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IMPACT OF DEFICIT IRRIGATION AND ANTI-TRANSPIRATION ON WATER USE EFFICIENCY, YIELD AND FRUIT QUALITY OF TWO GRAPEVINE CULTIVARS.

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ABSTRACT

The effect of irrigation deficit and anti-transpirant on water use efficiency, yield and fruit quality of two table grapes cultivars (*vitis vinifera* L.), namely Thompson seedless and Flame seedless, were studied in sandy soil for the two seasons. Split-split experiments were conducted under three water regimes [control, 100% (I1); moderate water stress, 75% (I2) and severe water stress 50% (I3)] of ETc as a main plot and three antitranspirant concentrations [0% (S0), 1% (S1) and 3% (S3)] of ELO (linus seed oil triethanolamine) as sub-main plot. The results showed that, water use efficiency (WUE) decreased significantly with increasing water stress levels but increased significantly with increasing antitranspirant concentration for the two grape cvs, while the highest water utilization efficiency (WUTE) was observed under I3 and S3. Flame variety showed little response to water stress as compared with Thompson variety. Water stress treatments I2 and I3 significantly decreased the yield by 10.40%, 21.86%; and by 9.48%, 18.64% for Thompson and Flame, respectively. Under the same water treatments, yield increased by 8.04 and 16.40%; and by 4.06 and 10.00% in Thompson, and by 4.41 and 11.49%; and by 1.23 and 4.38% in Flame for S1 and S3, respectively. The maximum antitranspirant dependency percentage was achieved under I3 and S3 which reached to 15.18% and 17.50% for Thompson and Flame seedless, respectively. Grape-water response factor (K_y) for the two grape varieties was reduced as the antitranspirant

concentration increased. Fruit quality (i.e. cluster weight, cluster length, cluster width, weight of 100 berries, and volume of 100 berries) for the two grapevine cvs showed negative significant effect with water stress and positive significant effect with antitranspirant concentration. While, percentage of total soluble solids and titratable acidity significantly increased with increasing water stress and decreases significantly with increasing antitranspirant concentration. No significant differences in the two seasons was found between water stress treatments and TSS/acid ratio for Thompson while in Flame a significant increase between I1and I3 was noticed. Flame berries had a significant increase of TSS/acid as the antitranspirant concentration increased. A significant difference was found between S0 and S3 in Thompson berries. Finally, we can conclude that Antitranspirant can be used as a tool for grape growers to improve water use efficiency. This may also lead to a reduced risk of water stress, maintain or increase yield and improve fruit quality

Key words: Grape vines, evapotranspiration, water stress, antitranspirant, fruit quality.

INTRODUCTION

Field water management practices are the most influential factors affecting crop yield particularly in irrigated agriculture in arid and semiarid regions. Water management is particularly critical in irrigated Sandy soils because of their low water-holding capacity and low clay contents (Al-Omran *et al*., 2004). Under hot climatic conditions and in non-irrigated vineyards, it is observed that shoot growth may be reduced and the canopy may be more open. However, the vines might suffer from water stress resulting in a yield reduction. Although the grape quality tends to be higher, the loss in yield may not be compensated for by the higher unit value of the crop. Furthermore, in some of these regions the area of vine plantings is still increasing, and water is becoming an increasingly scarce and valuable resource. At the same time, increase in both irrigation efficiency and water use efficiency is desirable (Gladstones, 1992). On the other side, Nikos *et al.* (2004) and Bittelli *et al*. (2001) found that the deficit in the irrigation level dramatically reduced all vegetative parameters without affecting fruit quality and yield components. Antitranspirant can be used as a tool by grape growers to improve water potential or reduce tree water use and water use efficiency. This may also lead to a reduced risk of water stress, maintain or increase yield and improve berry quality. The application of antitranspirant was demonstrated to be useful for regulating plant water status, plant growth, and protecting plants from short-term water stress. After antitranspirant application, leaf stomatal conductance, transpiration rate, whole-plant transpirational water loss, and growth were depressed by short-term water stress (Gu *et al*., 1996). El –Shazly and Abdel-Nasser (1992) found that spraying Roumi red grapevines with 10% (v/v) plastic emulsion antitranspirant significantly increased berry weigh, had no effect on fruit acidity and decreased total soluble solids and TSS/acid ratio. El-Morshedy *et al*. (1997) found that spraying sour orange seedlings with ELO antitranspirant (linus seed oil triethanolamine as emulsible effect), generally, increased leaf relative water content.

Drip irrigation is the most effective way to convey directly water and nutrients to plants while saving water and increases yields of crops (Tiwari *et al*., 2003). Loveys *et al*. (1998) showed that by applying a continuous water deficit, vegetative growth was restricted while quality and yield were maintained. As a consequence, the water use efficiency is improved. Bryla *et al*. (2003) reported that drip irrigation improved production and water-use efficiency of faba bean in California using different levels of irrigation based on percentage of evapotranspiration.

The present study was undertaken to investigate: (I) Effect of water stress on yield and the magnitude of yield reduction of two grape vines, (II) Role of antitranspirant on reducing or minimizing the adverse effect of water stress on yield, (III) Water response factor of grapes under different water regimes, and (IV) Effect of different water stress treatments on fruit quality of grape berries grown in sandy soil in El-Bostan region.

MATERIALS AND METHODS

This study was conducted during the two successive seasons 2004 and 2005 at Aly Mobarak Village in El-Bostan region (latitude

30˚ 20′ N, longitude 30˚ 50′ E, altitude 7.4 m) to study the influence of irrigation deficit and anti-transpirant spray on yield and fruit quality of two table grape vines *Vitis vinifera* L. (Thompson seedless and Flame seedless cultivars). Experimental trees were 3-years old, planted at 2x3 m spacing under Spanish Paron system and grown in sandy soil and irrigation water was applied through drip system. Mean soil physical, chemical and hydrological soil properties were illustrated in table (1).

Table (1): Some soil chemical, physical and hydrological properties for the experimental site.

Parameter	Unit	Soil depth (cm)		
		0-30	30-60	60-90
pH, 1:2.5 soil:water ratio		7.82	7.80	7.94
EC	dSm^{-1}	1.75	2.81	3.34
Soluble Cations:				
Ca^{2+}	*meq/l*	6.6	15.7	14.9
Mg^{2+}	*meq/l*	4.8	8.5	8.7
Na^{+}	*meq/l*	5.3	4.0	11.1
K^{+}	*meq/l*	0.8	0.9	1.2
Soluble Anions:				
HCO_3^{-}	*meq/l*	2.6	2.6	5.0
Cl^{-}	*meq/l*	5.0	5.0	8.5
SO_4^{2-}	*meq/l*	9.9	9.9	22.3
SAR		2.2	1.2	3.2
$CaCO_3$	%	2.0	1.77	4.27
B.D.	Mg/m^3	1.81	1.75	1.76
Gravel	%	0.7	0.1	0.1
Sand	%	92.3	89.2	89.5
Silt	%	5.2	7.2	7.0
Clay	%	2.5	3.6	3.5
Texture		Sand	Sand	Sand
Basic I.R.	$mmhr^{-1}$	99.3		

The recommended fertilizer requirements of grape in El-Bostan region were added, 143 kg N ha^{-1} as ammonium nitrate (33.5%), 95 kg P_2O_5 ha^{-1} as super phosphate (15.5%) and 190 kg K_2O ha^{-1} as potassium sulfate (50%). Trees sprayed with gibrillic acid (5%)

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at Jan 26, 2004 and Jan 28, 2005 for two seasons. Experimental vines were selected as uniform as possible and sprayed with 0, 1 and 3% (v/v) of ELO (linus oil seed, triethanol amine emulsion) as anti-transpirant. The vines were sprayed twice during the last week of March and the second week of May in both seasons.

Water regimes:

Irrigation scheduling was achieved by water budget approach using FAO crop evapotranspiration (ET) for determining irrigation needs. Three water regimes [100% (Treatment I1), 75% (Treatment I2) and 50% (Treatment I3)] of ET_c were applied under drip irrigation system. Four emitters per vine were installed with total discharge rate 16 L/hr. A split plot design with four replicates was followed for the statistical analysis.

Crop Evapotranspiration (ETc):

Crop evapotranspiration was determined by using reference evapotranspiration (ET_0) and crop coefficient (k_c) (Allen *et al.*1998 and Smith *et al*. 1998) as follows:

$$ET_c = ET_0 \times K_c$$

Reference evapotranspiration was computed from weather data collected from El-Bostan meteorological station according to the FAO Penman-Monteith method using crop water requirements (CWR4W, version 4.3) software (Smith *et.al*.1998). Monthly average metrological data and computed (ET_0) were listed in Table (2).

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Table (2): Monthly average metrological data and ET_0 for the area under investigation.

Month	mean Max. Temp. C°	mean Min. Temp. C°	Humidity %	Wind Speed Kmd^{-1}	Sunshine hours	Sol.Radiation $MJm^{-2}d^{-1}$	ET_0 mmd^{-1}
Jan.	17.2	5.8	69	103.7	6.5	11.9	1.72
Feb.	18.4	5.1	66	129.6	5.8	13.2	2.31
March	20.1	7.5	66	155.5	6.9	17.0	3.10
April	24.0	8.5	63	129.6	8.6	21.6	4.08
May	27.0	12.1	63	103.7	9.7	24.4	4.70
June	31.0	15.2	59	129.6	11.2	26.8	5.81
July	31.1	17.4	63	112.3	11.1	26.5	5.59
Aug.	31.2	19.6	67	86.4	10.9	25.3	5.13
Sept.	25.7	15.2	66	103.7	8.9	20.5	3.81
Oct.	25.7	15.2	66	103.7	8.9	17.7	3.19
Nov.	21.6	10.5	67	129.6	7.8	13.7	2.33
Dec.	19.1	7.1	70	224.6	7.6	12.3	2.31
Average	24.3	11.6	65.4	126	8.7	19.2	3.67

During the physiological dormancy, vines were irrigated with 5 mm each 10 days from first of November to first of February. Irrigation treatments began at first of February and ended after cessation of growth at late June in both seasons.

At harvest date, 20^{th} and 25^{th} of June for flame seedless and Thompson seedless in both seasons, the yield of each experimental vine was recorded and expressed as ton fruit ha^{-1}. Some fruit quality parameters were measured such as cluster weight, cluster width, cluster height, weight of 100 berries (g), size of 100 berries (cm^3), total soluble solids (TSS %), and titratable acidity.

The percentage of TSS in berry was measured by using a hand-refractometer. The acidity was determined based on tartaric acid as the dominant organic acid by using five millimeters of berry from each treatment and titrated with Sodium hydroxide solution of a known normality using phenolphthaline as an indicator (A.O.A.C. 1980). The results of these titrations were converted to percent of tartaric acid using the following equation:

$$\text{Percent of tartaric acid} = \frac{N_{NaOH} \text{ x } ml_{NaOH} \text{ x } 0.067^{*}}{\text{ml of berry must used}} \text{x}100$$

* 0.067 = milli-equivalent weight of tartaric acid.

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Water Use Efficiency:

Analysis of water use efficiencies was carried out using the efficiency parameters defined by Schneider and Howell (1999) and Hillel (1998) as follows:

$$\text{Water Use Efficiency (WUE)} = GY / CU$$

$$\text{Water Utilization Efficiency (WUTE)} = GY / ApW$$

where (GY) Grape Yield (kg)
(CU) Consumptive Use (mm)
(ApW) Applied Water (mm)

Statistical Analysis:

Significance of the difference among treatments was tested using the analysis of variance (ANOVA) according to Snedecor and Cochoran (1972), using STATISTICA program. Comparison between means of treatments was carried out at 5% significance level according to (Walter and Duncan, 1969).

RESULTS AND DISCUSSION

Applied water:

The three irrigation water treatments represented 100, 75 and 50% of the crop ET which corresponded to 3032.3, 2633.9 and 2233.3 m^3/ha/season, respectively. Irrigation started at first of Nov. as once a week (in dormancy period). Furthermore, the actual irrigation schedule started at first of March while irrigation treatments started at first of April at flowering stage (a critical period for water stress).

Yield:

Water stress treatments significantly affected the yield in both seasons as illustrated in Table (3) and shown in Figures (1 and 2). When the crop ET for Thompson cultivar was reduced by 25 and 50%, a reduction in yield in the order of 10.49 and 21.86% was found. Spray with 1% antitranspirant under the above water treatments resulted in an increase in yield by an average of 8.04 and 16.40%, respectively (Fig., 1). At the same time as, spray with 3% of antitranspirant led to an increase in grape yield by an average of 4.06 and 10.00% during the two seasons, respectively. It was evident that, Flame cultivar slightly responded to water stress as compared with Thompson. When crop ET was reduced by 25 and 50%, the yield decreased, in average, by 9.48 and 18.64% (Fig., 2) while spray with 1% antitranspirant under the same water treatments, caused an increase in yield by an average of 4.41 and 11.49%. Meanwhile, sprayed antitranspirant at 3% increased yield by an average of 1.23 and 4.38%, respectively. Bittelli *et al.* (2001) elucidated that foliar application of antitranspirant caused reduction of plants transpiration through partial or full closure of stomata. At the same time, the reduction in yield was attributed to induced closure of stomatal. Stomatal conductance decreased especially in deficit irrigated vines. This stomatal closure resulted in lower net photosynthesis which affected vegetative growth and productivity (Hera-Orts *et al*. 2004 and Yuste, 2004).

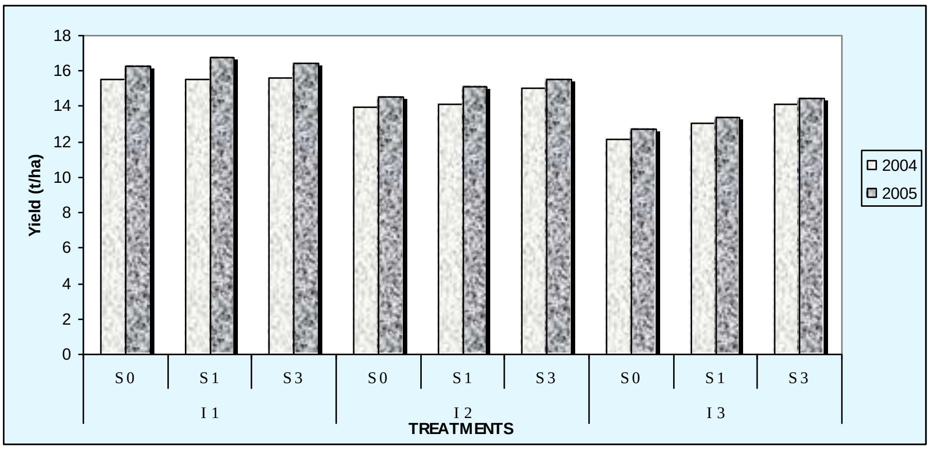


Fig.(1): Effect of water and antitranspiration treatments on Thompson seedless yield during 2004 and 2005 seasons

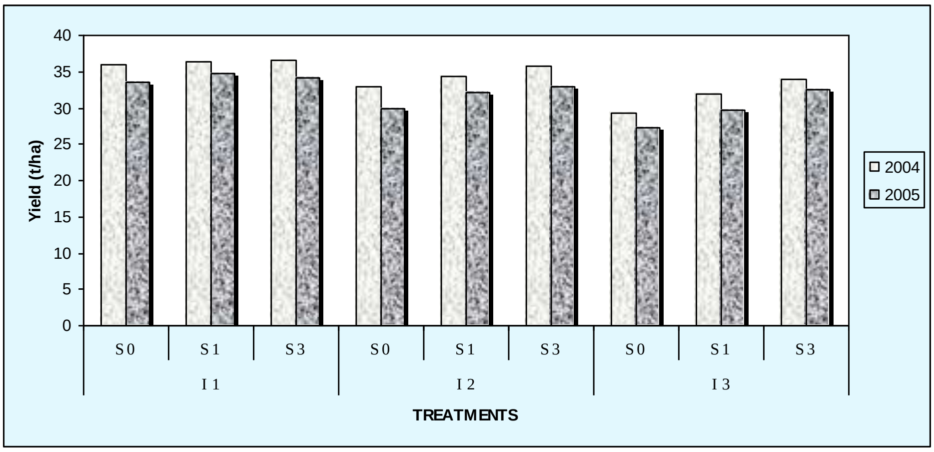


Fig.(2): Effect of water and antitranspiration treatments on Flame seedless yield during 2004 and 2005 seasons.

Table (3): Mean Effect of water and antitranspiration treatments on grape yield, the magnitude of yield reduction and antitranspirant dependency (AD%) in two seasons.

Treatment		Thompson seedless			Flame seedless		
Irrigation	Anti-transpirant	Yield (t ha^{-1})	Magnitude of Yield reduction (%)	AD (%)	Yield (t ha^{-1})	Magnitude of Yield reduction (%)	AD (%)
I 1	S 0	15.898	0.00	----	34.780	0.00	----
	S 1	16.128	0.00	1.50	35.590	0.00	2.30
	S 3	16.028	0.00	0.80	35.360	0.00	1.70
I 2	S 0	14.230	10.49	----	31.484	9.48	----
	S 1	14.620	8.04	2.74	33.247	4.41	5.60
	S 2	15.252	4.06	7.17	34.354	1.23	9.10
I 3	S 0	12.422	21.86	----	28.298	18.64	----
	S 1	13.211	16.90	6.35	30.784	11.49	8.80
	S 2	14.308	10.00	15.18	33.255	4.38	17.50

Antitranspirant Dependency (AD%):

Antitranspirant dependency means that the increase of yield due to the antitranspirant treatment under the same water treatment. The maximum AD% was achieved under I3 and S3 which reached to

15.18% and 17.50% for Thompson and Flame seedless, respectively (Table 3). The data also indicated that the increase of water stress clarified the need for antitranspirants. Under 1% of antitranspirant treatment, when water stress increased from I1 to I2 and I3, Thompson AD% was increased from 1.50 to 2.74 and 6.35% when compared to non-antitranspirant treatment. Meanwhile, under 3% of antitranspirant treatment, Thompson AD% was increased from 0.80 to 7.17 and 15.18% under the same water treatments. On the other hand, under the same water treatments, Flame AD% was increased from 2.30 to 5.60 and 8.80% with 1% antitranspirant. While under 3% of antitranspirant the Flame AD% was increased from 1.7 to 9.1 and 17.5%.

Water Use Efficiencies:

Mean water use efficiencies (WUE) and water utilization efficiencies (WUTE) for the two seasons were listed in Table (4). For two grape cultivars (Thompson and Flame), WUE was significantly decreased as water stress treatments increased but increased significantly with increasing antitranspirant concentration. On the other hand, WUTE was significantly increased with increasing water stress treatments and also increased significantly with increasing antitranspirant concentration. In general, the highest WUE for two grape cultivars was observed under water treatment (I-1) (100% of ET_c) and 3% of antitranspirant. While, the highest WUTE was observed under water treatment (I3) (50% of ET_c) and 3% of antitranspirant (Table, 4) (Palliotti *et al*. 2001; and Sepaskhah and Ghahraman 2004).

Table (4): Mean grape Water Use Efficiency (WUE) and Water Utilization Efficiency (WUTE) as influenced by water and antitranspirant treatments in two seasons.

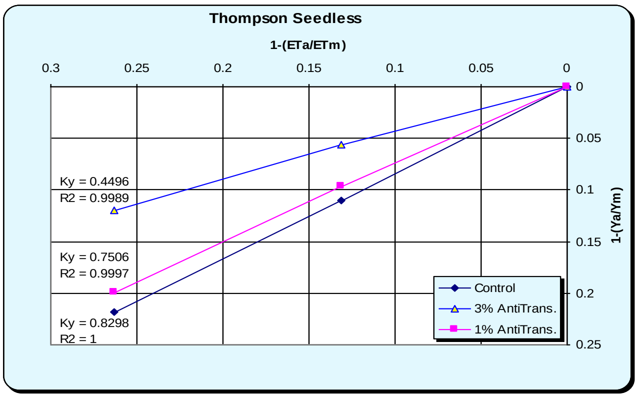
Treatment		WUE	WUE	WUTE	WUTE
		(kg $m^{-3}ha^{-1}$)			
Irrig.	**Spr.**	Thompson	Flame	Thompson	Flame
I-1	**S0**	5.24 c	11.47 c	5.24 c	11.47 c
	S1	5.32 b	11.74 b	5.32 b	11.74 b
	S3	5.29 a	11.66 a	5.29 a	11.66 a
	Mean	**5.28 a**	**11.62 a**	**5.28 c**	**11.62 c**
I-2	**S0**	4.69 c	10.38 c	5.40 c	11.95 c
	S1	4.82 b	10.96 b	5.55 b	12.62 b
	S3	5.03 a	11.33 a	5.79 a	13.04 a
	Mean	**4.85 b**	**10.89 b**	**5.58 b**	**12.54 b**
I-3	**S0**	4.10 c	9.33 c	5.56 c	12.67 c
	S1	4.36 b	10.15 b	5.92 b	13.78 b
	S3	4.72 a	10.97 a	6.41 a	14.89 a
	Mean	**4.39 c**	**10.15 c**	**5.96 a**	**13.78 a**
$LSD_{0.05}$ for Spr.		0.038	0.066	0.043	0.076
$LSD_{0.05}$ for Irrig.		0.091	0.145	0.061	0.165

Grape-water stress response factor (Ky):

Linear Grape-water production function was introduced by Doorenbos and Kassam (1979) and Allen, (1998) to predict the reduction in yield when crop stress was caused by a shortage of soil water, where:

$$\left(1-\frac{Y_a}{Y_m}\right)=k_y\left(1-\frac{ET_{c-act}}{ET_c}\right)$$

where, K_y a yield response factor (dimensionless), $ET_{c\text{-act.}}$ and ET_c, are actual and standard crop evapotranspiration (mm d^{-1}) and Y_a and Y_m are actual and maximum expected crop. In general, the reduction in yield due to water deficit during the vegetative and ripening period was relatively small, while during the flowering and yield formation periods it was large (Allen et al. 1998). The relation between $(1-Y_a/Y_m)$ and $(1-ET_{c-act}/ET_c)$ are shown in Fig. (3). Generally, values of K_y for the two grape cultivars were reduced with increasing antitranspirant concentration. Through the water stress treatments, when antitranspirant concentration increased from S0 to S1 and S3, the Thompson K_y value was reduced from 0.83 to 0.75 and 0.45, while Flame K_y value was reduced from 0.73 to 0.55 and 0.20, respectively. These data indicated that, Thompson seedless was more sensitive to water stress than Flame seedless.



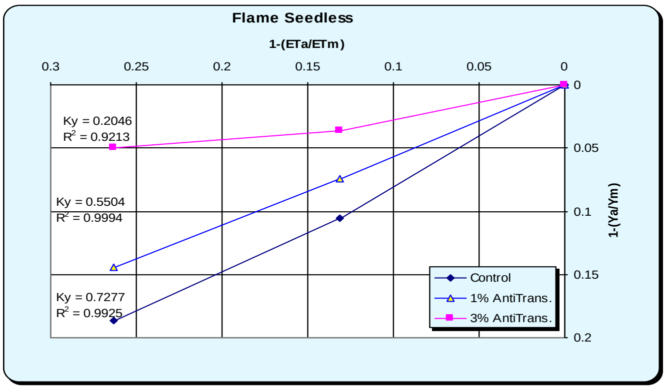


Fig.(3): Crop response factor for two grapevine cultivars

Fruit quality:

Cluster weight: as shown in Tables (5 and 6) the cluster weight of the two grape cultivars was significantly decreased with increasing water stress while it increased significantly with increasing antitranspirant concentration. When water stress increased to I2 and I3, the cluster weight of Thompson was decreased by 9.48 and 17.41%; 6.50 and 17.32% for 2004 and 2005 seasons, respectively. At the same time, increasing antitranspirant concentration to S1 and S3, caused an increase in the cluster weight by 4.24 and 9.95%; 4.87 and 10.50% for 2004 and 2005 seasons, respectively. On the other hand, the cluster weight of Flame decreased significantly by 9.41 and 17.53%; and by 9.35 and 17.24% with increasing water stress to I2 and I3 for 2004 and 2005 seasons, respectively. Meanwhile, increasing of cluster weight according to increase of antitranspirant treatments change in to seasons, where S1 gave the high cluster weight (5.16%) in 2004, the S3 gave the high cluster weight (19.26%) in 2005 season when respect to S0 (Gurovich, 2002 and Medrano, 2003)

Cluster length: the data presented in Tables (5 and 6) showed that the average cluster length for the two grape cultivars through the two seasons decreased significantly with increasing water stress. On the other side, Antitranspirant treatments has different results in the two cultivars, whereas in Flame cv, increasing antitranspirant to S1 and S3 caused an increase in cluster length by 1.26 and 1.91%; and 1.24 and 1.92% in 2004 and 2005 seasons, respectively. Differences between S0 and S1 has significantly increased by 6.67 and 6.64% through the two seasons, while no significant differences found between 1 and 3% of antitranspirant in Thompson.

Cluster width: The data in Tables (5 and 6) showed that the cluster width for the two grape cultivars significantly increase with increasing water stress treatments and decreased also significantly with increase antitranspirant concentration. Average reduction of Thompson cluster width when water stress increased to I2 and I3 were 3.59 and 8.44%, while average of Flame cluster width were 1.41 and 11.34%. On the other hand, average increases of Thompson cluster width when antitranspirant concentration increased to S1 and S3 were 2.85 and 2.94%, and average increases of Flame cluster width were 3.08 and 4.20%.

Weight of 100 berries: the data of two seasons indicated that weight of 100 berries of two grape cultivars decreased significantly with increasing water stress treatments to I2 and I3, and increased significantly with increasing antitranspirant concentration to S1 and S3 (Tables, 5 and 6). The average reduction of 100 berries weight with increasing water stress were 11.43 and 17.89% in Thompson and were 2.38 and 4.17% in Flame. Whereas the average increases of 100 berries weight with increasing antitranspirant concentration were 8.54 and 15.30% in Thompson and were 3.19 and 4.23% in Flame. Rodrigues, (1987) reported that an excessive amount of water can enhance berry size and berry weight. Williams & Matthews (1990) found that berry weight can be very responsive to water stress. McCarthy (2000) established that water deficit during the period after flowering resulted in the greatest reduction in berry weight as compared with that of well-watered vines.

Table (5): Effect of water and antitranspirant treatments on some fruit quality characteristics of Flame grapes during 2004 and 2005 growing seasons.

Treatments	Cluster weight (g)		Cluster Length (cm)		Cluster width (cm)		Weight of 100 berries (g)	
	2004	2005	2004	2005	2004	2005	2004	2005
Irrigation								
I 1	468.89a	486.23a	24.38a	24.87a	11.34a	11.79a	198.67a	206.61a
I 2	424.77b	440.77b	23.39b	23.85b	10.93b	11.37b	193.94b	201.70b
I 3	386.69c	402.41c	21.98c	22.42c	10.38c	10.80c	190.39c	198.00c
$LSD_{0.05}$	1.397	1.426	0.034	0.036	0.014	0.017	0.140	0.148
Antitranspirant								
S 0	415.52c	401.99c	23.01c	23.47c	10.68c	11.10c	189.64c	197.23c
S 1	436.95a	448.00b	23.30b	23.76b	10.98b	11.42b	195.69b	203.52b
S 3	427.88b	479.41a	23.45a	23.92a	10.99a	11.43a	197.67a	205.57a
$LSD_{0.05}$	0.2655	0.628	0.004	0.004	0.004	0.005	0.073	0.075

Table (6): Effect of water and antitranspirant treatments on some characteristics of Thompson grapes during 2004 and 2005 growing seasons.

Treatments	Cluster weight (g)		Cluster Length (cm)		Cluster width (cm)		Weight of 100 berries (g)	
	2004	2005	2004	2005	2004	2005	2004	2005
Irrigation								
I 1	398.39a	402.94a	22.50a	23.63a	11.54a	17.66a	327.67a	344.71a
I 2	372.50b	364.73b	21.67b	22.75b	11.38b	17.41b	290.22b	305.31b
I 3	329.37c	332.79c	19.22c	20.19c	10.23c	15.66c	269.13c	282.96c
$LSD_{0.05}$	1.1850	1.1936	0.0854	0.0910	0.0504	0.0776	7.2740	7.8422
Antitranspirant								
S 0	348.88c	350.25c	20.23b	21.25b	10.79c	16.51c	273.89c	288.13c
S 1	365.87b	365.10b	21.58a	22.66a	11.12b	17.02b	297.35b	312.65b
S 3	385.52a	385.11a	21.58a	22.66a	11.24a	17.21a	315.78a	332.20a
$LSD_{0.05}$	0.3338	0.3181	0.0312	0.0333	0.0279	0.0417	5.8138	5.9146

Volume of 100 berries: the data reflected negative significant effect of water stress and positive significant effect of antitranspirant concentration on volume of 100 berries on the two grape cultivars in two seasons. When water stress increases to I2 and I3, the average 100 berries volume decreased by 9.57 and 16.35% in Thompson variety, and by 3.58 and 9.06% in Flame variety. On the other side, when antitranspirant concentration increased to S1 and S3, the average 100 berries volume increased by 2.49 and 3.83% in Thompson cultivar, and by 4.08 and 5.77% in Flame cultivars (Tables, 7 and 8). This result agreed with McCarthy (1997b) who concluded that the period when berries were most susceptible to water stress, thereby causing a reduction in berry size is post flowering and before veraison.

Total Soluble Solids: percentages of TSS in two grape cultivars for two seasons are listed in Tables (7 and 8). The data elucidated that increasing water stress significantly increase the TSS, while increasing antitranspirant concentration significantly decreased the TSS for two grape cultivars. The TSS increased from 18.03 to 18.43 and 19.09; and from 17.10 to 17.43 and 19.02, when water stress increases I1 to I2 and I3 for Thompson and Flame cultivars, respectively. Meanwhile, TSS decreased from 18.83 to 18.44 and 18.27; and from 18.08 to 17.75 and 17.65, when antitranspirant concentration increased to S1 and S3 for Thompson and Flame varieties, respectively. Gurovich (2002) found that deficit irrigation to 75% ETc has a positive effect on cluster weight, berry weight and soluble solids concentration. Furthermore, Stoll (2000) reported that the reduction in berry weight was accompanied by an increase in TSS.

Acidity: data of the two grape cultivars acidity in relation to water stress and antitranspirant concentration treatments are listed in Tables (7 and 8). Data of two cultivars and two seasons illustrated that, increasing water stress led to an increase in caused a juice acidity while increasing antitranspirant concentration caused a significant reduction in juice acidity. This data agreed with Salón *et al*. (2004).

TSS/Acid ratio: data in Tables (7 and 8) explained that different responses between the two grape cultivars with water stress or antitranspirant treatments. Thompson cultivar has no significant differences in two seasons between water stress treatments and TSS/acid ratio, whereas only significant difference found between S0 and S3 of antitranspirant treatment. Moreover, Flame grapes had a significant increase of TSS/acid with increasing antitranspirant concentration. Water stress treatments gave significant decrease between I1 and I2, while gave significant increase between I1 and I3 in response to TSS/acid ratio.

Table (7): Effect of water and antitranspirant treatments on some Flame seedless fruit quality for 2004 and 2005 growing seasons.

Treatments	Volume of 100 berries (cm^{-3})		TSS (%)		Acidity (%)		TSS / TA	
	2004	2005	2004	2005	2004	2005	2004	2005
Irrigation								
I 1	178.22a	183.57a	16.93c	17.27c	0.679c	0.692c	24.99b	25.00b
I 2	171.83b	176.99b	17.17b	17.51b	0.711b	0.725b	24.15c	24.15c
I 3	162.08c	166.94c	18.83a	19.21a	0.750a	0.765a	25.12a	25.12a
$LSD_{0.05}$	0.184	0.188	0.039	0.033	0.003	0.003	0.006	0.006
Antitranspirant								
S 0	165.28c	170.24c	17.90a	18.26a	0.732a	0.746a	24.45c	24.46c
S 1	172.03b	177.19b	17.57b	17.92b	0.711b	0.724b	24.73b	24.73b
S 3	174.82a	180.06a	17.47c	17.82c	0.697c	0.710c	25.08a	25.08a
$LSD_{0.05}$	0.061	0.062	0.005	0.006	0.004	0.003	0.004	0.004

Table (8): Effect of water and antitranspirant treatments on some Thompson seedless fruit quality for 2004 and 2005 growing seasons.

Treatments	Volume of 100 berries (cm^{-3})		TSS (%)		Acidity (%)		TSS / TA	
	2004	2005	2004	2005	2004	2005	2004	2005
Irrigation								
I 1	290.10a	304.89a	18.07c	17.98c	0.707c	0.697c	25.57a	25.70a
I 2	262.33b	275.71b	18.50b	18.37b	0.734b	0.724b	25.23a	25.36a
I 3	242.67c	255.05c	19.17a	19.01a	0.750a	0.740a	25.56a	25.56a
$LSD_{0.05}$	1.0781	1.1365	0.0577	0.0577	0.0100	0.0101	0.3516	0.3505
Antitranspirant								
S 0	270.73a	284.54a	18.90a	18.77a	0.748a	0.738a	25.28b	25.37b
S 1	264.00b	277.46b	18.50b	18.38b	0.727b	0.717b	25.48ab	25.57ab
S 3	260.37c	273.65c	18.33c	18.21c	0.717c	0.707c	25.06a	25.69a
$LSD_{0.05}$	0.1248	0.1313	0.0889	0.0889	0.0083	0.0083	0.2935	0.2945

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الملخص العربي

تأثير نقص الرى ومضاد النتح على كفاءة استخدام المياه وانتاج وجودة الثمار لصنفين من العنب

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تم دراسة تأثير نقص الرى ومضاد النتح على كفاءة استخدام المياه ومحصول وجودة ثمار صنفين من العنب (طومسون وفليم) فى الاراضى الرملية خلال موسمين. تمت الدراسة تحت نظام القطاعات المنشقة فى ثلاث مستويات من الرجيم المائى (كنترول 100% (I1) واجهاد مائى متوسط 75% (I2) واجهاد مائى شديد 50% (I3)) من الاحتياج المائى للعنب كقطاعات رئيسية. ثلاث تركيزات من مضاد النتح (صفر (S0) و 1% (S1) و 3% (S3)) من مادة ELO كقطاعات تحت رئيسية.

اظهرت النتائج ان كفاءة استخدام المياه WUE قلت معنويا بزيادة معاملات الاجهاد المائى ولكن زادت معنويا مع زيادة تركيز مضاد النتح فى كلا صنفى العنب ، كما لوحظ اعلى كفاءة منفعة المياه WUTE تحت المعاملتين I3 و S3. اظهر صنف الفليم تاثرا ضعيفا مع الاجهاد المائىعن الصنف طومسون. معاملات الإجهاد المائىI2 و I3 قللت معنويا المحصول بنسبة 10.40 % و21.86 % وبنسبة 9.48 و18.64 % عن الكنترول لكل من الطومسون والفليم بالترتيب. وتحت نفس معاملات المياه زاد المحصول بنسبة 8.04 و16.40 % وبنسبة 4.06 و10.00 % فى الصنف طومسون وكذلك بنسبة 4.41 و11.49 % وبنسبة 1.23 و4.38 % للصنف فليم وذلك للمعاملتين S1 و S3 بالترتيب . أعلى معدل زيادة ترجع لمضاد النتح تم ملاحظتها تحت المعاملة I3 و S3 والتى بلغت 15.18 % و 17.50 % للصنفين طومسون وفليم بالترتيب.

معامل تأثر محصول العنب من نقص المياه (Ky) لكلا الصنفين انخفض مع زيادة تركيز مضاد النتح. جودة الثمار (وزن العنقود وطول العنقود وعرض العنقود ووزن 100 حبة وحجم 100 حبة) لكلا صنفى العنب أظهرت تأثير معنوى سلبى مع زيادة الإجهاد المائى وتأثير معنوى إيجابى مع زيادة تركيز مضاد النتح. فى نفس الوقت، نسبة المواد الصلبة الذائبة الكلية (TSS) والحموضة زادت معنويا مع زيادة الإجهاد المائى وقلت معنويا مع زيادة تركيز مضاد النتح. لم يلاحظ فرق معنوى خلال الموسمين بين معاملات الإجهاد المائى ونسبة TSS/acid لصنف الطومسون بينما لوحظ زيادة معنوية بين I1 و I3 فى صنف الفليم كما يوجد زيادة معنوية فى نسبة TSS/acid مع زيادة تركيز مضاد النتح. فى حين يوجد فرق معنوى فى نسبة TSS/acid بين S0 و S3 فى صنف التومسون.

ونستخلص مما سبق أنه يمكن إستخدام مضادات النتح كأداة لمنتجى العنب لتحسين كفاءة إستخدام المياه وهذا أيضا يؤدى إلى تقليل خطر الإجهاد المائى والحفاظ على أو زيادة المحصول وفى نفس الوقت تحسين جودة الثمار.