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Enhancing the Productivity of Early Grande Peaches under Northern Sinai Conditions via Supplemental Irrigation and Organic Fertilization

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Abstract: This study was carried out during two successive seasons (2009/2010 and 2010/2011) on ten years old of Early Grande peach trees. All trees are grown in a sandy soil that budded on non-bitter almond rootstock planted at 5 x 5 meters under rainfall condition in irrigation. Fifty four experimental trees, that grown in a private orchard at El Hosinat, Rafah, North Sinai Gov., Egypt, were chosen of normal growth and uniformly in shape and size to apply this study. The experimental design was spilt plot design, whereas, the main plot was supplemental irrigation treatment (rainfall only, 10 mm + rainfall and 20 mm + rainfall per feddan) and the sub-main plot was organic fertilizer treatment (0, 25 and 50 kg/tree of olive solid waste). The obtained results cleared that both supplemental irrigation and organic fertilization significantly enhanced the most vegetative growth and yield of Early Grande peaches. In addition, 20 mm supplemental irrigation with 50 kg/tree organic fertilization produced the highest vegetative growth, yield and fruit quality, as well as leaf minerals content. *Finally,* no significant differences were found, in the most characteristics under study, due to using 50 kg/tree organic with 10 or with 20 mm water over rainfall in the two seasons.

Key words: Supplemental irrigation · Organic Fertilization · Early Grande – Peach – Growth – Yield · Fruit Quality · Northern Sinai Conditions

INTRODUCTION

Peaches (*Prunus Persica* L.) are native to family Rosaceae. They were early cultivated in China since approximately 4000 years ago from it speeded world wide. In Egypt, Peach acreage increased rapidly to reach in 80609 feddan [1]. This rapid extension is dedicated chiefly to the availably of low chilling cultivars high due to their early harvest with low water requirement, high economic value and good potential for exportation.

Northern Sinai one of the focus points of peach cultivation, is a semi-arid region with a total precipitation of about 200 mm/year concentrated chiefly in January, February and March [2]. Average production in this region declined from 3.14 ton/feddan in 2007 to 1.64 ton/ feddan in 2010 [1]. Previous investigations by Girona *et al*.[3] declared higher precipitation requirements with more spreaded period. Also, Kassem and Marzouk [4] painted out that the nutritional status of trees growing at that region were towards the inadequate levels. These findings might verify the declining productivity in this region.

Peach trees tend to have high water requirements compared with other fruit trees [5]. Therefore, peaches evolved under conditions of abundant water and are therefore not very water-conservative or resistant to water stress [6]. Productivity in terms of quality, quantity and vegetative growth were mostly affected with irrigation which turns up available water to the optimum [7-9]. Fulfilling the water equipments of crops that are rain fed by irrigation was termed supplemental irrigation [10]. This irrigation enhanced the crop productivity markedly [8 and 9].

Enhancing the nutritional status of trees in crucial tool for increasing productivity in terms of quality and quantity [11]. Organic fertilizations an important tool in this respect due to its multiple effects as a foundation for clean agriculture, sustainable agriculture, soil condition and a source of slow release fertilizers [12-14]. Olive solid waste which is byproduct of olive oil extraction considered an organic fertilizer source [15]. That significantly increased soil total organic nitrogen content and soil fertility [16].

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Therefore, the main target of this study is to examine the effect of supplemental irrigation, organic fertilizer treatments on vegetative growth, physical, chemical fruit characteristics and maximum productivity with high fruit quality of Early Grand peach trees under Northern Sinai conditions.

MATERIALS AND METHODS

This study was carried out during two successive seasons (2009-2010 and 2010-20011) on ten years old Early Grande peach trees (*Prunus persica* L.) budded on bitter almond (*Prunus amygdalus* L.) rootstock. Trees were grown in a private orchard at El Hosinat, Rafah, North Sinai Governorate. They were planted at 5 x 5 meters in sandy soil with very low levels of organic matter and nutrients (Table 1). The trees were vase trained, rain fed with around 200 mm\year, unfertilized and subjected to usual cultural practices.

Fifty four trees were considered for each season. Trees were as much as possible of uniform vigour and bud load. The experimental design was a split plot, where irrigation treatments were in the main plot (rain fed only, rain fed + 10 mm supplemental irrigation/feddan or rain fed +20 mm supplemental irrigation/feddan). Supplemental irrigation treatments were divided into 8 equal doses added manually as one dose per week during April and May. Organic fertilization treatments were sub main plots (0, 25 or 50 kg olive solid waste\tree). Olive solid waste (Table 2) was added in mid December in two trenches (25 m deep, 1 m long and 25 cm wide) at both sides of trees row. Each treatment was replicated 3 times with two trees acting as a replicate.

The Following Parameters Were Assessed During the Study

Average Length of New Shoots: Was measured at growth cessation (mid-September).

Leaf Total Chlorophyll Content: The chlorophyll concentration per unit leaf area was estimated in the field using a SPAD 502 meter (Minolta Co., Osaka, Japan). Thirty leaves per tree selected from the middle of bearing shoots located all around the crown, were measured with SPAD to obtain average leaf chlorophyll of the outer part of the tree canopy. Measurements were carried out at the beginning of May during both seasons of the study.

Leaf NPK Content: On the first week of July of both seasons, 20 mature leaves from the middle portion of current year shoots of each replicate tree were taken from third to fifth leaf from the base of the shoots and then washed with tap water followed by distilled water to remove any residues that might affect the results [17].

Table 1: Soil mechanical and chemical analyses of the investigated peach orchard at Rafah region in North Sinai Governorate.

		Soil depth (cm)		
Soil properties		0-15	15-30	30-45
Mechanical analysis				
Coarse sand %		0.30	25.17	25.20
Fine sand %		98.50	65.73	65.70
Silt %		1.45	1.84	1.80
Clay %		2.64	7.26	7.30
Soil texture		Sandy	Sandy	Sandy
Chemical analysis				
Cations	Ca^{++}	2.36	1.90	2.01
($meq.l^{-1}$)	Mg^{++}	0.09	1.42	1.38
	Na^{+}	0.35	2.07	0.86
	K^{+}	0.03	0.21	0.34
Anions				
($meq.l^{-1}$)	$CO3^{-}$	-	-	-
	$HCO3^{-}$	0.87	2.50	2.60
	Cl^{-}	1.05	1.70	1.61
	$SO4^{-}$	1.20	1.40	0.38
E.C ($dS.m^{-1}$)		0.31	0.56	0.46
pH		7.81	8.50	8.70
CaCO3		1.45	4.21	4.03

Table 2: Chemical analysis of olive solid waste compost that used in the study during both seasons.

Parameter	value	Parameter	value
Moisture %	11.5	Total K %	0.62
Organic matter %	41	Total Ca %	0.18
pH (1:10)	7.2	Total Mg %	0.23
EC (ds/m)	3.2	Total Fe (ppm)	624
C/N ratio	12.3:1	Total Mn (ppm)	38
Total N %	1.54	Total Zn (ppm)	40
Total P %	0.58	Total Cu (ppm)	24

Their fresh weight was determined and then they were oven dried in a ventilated oven at 70 C till a constant weight. Samples were weighted and ground, with porcelain mortar and pestle and were used for the determination of N, P and K. Nitrogen percentage was estimated by micro-keldahl according to Pregel [18], phosphorus percentage was determined using Atomic Absorption Spectrophotometer Perkin Elmer-3300 according to Chapman and Pratt [19], potassium was estimated according to Brown and Lilleland [20].

Yield and Fruit Quality Measurements:

Total yield (kg\tree): Was estimated by weighting all fruits per tree at harvest time.

Fruit Physical Characteristics: A representing sample of 20 mature fruits was harvested from each considered tree for determining average fruit weight (g) and firmness (Lb/inch²) using pentometer (pressure tester).

Fruit Chemical Characteristics: Juice total soluble solids percentage (TSS %) was determined by using a hand refractometer [21], total soluble sugars percentage as described in AOAC [21] and titratable juice acidity percentage (as malic acid) [21].

Statistical Analysis: The experimental design was split plot with three replicates with two trees of each. The obtained data was tabulated and subjected to analysis of variance (ANOVA) according to Snedecor and Cochran [22], using MSTAT software package and means were compared using LSD range at 0.05 level.

RESULTS AND DISCUSSION

Supplemental irrigation treatments significantly increased the average shoot length in both seasons of the investigation (Table 3). Highest significant effect was attributed to 20 mm amounting to 31.82 and 33.22 cm in both seasons respectively. Also, it was evident that on the average organic fertilization treatments significantly increased this parameter with a more pronounced effect due to the %higher amount (32.75 and 33.22 cm in both seasons respectively). Interaction data were significant. Longest shoots in both seasons were detected on tree that were supplemental irrigated with 20 mm water/fed and that were fertilized with 50 kg olive solid waste (32.75 and 54.33 cm in both seasons respectively). Statistically equal results were detected in all fertilized trees in the first season only.

These results are in harmony with those reported by many investigators indicating positive relationship between amounts of water supply and growth vigor in peaches [23-26].

Also enhancing the vegetative growth through fertilization was cited by Johnson and Phene [27] they stated that a deficiency of nutrients on peach orchard can lead to problems with vegetative growth or tree health. Also organic manures were found to increase the soil contents of growth regulators (IAA and cytokinins) which lead to enhancing plant growth, supplying trees with their requirements from various nutrients, reducing soil pH, encouraging of microorganisms activity, producing natural auxins and improving physical and chemical properties of soil in favor of good growth of roots [28, 29].

On the average supplemental irrigation significantly increased the leaf chlorophyll content in both seasons of the investigation with a more pronounced effect attributed to the higher rate in both seasons. With respect to the fertilization effect, significant increments in leaf chlorophyll content were detected in leaves of fertilized trees compared with control ones that were not fertilized. The higher rate resulted in more pronounced effect compared with the lower one in both seasons. Yet, results of both rates were statistically equal in the second season. Interaction results were significant. Significantly the highest leaf content of chlorophyll was due to supplemental irrigation with 20 mm water and organic fertilization with 50 Kg/tree in both seasons. Statistically equal results were due to irrigation with 10 mm and 50 Kg/tree fertilization in both seasons of the investigation (Table 4).

Table 3: Effect of supplemental irrigation and organic fertilization treatments on new formed shoot length (cm) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization kg/tree				Organic fertilization kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	25.63	30.15	31.80	29.19	27.33	29.82	30.33	29.16
10 mm + rainfall	29.50	32.02	32.20	31.24	28.67	30.31	31.67	30.22
20 mm + rainfall	30.33	32.37	32.75	31.82	32.33	33.00	34.33	33.22
Mean	28.5	31.5	32.3		29.4	31.0	32.1	
LSD at 5% level for :		First season		Second season				
Supplemental irrigation (A) =		0.30		0.32				
Organic fertilization (B) =		0.30		0.32				
A X B =		0.74		0.78				

Table 4: Effect of supplemental irrigation and organic fertilization treatments on leaf chlorophyll content (spad value) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization kg/tree				Organic fertilization kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	32.50	33.37	35.47	33.78	36.47	37.27	37.87	37.20
10 mm + rainfall	34.37	35.13	36.93	35.48	38.30	40.27	40.80	39.79
20 mm + rainfall	35.73	36.00	37.07	36.27	40.97	41.33	41.63	41.31
Mean	34.20	34.83	36.49		38.58	39.62	40.10	
LSD at 5% level for :		First season		Second season				
Supplemental irrigation (A) =		0.47		0.48				
Organic fertilization (B) =		0.47		0.48				
A X B =		1.13		1.15				

Table 5: Effect of supplemental irrigation and organic fertilization treatments on nitrogen leaf content (%) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization kg/tree				Organic fertilization kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	2.04	2.23	2.72	2.33	2.39	2.67	2.87	2.64
10 mm + rainfall	2.17	2.40	2.80	2.46	2.64	2.95	2.96	2.85
20 mm + rainfall	2.21	2.43	2.91	2.52	2.80	2.96	3.00	2.92
Mean	2.14	2.35	2.81		2.61	2.86	2.94	
LSD at 5% level for :		First season		Second season				
Supplemental irrigation (A) =		0.08		0.09				
Organic fertilization (B) =		0.08		0.09				
A X B =		0.13		0.16				

Table 6: Effect of supplemental irrigation and organic fertilization treatments on phosphorus leaf content (%) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization kg/tree				Organic fertilization kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	0.47	0.54	0.60	0.54	0.51	0.63	0.72	0.62
10 mm + rainfall	0.55	0.60	0.65	0.60	0.53	0.70	0.77	0.67
20 mm + rainfall	0.56	0.67	0.70	0.64	0.56	0.75	0.80	0.70
Mean	0.53	0.60	0.65		0.53	0.69	0.76	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.20		0.03			
Organic fertilization (B) =			0.02		0.03			
A X B =			0.04		0.06			

Table 7: Effect of supplemental irrigation and organic fertilization treatments on potassium leaf content (%) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization kg/tree				Organic fertilization kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	1.33	1.44	1.86	1.54	1.75	1.96	2.07	1.93
10 mm + rainfall	1.34	1.70	1.95	1.66	1.76	1.97	2.10	1.94
20 mm + rainfall	1.38	1.95	2.05	1.79	1.81	2.06	2.14	2.00
Mean	1.35	1.70	1.95		1.77	2.00	2.10	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.04		0.04			
Organic fertilization (B) =			0.04		0.04			
A X B =			0.08		0.08			

Leaf N content was significantly increased as a result of supplemental irrigation with insignificant differences between the 2 used rates. Organic fertilization resulted in a significant increase in the leaf N content with a more pronounced effect due to the higher rate. Interaction data were significant in both seasons of the study. Highest leaf N in both seasons was attributed to supplemental irrigation with 20 mm and fertilization with 50 Kg/tree (2.91 and 3.00%). Insignificant differences were attributed with fertilizing with the same rate and supplemental irrigation with the lower rate in both seasons and to fertilization with 25 Kg with any of the supplemental irrigation rates (Table 5).

The phosphorus level in leaves of supplemental irrigated trees increased significantly compared with control in both seasons of the investigation (Table 6). Superiority in this parameter was dedicated to the higher level of supplemental irrigation. Also significant increases in phosphorus levels were achieved by organic fertilization with a more pronounced effect due to the higher level. Interaction showed significant effects. Statistically the highest level of phosphorus was detected in leaves from trees receiving the highest irrigation and fertilization rates (0.70 and 0.80%). Statistically equal results were attained same irrigation level and 25 kg/tree fertilization in both seasons and 10 mm supplemental irrigation & 50 kg/tree organic fertilization in the second season only.

On the average leaf K was significantly increased with supplemental irrigation in both seasons with a more significant increment due to the higher level treatment. Increment due to 10 mm water in the second season only was insignificantly different from control. Organic fertilization significantly increased this parameter significantly in both seasons. The effect of 25 Kg/tree was statistically equal to control in the second season only. Highest significant effect was attributed to the 50 Kg/tree treatment in both seasons of the study. Interaction study showed significant effects in both seasons. Superiority in this respect was due to the treatment of 20 mm irrigation water and 50 kg/tree organic fertilizer amounting to 2.05 and 2.14 % in both considered seasons respectively. In the second season however, comparable results were due to all 50 kg/tree organic fertilizer treatments and the 20 mm and 25 kg/tree organic fertilizer treatment (Table 7).

Table 8: Effect of supplemental irrigation and organic fertilization treatments on average yield (kg/tree) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	11.87	16.25	21.10	16.41	11.35	15.95	19.20	15.50
10 mm + rainfall	14.16	20.00	24.00	19.39	13.10	18.67	23.50	18.42
20 mm + rainfall	17.50	21.22	24.15	20.96	15.18	20.20	24.25	19.88
Mean	14.51	19.16	23.08		13.21	18.27	22.32	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.33		0.35			
Organic fertilization (B) =			0.33		0.35			
A X B =			0.78		0.84			

Several reports were in accordance with the present results. Photosynthetic pigments content in leaves was significantly higher in the trees grown under high irrigation rate [30]. Also leaf nitrogen, phosphorus and potassium content decreased significantly with decreasing water irrigation levels [31]. These results may be due to that nutrient uptake was retarded under water stress conditions and impaired active transport and membrane permeability and depletion of soil moisture level caused a reduction in leaf mineral content. So, the increment of leaf pigments concentration could be attributed to increasing in macronutrient uptake especially N and Mg as a consequence of improved soil [32].

Furthermore, organic fertilizer gave a significant increasing in peach leaf content of chlorophyll and NPK [33, 27].Generally, addition of organic fertilizer to soil was efficient in supplying the nutritional requirements of peach trees of each Nitrogen, phosphor and Potassium and that reflected on tree growth and productivity, that could be attributed to the role of NPK. Hence N is found in many important compounds including amino acids, proteins, enzymes, nucleic acids and chlorophyll. Also, P is the key factor in compounds that store, transfer and utilize energy in plants. It is also building blocks for DNA. However, K plays an important role in maintaining cell turgid and in the opening [27]. Organic fertilizers improved peach leaf mineral content (34, 14 and 35). The enhancement of leaf mineral content due to application of organic manure may explained by the fact that it induced positive effect on physical condition of soil; creates favorable conditions for root growth and nutrients absorption, it supplies much nutrients and it facilitates the absorption of fixed nutrients by tree roots [36]. Moreover, the organic fertilizer contains high organic matter and high macro and micro nutrients which help to improve soil physical and chemical characteristics [12].

On the average supplemental irrigation significantly increased the yield/tree. Significantly the highest yield was attributed to the 20 mm treatment. As for the average effect of organic fertilization, significant increments in this were detected due to it. Highest statistical results were attributed to 50 kg/tree in both seasons. Interaction results were significant. Significantly the highest yield (24.15 and 24.25 kg/tree in both seasons respectively) was achieved when highest rates of supplemental irrigation and fertilization were applied. Comparable results were attained with same level of fertilization and 10 mm supplemental irrigation (Table, 8).

Supplemental irrigation during the growing season can lead to improve tree yield [37-39]. Furthermore, supplemental irrigation applied to peach trees cv. 'Redglobe' resulted in double yield compared to non irrigated trees [40]. Similar results were found by many workers in this field [24-26, 41,] on peach trees. Organic fertilizers increased tree yield and the positive effect of organic manure were attributed to, improves soil physical conditions, creates more favorable conditions for plant growth and supplies the trees with the nutrient element [42]. Moreover, organic fertilizer is very beneficial in increasing productivity due to conversion of unavailable minerals into soluble forms that plant can use. Also, it improves plant nutrition by stimulation the absorption of mineral elements through roots, stimulating roots growth especially in vertical direction. Thus, enabling better uptake of nutrients, retaining water-soluble inorganic fertilizers in root zones, reducing

Table 9: Effect of supplemental irrigation and organic fertilization treatments on average fruit weight (g) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

Supplemental irrigation	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
	0	25	50	Mean	0	25	50	Mean
Rainfall only	62.33	70.20	74.83	69.12	70.00	78.42	82.50	76.97
10 mm + rainfall	70.40	87.00	94.14	83.85	89.65	98.29	107.00	98.31
20 mm + rainfall	75.50	91.20	101.30	89.33	93.31	103.30	110.00	102.20
Mean	69.41	82.80	90.62		84.32	93.34	99.83	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			3.09		2.94			
Organic fertilization (B) =			3.09		2.94			
A X B =			7.35		7.10			

Table 10: Effect of supplemental irrigation and organic fertilization treatments on fruit firmness (Ib/inch^2) of Early Grand peach during 2009/2010 and 2010/2011 seasons.

Supplemental irrigation	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
	0	25	50	Mean	0	25	50	Mean
Rainfall only	10.67	12.75	13.64	12.35	11.00	13.86	14.85	13.24
10 mm + rainfall	9.33	12.27	13.22	11.61	10.56	13.08	13.75	12.46
20 mm + rainfall	8.96	11.23	12.08	10.76	9.93	11.93	13.20	11.69
Mean	9.99	13.08	14.31		12.96	15.06	15.57	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.25		0.30			
Organic fertilization (B) =			0.25		0.30			
A X B =			0.63		0.74			

their leaching and enhancing the uptake of nitrogen by plants [43]. Moreover, average Florida Prince Peach yield was significantly increased as a result of organic fertilizer [14].

Supplemental irrigation significantly increased the average fruit weight in both seasons with more significant effects due to 20 mm supplemental irrigation. Organic fertilization significantly enhanced the average fruit weight. The effect of 50 kg/tree was more pronounced. The effect of interaction was significant. Application of highest supplemental irrigation and fertilization rates results in significantly the highest average fruit weight (101.3 and 110 gm for both seasons respectively). Application of 10 mm supplemental water with same fertilization rate did rescored this weight significantly in both seasons. In the second season the 20 mm supplemental water and 25kg/tree organic fertilizer showed statistically equal effect (Table 9).

The fruit firmness significantly decreased by the supplemental irrigation treatments. This decrease was significantly in parallel with the applied water rates. Whereas, the opposite was identically true concerning the organic fertilization effects. This parameter was found to increase statistically with increasing the fertilization rates. Interaction date show that least fruit firmness was due to the unfertilized and 20 mm treatment supplemental irrigation with insignificant difference from unfertilized and 10 mm supplemental irrigated treatment. Whereas significantly the firmest fruits were attained from trees that were rain fed and received 50 kg/tree organic fertilizer with insignificant differences from trees that attained 10 mm supplemental irrigation and same fertilization treatment in the first season only (Table 10).

Several reports were in accordance with the present results such as Li *et al*. [44] who stated that deficit irrigation in the first stage of peach fruit development

Table 11: Effect of supplemental irrigation and organic fertilization treatments on TSS (%) of Early Grand peach fruit during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	9.97	11.58	12.05	11.20	9.10	11.43	12.07	10.87
10 mm + rainfall	10.17	11.83	12.55	11.52	9.67	11.77	12.60	11.35
20 mm + rainfall	10.83	11.87	12.97	11.89	9.93	11.93	13.00	11.62
Mean	10.32	11.76	12.52		9.57	11.71	12.56	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			n.s.		n.s.			
Organic fertilization (B) =			0.77		0.86			
A X B =			1.85		2.06			

Table 12: Effect of supplemental irrigation and organic fertilization treatments on total sugars (g\100g DW) of Early Grand peach fruit during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	2.77	3.92	4.05	3.58	2.86	3.86	4.15	3.62
10 mm + rainfall	3.18	4.83	5.20	4.40	3.93	4.00	4.17	4.03
20 mm + rainfall	3.42	4.97	5.43	4.61	3.97	4.25	4.33	4.18
Mean	3.12	4.57	4.89		3.59	4.04	4.22	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.12		0.11			
Organic fertilization (B) =			0.12		0.11			
A X B =			0.28		0.26			

and pit hardening reduced fruit size and weight of peach fruit which are major attributes related to fruit quality. In this respect, Maria [45] on peach trees observed that, fruit size, weight and yield increased with increasing irrigation. On other hand, moderate water stress at the fruit growth stage of peach and nectarine increased fruit firmness [46]. However, deficit irrigation with 50% of ETc in 'Royal Glory' peach and 'Caldesi 2000' nectarine trees had higher flesh firmness than control fruit trees (drip irrigated close to Etc) [47]. While, deficit irrigation (30% Etc) during stage III of peach fruit increased fruit firmness [24].

In parallel organic manure increasing peach fruit weight and size [34]. The positive effect of organic fertilization on fruit weight and size may be due to its effect in enhancing both leaf area and total chlorophyll. Hence increasing net photosynthesis, as well as, the effect of organic matter in increasing water holding capacity, which was reflected on fruit weight and size of peach fruit [14]. Similar results were found by El- Khawaga [35] on peach trees. Furthermore, providing peach trees with organic fertilization treatments increased fruit firmness compared with the chemical fertilizers [48, 14]. Also, Stino *et al*. [33] demonstrated that, amino acid, compost tea and their combination treatments decrease fruit firmness on Florida Prince peach trees compared to the control treatment.

On the average insignificant differences were attributed to the supplemental irrigation treatments in both seasons with respect to the juice TSS%. Organic fertilization increased this parameter statistically. Differences between the 25 and 50 kg/tree were insignificantly different in the second season only. Interaction showed significant differences in both seasons. Highest juice TSS% was attributed to highest levels of both supplement irrigation and organic fertilization treatments (12.97 and 13 %). Comparable results were due to all 50 kg/tree treatments (Table 11).

Supplemental irrigation significantly increased the juice total sugars in both seasons. The higher rate resulted in significantly the highest effect. Also significant increments were detected as a result of

Table 13: Effect of supplemental irrigation and organic fertilization treatments on acidity (%) of Early Grand peach fruit during 2009/2010 and 2010/2011 seasons.

	First season				Second season			
	Organic fertilization Kg/tree				Organic fertilization Kg/tree			
Supplemental irrigation	0	25	50	Mean	0	25	50	Mean
Rainfall only	0.92	1.11	1.17	1.07	0.95	1.08	1.11	1.05
10 mm + rainfall	0.81	0.96	1.03	0.93	0.89	0.95	1.08	0.97
20 mm + rainfall	0.81	0.92	1.04	0.92	0.85	0.97	1.06	0.96
Mean	0.85	1.00	1.08		0.90	1.00	1.08	
LSD at 5% level for :			First season		Second season			
Supplemental irrigation (A) =			0.05		0.04			
Organic fertilization (B) =			0.05		0.04			
A X B =			0.12		0.10			

the usage of organic fertilization treatments. The most pronounced effect was due to the higher dosage. Interaction data show significant differences. High water and organic fertilizer dosage showed significantly the highest juice sugars percentage. Insignificant differences were shown by same fertilization treatment and the 10 mm supplemental irrigation treatment in both seasons and the rain fed and the 50 kg/tree organic fertilization treatment in the second season only (Table 12).

On the average supplemental irrigation significantly decreased the acidity percentage with insignificant differences between used treatments. With respect to the organic fertilization treatments significant increments were observed due to used treatments. Higher rate resulted in significantly higher acidity percentage. Interaction data showed significant differences. Unfertilized trees that were supplemental irrigated with 20 mm water showed the lowest acidity percentage with insignificant differences from all unfertilized treatments (Table 13).

In this line, moderate water stress at the fruit growth stage of peach and nectarine improves total soluble solids fruit content and had higher acidity than control ones [46]. Similar results were recorded by Pliakoni and Nanos [47] on 'Royal Glory' peach. Also, deficit irrigation at 30% Etc during stage III increased total soluble solids, totalsoluble sugars and decreased acidity in comparison to the control [24]. This may be attributed to the increased light interception inside the tree canopy which results in an increase of photosynthetic rate and production of more carbohydrates [26]. Moreover, organic fertilizer increased fruit TSS % content, sugars fruit content and total acidity comparing to control treatment of peach trees [49, 14, 33]. In this respect, the highest level of organic treatment resulted in the highest significant TSS % of peach (cv. Florida Prince). While, the lowest significant TSS % was produced as a result of chemical fertilization [14]. Also, the role of organic fertilizer in improving TSS % was reported previously by Stino *et al*. [33] in peach tree. While, accumulating of macro nutrients, especially N and K in peach fruit, resulted in stimulate organic acids synthesis in the cytoplasm that caused increasing acidity [50]. Also, citrate content of mature peach fruit is correlated negatively with total sugar content. Whereas, increasing in sugar content induce a related reduction in estimated "mitochondrial equipment" which diminishes the potential for citrate synthesis. Furthermore, decreasing percentages of inorganic N and, at the same time, increasing levels of humic acid resulted in decreasing total acidity of Florida Prince Peach comparing with using the suitable N completely via inorganic form alone [35]. In addition to that, increases in total sugars of fruits may result from the increase of chlorophyll content which is combined by an increase in apple leaves photosynthetic capacity and there was a liner relationship between total sugars and total chlorophyll content (51, 33 and 35).

CONCLUSION

From the aforementioned results, it can be concluding that using high dose of organic fertilization (50 kg/tree olive solid waste) had enhanced the performance of Early Grande peaches under Northern Sinai conditions in terms of vegetative growth and yield especially under heavy rain season. In addition, we can add 10 mm of irrigation water with the same organic previous dose during insufficient rains of season. In general, highest supplemental irrigation and fertilization rates results the highest yield and fruit quality.

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