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Effect of Decreasing Water Irrigation Quantity on Growth and productivity of Flame Seedless Grapevines in Clay Soils Conditions

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ABSTRACT

The present investigation was carried out during three successive seasons (2015, 2016 and 2017)to determine water requirement on growth, yield and fruit quality features of Flame seedless grapevines. In Aga, Dahlia Governorate, Egypt, the chosen vines were seven years old, planted in a clay soil, spaced 2.5×2 meters apart and irrigated by flood system, spur pruned, trained to the quadrilateral cordon and trellised by the pergola system. The vines were pruned during the second week of January with bud load (56 buds/vine).The work in the first year was considered as a preliminary trial and then the experiment proceeded with the same manner during the second and third seasons, respectively. Four levels of irrigation water as follows: irrigation with5000m^3/Fadden (control), 4500m^3/Fadden, 4000m^3/Fadden and 3500m^3/Fadden. Obtained results revealed that irrigation of Flame seedless grapevines with 4000m^3/Fadden recorded the highest water use efficiency which it reflected in getting vegetative growth better, increasing yield/vine and improving berry quality attributes of Flame seedless grapevines in both seasons. From the obtained results, it can be recommended that Flame seedless grapevines irrigated with 4000m^3/Fadden had the best results which it gained a good yield with high fruit quality attributes.

Keywords: Grapevines, Flame seedless, irrigation, soil conditions

INTRODUCTION

Good irrigation scheduling means applying the right amount of water at the right time. Scheduling maximizes irrigation efficiency through avoiding over irrigating this often results in lower costs and optimum water use and crop yield. However, information on the applied irrigation economic amount is scarce for maximizing the crop, especially for the system, which represents approximately 50% of total vineyards cultivated area with limitations in growth, abnormal ripening and reduced berry quality. Regulated deficit irrigation can be applied as a strategy to reduce the possible negative impact of irrigation on wine quality. In Europe, irrigation tends to be reduced after verais on stage, while in Australia deficit irrigation generally is applied during the period from fruit set to verais on stage (McCarthy *et al*. 2000).Lovisolo *et al.*(2000) reported that for all the plants the pattern of water flow during the day was similar and it depended mainly on the evapotranspiration demand, but water-stressed plants always had less flow than control irrigated plants. Mean leaf surface area was 15% higher in irrigated plants. Selles *et al.*(2004) investigated the effect of three irrigation frequencies and the quality of grape cv. Thompson seedless at Santa, Maria the drip irrigation frequencies were established according to the daily crop evapotranspiration (ETc), estimated by pan evapotranspiration and a crop coefficient (Kc) normally used for table grapes, which ranged from 0.25 to 0.7. The treatments were: irrigation when the accumulated daily ETc was equivalent to 6, 12 and 18 h. of irrigation with 9.36, 18.72 and 28.08mm of irrigation water (T6, T12 and T18, respectively).T18 recorded the highest values the different growth stages. Shellie (2005) found that vines from high water stress plots had lower yield. Abd EL-Maksoud (2009) found that increasing irrigation water decreased berry firmness and berry adherence. Nonetheless, an appropriate balance between vegetative and reproductive development (Chaves *et al.,* 2010) is the key to improve wine grape quality in irrigated vineyards. Having a short period of water stress immediately after berry set is dependent on the soil water available at flowering time, which in turn depends on the amount of winter and early spring rains and on the water used during spring (Lopeld *et al.* 2011).Mohamed *et al., (*2016) recommended that Flame seedless grapevines irrigated at 1.0 ET had the best results, which it gained a good yield with high fruit quality attributes.

Thus, the goal of this work is to study the effect of deficit irrigation on vegetative growth, yield and fruit quality attributes of Flame seedless grapevines under flood irrigation system.

MATERIALS AND METHODS

The present investigation was carried out during three successive seasons (2015 , 2016 and 2017)to determine water requirement on growth, yield and fruit quality attributes of Flame Seedless grapevines. In Aga, Dakahlia Governorate, Egypt, the chosen vines were seven years old, planted in a clay soil, spaced 2.5×2 meters apart and irrigated by flood system. The vines were pruned during the second week of January during the three seasons of study. Flame seedless grapevines were trained according to quadrilateral cordon using pergola trellis system and spur pruned by leaving 7 spurs with two eyes on each cordon, the total load was 56 eyes. The work in the first year was considered as a preliminary trial and then the experiment proceeded with the same manner during the second and third seasons, respectively, The experiment consisted of for treatments arranged in a randomized complete blocks design, One hundred and forty four uniform vines were chosen for this experiment (4 treatments x 3 replicates x 12 vines/ replicate). A distance of 2 m was left between each two irrigation treatments to avoid the overlapping infiltration of irrigation or spraying solutions. All treatments received cultural managements as recommended by the Egyptian Ministry of Agriculture.

Treatments were conducted as follows:

1-Irrigation with5000m^3/Fadden/season (control)
2-Irrigation with4500m^3/Fadden/season
3-Irrigation with4000m^3/Fadden/season
4-Irrigation with3500m^3/Fadden/season

Table 1. Chemical and physical analysis of the experimental soil

Characters	Values
Fine Sand %	15.56
Coarse sand%	4.04
Silt %	14.78
Clay %	65.27
Texture	Clay
pH (1:2.5)	7.90
O.M. %	1.82
CaCO3 %	1.62
E.C. (1:5 extract) (mmhos/1 cm)	0.89
N (ppm)	30.63
P (ppm)	13.72
K (ppm)	322

Table 2. The soil moisture constant (% by weight) of the experimental soil

Constants depth (cm)	Saturation (%)		Field capacity (%)		Wilting point (%)		Available water (%)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
0-15	80.6	80.8	40.4	40.5	16.40	16.44	18.58	19.16
15-30	81.7	81.3	40.8	40.6	16.70	16.61	19.26	19.32
30-45	82.8	82.5	41.5	41.4	16.88	16.82	20.11	20.03

Irrigation by flooding was used from the beginning to the end of the two seasons. The total amount of irrigation by flooding at different treatment was calculated and expressed in terms of time based on the rate of water flow through the irrigation (2L/h.) to give such amount of water for each treatment (EC of water irrigation 0.8 dS/m). Irrigations number, the time and water quantity (m^3) in every irrigation are shown in Table 3.

The meteorological data represented by temperature ^oC, relative humidity (RH, %) and rainfall (mm/month) for Aga Weather Station are presented

Table 3. The time (minute) and amounts of applied irrigation water (m^3/fed as well as /plot) in every irrigation during the growth period of Flame seedless via dripper lines with discharge of 2 liter /h. for each dripper at 0.5 bar.

Water quantity (m^3/fed*)	Irrigation numbers	Irrigation time in every irrigation (min.)	Water quantity (m^3/fed*) in every irrigation	Water quantity (m^3/plot**) in every irrigation
5000	11	55	454.54	41.32
4500	11	49	409.09	37.19
4000	11	33	363.64	33.06
3500	11	25	318.18	28.93

Table 4. Seasonal crop water requirements (m^3/fed) and seasonal water consumptive use (m^3/fed) for Flame seedless grapevine

Treatment	Seasonal crop water requirements(m^3/fed)	Seasonal water consumptive(m^3/fed)
5000(control)	3333.31	2824.84
4500	2.941.18	2492.53
4000	2631.58	2230.15
3500	4545.45	3852.08

Table 5. Meteorological data during 2016 and 2017 seasons.

Season	2016				2017			
Parameters / Months	Temp .^{o} C Max	Temp .^{o} C Min	Mean RH (%)	Rain Fall (mm)	Temp .^{o} C Max	Temp .^{o} C Min	Mean RH (%)	Rain Fall (mm)
Mar	24.7	11.5	52.5	2.0	23.2	12.7	55.6	2.0
Apr	27.8	15.1	49.33	2.0	25.6	14.8	52.5	2.0
May	34.5	18.5	50.1	0.0	31.5	21.1	52.8	0.0
Jun	40.8	20.8	51.7	0.0	39.8	21.8	53.5	0.0
July	41.1	23.5	60.1	0.0	40.6	22.4	62.8	0.0
Aug	41.2	24.6	65.5	0.0	44.5	22.6	66.4	0.0
Sep	36.5	20.1	64.4	0.0	34.5	19.8	66.9	0.0
Oct	29.5	15.6	62.33	0.0	28.6	15.3	62.8	0.0

The Experiment started on the 3 rd week of March at 50%(bud break stage)for the two growing seasons 2016 and 2017 by applying a heavy irrigation for all treatments. After that the suggested irrigation program concerning the frequencies and the applied quantities for the different irrigation treatments was done according to what mentioned before.

Table 6. Irrigation frequencies and dates for2016 and 2017

	Irrigation frequencies and dates								Total irrigation frequencies
Months	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	
Seasons	**Frequencies**								
	1	**1**	**2**	**2**	**2**	**1**	**1**	**1**	
2016	22/3	25/4	11/5 25/5	6/6-21/6	6/7-23/7	20/8	17/9	14/10	11
2017	24/3	22/4	9/5- 24/5	8/6- 25/6	8/7-26/7	22/8	19/9	19/10	

Water requirement (WR) =ET_O×Kc×IE

ETo: Daily reference evapotranspiration (mm/day)as shown in (Table7) can be calculated from the actual temperature, humidity, sunshine radiation and wind speed data, according to the FAO penman Monteith method (Allen *et al.*1998)

Kc: Crop coefficient values were taken from FAO(Allen *et al.,* 1998) as shown in (Table7)

IE: Irrigation efficiency or water consumptive use (85% of crop water requirements for irrigation by flooding system).

Table 7. Monthly crop coefficient (Kc), evapotranspiration values (Et_o) (mm/day) of different treatment for Flame Seedless grapevines.

Treatments	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Kc	0.28	0.22	0.18	0.16	0.18	0.19	0.22	0.34
Et_o mm/day	2.9	2.3	1.89	1.68	1.86	2.00	2.28	3.55
Etc mm/day	0.58	0.46	0.38	0.34	0.37	0.4	0.46	0.71

1-Bud behavior

a- Bud burst:

Number of burst bud was counted one month after bud burst the percentage of bud burst were calculated as follows according to Bessis (1960).

$$\textit{Bud burst}\% = \frac{\textbf{No of bursted buds per vine}}{\textbf{Total buds per vine}} x100$$

b-Bud fertility:

Number of clusters per vine were counted and divided by the total number of buds and the fertility was calculated as follows according to Bessis, (1960).

$$\textbf{Bud fertility}\% = \frac{\textbf{No of clusters per vine}}{\textbf{No of Total buds left at winter pruning}} \times 100$$

2-Vegetative growth parameters

At veraison stage, the following morphological determinations were carried out on 4 shoots / the considered vine. Vegetative growth parameters were taken from non-bearing shoots

a- Average shoots length (cm).
b- Average number of leaves/shoot
c- Average leaf surface area (cm^2)

Twenty leaves / vine were picked at veraison stage of the apical 6^{th} and 7^{th} leaves using a CI-203-Laser Area-meter made by CID, Inc., Vancouver, USA.

3-Yield and physical characteristics of cluster

Harvesting indices (TSS% and acidity %) were weekly monitored from veraison stage till maturity when TSS reached about 16-17% according to Tourky *et al.* (1995).

a- Yield/vine was determined by multiplying number of clusters/vine by average cluster weight.
b- Average cluster weight (g)
c- Number of Cluster
d- Average cluster length (cm)
e- Average cluster width (cm)

5-physical characteristics of berries

a- Number of berries per cluster
b- Average 100 berry weight (g)
c- Average cluster diameter (cm)

6- Chemical characteristics of berries

a- Total soluble solids (TSS %) in berry juice using a hand refractometer,
b- Total titratable acidity (as tartaric acid %) according to the Official Analysis Methods (A.O.A.C., 1980) and TSS / acid ratio.
c- Total anthocyanin of the berry skin (mg/100g fresh weight) was calculated according to (Husia *et al.,* 1965).

7- N, P and K content in the leaves:

Twenty leaf petioles / vine were picked at verais on stage from leaves opposite to cluster were used for the determination of N, P and K content in the leaves.

Nitrogen content was estimated in the obtained digests using micro-kjeldahl distillation method (A.O.A.C., 1975). Phosphorus content was determined, using colourimetric method according to Fiske and Subbarow (1925). Potassium content was determined, using flame photometer according to Brown and Lilleland (1946).

8- At growth cessation parameters:

a- Total carbohydrates contentof canes (%):

Total carbohydrates were taken from canes for next season and determined at winter pruning according to modified method of (Schaffer and Hartman, 1921).

b- Wood ripening :

Wood ripening was determined at the end of growth season as a parameter of canes ripening. Smith *et al.,* (1956)

c- Weight of pruning:

It was carried out at the time of winter pruning.

9-Water use efficiency (WUE)

Water use efficiency was calculated according to Viets(1962).

WUE=Y/WU (Kg/m3)

Y: yield (K/fed)

WU: consumptive use (m^3/season)

Statistical analysis :

The complete randomized block design was adopted for the experiment. The statistical analysis of the present data was carried out according to Snedecor and Cochran (1994). Average was compared using the new L.S.D. values at 5 % level.

RESULTS AND DISCUSSION

1-Bud behavior

a- Bud burst %:

Data obtained in Table (8) clearly show that a significant gradual decrease in bud burst percentage with irrigation 5000m^3/Fadden in Flame seedless grapevines during in both seasons, while irrigation 4000m^3/Fadden followed by 4000m^3/Fadden gave significant increase of bud burst % from other studied treatments. The present results are in the same trend with those mentioned by Abd EL-Mksoud (2009)who found that bud burst percentage of Thompson seedless grapevines decreased by increasing irrigation water levels.

b-Bud fertility%:

Results presented in Table(8) show that bud fertility% were significantly affected by different levels of irrigation in both seasons of study. Data indicated that vines irrigated with 4000m^3/Fadden had significant values followed by vines irrigated with4500m^3/Fadden, 3500m^3/Fadden and the5000m^3/Fadden(control)which had the lowest values in both seasons. These results, as a general trend, are in agreement with those of Al-Obeed, (2010)and El-Gendy,(2012)who reported that gradual increase in fruitful bud percentage of grapevine was in parallel with increasing the irrigation rate.

Table 8. Effect of different levels of irrigation on percentages of bud burst and bud fertility of Flame seedless grapevines during 2016 and 2017

Treatments	Bud burst%		Bud fertility%	
	2016	2017	2016	2017
5000m^3/Fadden(Control)	91.33	92.67	45.839	47.625
4500m^3/Fadden	92.33	94.33	54.160	57.732
4000m^3/Fadden	96.00	96.33	55.357	60.125
3500m^3/Fadden	89.67	90.67	52.982	55.946
New LSD 5%	0.72	0.93	1.12	1.13

2- Vegetative growth parameters, wood ripening and weight of pruning wood:

Data given in table (9)show that vegetative growth traits namely average shoot length, average leaves number per shoot and leaf surface area were significantly affected by different tested levels of irrigation in 2016 and 2017 seasons .The significant value were obtained by vines irrigation with 4000m^3/Fadden followed by irrigation 4500m^3/Fadden followed by3500m^3/Fadden, while control vines gave significant decrease of average shoot length, average leaves number per shoot and leaf surface area in both seasons. The obtained result are in harmony with those reported by Nadal and lampereave (2005),Behairy *et al*.(2009) reported that water stress decreased leaf surface area on grapevine and Mohamed *et al.* (2016)who stated that vegetative growth were significantly affected by different level of irrigation .They found that vines irrigated with1.4EThad the highest values of these parameters followed by vines irrigated with 1.2 ET, while vines irrigated with 1.0 ET ranked the third position.

Regarding wood ripening and weight of pruning wood/ vine, the data in Table (9) reveal significant differences in irrigating application of Flame seedless grapevines cultivar. The significant values were obtained for vines irrigating with 4000m^3/Fadden followed in increasing order by irrigating with 4500m^3/Fadden and irrigating with3500m^3/Fadden, while irrigating with 5000m^3/Fadden(control) gave significant decreased of wood ripening and weight of pruning values in both seasons.These result as general trend were in agreement with the conclusion given with Bravdo and Naor(1997) in Cabernet sauvignon cv., who reported that pruning weight was affected by irrigation due to a differential effect of irrigation on fruit bud differentiation and on vegetative growth .Yuste *et al* . (2005)found that pruning weight of vine increased with an increase in water availability. Abd El-Maksoud (2009) found that wood ripening coefficient decreased by increasing irrigation water.

Table 9. Effect of different levels of irrigation on shoot length, number of leaves/shoot, leaf area, wood ripening and weight of pruning/vine of Flame seedless grapevines during 2016 and 2017

Treatments	Shoot length (cm)		Number of leaves/shoot		Leaf area (cm^2)		Wood ripening%		Weight of pruning/vine(kg)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
5000m^3/Fadden	182.33	190.33	30.33	34.33	138.77	140.97	82.33	90.67	2.20	2.13
4500m^3/Fadden	193.00	193.33	36.33	38.33	149.73	149.70	91.33	93.67	2.80	2.77
4000m^3/Fadden	195.00	201.00	38.33	42.00	152.17	153.23	94.00	95.33	3.07	3.10
3500m^3/Fadden	190.00	192.00	33.33	36.00	140.00	142.27	89.00	92.33	2.63	2.50
New LSD 5%	1.13	1.21	1.57	1.77	1.1	1.2	1.12	1.20	0.15	0.23

3-Yield and physical characteristics of cluster:

The obtained results in Table(10) clearly showed that yield and physical of cluster i.e. average cluster weight, cluster number, average cluster length and cluster width. All parameters significantly affected by different levels of irrigation in the both growing seasons. The significant values in terms of average cluster weight, clusters number, average cluster length and width obtained for the vine irrigation with 4000m^3/Fadden followed by irrigation with 4500m^3/Fadden and irrigation with 3500m^3/Fadden compared with the control(5000m^3/Fadden).These results seemed to be in harmony with the results mentioned by Ferreyra *et al.(*2006)disclosed that different irrigation water amounts were applied, between 40 and 100% crop evapotranspiration (ET).They found that Crimson seedless grapevine yield was increased as the irrigation water rates increased. Mohamed *et al.*(2016) who found that moderate water irrigation represented in vine irrigated with 1.0 ET had recorded the highest water use efficiency which it reflected in achieving an appropriate balance between yield and bunch quality attributes of flame seedless grapevines.The increase of cluster weight and yield observed in irrigation treatment can be interpreted in view of the fact these treatments led to the increase in photosynthetic rate of leaves then cluster enhanced.

Table 10. Effect of different levels of irrigation on yield and physical characteristics of cluster of Flame seedless grapevines during 2016 and 2017

Treatments	Yield /vine (kg)		No. of clusters		Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
5000m^3/Fadden	10.95	12.26	25.67	26.67	426.67	460.00	19.30	20.33	16.00	16.33
4500m^3/Fadden	14.63	15.94	30.33	32.33	482.67	493.33	22.97	23.10	16.67	17.17
4000m^3/Fadden	15.81	18.85	31.00	33.67	510.00	560.00	23.47	24.13	16.83	17.84
3500m^3/Fadden	13.45	15.03	29.67	31.33	453.33	480.00	21.53	21.93	16.27	16.60
New LSD 5%	0.71	0.93	0.54	0.96	11.34	12.22	0.41	0.94	0.12	0.22

4-Physical characteristics of berries:

Data tabulated in Table (11) reveal that physical characteristics of grape berries expressed average number of berries per cluster, average 100 berry weight and average berry diameter were significantly affected by all different tested level of irrigation in both seasons, where found that the significant values of these parameters obtained from vine irrigation with 4000m^3/Fadden followed by vines irrigated with 4500m^3/Fadden, and3500m^3/Fadden, while vine irrigated with 5000m^3/Fadden (control) gave significant decrease in this respect in both seasons. The present data are generally in line with those recorded by Gurovich (2002)who indicated that the weight of berry was influenced in apositive correlation when 75%ETcwas applied by trickle irrigation particularly when compared with 50%ETc.Palma *et al.(*2000)found that water deficit is the best irrigation strategy to achieve equilibrium between vegetative and reproductive activity and good berry quality of *vitisvinifera* grapevines.

Table 11. Effect of different levels of irrigation on physical characteristics of berries of Flame seedless grapevines during 2016 and 2017

Treatments	No .of berries/ cluster		Average 100 berries weight(g)		Average berry diameter (mm)	
	2016	2017	2016	2017	2016	2017
5000m^3/Fadden	219.00	220.00	208.33	214.00	14.33	15.50
4500m^3/Fadden	222.00	224.33	211.33	220.67	17.33	17.93
4000m^3/Fadden	228.33	238.67	216.67	227.67	18.33	19.33
3500m^3/Fadden	220.33	222.00	210.67	218.67	16.83	16.83
New LSD 5%	1.12	1.52	0.64	1.00	0.92	1.00

5-Chemical characteristics of berries:

The different berry characteristics are presented in Table (12). Obtained data indicated that vine irrigation with 4000m^3/Fadden gave significant values on total soluble solids (TSS %), TSS / acid ratio content and anthocyanin of berry skin and the least value of total treatable acidity (%)

These results are in line with those previously stated by Liumi *et al.*(1999), Abd EL-Mksoud (2009)and Shellie,(2005)who investigated the effect of different levels of irrigation(500,1300or2100m^3/ha)on Chardonnay grapevines. They found that TSS was decreased by increasing irrigation level. Moreover, Intrigliolo and castel (2015)found that Overall, irrigation did not significantly affect anthocyanin concentration and total phenolic content of the wines. However, irrigation reduced anthocyanin concentration a similar trend on the variable effect of irrigation among years could be observed for the color intensity of the wine. Nonetheless, irrigation decreased wine color on average over the 6 years.

Table 12. Effect of different levels of irrigation on chemical characteristics of berries of Flame seedless grapevines during 2016 and 2017

Treatments	TSS (%)		Acidity (%)		TSS/acid ratio (%)		Anthocyanin (mg/100g F.W.)	
	2016	2017	2016	2017	2016	2017	2016	2017
5000m^3/Fadden	16.00	16.00	0.43	0.45	37.20	35.55	10.56	10.60
4500m^3/Fadden	17.00	17.00	0.42	0.44	40.47	38.63	10.89	10.90
4000m^3/Fadden	17.50	17.67	0.40	0.40	43.75	44.17	10.93	10.95
3500m^3/Fadden	16.50	16.50	0.41	0.41	40.24	40.24	10.75	10.85
New LSD 5%	0.44	0.48	0.03	0.06	0.21	0.22	0.02	0.04

6-NPK content of leaves (%) and total carbohydrates (%) of canes

Concerning content of N, P and Kin the leaves, the obtained data clear that significantly increased of N, P and K content% when]irrigated with 4000m^3/Fadden in both seasons of study followed by vines irrigated with4500m^3/Fadden comparing to irrigated at 5000m^3/Fadden which had significantly decreased in this respect

Regarding total carbohydrates content (%)it is evident from the obtained data in Table (13) there is a pronounced significant on the average total carbohydrates content in canes with using irrigation with 4000m^3/Fadden. the present results were agreement with (EL-Gendy,2012 and Ali and Abd-EL-Moniem, (2006)who found that the positively effect of irrigation treatments on total carbohydrates % of canes significantly increase with increasing the amount of irrigation water content of total carbohydrates%.

Table 13. Effect of different levels of irrigation on NPK content of leaves (%) and total carbohydrates (%) of canes of Flame seedless grapevines during 2016 and 2017

Treatments	N (%)		P (%)		K (%)		Total carbohydrates (%)	
	2016	2017	2016	2017	2016	2017	2016	2017
5000m^3/Fadden	2.31	2.32	0.29	0.30	2.02	2.03	24.88	25.83
4500m^3/Fadden	2.33	2.34	0.32	0.34	2.04	2.05	26.26	28.5
4000m^3/Fadden	2.36	2.40	0.35	0.37	2.06	2.07	27.82	30.07
3500m^3/Fadden	2.32	2.33	0.30	0.32	2.03	2.04	25.86	26.09
New LSD 5%	0.01	0.03	0.01	0.02	0.01	0.02	0.23	0.24

7- Water use efficiency (WUE)

Result presented in Table (14) showed that water use efficiency (WUE)was significantly affected by different levels of irrigation in 2016 and 2017 seasons of this study. It was found that vines irrigated with 4000m^3/Fadden had significant values of this parameter followed by 4500m^3/Fadden, while 5000m^3/Fadden ranked the third position .On the other hand, vines irrigated with 3500m^3/Fadden had significant decreased in both seasons. Zayan *et al.*(2016)revealed that significant values of WUE and WP were obtained from trees irrigated at level 3 compared to the control which gave the lowest values in both seasons.

Table 14. Effect of different levels of irrigation on water use efficiency(WUE) of Flame seedless grapevines during 2016 and 2017

Treatments	2016	2017
5000m^3/Fadden	2.19	2.55
4500m^3/Fadden	3.18	3.44
4000m^3/Fadden	3.95	4.43
3500m^3/Fadden	3.93	4.39
New LSD 5%	0.01	0.03

CONCLUSION

From the previous results, it can be recommended that irrigation of Flame seedless grapevinesby4000m^3/Fadden/seasons gave promoting shoot length, leaf surface area, leaves number, yield, cluster weight and berry weight as well as enhanced chemicals properties of berries, wood ripping, pruning wood weight, leaf minerals content, total carbohydrates in canes and will increasing farmer income.

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تأثير تقنين كمية ماء الري على النمو والإنتاجية لكرمات عنب الفليم سيدلس تحت ظروف التربة الطينية

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أجرى هذا البحث لمدة ثلاثة مواسم متتالية (2015، 2016، 2017) بهدف تحديد الاحتياجات المائية على النمو والمحصول وجودة ثمار عنب الفليم سيدلس في منطقة أجا التابعة لمحافظة الدقهلية، كانت الكرمات المختارة عمرها سبعة سنوات نامية في تربة طينية، منزرعة على مسافة 2,5X2 متر، وكانت تروى بنظام الري بالغمر ، ومرباه تحت نظام الكردون الرباعي من خلال التدعيم تحت نظام التكاعيب،وتم تقليم الكرمات تقليما دابريا في الأسبوع الثانى من شهريناير بحمولة عيون (56 عين/كرمة)، وكان إجراء التجربة فى الموسم الأول تمهيديا بينما تم أخذ البيانات فى الموسمين الثانى والثالث،وقد تم إجراء أربعة مستويات مختلفة من الرى (5000م^3 (كنترول)، 4500م^3 ، 4000م^3 ،3500م^3/فدان / موسم). أشارت نتائج الدراسة إلى أن الرى عند مستوى 4000م^3/فدان/ موسم سجل أعلى كفاءة استخدام المياه والذىإنعكس بعد ذلك في الحصول على نمو خضرى جيد وزيادة المحصول وتحسين صفات الجودة لكرمات عنب الفليم سيدلس فىكلا الموسمين. ومن النتائج التي تم الحصول عليها، فإنه يمكن التوصية بربكرمات عنب الفليم سيدلس عند مستوى 4000م^3/فدان فى الموسم حيث أعطتهذة المعاملة أفضل النتائج متمثلة فى الحصول على محصول جيد ذو صفات ثمرية عالية الجودة.

الكلمات الدالة: كرمات العنب، الفليم سيدلس، الرى، ظروف التربة