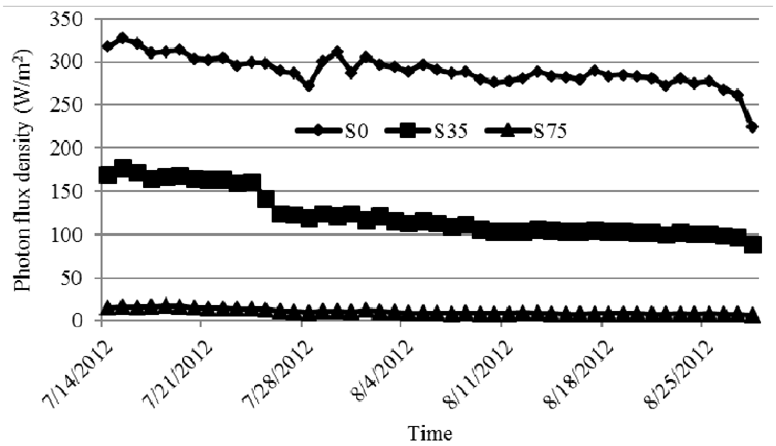

Figure 1. Photon flux density as affected by different shading ratios. Shading ratios: S0= 0%; S35= 35%, S75= 75%.

Moderate, 3: Severe). Visual appearance, flavor, and crunchiness of grapes were evaluated on a nine-point scale (1: Extremely poor or soft in case of texture; 3: Poor or soft; 5: Moderate and limit of marketability; 7: Good, 9: Excellent) according to Artés-Hernandez *et al.* (2004). Rachis condition was then rated according to Crisosto and Mitchell (2002), as follows: (1) Healthy= Entire stem including the pedicels green and healthy, (2) Slight= Stem in good condition, but noticeable browning of pedicels, (3) Moderate= Browning of pedicels and secondary stem, or (4) Severe= Pedicels, secondary, and primary stem completely brown.

Statistical Analysis

The study was planned as randomized split plot design with 3 replications and 6 vines per parcel. All data were subjected to Analyses Of Variance (ANOVA) by using IBM® SPSS® Statistics 19 statistical software (IBM, NY, USA). Significant differences between the means for each storage period were determined by Duncan's multiple range tests at $P< 0.05$. Standard Deviation of the mean (SD) was also calculated from the replicates.

RESULTS AND DISCUSSION

Grapes on vines that received no covering matured (17-18% TSS) on September 1, whereas, those with 35% shading reached maturity 7 days later and those with 75% shading 21 days later. Vines covered with shading nets and/or covering materials were harvested nearly 50 days after (18 October, 2012) compared to those maturing under open conditions.

Decay Development

There was no decay incidence in all treatments after 60 days of storage. At the end of 90 days, decay development and stem browning occurred in unshaded and S35+LP treatments. In unshaded (S0) treatments, decay incidence was found as 60, 70, and 60% with PC, LP and MG covering materials, respectively. In S35+LP treatment, decay incidence was found as 55%. The rate of decay was moderate to high levels on bunches. In these treatments, grapes sampled at 90 days were not analyzed since they had lost marketability. *Botrytis cinerea* was found as the main causal agent of decay. For preventing decay development, sulfur dioxide pads, pre-harvest cultural treatments especially in respect to plant protection, care at harvest and packaging, pre-cooling and convenient storage conditions are known to be effective (Snowdon, 1990; Crisosto and Mitchell, 2002; Crisosto and Smilanick, 2004). These parameters directly affected decay development during storage of grapes.

Quality Attributes

Since the berry removal force indicates the bonding force of the berry to the bunch, it is closely related to fruit abscission. Effects of tested shading ratios and cover materials on removal force of a grape berry from the pedicle were found significant after the harvest ($P< 0.05$), but such an effect disappeared with the progression of the storage period (60^{th} and 90^{th} day). Fruit removal force was higher in S75-treated grapes berries than S0-treated ones. Such a difference also decreased with the progression of storage period, therefore, effect of shading on fruit removal force from the pedicle was limited and removal forces varied between 1.67-1.98 N (Figure 2). In general, berry removal force decreased at different rates in all treatments at the end of the storage period compared to initial values. Higher removal forces in shaded grapes comply with the ripening-retarding effect of shading. A decrease usually is observed in fruit removal force from the pedicle with the aging of grape bunches (Crisosto *et al.,* 2001).

[DOR: 20.1001.1.16807073.2016.18.1.13.1]

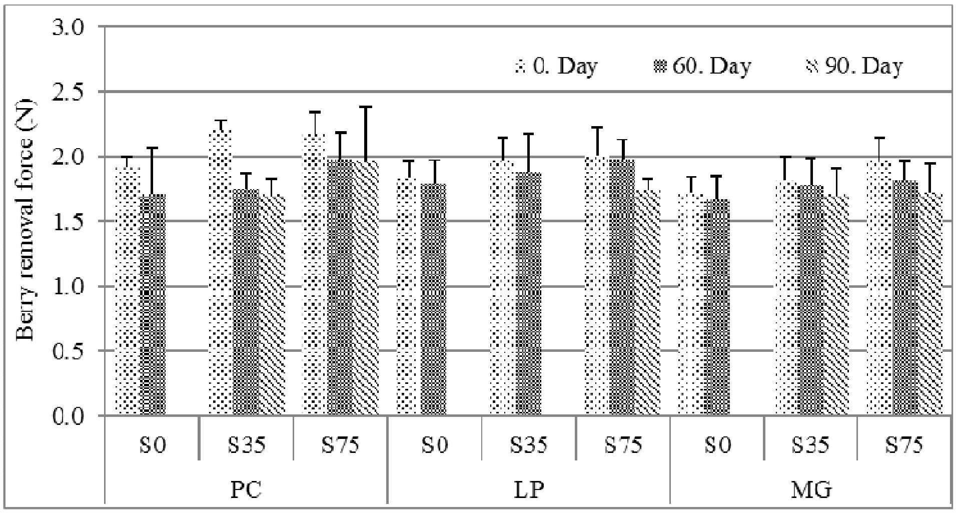

Figure 2. Effects of different shading ratios and covering materials on berry removal force of grapes during storage. PC: Polypropylene Cross-stitch; LP: Life Pack; MG: Mogul; Shading ratios: S0-= 0%; S35= 35%, S75= 75%.

Effects of shading ratios and cover materials on color parameters (C* and h°) of grape berries during the storage period is presented in Figure 3. Significant post-harvest increases were observed in *C** values of grapes with increasing shading ratios ($P< 0.01$). However, effects of treatments on *C** at the end of 60- and 90-day storage periods were similar to each other. During the storage period, while there was a significant decrease in *C** values of S75 treatments, there were limited changes in other treatments. Increasing shading ratios also yielded significant increases in h^o values of the grapes at harvest and at the end of 60 days storage period ($P< 0.05$). Such increases were especially distinctive in LP-covered treatments. However, there was a general decrease in h^o values of grapes during the storage period. Higher h^o values of 75% shaded grapes compared to the un-shaded ones were considered as the indication of more dominant green color of the berry. Such a

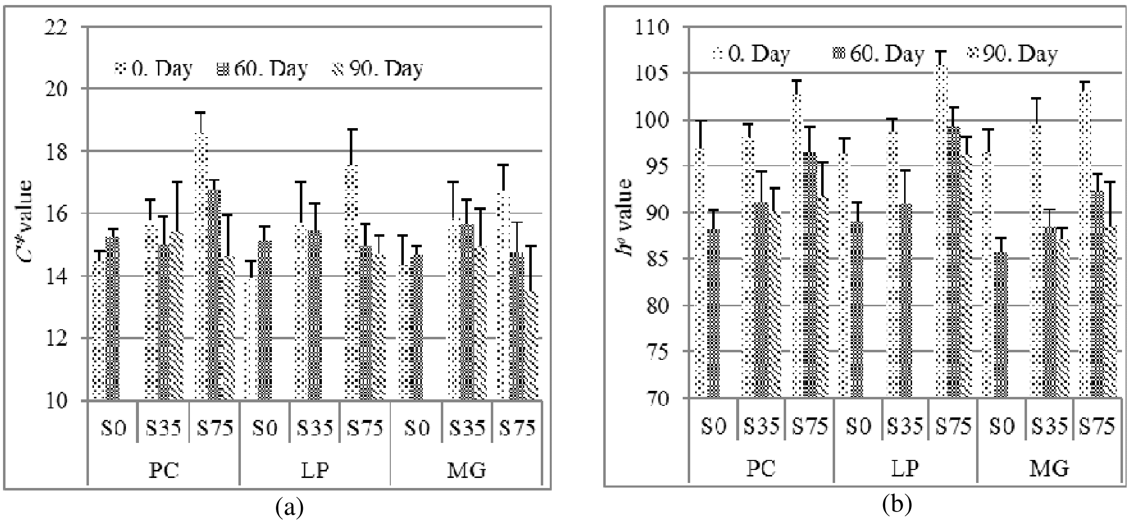

Figure 3. Effects of different shading ratios and covering materials on *C** (A) and h^o (B) value of berry during storage. PC: Polypropylene Cross-stitch; LP: Life Pack; MG: Mogul; Shading ratios: S0-= 0%; S35= 35%, S75= 75%.

finding complies with the ripening of grape berries (Şen *et al.,* 2012). In "Sultana Seedless", berry color loses green tone with the progression of ripening and turns into a greenish-yellow color.

Effects of different shading ratios and cover materials on TSS contents of grapes during the storage period were significant (P< 0.01). TSS contents of unshaded grapes were higher than the shaded ones (Figure 4). TSS contents of S0-treated grapes were, respectively, 14.5% and 27.5% higher than S35 and S75-shaded ones. Till the end of 60 days storage period, the differences between unshaded and 75%-shaded grapes were maintained. It was observed that shading implemented at veraison period slowed down TSS accumulation. Increasing shading ratios significantly decreased sugar concentration (Smart *et al.,* 1988; Bergqvist *et al.,* 2001; Şen *et al.,* 2012). The effects of nets on photon flux density also support such findings (Figure 1). Current findings about the effects of shading on TSS contents also comply with the findings indicating higher sugar accumulations of light-exposed fruits than non-exposed ones (Kliewer and Lider, 1968; Crippen and Morrison, 1986; Smart *et al.,* 1988; Bergqvist *et al.,* 2011). Similarly, shading of leaves of white grapes decreased TSS contents of fruits (Kliewer *et al.,* 1967; Kliewer and Antcliff, 1970). Fruit-zone shading reduced TSS and anthocyanin accumulation in '*Nebbiolo*' grapes during ripening, as well (Downey *et al.,* 2004; Chorti *et al.,* 2010).

Effects of shading ratios and cover materials on maturity index of grapes at harvest and end of 60 days storage period were found to be significant (P< 0.01). Maturity index of S75-shaded grapes was lower than unshaded (S0) ones (Figure 5). The limited impact of S75 shading on increasing maturity index was also observed in PC and LP-covered grapes at the end of 60 days storage period. In such a limitation, changes in TSS contents were determinant rather than TA values. The changes in maturity index values were not stable during the storage period. Especially the decreasing effect of 75% shading treatments over maturity index of grapes complies with the decreasing effect of shading over TSS contents (Smart *et al.,* 1988). Shading practices reduce light, causing slower sugar accumulation and delaying ripening because of limiting photosynthesis. Light intensity, quality and duration of light exposure are effective on photosynthesis and, in general, as light intensity per unit leaf area increases, photosynthesis rate rises (Berry and Downton, 1982).

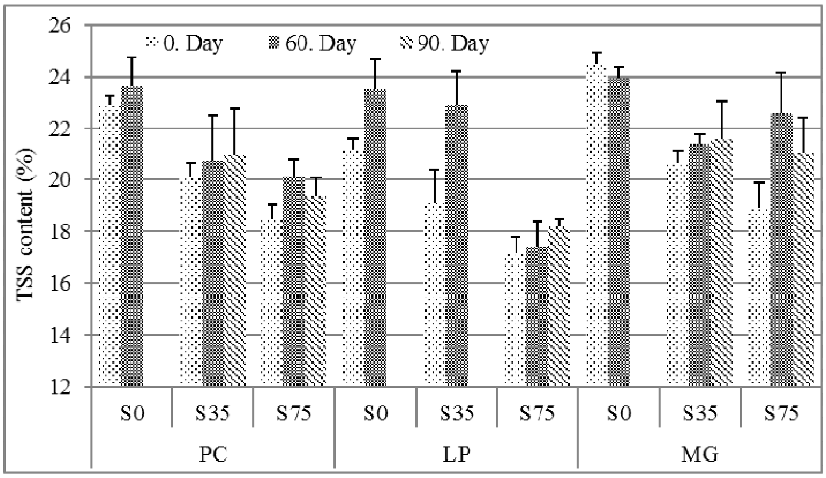

Figure 4. Effects of different shading ratios and covering materials on TSS content of grapes during storage. PC: Polypropylene Cross-stitch; LP: Life Pack; MG: Mogul; Shading ratios: S0-= 0%; S35= 35%, S75= 75%.

[DOR: 20.1001.1.16807073.2016.18.1.13.1]

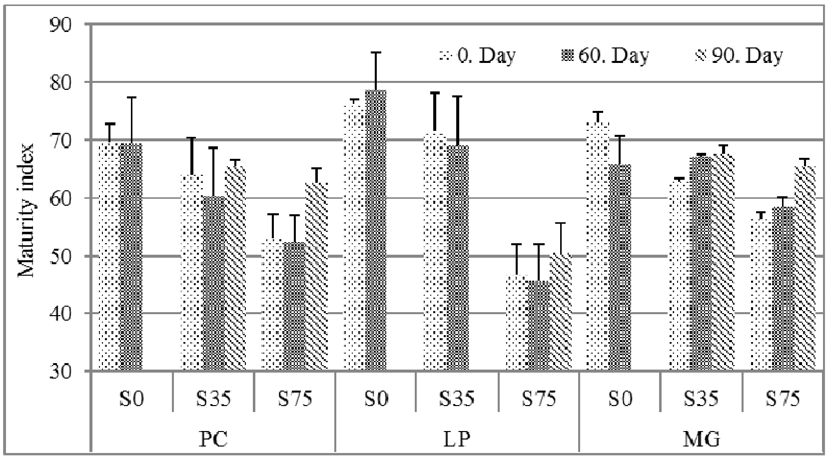

Figure 5. Effects of different shading ratios and covering materials on maturity index of grapes during storage. PC: Polypropylene Cross-stitch; LP: Life Pack; MG: Mogul; Shading ratios: S0-= 0%; S35= 35%, S75= 75%.

Sensory Analyses

SO_2 taste or odor was not observed at either moderate or severe levels during storage. Using dual release sulfur dioxide pads and convenient pre-cooling and storage conditions were effective in finding no residual sulfur dioxide taste or odor (Crisosto and Mitchell, 2002). Controlled SO_2 release in-package also prevents SO_2 damages.

Effects of shading ratios and cover materials on sensory characteristics are presented in Figure 6. Grapes were evaluated in respect to visual appearance, flavor, and crunchiness at harvest and after 60 days storage period and the scores varied between 7 (good) and 9 (perfect). The lowest scores (1.7–3.3) were observed in unshaded and S35+LP treatment at the end of 90 days storage. The fruits lost their marketability because of decay development and medium level browning. Liking-scores of other treatments varied between 5.3 and 6.7; appearance, taste, and crunchiness were good and marketable value was preserved at the end of storage period. Slow aging, limited weight loss and bunch browning and absence of decay were effective in those

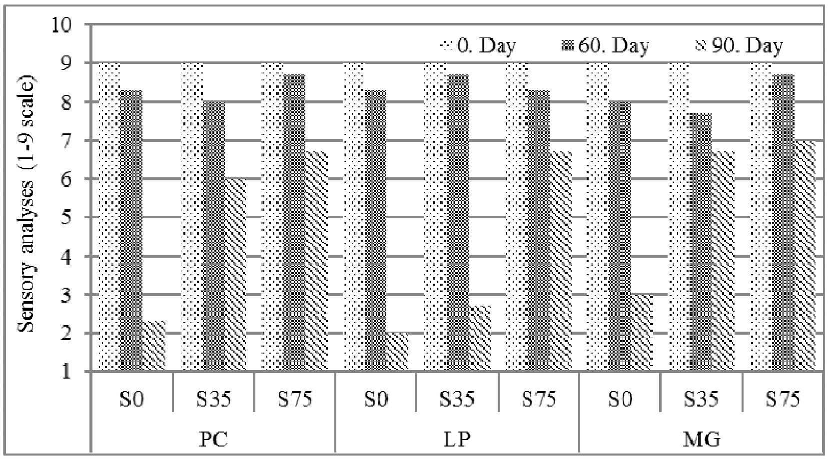

Figure 6. Effects of different shading ratios and covering materials on overall acceptance of grapes during storage. PC: Polypropylene Cross-stitch; LP: Life Pack; MG: Mogul; Shading ratios: S0-= 0%; S35= 35%, S75= 75%.

liking-scores. The decreases in liking-scores were basically related to changes in taste and flavor rather than appearance. Fruit softening was especially effective in the obtained low scores (Kanellis and Roubelakis-Angelakis, 1993; Şen *et al.,* 2012). Decay development and stem browning were distinctively effective in low liking-scores and marketable values.

At the end of 60 days storage period, stems were healthy (1.0-1.4) and there were no browning. However, at the end of 90 days storage period (22 January 2013), medium level stem browning was observed in unshaded and S35+LP treatments (2.7-3.4) and light browning (1.5-2.3) was observed in the other treatments. Absence of bunch browning in some treatments at the end of 90 days storage was because of limited weight loss and SO_2-generating pads (Şen *et al.,* 2012). Quick pre-cooling after harvest, packing in PE bags and limiting water loss during storage and using SO_2-generating pads had a positive effect and stem browning was not seen even after 60 days of storage. There is a high correlation between grape stem browning and weight loss. In various table grape cultivars, 2% weight loss can cause stem browning, berry shatter, and wilting and shriveling of berries (Crisosto *et al.,* 2001; Crisosto and Mitchell, 2002).

CONCLUSIONS

It was concluded that different shading ratios and cover materials may delay harvest of "Sultana Seedless" grapes for 50 days. Since the type of cover material had similar effects on quality parameters, low cost, and easy handling characteristics may receive priority in the selection of the cover material. After 90 days of storage (-0.5°C, 95% RH) decay development was not observed in PC and MG covers following 35 and 75% shading, and LP cover following 75% shading. The changes in some quality and sensory parameters of these treatments were also limited. Especially, 75% shading retarded coloration, TSS accumulation, and ripening and increased the fruit removal force from the pedicle. However, such impacts slowed down and ultimately disappeared with the progression of ripening. Applying PC or MG covers used after 35% shading would be useful to delay harvest period, provide higher TSS content, and keep quality during storage.

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Food, Agriculture and Livestock as the Project TAGEM-TA-10 45-02-109.

REFERENCES

1. Anonymous. 1996. *Standard Spraying Methods in Plant Protection.* Ministry of Agriculture and Rural, Plant Diseases, Ankara, Turkey, PP. 1-261.
2. Anonymous. 2011. Statistics of the Aegean Exporters'Associations.www.egebirlik.org.tr/bilgi-merkezi-raporlar.asp (15 February 2013).
3. Anonymous, 2014. Turkish Statistical Institute Statistics. www.turkstat.gov.tr (22 March 2014).
4. Artes-Hernandez, F., Aguayo, E. and Artes, F. 2004. Alternative Atmosphere Treatments for Keeping Quality of 'Autumn Seedless' Table Grapes during Long-Term Cold Storage. *Postharvest Biol. Technol.***, 31(1):** 59-67.
5. Bergqvist, J., Dokoozlian, N. and Ebisuda, N. 2001. Sunlight Exposure and Temperature Effects on Berry Growth and Composition of Cabernet Sauvignon and Grenache in the Central San Joaquin Valley of California. *Am. J. Enol. Vitic.,* **52:** 1-7.
6. Berry, J. A. and Downton, W. J. S. 1982. Environmental Regulations of Photosynthesis. In: "*Photosynthesis: Development, Carbon Metabolism and Plant Productivity*", (Ed.): Govindjee, Academic Press Inc., New York, **2:** 263-344.
7. Carvajal-Millan, E., Carvallo, T., Orozco, J. A., Martínez, M. A., Tapia, I., Guerrero. A., Rascón-Chu, J., Llamas. J. and Gardea, A. A. 2001. Polyphenol Oxidase Activity, Color Changes, and Dehydration in Table Grape Rachis during Development and Storage as Affected by N-(2-chloro-4-pyridyl)-n-

phenylurea. *J. Agric. Food Chem.*, **49:** 946-951.
8. Chorti, E., Guidoni, S., Ferrandino, A. and Novello, V. 2010. Effect of Different Cluster Sunlight Exposure Levels on Ripening and Anthocyanin Accumulation in Nebbiolo Grapes. *Am. J. Enol. Viticult.*, **61:** 23-30.
9. Crippen, D. D. and Morrison, J. C. 1986. The Effects of Sun Exposure on the Compositional Development of 'Cabernet Sauvignon' Berries. *Am. J. Enol. Viticult.*, **37:** 235-242.
10. Crisosto, C. H., Smilanick, J. L. and Dokoozlian, N. K. 2001. Table Grapes Suffer Water Loss, Stem Browning During Cooling Delays. *California Agriculture*, **55:** 39-42.
11. Crisosto, C. H. and Mitchell, F. G. 2002. Postharvest Handling Systems: Table grapes. In: *"Postharvest Technology of Horticultural Crops"*, (Ed): Kader, A. A.. University of California Agricultural and Natural Resources Pub., 3311, USA, PP. 357-363.
12. Crisosto, C. H. and Smilanick, J. L. 2004. Grape (Table). In: *"The Commercial Storage of Fruits, Vegetables and Florist and Nursery Stocks",* (Eds): Gross, K. C., Yi Wang, C. and Saltveit, M.. Agricultural Handbook Number 66, USA.
13. Downey, M. O., Harvey, J. S. and Robınson, S. P. 2004. The Effect of Bunch Shading on Berry Development and Flavonoid Accumulation in Shiraz Grapes. *Aust. J. Grape Wine Res.,* **10(1):** 55-73.
14. Ergenoğlu, F., Tangolar, S., Gök, S., Büyüktaş, N. and Orhan, E. 1999. Effects of Different Shading Ratios and Covering Materials on Storage Life and Quality of Sultana Seedless Grapes. *Turk. J. Agric. For.,* **23:** 899-908.
15. Kacar, B. 1989. *Plant Physiology.* Faculty of Agriculture Pub., University of Ankara, Ankara, Turkey, PP. 1-323.
16. Kanellis A. K. and Roubelakis-Angelakis, K. A. 1993. Grape. In: *"Biochemistry of Fruit Ripening"*, (Eds): Seymour, G. B., Taylor, J. E. and Tucker, G. A.. Chapman and Hall, London, England, PP. 189-220.
17. Kara, S. and Çoban, H. 2002. An Investigation on Conservation of Grape on the Vine Protected Cultivation. *J. Ege Univ. Fac. Agric.,* **39(3):** 25-32.
18. Karaçalı, İ. 2009. *Storage and Marketing of Horticultural Products.* Faculty of Agriculture Pub., Ege University, İzmir, Turkey, PP. 1-486.
19. Keller, M., Arnink, K. J. and Hrazdina, G. 1998. Interaction of Nitrogen Availability During Bloom and Light Intensity During Veraison. I. Effects on Grapevine Growth, Fruit Development, and Ripening. *Am. J. Enol. Viticult.*, **49:** 341-349.
20. Kliewer, M., Lider, L. A. and Schultz, H. B. 1967. Influence of Artificial Shading of Vineyards on the Concentration of Sugar and Organic Acid in Grapes. *Am. J. Enol. Viticult.*, **18(2):** 78-86.
21. Kliewer, W. M. and Lider, L. A. 1968. Influence of Cluster Exposure to the Sun on the Composition of 'Thompson Seedless' Fruit. *Am. J. Enol. Viticult.*, **19:** 175-184.
22. Kliewer, W. M. and Antcliff, A. J. 1970. Influence of Defoliation, Leaf Darkening and Cluster Shading on the Growth and Composition of Sultana Grapes. *Am. J. Enol. Viticult.*, **21:** 26-36.
23. Novello, V. and de Palma, L. 2008. Growing Grapes under Cover. *Acta Hortic.,* **785:** 353-362.
24. Shakak, Y., Gussakovsky, E. E., Cohen, Y. and Lurie, S. 2004. Color Nets: A New Approach for Light Manipulation in Fruit Trees. *Acta Hortic.,* **636:** 609-616.
25. Shrestha, G. K., Nilnond, S., Phavaphotanon, L., Juntawong, N. and Sukumalandane, C. 2000. Influence of Plastic Roof on Fruit Quality and Yield of "Beauty Seedless" Grape during Dry and Rainy Seasons. *Kasertsart J. Natur. Sci.,* **34:** 179-189.
26. Smart, R. E., Smith, S. M. and Winchester, R. V. 1988. Light Quality and Quantity Effects on Fruit Ripening for Cabernet Sauvignon. *Am. J. Enol. Viticult.*, **39:** 250-258.
27. Snowdon A., 1990. Color Atlas of Post-Harvest Diseases and Disorders of Fruits and Vegetables. Wolfe Scientific Ltd., Barcelona, Spain, **1:** 1-302.
28. Şen, F., Altun, A., Kesgin, M. and Sacid, M. 2012. Effect of Different Shading Practices Used at Pre-harvest Stage on Quality and Storage Life of Sultana Seedless Grapes. *J. Agric. Sci. Technol. B,* **2:** 1234-1240.
29. Zoffoli, J. P., Latorre, B. A. and Naranjo, P. 2009. Preharvest Applications of Growth Regulators and Their Effect on Postharvest Quality of Table Grapes during Cold Storage. *Postharvest Biol. Technol.,* **51:** 183-192.

اثر سایه اندازی و پوشش دادن انگور بی دانه سلطانا 'Sultana Seedless'روی کیفیت و انبارداری محصول

ف. سن، ر. ا. اکسار، و م. کسگین

چکیده

هدف این پژوهش تعیین اثر سایه اندازی های مختلف و پوشاندن انگور بی دانه سلطانا بر کیفیت و انبارداری محصول بود. به این منظور، تاک های انگور در مرحله دگرفامی(veraison) با سه تور سایه انداز (۰٪، ۳۵٪، و ۷۵٪ سایه) پوشانده شدند و سپس درست قبل از برداشت، با موادی شامل پلی پروپیلین بخیه دار(PC)، لایف پک **(LP)**و موگل**(MG)** پوشش دار شدند. انگور های چیده شده در همه تیمارها به مدت ۹۰ روز در سردخانه (۰/۵- سانتی گراد) نگهداری شدند. در انگور های بدون سایه انداز و در آن هایی که تور۳۵٪ داشتند و سپس با لایف پک پوشانده شده بودند پوسیدگی بعد از برداشت و کاهش کیفیت حسی(sensory quality) مشاهده شد. مواد جامد محلول، شاخص رسیدگی میوه، و اجزای رنگ (C^* وh^o) در تیمار ۷۵٪ سایه اندازی کمتر از تیمارهای بدون سایه انداز بود. در طی دوره انبارداری، اثر تیمارها و افزودن مواد آزمون شده بر صفات کیفی یا کم شد یا از میان رفت. همه مواد پوششی که بعد از تورهای سایه انداز استفاده شدند موجب تاخیر ۵۰ روزه در تاریخ برداشت شدند.درنتیجه می توان گفت که پوشش هایPC یا MG که بعد از تیمار ۳۵٪سایه اندازی استفاده شدند، افزون بر تاخیر انداختن زمان برداشت، موجب کیفیت بهتر و انبارداری موفق انگور برای مدت ۹۰ روز شدند.

[DOR: 20.1001.1.16807073.2016.18.1.13.1]