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THE EFFECT OF WATER SHORTAGE AT DIFFERENT STAGES OF FRUIT GROWTH ON THE YIELD AND FRUIT QUALITY IN "DESERT RED" PEACH TREES

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ABSTRACT: This study was carried out during two successive growing seasons 2019 and 2020 on nine years old "*Desert Red*" peach trees (*Prunus Persica L. Batsch*) budded on Nemaguard rootstock. spaced at 4×4 m. trained to an open –vase system and grown in private orchard located at sedy Salem district, Kafrelsheikh Governorate. Subjected to Trees were horticulture practices usually, done in this region. The depth of water table is about 140-160 cm. the orchard soil is classified as clay. Egypt to study the effect of water shortage at different growth stages on some vegetative growth parameters, yield and fruit quality of " *Desert Red* " peach trees. The obtained data showed that, the highest mean values for studied vegetative growth parameters such as shoot length, shoot diameter, leaf area and specific leaf weight, yield (kg/tree – ton/fed.), and some fruit characters (fruit weight, fruit size, fruit length, fruit diameter and fruit shape) were recorded under control treatment (conventional irrigation). Meanwhile, vegetative growth parameters recorded the lowest values under T6 treatment, while the lowest values yield were recorded under T5. Fruit weight, fruit size, fruit length treatment, while the lowest values of yield were recorded under T5. Fruit weight, fruit size, fruit length and fruit diameter recorded the least values with T7 treatment. Concerning, productivity of irrigation water (PIW), whereas the highest values were obtained by T6 treatment, T5 treatment gave the lowest values. Fruit firmness, TSS and anthocyanin content in fruit peel of " Desert Red " peach trees were significantly affected by irrigation treatments, where, T7 treatment recorded the highest values for measured fruit firmness and TSS, while T6 treatment recorded the highest values for anthocyanin. The lowest values for measured fruit firmness, TSS and anthocyanin content were found under control condition (standard irrigation). Hence, we can recommend peach growers to apply T3 Treatment (10.186 m3/tree/year = 2678.92 m3/fed./year) to save 25%of irrigation water, as well as, to obtain about the same yield of control trees.

Key words: "*Desert Red*"peach, water shortage, different growth stages, yield, Fruit quality.

INTRODUCTION

" Desert Red" peach (Prunus Persica L. Batsch) has low chilling requirements. It needs about 150 - 400 hrs blew 7.2oC to break their bud dormancy, In Egypt, the cultivated area of " *Desert Red*" peach cultivar increasing very rapidly in the reclaimed land, especially during the last few years. In order to obtain an abundance of production and high fruit quality of deciduous fruit trees, suitable irrigation water must be available, however in many areas in the world; water resources may be not enough to optimize irrigation and to achieve the maximum yield for the highest reverting. These problems could exacerbated in the future due to this reasons; i) water resources are becoming more limited all over the world and they will not have been sufficient to meet the increasing

demands by 2025 Postel, (1998) reducing irrigation water due to increasing competition with urban and industrial users and economic and social pressures Fereres and Evans, (2006) worldwide, irrigation consumes at least 85% of all water used Jury and Vaux, (2007). Therefore agricultural irrigation will face water scarcity in the near future, so it is very important to understand the effects of water shortage in deciduous fruit trees with the use of techniques that reduce the drought effects. Regulated irrigation deficit is an important technique of saving water and developed to improve control of vegetative growth in high-density orchards to achieve the optimize productivity and high fruit quality. Regulated irrigation deficit is usually applied during the period of slow fruit growth when shoot growth is rapid. Thus, it is beneficial for reducing excessive vegetative growth and nutrient loss through leaching as well as the provision of irrigation water Chalmers *et al*., (1981). However, this technique requires accurate information about the response of deciduous fruit trees to water stress, which depends mainly on growth stages of trees, as will, to determine the periods when fruit trees are less sensitive to stress. So, it is very important for growers know the application periods of irrigation deficit Fereres and Goldhamer, (1990). Many studies such as, Mitchell and Chalmers (1982) and Mitchell *et al*. (1989) found that, water use efficiency, expressed as yield per unit irrigation, increased under regulated irrigation deficit in peach and pears. In this respect, Goldhamer (1999) using regulated irrigation deficit technique on olive, and found, this way save water about 25% without yield decline. Also, many studies have shown that mild water stress applied during the period of slow fruit growth controlled excessive vegetative growth, while maintaining or even increasing yields Mitchell *et al* (1989) on European pear, Ebel *et al*., (1995) on apple, Elmorshedy and Haggag, (1997) and Lopez *et al*., (2008a) on peach and Cheng *et al.,* (2012) on Asian pear

The purpose of this research is to study the effect of periodic deficit of irrigation water at different fruit growth stages of "*Desert Red*" peach on vegetative growth, yield and fruit quality; and to clear the effect of regulated irrigation deficit system on productivity of irrigation water (PIW, kg/m3) .

MATERIALS AND METHODS

This experiment was carried out during the two successive seasons 2019 and 2020 on nine-year-old "*Desert Red*" peach trees (*Prunus Persica L. Batsch*) budded on *Nemaguard* rootstock, planted at 4×4 meters. The selected trees were in a good health condition and uniform in both vegetative growth and fruit load. on Clay soil under drip irrigation characteristics of experimental soil was presented in Tables (1&2). The amounts of irrigation water as liters per tree for each treatment in both seasons are shown in Table (3). Date of full bloom and maturity and fruit development, (Table 4 and fig 1) The complete randomized block design was used, as each treatment was represented by three replicates Twenty one trees were selected in this study and divided randomly into seven groups; each group was subjected to one of the following irrigation treatments:

T1: (Control): conventional irrigation, like practice by the local farmers in the studied region.

T2:Irrigation with 75% of control starting from flowering to 40 days after full bloom (stage I)

T3: Irrigation with 75% of control from 40 to 70 days after full bloom (stage II)

T4:Irrigation with 75% of control from 70 days after full bloom until harvesting (stage III).

T5:Irrigation with 50% of control starting from flowering to 40 days after full bloom (stage I)

T6: Irrigation with 50% of control from 40 to 70 days after full bloom (stage II).

T7: Irrigation with 50% of control from 70 days after full bloom until harvesting (stage III).

The investigated irrigation levels (75 & 50%) were basily calculated upon the conventional supply of irrigation water (control-100% level) during each of the three phonological growth stages (Table 3&4).

Table (1): The mean values of some chemical characteristics of experiment soil:

Soil depth (cm)					(Meq|L) CationsSoluble				Soluble anions (meq|L)		
	PH*	E.C*mmhos\cm	O.M* %	SAR*	Na+	Ca++	Mg++	K+	HCO3-	CL-	SO4-
0-30	8.20	2.29	2.15	4.78	12.30	5.36	4.11	0.15	3.50	14.21	4.21
30-60	8.20	1.78	1.34	3.89	10.89	4.39	4.03	0.16	3.41	12.20	3.86
60-90	7.90	1.75	0.89	3.91	7.	3.28	3.96	0.13	3.15	8.14	4.01
Mean	-	1.94	1.46	4.19	10.37	4.34	4.03	0.14	3.35	11.51	4.02

pH*: was measured in 1:2.5 (soil water suspension) SO4-was calculated by difference between cations and anions, EC*: was measured in the extract of soil paste at 25 C0,OM*:Organic Matter, SAR*: Sodium absorption ratio

Table (2): The mean values of some soil physical characteristics and water contants :

Soil depth (cm)	Particle size Distribution			Textural Class	Soil moistureCharacteristic			Buek demsity (kg\m3)
	Sand	Silt	Clay		Fc* %	PWP* %	AW* %	
0-30	31.1	14.4	54.5	Clay	22.6	18.3	9.7	2.34
30-60	27.6	16.1	56.3		35.4	22.7	11.4	2.45
60-90	29.7	12.9	57.4		40.3	26.3	12.8	3.11
Mean	29.46	14.46	53.06		32.7	22.43	11.3	2.63

Fc*: Field capacity , WP*: wilting point , AW: available wat

Table (3): Combination of irrigation treatments applied during three fruit growth stages of " *Desert Red*" peach over two season.

Fruit growth stages	Irrigation treatments						
	T1	T2	T3	T4	T5	T6	T7
1	100	75	100	100	50	100	100
11	100	100	75	100	100	50	100
111	100	100	100	75	100	100	50
Total(m3\tree\year	13.582	10.186	10.186	10.186	6.791	6.791	6.791
Seasonal water applied (m3/fed.)	3572.06	2678.92	2678.92	2678.92	1786.03	1786.03	1786.03

T1 (control): irrigated 100% at all fruit stages .

T2,T3 and T4: irrigated 75% at fruit growth stages 1,11and111 respectively.

T5,T6 and T7: irrigated 50% at fruit growth stages 1,11and111 respectively.

Fruit growth stages. stage1: flowering-40 days, stage11:40 -70 days and stage111: 70 days harvest time.

Table (4): Date of fuil bloom and maturity and fruit developmentof "*Desert Red*" peach trees in 2019-2020 season.

Treatment	Date ofBloom		Date of Maturity		FDB* days	
	2019	2020	2019	2020	2019	2020
T1	Jan31	Jan31	May20	May20	110	110
T2	Feb3	Feb2	May19	May18	111	112
T3	Feb1	Feb3	May17	May19	113	111
T4	Feb3	Feb2	May19	May18	111	112
T5	Feb1	Feb2	May17	May18	113	112
T6	Feb3	Feb1	May19	May17	111	113
T7	Feb2	Feb2	May18	May18	112	112

FBD*fruit development period (No. of days from full bloom to maturity).
T1 (control): irrigated 100% at all fruit stages .
T2,T3 and T4 : irrigated 75% at fruit growth stages 1,11and111 respectively.
T5,T6 and T7:irrigated 50% at fruit growth stages 1,11and111 respectively.
Fruit growth stages.. stage1: flowering-40 days, stage11:40 -70 days and stage111: 70 days harvest time.

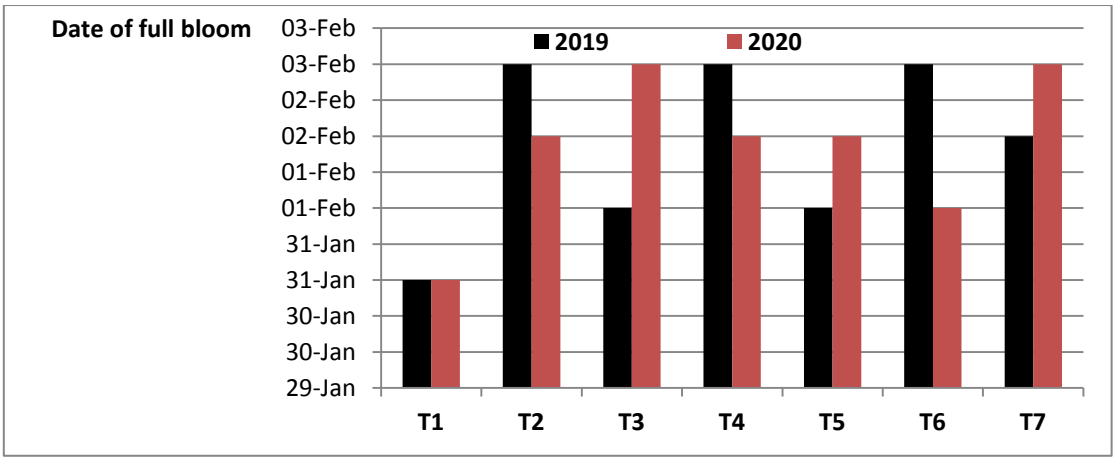

Fig (1): Date of fuil bloom of "*Desert Red*" peach trees in 2019-2020 season.

The effect of the previous treatments was studied byevaluating their influence on the following parameters:

1- Productivity of irrigation water (PIW, kg/m3).

Productivity of irrigation water (PIW) was calculated by the following equation according to Ali *et al*., (2007).

$$PIW^{*}=Y^{*}/Wa^{*}$$

Where:
***PIW: Productivity of irrigation water (kg fruits /m3 of water),**
***Y: fruit yield (kg/fed.)**
***W a: Water applied to the field (m3).**

2- Vegetative parameters:

At the end of each growing season, the selected shoots were used for the following measurements: the average shoot length cm, shoot diameter cm, leaf area (cm^2), leaf/fruit ratio and specific leaf weight (leaf dry weight/ cm^2).

3- Fruit yield:

Four main branches at different directions of each tree were chosen and tagged in the beginning of june of the two experimental seasons, the number of flowers was recorded calculated according to the following equation:

Yield peach tree (kg/tree) and the yield peach/ fed in ton were estimated at harvesting time (2rd week of June).

4- Fruit quality:

At harvest, ten fruits were randomly taken from each replicate for determination of both physical and chemical characteristics: :

A- Fruit physical characteristics:

Fruit weight (g), fruit size (cm3), fruit dimensions (fruit length and diameter in, mm) and fruit was shape index (fruit length /fruit diameter ratio) were. Fruit firmness (I b/inch2). Adjusted firmness determined with the equation of Bartram (1986).

B- Fruit chemical characteristics:

Total soluble solids (TSS %) were determined using a hand refracto-meter, percentage of titra table acidity in fruit juice (%) was determined according to AOAC (1995), Ascorbic acid (VC) as mg/100g fresh weight was determined by 2,6-dichlorophenol indophenols according to A.O.A.C (1980) and anthocynins were determined as mg/100g fresh weight of peel according to the method described by Rabino *et al*., (1977).

5- Soil physical and chemical properties:

The studied physical properties and soil water constants were determined according to the method described by Klute, (*1986*). The studied chemical properties, were determined according to the method described by Jackson, (1973)

6- Statistical analysis:

The results were statistically evaluated by analysis of variance. Comparisons of means were doneat $p \leq 0.05$ with the Duncan Multiple Range test.

RESULTS AND DISCUSSION

A. Vegetative growth parameters:

The effects of periodic deficit of irrigation water at different fruit growth stages of " *Desert Red*" peach on some vegetative growth parameters are presented in (Table 5 and fig 2). The obtained data showed that, the vegetative parameters such as shoot length, shoot diameter, leaf area, specific leaf weight and Leaf /fruit ratio were significantly affected in the two growing seasons by the studied treatments. The highest shoot length, shoot diameter, leaf area as well as specific leaf weight values were belonged to the control treatment T1 ' T3 andT4, which irrigated by water at 100% level in all fruit growth stages followed by trees irrigated with 75% of control starting from 70 days after full bloom until harvesting –stage III (T4 treatment). While T6 treatment (irrigation with 50% of control starting from 40 to 70 days after full bloom –stage II) achieved the lowest values in this respect. Generally, the effects of periodic irrigation deficit on vegetative growth were dependent on the time and the water shortage rate, therefore it was observed that deficit irrigation treatments in a second period (Stage II) such as T6 (irrigation with 50% of control starting from 40 to 70 days after full bloom) had more negative effects on vegetative growth compared to irrigation with 75% of control and two other periods

(Stage I and Stag III). The reason may be that stage IIinclude both rapid shoot growth and spring root growth, accordingly, water deficit in this stage has a negative impact on vegetative growth Boland *et al*., (2002). The effects of regulated irrigation deficit on vegetative growth were studied by many researchers such as, Elmorshedy and Haggag (1997) and Cheng *et al.,* (2012), they reported that, the vegetative growth is influenced by the time and rate of water shortage.

Table (5): Effect of irrigation deficit different fruit growth stages on some vegetative growth parameters of "*Desert Red*" peach trees in 2019-2020 seasons

Treatment	Shoot length (cm)		Shoot Diameter(cm)		Leaf Area(cm^2)		Specific leaf weight Mg\ cm^2		Leaf \fruit Ratio	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1	47.72a	51.41a	0.83a	0.84a	40.61a	40.92a	0.301a	0.304a	57.15a	60.61a
T2	46.51b	48.32b	0.82b	0.79b	38.02b	38.31b	o.293b	0.297b	52.10d	55.17b
T3	45.07c	46.51c	0.72c	0.76c	37.71b	37.11c	0.247c	0.255c	50.03c	51.15c
T4	47.31a	51.63a	0.83a	0.80a	40.11a	40.72a	0.311a	0.3o2a	60.60a	57.81a
T5	43.32d	44.72d	0.69d	068d	36.47d	36.78d	0.238d	o.235d	51.11c	50.32c
T6	40.35e	42.91e	0.66e	0.67e	35.92c	35.17e	0.202e	0.219e	45.73e	45.11d
T7	42.72f	42.53f	0.70c	0.78b	39.64a	37.12d	0.284b	0.293b	53.11b	54.18b

T1 (control): irrigated 100% at all fruit stages .
T2,T3 and T4 : irrigated 75% at fruit growth stages 1,11and111 respectively.
T5,T6 and T7:irrigated 50% at fruit growth stages 1,11and111 respectively.
Fruit growth stages.. stage1: flowering-40 days, stage 11:40 -70 days and stage111: 70 days harvest time.

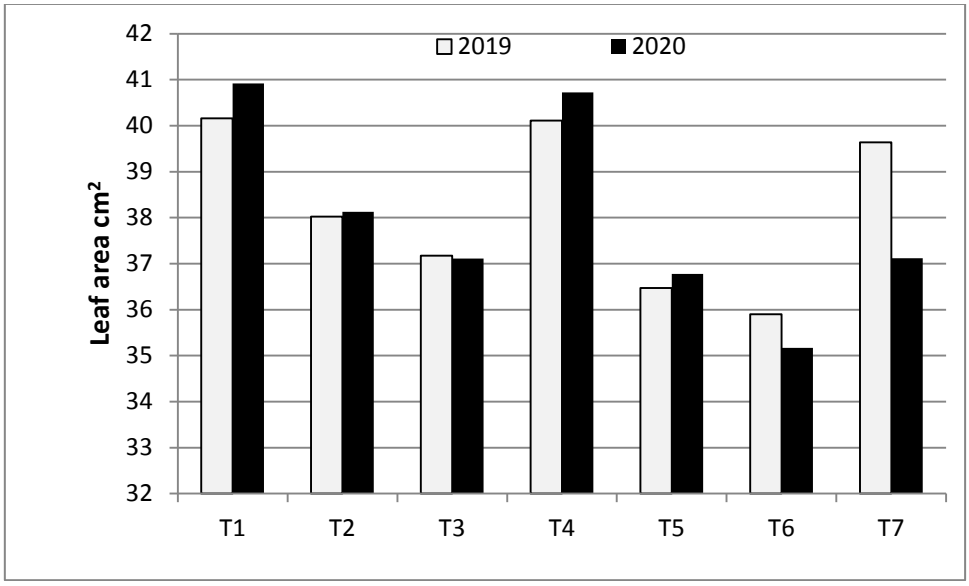

Fig (2): Effect of irrigation deficit different fruit growth stages on Leaf area cm2 of "*Desert Red*" peach trees in 2019-2020 seasons.

B. Fruit yield:

It is clear from the date of Table and fig (6), the influence of irrigation shortage at different fruit growth stages on yield of "Desert Red" peach trees, explained, mostly periodic deficit of irrigation water significantly decreased fruit yield in the two growing seasons. T5 treatment (trees irrigated with50% of control starting from flowering to 40 days after full bloom – stage I) gave the least yield as compared to other treatments in both seasons. The yield obtained from T3 treatment (trees irrigated with 75% of control from 40 to 70 days after full bloom –stage II) was found to be at par with that obtained from control in the two growing seasons, so the trees irrigated with 75% of control achieved the least effect from those

irrigated with 50% in the three stages. These results may be probably due to the different growth rates of apples during the three development stages. Stage I (cell division): the number of cells of the fruit is determined and irrigation is critical at this stage, accordingly, soil moisture must be readily available. Stage II: involves both rapid shoot growth and spring root growth, the fruit development is slow. Stage III (cell enlargement): in this stage the size of the fruit increases rapidly, shoots and roots growth is slow and bud formation for the following season' begins, irrigation is critical at this stage and soil moisture should be readily available Boland *et al*., (2002) and Atay, (2007). Accordingly, the influence of reduction of irrigation at the period from 40 to 70 days after full bloom (stage II) was less negatively on yield and fruit quality than the other two periods (stage I) had a negative effect on the yield.

C. Productivity of irrigation water (PIW):

Regarding productivity of irrigation water (PIW), the values studied here and above mentioned parameters which were affected by periodic deficit of irrigation water (Table 6 and fig 3). The highest values were recorded under T6 treatment (Irrigation with 50% of control from 40 to 70 days after full bloom –stage II) which were 2.316 and 2.368 (kg/m3) in 2019& 2020 seasons, respectively. Meanwhile, the lowest values were obtained by T5 treatment Irrigation with 50% of control starting from flowering to 40 days after full bloom values of productivity of irrigation water (PIW) stage I) which were 1.878 and 1.807 (kg/m3) in the2019and 2020 seasons, respectively. Generally, the can be descended in order T6> T3> T4>control> T7> T2> T5 in the first season and T6> T3> T4> T7 > control > T2> T5 in the second season, this means that, under deficit irrigation conditions in the stage II(40 to 70 days after full bloom), the values of PIW increased comparing with conventional irrigation (control 100%), meanwhile, irrigation deficit conditions at stage Irecorded the lowest values. Increasing productivity of irrigation water under water stress, especially, in stage II may be due to the slowing of fruit growth and decreasing the amount of water consumptive use in this stage Kucukyumuk *et al*., (2013). Many studies such as Chalmers *et al*., (1981); (Marsal and Girona, (1997) and Cheng *et al*., (2012) reported that regulated irrigation deficit technique is only applied during periods in which the fruit growth is less sensitive to water shortage is an important water-saving technique and increasing productivity of irrigation water.

Table (6): Effect of irrigation deficit different fruit growth stages on yield of "*Desert Red*" peach trees in 2019-2020 seasons

Treatment	No.of fruit/ tree		Yield/tree(kgm)		Yield/fed (ton)	
	2019	2020	2019	2020	2019	2020
T1(control)	429b	420b	40.21ab	40.42ab	10.31b	10.36b
T2	400c	389c	36.20c	36.35c	9.52c	9.56c
T3	453a	446a	44.67a	43.30a	10.98a	10.88a
T4	440a	439a	40.70a	41.57a	10.70a	10.63a
T5	397d	365d	32.55d	32.35d	8.56d	8.50d
T6	324e	266e	28.83e	23.43e	7.58e	6.16e
T7	409c	411c	36.17c	36.23c	9.43c	9.52c

T1 (control): irrigated 100% at all fruit stages .
T2,T3 and T4 : irrigated 75% at fruit growth stages 1,11and111 respectively.
T5,T6 and T7:irrigated 50% at fruit growth stages 1,11and111 respectively.
Fruit growth stages.. stage1: flowering-40 days, stage 11:40 -70 days and stage111: 70 days harvest time.

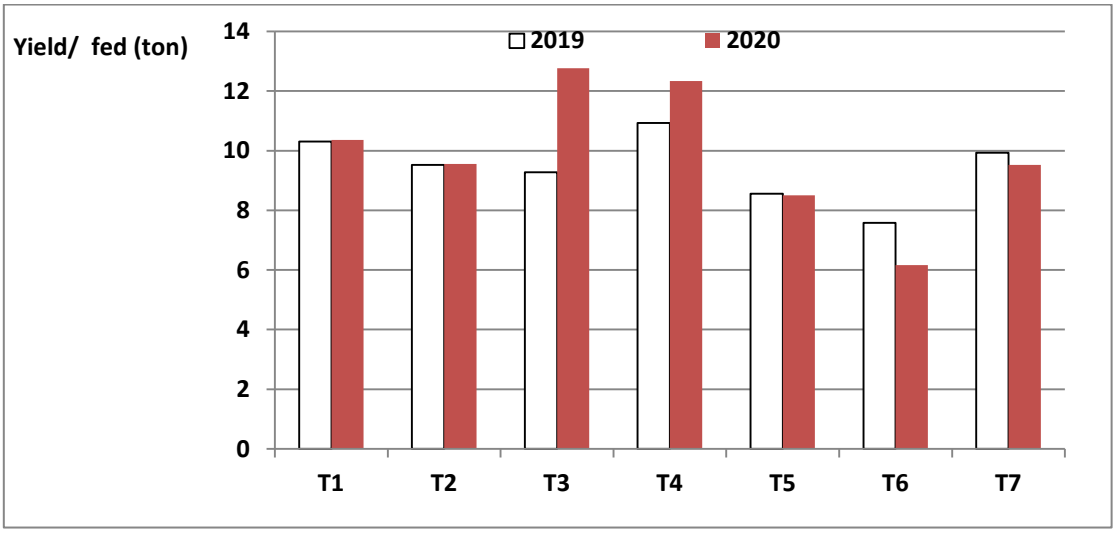

Fig (3): Effect of irrigation deficit different fruit growth stages on yield/fed (ton) of "*Desert Red*" peach trees in 2019-2020 seasons

D- Fruit characteristics:

Data in (Table 7 and fig 4) showed that, all irrigation deficit treatments had a significant effect on fruit characters in terms of fruit weight, size, length and diameter of "*Desret Red*" peach as compared to control treatment in both seasons. Decreasing mentioned fruit measurements were different based on the level and the time of irrigation water. While the highest values were obtained with control, T7 (irrigation with 50% of control from 70 days after full bloom until harvesting- stage III) had the lowest values. Irrigation with 50% and 75% of control in different stages had different effects on studied fruit measurements. Under the periodic control in different stages had different effects on studied fruit measurements. Under the periodic irrigation deficit treatments, the highest values were observed in T3 treatment (irrigation with 75% of control from 40 to 70 days after full bloom stage II), while the lowest values were observed in T7 (irrigation with 50% of control from 70 days after full bloom until harvesting- stage III) and T5 (irrigation with 50% of control starting from flowering to 40 days after full bloom- stage I). May be this is due to the more soil moisture affects the amount of water absorbed by roots, which reflects on apple fruit characters. Decreased mentioned fruit measurements were different based on the level of deficit irrigation water and periodic irrigation treatments. O'Connel and Goodwin (2007), Zaliha and Singh (2009b) and Kucukyumuk *et al*., (2013) on apple, they reported that fruit diameter decreased in irrigation deficit applications compared to none irrigation deficit. The same trend was observed on fruit length and fruit weight. However, all irrigation deficit treatments decreased fruit weight, fruit size, fruit length and fruit diameter, it was observed that irrigation with 75% of control from 40 to 70 days after full bloom (T3 treatment) and control (Conventional irrigation) resulted in fruit weight, fruit size, fruit length and fruit diameter close to each other. As for fruit shape the results showed a significant effect in the first season, whereas the highest value recorded T7, while the lowest with T6 treatment.

Table (7): Effect of irrigation deficit different fruit growth stages on fruit weight, volume, length diameter and shape of "*Desert Red*" peach trees in 2019-2020 seasons.

Treatment	Fruit weight		Fruit size(cm^2)		Fruit length (mm)		Fruit dimeter (mm)		Fruit shabe (L/D)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1	91.41a	93.86a	89.94a	91.75a	5.47d	5.58e	5.89b	6.00e	0.93b	0.96a
T2	90.51b	91.11b	79.82c	80.63c	5.36f	5.86c	5.58e	6.10d	0.96a	0.96a
T3	92.71a	93.16a	84.72b	86.63b	5.41e	5.85d	5.64d	6.16b	0.96a	0.95a
T4	92.52a	94.71a	84.16b	85.71b	5.53c	5.96b	5.76c	6.21c	0.96a	0.96a
T5	88.70d	88.65d	81.65d	82.17d	5.87b	6.17a	6.18a	6.56a	0.95a	0.94a
T6	89.01c	88.11c	80.65c	80.91c	6.07a	6.12a	6.39a	6.58a	0.95a	0.93a
T7	89.51ab	90.17b	77.56e	79.16e	5.79c	5.95b	6.09b	6.31b	0.95a	0.95a

T1 (control): irrigated 100% at all fruit stages .
T2,T3 and T4 : irrigated 75% at fruit growth stages 1,11and111 respectively.
T5,T6 and T7:irrigated 50% at fruit growth stages 1,11and111 respectively.
Fruit growth stages.. stage1: flowering-40 days, stage 11: 40 -70 days and stage111: 70 days harvest time.

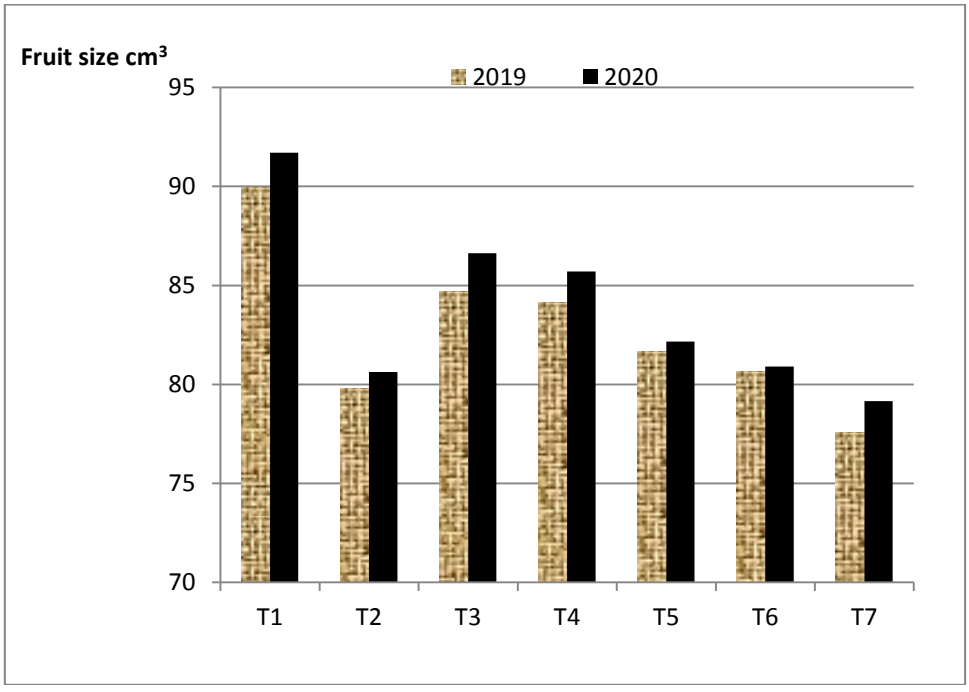

Fig (4): Effect of irrigation deficit different fruit growth stages on Fruit size cm3 of "*Desert Red*" peach trees in 2019-2020 seasons.

E- Fruit physical and chemical characters:

From data in (Table 8 and fig 5), it can be noticed that, tested irrigation treatments had a significant effect on fruit firmness in both experimental seasons. The highest harvesting - stage III (T7 treatment), on the other hand, fruit firmness values were obtained from trees irrigated with 50% of control from 70 days after full bloom until conventional irrigation (control – T1) had the least values. Irrigation deficit (75% and 50% of control) at different stages had different effects on fruit firmness. Among periodic irrigation deficit treatments, forasmuch

T7 (irrigation at 50% of control from 70 days after full bloom until harvesting time -stage III) had the highest fruit firmness, T3 treatment (irrigation at 75% of control from 40 to 70 days after full bloom –stage II) gave the lowest values. Similarly, the shortage of irrigation water treatments increased fruit firmness, as previously decided by other authors Zaliha and Singh, (2009 a); Kucukyumuk *et al.*, (2013). Inverse linear relation ships were determined between fruit size and fruit firmness, when fruit size increased fruit firmness decreased, this is due to higher cellular density Ebel and Proebsting, (1993), so that when adjusted firmness was calculated to remove the effect of size, there were no significant differences in firmness between irrigation treatments As for to the TSS results, a significant differences were found among the treatments. The highest TSS value was obtained from T7 treatment whereas the lowest TSS value was determined in the control (conventional irrigation). Deficit irrigation especially in stage III (cell enlargement stage) increased TSS values. These results agreed with those mentioned by Mpelasoka *et al.* (2001) and Leib *et al.* (2006) who found that irrigation deficit applications increased total soluble solids (TSS) of peach fruits. In addition, Zaliha and Singh (2009a) reported that, TSS affected by the rate and the time of irrigation water. These results explained that different water deficit application periods led to different TSS values. According to the acidity, data did not show significant differences between control and most the second one. treatments in the first season and with all treatments in Regarding to the effect of irrigation deficit at different growth stages on anthocyanin content of" *Desert Red*" peach fruits, data presented in Table 8 and fig (5) revealed growing seasons. Irrigation deficit applied (75% and50% from control) at different stages had effects on anthocyanin content compared to the control (conventional irrigation - T1). The highest anthocyanin content was obtained from irrigation with 50% of control from 40 to 70 days after full bloom – stage II (T6 treatment), whereas the lowest value belonged to the control. These results can be due to the effects of water shortage on the shoot length, especially in stage II, which allowing more light to penetrate the canopy thus improving the coloring in the fruits accordingly, the highest anthocyanin contents were found in T6, T5 and T3 treatments. Improving the coloring in the peach fruits by regulated deficit irrigation decided by many of researchers such as, Mills *et al*. (1997); Zaliha and Singh (2009a) and Kucukyumuk *et al*., (2013).

Table (8): Effect of irrigation deficit different fruit growth stages on physical and chemical characters of "*Desert Red*" peach trees in 2019-2020 seasons

Treatment	TSS%		Acidty%		V.C		Firmness fruit lb/inch^2		Anthocyanin Mg\gF.W.T	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1	11.56c	11.47d	1.10b	1.08c	9.47a	9.44b	11.65c	12.29a	15.62b	15.69b
T2	10.53d	10.50c	1.11b	1.09c	9.33c	9.41b	11.62c	11.61c	15.71a	14.98c
T3	11.71a	11.56a	1.12a	1.09b	9.43a	9.54a	12.76a	11.56d	15.71a	15.61d
T4	10.61b	10.73b	1.06d	1.11a	9.43a	9.40b	12.34a	12.71a	15.62b	15.56e
T5	10.17f	10.21f	1.01f	1.01d	8.08e	8.06e	11.61c	11.52e	13.78e	13.72f
T6	10.56c	10.46d	1.07c	1.11a	8.15d	9.33c	11.71b	11.63b	15.71a	15.78a
T7	10.51e	10.37e	1.05e	1.08c	9.61a	9.49a	12.61a	12.17a	15.62a	15.62c

T1 (control): irrigated 100% at all fruit stages .
T2,T3 and T4 : irrigated 75% at fruit growth stages 1,11and111 respectively.
T5,T6 and T7:irrigated 50% at fruit growth stages 1,11and111 respectively.
Fruit growth stages.. stage1: flowering-40 days, stage 11: 40 -70 days and stage111: 70 days harvest time.

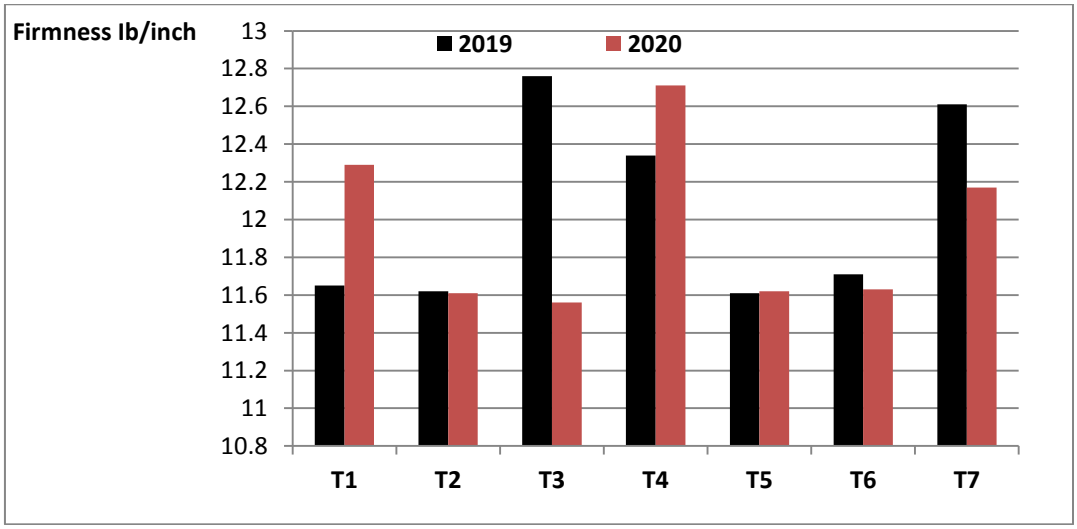

Fig (5): Effect of irrigation deficit different fruit growth stages on firmness ib/inch l of "*Desert Red*" peach trees in 2019-2020 seasons

CONCLUSION

According to the above mentioned results, it could be noticed that short-term (40 days) irrigation water deficit during the growth season decrease vegetative growth and yield but saving irrigation water. The water deficit treatments between the 40 to 70 days after full bloom (T3 & T6) not only saved irrigation water but also have a least negative impact on yield and fruit quality. The fruits that have good coloring were obtained from irrigation deficit treatments compared to the conventional supply of irrigation water (control). To increase the use efficiency of irrigation water resources, especially in case of limited water, T3 followed by T6 treatments may be recommended to peach farmers because it not only saves water by 25 and 50%, but also have a least negative effect on yield and fruit quality.

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تأثير النقص المائي عند المراحل المختلفة لنمو الثمارعلى محصول وجودة الثمار في اشجار الخوخ صنف "دزرت رد"

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الملخص العربى

اجريت هذه الدراسة خلال موسمي٢٠١٩و٢٠٢٠ وذلك في مزرعة خاصة بناحية مركز سيدي سالم محافظة كفر الشيخ– مصر بهدف دراسة تأثير النقص المائي عند المراحل المختلفة لنمو الثمارعلي بعض الصفات الخضرية والمحصول وجودة الثمار في أشجار الخوخ صنف "دزرت رد" وكان عمر الأشجار ٩ سنوات ومسافات الزراعة ٤×٤ متر والاشجار بحالة جيدة. والتصميم الاحصائي المستخدم في الدراسة قطاعات كاملة العشوائية في ثلاث مكررات ولذلك تم اختيار ٢١ شجرة قسمت الي سبع مجموعات كل مجموعة نفذت عليها واحدة من المعاملات الاتية :

١- المعاملة الاولي الكنترول ري عادي كما يمارسه المزارع في الحقل

٢- المعاملة الثانية الري عند ٧٥% من الكنترول من بداية من التزهير حتي ٤٠ يوم من التزهير الكامل

٣- المعاملة الثالثة الري عند ٧٥% من الكنترول خلال الفترة من ٤٠ يوم الي ٧٠ يوم من التزهير الكامل

٤- المعاملة الرابعة الري عند ٧٥% من الكنترول خلال الفترة من ٧٠ يوم من التزهير الكامل حتي وقت الحصاد

٥- المعاملة الخامسة الري عند ٥٠% من الكنترول بداية من التزهير حتي ٤٠ يوم من التزهير الكامل

٦- المعاملة السادسة الري عند ٥٠% من الكنترول خلال الفترة من ٤٠ الي ٧٠ يوم من التزهير الكامل

٧- المعاملة السابعة الري عند ٥٠% من الكنترول خلال الفترة من ٧٠ يوم من التزهير الكامل حتي وقت الحصاد

ويمكن تلخيص النتائج المتحصل عليها كما يلي:

اعلي متوسطات القيم بالنسبة للصفات الخضرية (طول الفرع – قطر الفرع – مساحة الورقة – الوزن النوعي للورقة– عدد الاوراق / ثمرة) سجلت تحت معاملة الكنترول والمعاملة الثالثة والمعاملة الرابعة اما بالنسبة للمحصول فكانت اعلي متوسطات للمحصول (كجم/شجرة– طن /فدان– وعدد الثمار/شجرة) سجلت تحت المعاملة الثالثة والمعاملة الرابعة اما أعلي متوسطات للصفات الثمرية (وزن الثمرة– حجم الثمرة– طول الثمرة – قطر الثمرة – شكل الثمرة)سجلت تحت معاملة الكنترول والمعاملة الثالثة.

فى حين ان اقل القيم بالنسبة للصفات الثمرية سجلت تحت معاملة الري السابعة.

و بالنسبة للصفات الثمرية (وزن الثمرة– حجم الثمرى– طول الثمرة – قطر الثمرة) بالنسبة لانتاجية وحدة المياة المستهلكة والمضافة سجلت اعلي قيم تحت معاملة الري الثالثة ومعاملة الري السادسة ولكن اقل القيم سجلت تحت معاملة الري الخامسة.

و بالنسبة للصفات الفيزيائية والكيميائية للثمار تأثرت كل من صلابة الثمار و TSSوشكل ومحتوي الثمار والتي زادت تحت ظروف معاملة الري الثالثة.

وكذلك محتوي قشرة الثمار من صبغة الانثوسيانين زادت تحت ظروف معاملة الري الثالثة ومعاملة الري السادسة.

بينما كانت اقل القيم بالنسبة لصلابة الثمار وTSS ومحتوي قشرة الثمرة من صبغة الانثوسيانين تحت ظروف معاملة الكنترول .

ولم تظهر نتائج تقليل الري حتي ٧٥%خلال الفترة من ٤٠يوم حتي ٧٠ يوم من التزهير الكامل "المعاملة الثالثة" (١٨٦و١٠ متر٣/شجرة /سنة= ٩٢و٢٦٧٨ متر٣/ فدان) اي فرق عن كمية الري المعطاة لاشجار معاملة االكنترول (٥٨٢و١٣متر٣/شجرة /سنة= ٠٦و٣٥٧٢متر٣/ فدان) ولم تظهرفروق معنوية مع معاملة رى الكنترول في عقد الثمار وكمية المحصول وكفاءة استخدام مياة الري.

لذلك يوصي بتقليل الري حتي ٧٥%خلال الفترة من ٤٠يوم حتي ٧٠ يوم من التزهير الكامل "المعاملة الثالثة" وذلك لتوفير ماء الري بنسبة ٢٥%.

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