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Effects of Plastic Covering on Yield, Physical and Chemical Characteristics of Some Table Grapes (*Vitis vinifera* L.)

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This study was aimed to determine the effect of plastic covering on phenological stages (bud-burst, blooming, verasion, ripening) and the physical characteristics (the yield, cluster weight, cluster length, cluster width, berry weight, berry length, berry width, berry rupture point force, shoot weight, shoot length) as well as the chemical characteristics (total soluble solids, titratable acidity and sugar fractions) of Cardinal, Yalova Incisi and round seedless grape cultivars. The trial were planed as a plastic greenhouse for each variety. The greenhouse, including three lines of the vines were covered by 5.0 m in height and 8.0 m in width with UV and IR type of polyethylene, from mid-February to mid-April. Side lines were ignored due to the border effect and only middle lines of the vines were statistically analyzed by t-test for paired plots.

Key Words: Grapevine, Covering material, Sugar fractions.

INTRODUCTION

Turkey takes an important position in the viniculture of the world and ranks 5th place in fresh production and 4th place in the vineyard area[1]. A substantial part of fresh grapes are produced in the Gediz valley of the Aegean region. Alasehir location (Manisa), where this experiment was set up, has the largest vineyard area in this region[2].

Varieties of the grapes grown in Turkey are harvested between 15th July and 15th September. In this period, the table grape market is suffering from oversupply. Thus, prices decrease considerably in the market. On the contrary, early harvesting (before 15-30 d from usual harvesting time) leads to a 40 % increase in the total income. Therefore, the method of using plastic covering for the table grapes grown in the region gains importance over time. A micro-climate is created in the vineyards covering them with plastic materials. As a consequence of this, plastic covers cause to hasten grape maturity and are able to resist harsh climate condition such as frost, heavy rains and hailstones. Additionally, this prevents bird and other harmful animals damage to vineyards[3-5].

Protected cultivation of grapevines under plastic covers to advance the maturity is of great importance especially in the Mediterranean countries. These regions have a potential value for early ripening of table grapes under plastic covers without heating[6-13].

In this experiment, the effect of plastic covering on the yield, the physical characteristics and the chemical characteristics of Cardinal, Yalova Incisi and round seedless, grape cultivars were determined.

EXPERIMENTAL

This experiment was carried out in 2004-2005 at the grapevines of Cardinal, Yalova Incisi and round seedless (*Vitis vinifera* L.) in Alasehir location, Manisa, in the Gediz Valley. The climate of the region is semi-arid with hot dry summers and cold wet winters. Average yearly temperature is 19ºC and the total amount of annual rainfall is 575 mm[14]. Cardinal and Yalova Incisi were grafted on Chasselas X Berlandieri 41 B in 1994. The planting distances were 3.0 m between the rows and 2.0 m on the row and trained onto a gable trellis system. Round seedless was grafted on Berlandieri X Riparia 5 BB in 1990. The planting distances was 2.8 m between the rows and 1.7 m on the row and trained onto a big T system.

A basal dressing was applied equally to all plots on February, as follows:138 kg N ha^{-1} (as ammonium sulphate), 65 kg P ha^{-1} (as triple super phosphate) and 236 kg K ha^{-1} (as potassium sulphate). A drip irrigation system was used on the loamy alluvial soil. Physical and chemical parameters of the soils sampled from the experimental vineyard are shown in Table-1. The trial were planed as a plastic greenhouse for each variety. The greenhouse, including three lines of the vines were covered by 5.0 m in height and 8.0 m in width with UV and IR type of polyethylene, from mid-February to mid-April (Covered field is about 250 m^2 for a variety). Side lines were ignored due to the side effect and only middle lines of the

TABLE-1
CHEMICAL AND PHYSICAL PROPERTIES OF THE EXPERIMENT SOILS
(0-30 cm, 30-60 cm AT THE SOIL DEPTH

Depth (cm)	pH	Total soluble salt (%)	$CaCO_3$ (%)	Organic matter (%)	Texture	Total N (%)
0-30	7.48	< 0.030	1.35	1.55	Sandy-Loam	0.067
30-60	7.58	< 0.030	1.43	0.98	Sandy-Loam	0.059

	Available (mg kg^{-1})								
Depth (cm)	P	K	Ca	Mg	Na	Fe	Zn	Mn	Cu
0-30	6.33	100	2100	240	20	9.4	0.6	3.6	11.7
30-60	4.30	80	2100	200	20	8.5	0.3	3.0	6.8

vines were statistically analyzed by a t-test for paired plots. Grapevines grown in the open field (uncovered) were regarded as controls[15-18]. Phenological stages were observed by using OIV (Office International de la Vigne et du Vin) and IBPGR (International Board For Plant Genetic Resources) methods[19].

At harvest, the yield (g vine^{-1}), cluster weight (g), cluster length (cm), cluster width (cm), shoot weight (g vine^{-1}), shoot length (cm), berry weight (g), berry length (mm), berry width (mm), berry rupture point force (g), were determined in fresh fruit samples randomly taken from each vine[20-22]. Total soluble solids (%) were obtained with a hand-held refractometer (Atago,Japan). Titratable acidity (%) was assessed with 0.1 NaOH (to a pH of 7.0).

After the fruit samples were lyophilized, sugar fractions were also determined using the gas chromatography method[23,24]. Genstat package program was used for the evaluation of the results obtained[25].

RESULTS AND DISCUSSION

Statistical analysis (5 % t-test) of the obtained data were done and effects of plastic covering of physical as well as the chemical characteristics total soluble solids (%), titratable acidity (%) and sugar fractions (%) of Cardinal, Yalova Incisi and round seedless grape cultivars were determined.

Effect of plastic covering on phenoligical stages

Plastic covering of grapevines of Cardinal, Yalova Incisi and round seedless advanced the dates of phenological stages such as bud-burst, flowering, verasion and ripening (Table-2). Plastic covering hastened bud-burst for 17-31 d compared with vines grown in the open field. In all cultivars, bud-burst of covered vines were earlier in 2004 than in 2005. Bud-burst was of Yalova Incisi under plastic cover 7-10 d earlier than of other two cultivars in 2004.

Plastic covering advanced flowering 31-33 d in Cardinal, 25-27 d in Yalova Incisi and 35-39 d in round seedless, depending on the years and verasion 28-30 d in Cardinal 23 d in Yalova Incisi and 31 d in round seedless.

Grapes of plastic covered vines ripen earlier 27 d in Cardinal, 29-30 d in Yalova Incisi and 26-33 d round seedless, than outdoor grown vines. This was also confirmed by previous researchers[7,8,11-13,16].

Plastic covering of grapevines are highly effective in advancing phenological stages. This can be attributed to higher air temperatures under plastic covers. At the same time, higher air temperatures in February under plastic covers have been accounted for earlier bud-burst in 2004 compared

TABLE-2
EFFECTS OF PLASTIC COVERING ON THE DATES OF PHONOLOGICAL STAGES OF CARDINAL, YALOVA INCISI AND ROUND SEEDLESS (mm/dd)

Phenological stages	2004		Difference (d)	2005		Difference (d)
	Covered	Uncovered		Covered	Uncovered	
Cardinal						
Bud-burst	03/16	04/02	17	03/22	04/05	14
Flowering	04/15	05/17	33	04/20	05/20	31
Verasion	06/07	07/05	28	06/15	07/15	30
Ripening	06/25	07/22	27	06/29	07/25	27
Yalova Incisi						
Bud-burst	03/10	04/10	31	03/08	04/06	29
Flowering	04/15	05/12	27	04/16	05/10	25
Verasion	06/02	06/25	23	06/05	06/28	23
Ripening	06/17	07/17	30	06/20	07/19	29
Round seedless						
Bud-burst	03/10	04/06	27	03/14	04/10	28
Flowering	04/20	05/29	39	04/26	05/30	35
Verasion	06/15	07/16	31	06/19	07/20	31
Ripening	07/10	08/12	33	07/15	08/10	26

to in 2005. The differences between plastic covered and control vines with regard to the number of the days at bud-burst increased at later phenological stages[21].

Effect of plastic covering on some quality characteristics

Plastic covering generally had no significant effects on physical characteristics such as the yield, cluster weight, cluster length, cluster width, berry weight, berry length, berry width, berry rupture point force, but a positive effect on shoot weight and length. Plastic covered generally had significant effects on the chemical characteristics (Table-3).

Despite the fact that chemical quality parameters such as titratable acidity were not significantly affected by plastic covered, the total amount of soluble solids was positively affected ($p < 0.05$), (Cardinal, 0.66 ± 0.11 for control and 0.67 ± 0.02 for covered, means ± SE with $n = 16$ over two seasons t-test $p = 0.005$; Yalova Incisi 0.59 ± 0.010 for control and 0.56 ± 0.002 for covered, means ± SE with $n = 16$ over two seasons t-test $p = 0.001$; round seedless 0.80 ± 0.025 for control and 0.76 ± 0.029 for covered, means ± SE with $n = 16$ over two seasons t-test $p = 0.002$).

TABLE-3
SOME CHARACTERISTICS OF PLASTIC COVERED AND UNCOVERED (CONTROL) OF SOME TABLE GRAPES (CARDINAL, YALOVA INCISI AND ROUND SEEDLESS) AT HARVEST TIME

Characteristics	2004		p value t-test*	2005		p value t-test*
	Covered	Uncovered		Covered	Uncovered	
Cardinal						
Yield (g vine^{-1})	9200.0	9650.0	0.350	8400.0	8950.0	0.275
Cluster weight (g)	315.0	340.0	0.335	305.0	320.0	0.100
Cluster length (cm)	18.3	19.7	0.012	17.0	18.2	0.060
Cluster width (cm)	9.0	11.2	0.016	10.3	10.5	0.080
Berry weight (g)	5.0	5.2	0.530	4.8	5.1	0.150
Berry length (mm)	19.1	22.0	0.018	17.9	17.7	0.020
Berry width (mm)	18.0	21.7	0.020	16.9	17.3	0.016
Berry rpf** (g)	322.5	311.7	0.085	305.7	300.4	0.345
Shoot weight (g vine^{-1})	1800.0	1950.0	0.015	1700.0	1580.0	0.530*
Shoot length (cm)	220.5	201.6	0.171	230.0	205.6	0.125*
Total soluble solids (%)	14.6	14.8	0.350	14.1	14.0	0.020
Titratable acidity (%)	0.724	0.680	0.010	0.625	0.640	0.015
Yalova Incisi						
Yield (g vine^{-1})	8500.0	9100.0	0.600	7400.0	7600.0	0.100
Cluster weight (g)	450.0	470.0	0.200	420.0	430.0	0.050
Cluster length (cm)	22.4	24.3	0.050	20.5	21.0	0.025
Cluster width (cm)	11.8	11.9	0.015	11.3	10.9	0.200
Berry weight (g)	5.3	5.4	0.005	5.2	5.5	0.050
Berry length (mm)	24.0	24.0	0.001	23.0	24.0	0.010
Berry width (mm)	22.0	23.0	0.012	23.0	23.0	0.000
Berry rpf** (g)	305.0	312.0	0.550	290.0	305.0	0.750
Shoot weight (g vine^{-1})	1900.0	1980.0	0.450	1800.0	1850.0	0.025
Shoot length (cm)	230.0	218.0	0.170	220.0	211.0	0.530
Total soluble solids (%)	16.1	15.9	0.015	16.0	15.5	0.050
Titratable acidity (%)	0.560	0.585	0.012	0.570	0.600	0.012
Round Seedless						
Yield (g vine^{-1})	9300.0	10700.0	0.680	8400.0	9000.0	0.275
Cluster weight (g)	470.0	550.0	0.040	450.0	460.0	0.050
Cluster length (cm)	25.0	30.5	0.016	28.0	29.5	0.075
Cluster width (cm)	12.6	13.0	0.040	11.0	11.2	0.020
Berry weight (g)	3.4	3.6	0.036	3.0	3.1	0.010
Berry length (mm)	33.0	34.0	0.020	3.0	2.9	0.012
Berry width (mm)	29.0	27.0	0.100	3.0	28.0	0.016
Berry rpf** (g)	380.0	410.0	0.140	350.0	350.0	0.001
Shoot weight (g vine^{-1})	2350.0	2600.0	0.035	2250.0	2300.0	0.630
Shoot length (cm)	245.0	220.0	0.250	225.0	205.0	0.035
Total soluble solids (%)	16.5	16.9	0.200	16.6	16.3	0.012
Titratable acidity (%)	0.730	0.760	0.025	0.800	0.850	0.010

*5 %; n = 16 over two season, 2004-2005; **rpf: rupture point force.

Plastic covering did not significantly affected sugar fractions such as β-glucose; sorbitol and galactose. However in covered, increased substantially the amounts of fructose and α-glucose in all grape varieties (Table-4).

TABLE-4
EFFECTS OF PLASTIC COVERED AND UNCOVERED APPLICATIONS ON SUGAR FRACTIONS OF FRESH FRUIT

Characteristics	2004		p value t-test*	2005		p value t-test*
	Covered	Uncovered		Covered	Uncovered	
Cardinal						
Fructose (%)	38.30	35.30	0.018	36.10	34.50	0.245
β-Glucose (%)	20.70	19.50	0.020	19.90	19.10	0.110
α-Glucose (%)	11.80	10.90	0.015	10.80	9.50	0.040
Sorbitol (%)	2.83	2.54	0.012	2.83	2.54	0.080
Galactose (%)	0.65	0.52	0.006	0.85	0.65	0.050
Yalova Incisi						
Fructose (%)	33.90	32.10	0.160	32.40	31.80	0.100
β-Glucose (%)	20.10	19.70	0.004	23.20	22.30	0.050
α-Glucose (%)	10.10	9.70	0.009	11.00	9.90	0.025
Sorbitol (%)	2.53	2.54	0.015	2.34	2.28	0.020
Galactose (%)	0.51	0.45	0.012	0.48	0.45	0.010
Round seedless						
Fructose (%)	41.80	40.80	0.020	40.80	38.80	0.086
β-Glucose (%)	22.10	22.00	0.010	23.00	21.30	0.050
α-Glucose (%)	12.00	11.00	0.016	12.50	11.20	0.075
Sorbitol (%)	2.85	2.00	0.040	2.03	1.43	0.020
Galactose (%)	0.55	0.83	0.006	0.33	1.29	0.010

*5 %; n = 16 over two season, 2004-2005.

In conclusion, it was found that plastic covering was more effective on phenological stages as well as some quality factors as compared to open field conditions. Therefore, it was concluded that growing table grapes under plastic covered condition could be preferred as it is more profitable and longer to marketing. These results are in accord with findings of various researchers[7,8,11-13,16].

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