Effect of Irrigation Regimes and Nitrogen Rates on Growth, Yield and Fruit Quality of Florida Prince Peach Trees

Soliman M. A. M.[1]; Hassan A. Ennab[2] and Aly E. Zaghloul[3]
[1]Deciduous Fruit Trees Research Department,.[2]Citrus Research Department and[3]Fruit Handling Research Department, Hort. Res. Instit. ARC. Giza, Egypt.

Received on: 3/2/2016 *Accepted: 28/4/2016*

ABSTRACT

This study was carried out during two successive seasons 2014 and 2015 at a private orchard at El-Nobaria region, El-Bohaira Governorate, Egypt, to determine the effect of nitrogen at three rates i.e., 500, 600 and 700 gm /tree/year, irrigation at four levels i.e., 9.41, 11.55, 13.41 and 15.42 m^3/tree/year and their combinations on growth, yield and fruit quality of eight years old "Florida prince" peach trees budded on Nemaguard rootstock. Results show that nitrogen fertilization rate and irrigation level significantly enhanced vegetative growth in terms of shoot length, leaves number per shoot, leaf area and specific leaf weight. Moreover, yield as kg/tree, chlorophyll and leaf NPK were positively affected by nitrogen rate, irrigation level and their combinations. Also, weight, volume, length, and diameter of the fruits were significantly increased by increasing nitrogen rates from 500 to 700 gm/tree/year and irrigation levels from 9.41 to 15.42 m^3/ tree / year, whereas fruit firmness, TSS, acidity and anthocyanins were significantly increased with nitrogen and decreased with irrigation. Meanwhile, TSS/ acid ratio was not affected by treatments. It might be recommend using 13.41 m^3/tree/year, with the addition of fertilizer nitrogen rate of 600 g/tree/year, this treatment had a positive impact on the trees and provided 13% of irrigation water without adversely affecting on vegetative growth, yield and fruit quality.

Key words: Irrigation, nitrogen, peach, yield, fruit firmness, total soluble solids.

INTRODUCTION

Florida prince Peach (*Prunus persica* L.) is a promising cultivar under the Egyptian conditions. It requires least chill hours, and the fruit ripens in mid-April, so its early appearance in the markets brings the highest prices. This cultivar increased rapidly and cultivation spreads in many areas in Egypt especially in the newly reclaimed lands. The major problem of the new lands in Egypt is low fertility and limited available water. So, fertilization and irrigation practices have aimed to supply enough nutrients and water to ensure economical yield with a good quality in peach production in such soil type. Several studies were carried out for finding the best irrigation and nitrogen management that are responsible for improving fruiting of peaches at different area in the world (Abrisqueta et al., 2010 in Spain; Sotiropoulos et al., 2010 in Greece; Alaoui et al., 2013 in Morocco; Ali et al., 2014 in Pakistan and El-Shewy and Abdel-Khalek 2014 in Egypt). In this respect, Girona et al., (2003) stated that, shoot elongation and trunk cross sectional area were varied in accordance with amount irrigation water. Hernandez et al., (1994) and Bybordi (2013) mentioned that, using drip irrigation was responsible for enhancing percentage of N, P and K in apricot and peach leaves. Mercier et al., (2009) and Stino et al., (2010) on peaches, stated that, irrigation and nitrogen had announced effect on the yield and fruit quality. The objectives of this study were to: 1) Compare the effects of different irrigation levels and nitrogen on growth, yield and fruit quality of Florida prince peach trees, and 2) Determine the optimum irrigation-nitrogen practices for Florida prince peach trees under El-Nobaria region, El-Bohaira governorate conditions.

MATERIALS AND METHODES

The present study was carried out during two successive seasons, 2014 and 2015 on 8 years old "Florida prince" peach (*Prunus persica*, L.) trees budded on Nemaguard rootstock. Trees were planted at 5 x 5 meters apart on sandy soil under drip irrigation system with two lateral lines per row and two 4 L/hr emitters per tree at a private orchard at El-Nobaria region, El-Bohaira Governorate, Egypt. The soil texture was sandy (10.40% clay, 18.45% silt and 71.15% sand), 1.58% total carbonate content, 2.20 ds m^{-1} an electrical conductivity and a pH of 7.62. Seventy two uniform in vigour trees were selected and subjected to the usual management and cultural practices. Treatments were arranged in field according to split plot experimental design, replicated three times with two trees. The nitrogen rates were randomized in the main plots and irrigation levels in the sub – plots. Treatments consisted of three nitrogen rates i.e. 500, 600 and 700 gm./tree/year, equivalent 1.5, 1.8 and 2 kg ammonium nitrate (33.5 %) and four irrigation levels i.e. 9.41, 11.55, 13.41 and 15.42 m^3/tree/year, making a total of 12 treatments. All agricultural practices were carried out according to the crop and the area except the studied treatments which

abovementioned. 700gm./tree/year it traditional N fertilization practice by local farmers in the studied area, giving through the vegetative growth period. The amount of ammonium nitrate was divided equally to be added in 2 or 3 doses weekly with irrigation water, from swollen bud to after complete fruit set in late March. The daily amount of irrigation water as liters per tree for each level in both seasons are shown in Table (1).

The following data were recorded in this study:

1. Vegetative growth:

On each tree three spring shoots were selected. In April shoot length (cm) was measured and leaf number/Shoot was counted. Twenty mature leaves were sampled from non fruiting shoot in July to determine leaf area (cm^2) by using a leaf area meter Model Li 3100 area- meter. Leaf dry weight was recorded after drying at 70 ºC for 4 days; specific leaf weight was calculated as mg/cm^2.

2. Leaf NPK content:

Dried leaves were sampled and digested with H_2SO_4 and H_2O_2 according to Evenhuis and DeWaard (1980). In the digested solution samples N, P and K content was determined as follows: nitrogen was determined by micro-kjeldahl methods described by Pregl (1945), phosphorus was determined calorimetrically according to Murphy and Reily (1962) and potassium was measured according to Jackson (1973) by flame photometer.

3. Leaf chlorophyll content as µmole/cm^2:

Fresh leaf sample was taken from each replicate in May to determine chlorophyll a, b and its total by using N, N dimethyl formamide according to Moran and Porath (1980).

4. Yield as kg/tree:

The average yield per tree in kg for each treatment was determined at the harvesting time – at maturity stage.

5. Fruit quality:

To determine fruit quality, 20 fruits were taken at random from each tree at harvest time of both seasons and prepared for determination of physical and chemical fruit characteristics.

5.1. Physical characters:

Fruit weight (g), fruit volume (cm^3), fruit dimension (fruit height and diameter in, mm), and fruit firmness (I $b/inch^2$) which was measured by fruit pressure tester on the two opposite sides of the fruit.

5.2. Chemical characters:

Total soluble solids was determined by handly refractometer, total acidity was determined as malic acid according to (A.O.A.C., 1995), and TSS/acid ratio was calculated. Total anthocyanin in fruit flesh as mg/100g fresh fruit was determined by spectrophotometer as described by Hsia et al (1965).

Data were s analyzed using the statistical program according to Snedecor and Cochran (1967), and L.S.D. test at 5% level was used to compare the means values.

RESULTS AND DISCUSSION

1. Vegetative growth:

Data in Table 2 show the effect of nitrogen rates, irrigation levels and their interaction on shoot length, leaves number per shoot, leaf area and specific leaf weight of Florida prince peach trees. As for the effect of nitrogen rates, it is clear that shoot length, leaves number per shoot, leaf area and specific leaf weight were significantly increased by increasing rates of nitrogen fertigation from 500 to 700 gm/tree/year in both seasons. Similar results were obtained by Lobit et al., (2001) and Shah et al., (2014) on peach cv. Aligrain. In this respect, Kandil et al., (2010) concluded that raising nitrogen rates from 500 to 1000 g/tree have high positive effect and significantly improved shoot length and leaf area of Mit Ghamr peach tree. Also, Mirabdulbaghi and Pishbeen (2012) found that application of 600 kg sulfate ammonium ha^{-1} stimulated shoot length, shoot diameter and leaf surface of peach cv. Dixered.

Table 1: The daily amount of irrigation water as liters per tree for each level in both seasons.

Months	Irrigation levels (liter/tree/day)			
January	14	17	21	25
February	15	18	23	28
March	17	21	25	33
April	31	30	34	42
May	43	54	60	65
June	47	59	66	72
July	47	59	66	72
August	43	53	59	65
September	36	45	53	59
October	10	13	18	25
November	6	10	15	20
Total (m^3/tree/year)	9.41	11.55	13.41	15.42

Table 2: Effect of irrigation and nitrogen rates on vegetative growth of Florida prince peach trees.

Treatments		Shoot length (cm)		Leaves number per shoot		Leaf area (cm^2)		Specific leaf weight (mg/cm^2)	
Nitrogen gm/tree/year	**Irrigation water m^3/tree/year**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
500	9.41	36.36	42.76	24.90	26.36	31.73	33.36	5.53	5.50
	11.55	38.90	44.50	26.30	29.50	34.10	34.30	5.86	5.80
	13.41	40.80	47.50	29.80	31.10	35.93	35.93	5.93	8.83
	15.42	45.40	46.96	31.86	32.20	34.86	35.80	6.00	6.13
600	9.41	42.36	44.83	28.13	32.16	33.10	33.03	6.06	6.20
	11.55	42.93	45.86	30.96	33.03	34.76	34.26	6.13	6.26
	13.41	44.90	46.98	33.45	32.96	36.53	36.80	6.20	6.40
	15.42	45.70	47.03	33.86	33.06	36.00	36.50	6.30	6.43
	9.41	44.30	46.10	29.36	32.00	34.93	35.53	6.23	6.23
700	11.55	44.40	47.90	31.86	32.93	35.03	35.83	6.30	6.33
	13.41	45.00	47.63	33.48	33.40	36.76	36.30	6.31	6.46
	15.42	45.70	47.86	33.90	33.03	36.80	36.66	6.33	6.45
Average nitrogen									
500		40.61	45.43	28.21	29.79	34.15	34.85	5.83	5.81
600		43.97	46.17	31.60	32.80	35.10	35.14	6.17	6.32
700		44.85	47.37	32.15	32.84	35.88	36.08	6.30	6.37
Average irrigation									
9.41		41.00	44.56	27.46	30.17	33.25	33.97	5.94	5.97
11.55		42.07	46.08	29.71	31.82	34.63	34.80	6.10	6.13
13.41		43.56	47.37	32.24	32.48	36.40	36.34	6.15	6.23
15.42		45.61	47.28	33.20	32.76	35.88	36.32	6.21	6.23
L.S.D. at 5%									
	Nitrogen	0.79	0.69	0.41	0.34	0.25	0.27	0.13	0.16
	Irrigation	0.49	0.59	0.34	0.26	0.40	0.31	0.10	0.22
	Interaction	0.85	0.89	0.63	0.45	0.83	0.57	ns	ns

*ns: not significant

With regard to the effect of irrigation only , it was evident that shoot length, leaves number per shoot, leaf area and specific leaf weight of Florida prince peach trees were significantly affected by irrigation levels as shown in Table 2.

In other words, all growth parameters were significantly increased by increasing irrigation level from 9.41 to 15.42 m^3 water/tree/year in both seasons. In this respect, Ibrahim and Abd El-Samad (2009) reported that increasing water irrigation from 30 to 70% of available soil water significantly increased vegetative growth parameters of pomegranate trees.

Also, a significant effect interaction between nitrogen rates and irrigation levels on growth parameters was obtained. The highest values occurred with the treatment (700 gm N/tree/year × 15.42 m^3 water/tree/year) followed by trees receiving (700 gm N/tree/year × 13.41 m^3 water/tree/year), (600 gm N/tree/year × 15.42 m^3 water/tree/year) and (600 gm N/tree/year × 13.41 m^3 water/tree/year) respectively. The results are in agreement with those of Rufat et al., (2013) who showed that irrigation and N fertilization significantly enhanced the most vegetative growth of peaches.

Generally, the data in Table (2) indicated that, vegetative growth parameters were gradually increased with increasing nitrogen rates from 500 to 700 gm N/tree/year and irrigation levels from 9.41 to 15.42 m^3 water/tree/year in both seasons. Moreover, four combinations between nitrogen rates and irrigation levels gave the best vegetative growth without significant difference among them; (700gm N/tree/year × 15.42 m^3 water/tree/year), (700gm N/tree/year × 13.41 m^3 water/tree/year), (600gm N/tree/year × 15.42 m^3 water/tree/year) and (600gm N/tree/year × 13.41 m^3 water/tree/year) respectively.

2. Leaf NPK content:

The results in Table 3 revealed that, increasing nitrogen rate from 500 to 700 gm N/tree/year significantly enhanced percentages of N, P and K in leaves of Florida prince peach trees in both seasons. These results are similar with those reported by Mirabdulbaghi and Pishbeen (2012) and Bybordi (2013) on peach and apricot trees. Increasing nitrogen applied encourages uptake of other nutrients such as P and K and hence N.

Table 3: Effect of irrigation and nitrogen rates on leaf NPK content of Florida prince peach trees

Treatments		N %		P %		K %	
Nitrogen gm/tree/year	**Irrigation water m^3/tree/year**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
500	9.41	2.276	2.320	0.180	0.200	1.200	1.280
	11.55	2.333	2.413	0.193	0.236	1.250	1.286
	13.41	2.400	2.498	0.200	0.236	1.333	1.330
	15.42	2.413	2.493	0.230	0.240	1.350	1.350
600	9.41	2.306	2.383	0.200	0.220	1.266	1.296
	11.55	2.406	2.440	0.210	0.236	1.276	1.316
	13.41	2.440	2.498	0.246	0.255	1.353	1.353
	15.42	2.447	2.506	0.253	0.260	1.366	1.361
	9.41	2.363	2.456	0.233	0.240	1.283	1.310
700	11.55	2.460	2.500	0.253	0.240	1.293	1.323
	13.41	2.443	2.533	0.260	0.256	1.353	1.356
	15.42	2.465	2.536	0.263	0.261	1.366	1.364
Average nitrogen							
500		2.355	2.422	0.200	0.228	1.283	1.311
600		2.399	2.456	0.227	0.242	1.315	1.331
700		2.432	2.506	0.252	0.249	1.324	1.338
Average irrigation							
9.41		2.315	2.386	0.204	0.220	1.250	1.295
11.55		2.400	2.451	0.218	0.237	1.273	1.308
13.41		2.427	2.509	0.235	0.249	1.346	1.346
15.42		2.441	2.511	0.248	0.253	1.361	1.358
New L.S.D. at 5%							
	Nitrogen	0.007	0.016	0.014	0.005	0.011	0.006
	Irrigation	0.016	0.018	0.008	0.006	0.039	0.007
	Interaction	0.035	0.044	0.019	0.012	0.025	0.015

In this respect, Kandil et al., (2010) concluded that raising nitrogen levels from 500 to 1000 g/tree/year causes high level of leaf N, P and K percentages of Mit Ghamr peach trees.

As for the effect of irrigation levels, it is clear from Table 3 that an increases in the leaf- N, P and K contents with increasing water quantities applied via drip irrigation from 9.41 to 15.42 m^3 water/tree/year. Similar results were obtained by Abd El-Samad et al., (2006) on pear trees and Khattab et al., (2011c) indicated that leaf N, P and K content significantly increased with increasing irrigation level from 7 to 13 m^3 water/tree/year in pomegranate trees. This result might be due to increasing availability of these nutrients under the highest level of irrigation water applied which would enhance uptake rate by trees.

The interaction between the two factors revealed that, treatment of (700 gm N/tree/year × 15.42 m^3 water/tree/year) gave the highest values of N, P and K followed by (700 gm N/tree/year × 13.41 m^3 water/tree/year), (600 gm N/tree/year × 15.42 m^3 water/tree/year) and (600 gm N/tree/year × 13.41 m^3 water/tree/year), respectively, Whereas, the lowest values belonged to (500 gm N/tree/year × 9.41 m^3 water/tree/year, (Table 3). The results are in agreement with those of Hernandez et al., (1994) and El-Kosary et al., (2013) reported that, leaf N, P and K content were significantly increased as a result of supplemental irrigation with 20 mm and fertilization with 50 kg/tree organic and inorganic N fertilizer. Also, the results are in harmony with those reported by many investigator at different fruit crops (Zayan et al., 2002 on grapevine, Melgar et al., 2010 on citrus and Mehanna et al., 2012 on olive).

3- Leaf chlorophyll content:

Regarding the effect of N fertilization only, data in Table 4 clearly showed that, chlorophyll a, b and total content was significantly increased with increasing nitrogen rates in both seasons. Florida prince peach trees fertilized with 700 and 600 gm N/tree/year recorded the highest values of chlorophyll a, b and total content. While the 500 gm N/tree/year recorded the least values of chlorophyll in both seasons. These results agreed with those published by Almaliotis et al., who stated that, nitrogen content of upper and basal leaves increased by increasing N level of nutrient solution and were correlated significantly with most of the growth parameters as well as with total chlorophyll content on three peach cultivars. N is the base for protein synthesis and is integral component of chlorophyll (Marschner, 1995). Thus, N deficiency results in pale green leaves, reduces leaf growth and leaves

tends to abscise as the season progresses. Under low N conditions, anthocyanin production is favoured, and appears a reddish tinge that develops on the petioles, stems and leaf blades. These symptoms can be pronounced in peach (Ogawa et al., 1995 and Strand, 1999).

In according to irrigation treatments, data in Table 4 showed that, applying different irrigation levels to Florida prince peach trees significantly increased chlorophyll a, b and its total in both seasons. The positive effect of irrigation water was pronounced at irrigation level of 15.42 m^3 water/tree/year followed by 13.41, 11.55 and 9.41 m^3 water/tree/year, respectively. These results are similar to those of pervious studies (Mikhael and Mady 2007, Khattab et al., 2011c and Bybordi, 2013). However, El-Sayed and El-Hagarey (2014) concluded that increment in irrigation rate was concurrent with chlorophyll content of Florida prince peach trees.

Concerning the interaction between nitrogen rates and irrigation levels, it is clear that the interaction effect on leaf chlorophyll a, b and total content was not significant in both seasons, except chlorophyll b and total chlorophyll in the second season only (Table 4). However, the highest values of chlorophyll a, b and total chlorophyll were found on trees treated with (700 gm N/tree/year × 15.42 m^3 water/tree/year) followed by (700 gm N/tree/year × 13.41 m^3 water/tree/year), (600 gm N/tree/year × 15.42 m^3 water/tree/year) and (600 gm N/tree/year × 13.41 m^3 water/tree/year), respectively, while the least values belonged to the lowest rates of nitrogen and irrigation level (500 gm N/tree/year × 9.41 m^3 water/tree/year).

4. Tree yield:

It is clear from Table (4) that, yield as kg/tree of Florida prince peach trees was significantly increased with increasing nitrogen rates up to 700 gm/tree/year in both seasons. Trees fertilized with 700 and 600 gm N/tree/year recorded the highest of yield while the 500 gm N/tree/year recorded the least value of yield in both seasons. Similar results were obtained by Chatzitheodorou et al., (2004) on peach cultivars Spring Time and Red Haven, and by Shah et al., (2014) working on peach cv. Aligrain. In this respect, Kandil et al., (2010) showed that increasing nitrogen level from 500 to 1000 g/tree/year resulted in an increase of "Mit Ghamr" peach trees yield. Moreover, Wrona (2004) concluded that apple tree received 100 kg N ha^{-1} produced high yield with good fruit quality.

Table 4: Effect of irrigation and nitrogen rates on leaf chlorophyll content of Florida prince peach trees.

Treatments		Chlorophyll µmole/cm^2 fresh leaves						Yield (kg/tree)	
		a		b		total			
Nitrogen gm/tree/year	Irrigation water m^3/tree/year	2014	2015	2014	2015	2014	2015	2014	2015
500	9.41	59.76	60.10	24.93	26.36	84.76	86.46	47.96	51.70
	11.55	60.63	60.46	25.80	26.80	86.43	87.26	49.93	53.00
	13.41	61.13	61.30	26.30	27.46	87.43	88.76	50.73	54.70
	15.42	61.60	61.80	26.76	27.80	88.36	89.60	52.43	55.63
600	9.41	62.03	61.73	26.70	27.86	88.73	89.60	49.83	53.50
	11.55	62.30	62.06	27.40	28.00	89.70	90.06	50.90	54.26
	13.41	62.53	62.86	28.36	29.61	90.90	92.47	53.46	57.23
	15.42	62.90	63.50	28.80	29.73	91.70	93.23	53.43	57.63
	9.41	62.60	62.60	28.26	28.66	90.86	91.26	52.40	55.66
700	11.55	63.33	62.66	28.60	29.76	91.93	92.42	52.26	56.66
	13.41	63.53	63.26	29.50	29.75	93.03	93.01	53.86	57.66
	15.42	63.83	63.90	29.66	29.83	93.50	93.73	53.93	57.43
Average nitrogen									
500		60.78	60.91	25.95	27.10	86.75	88.02	50.26	53.75
600		62.44	62.53	27.81	28.80	90.25	91.33	51.90	55.65
700		63.32	63.10	29.00	29.50	92.33	92.60	53.11	56.85
Average irrigation									
9.41		61.46	61.47	26.63	27.63	88.12	89.11	50.06	53.62
11.55		62.08	61.73	27.26	28.21	89.35	89.94	50.13	54.64
13.41		62.40	62.47	28.05	28.94	90.45	91.41	52.68	56.53
15.42		62.77	63.06	28.41	29.12	91.18	92.18	53.26	56.90
New L,S.D. at 5%									
Nitrogen		0.67	0.94	0.47	0.24	1.07	0.52	0.42	0.72
Irrigation		0.34	0.41	0.40	0.13	0.51	0.38	0.60	0.58
Interaction		ns	ns	ns	0.25	ns	0.79	1.34	1.29

*ns: not significant

As for the effect of irrigation levels, trees irrigated with 15.42 and 13.41 m^3 water/tree/year gave the highest yield without significant difference between them in both seasons. On the contrary, the 11.55 and 9.41 m^3 water/tree/year gave the least yield in both seasons. On other words, yield as kg/tree was gradually increased with increasing water applied from 9.41 to 15.42 m^3 water/tree/year. These results were supported by those of Girona et al., (2003), Mercier et al., (2009) and Abrisqueta et al., (2010) on different peaches cultivars. Also, Khattab et al., (2011a) reported that increasing irrigation levels from 7 to 13 m^3/tree/year increased the average yield of pomegranate trees from 18.94 to 42.45 kg/tree. Also, similar results coincided with those reported by Moursi and Soliman (2015) on Early Grand peach trees.

Regarding the interaction effect between the two studied factors, the obtained data showed that, yield as kg/tree tended to increase by increasing amounts of applied water and nitrogen fertilizer (Table, 4). Moreover, the highest yield was observed with applying (700 gm N/ tree/ year × 15.42 m^3 water/tree/year) followed by those received (700 gm N/ tree/year × 13.41 m^3 water/tree/year), (600 gm N/tree/year × 15.42 m^3 water/ tree/year) and (600 gm N/tree/year × 13.41 m^3 water/tree/year), respectively. While the least yield belonged to the lowest rates of nitrogen and irrigation levels (500 gm N/tree/year × 9.41 m^3 water/tree/year). The results are in agreement with those of Rufat et al., (2011) who showed that the highest yield was achieved with highest rates of irrigation and fertilization.

5. Fruit quality:

5.1. Physical characters:

Data presented in Table (5) show the effect of nitrogen rates, irrigation levels and their interaction on physical fruit characters of Florida prince peach trees. As for the effect of nitrogen rates only, it is clear that length, diameter, weight, volume and firmness of the fruits were significantly increased by increasing nitrogen rates from 500 to 700 gm N/tree/year in both seasons. Similar results were obtained by Chatzitheodorou et al., (2004). Also, the obtained results were in line with those reported by Kandil et al., (2010) who found that fruit length,

Table 5: Effect of irrigation and nitrogen rates on physical fruit characters of Florida prince peach trees.

Treatments		Length (cm)		Diameter (cm)		Weight (g)		Volume (cm^3)		Firmness ($lb/inch^2$)	
Nitrogen gm/tree/year	Irrigation water m^3/tree/year	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
500	9.41	4.15	4.82	4.47	5.10	50.63	58.96	47.00	49.10	11.41	12.98
	11.55	4.23	5.12	4.56	5.13	56.86	60.73	50.96	59.33	9.38	13.58
	13.41	4.27	5.22	4.61	5.21	61.33	61.33	54.56	60.20	8.92	13.32
	15.42	4.30	5.32	4.64	5.23	62.56	63.70	57.13	60.36	8.45	11.95
600	9.41	4.20	5.15	4.54	5.18	59.80	60.30	51.90	52.63	12.57	13.06
	11.55	4.28	5.17	4.62	5.20	61.70	62.70	55.53	61.23	11.86	13.22
	13.41	4.38	5.51	4.70	5.27	63.56	63.60	57.70	62.50	10.21	13.03
	15.42	4.41	5.55	4.71	5.27	64.20	64.38	59.62	63.23	9.95	12.20
700	9.41	4.23	5.21	4.66	5.24	60.50	60.73	54.56	55.56	13.55	12.97
	11.55	4.32	5.22	4.69	5.25	62.33	63.50	57.43	62.60	12.10	12.61
	13.41	4.41	5.50	4.73	5.30	64.26	64.40	57.80	63.63	11.82	13.04
	15.42	4.44	5.57	4.73	5.30	64.39	64.33	59.26	63.70	10.73	11.56
Average nitrogen											
500		4.23	5.12	4.57	5.17	57.84	61.18	52.41	57.24	9.54	12.96
600		4.31	5.34	4.64	5.23	62.31	62.74	56.18	59.89	11.15	12.87
700		4.35	5.37	4.70	5.27	62.87	63.24	57.26	61.37	12.05	12.54
Average irrigation											
9.41		4.19	5.06	4.55	5.17	56.97	59.99	51.15	52.43	12.51	13.00
11.55		4.27	5.17	4.63	5.19	60.29	62.31	54.64	61.05	11.11	13.14
13.41		4.35	5.41	4.68	5.26	63.05	63.11	56.68	62.11	10.32	13.13
15.42		4.38	5.48	4.69	5.26	63.71	64.13	58.67	62.43	9.71	11.90
New L,S.D. at 5%											
Nitrogen		0.07	0.08	0.05	0.05	0.34	0.36	1.06	0.23	0.08	0.12
Irrigation		0.06	0.07	0.04	0.04	0.50	0.37	0.90	0.57	0.05	0.09
Interaction		0.07	0.08	0.06	0.07	0.87	0.83	1.98	1.26	0.10	0.15

diameter, weight and volume were positively affected in response to application of nitrogen fertilizers. In this respect, Abd El-Razek and Saleh (2012) indicated that foliar and/or soil application of amino acids had a positive effect on fruit length, width, weight, volume and firmness of Florida prince peach trees. While, Wrona (2004) concluded that fruit firmness was not affected by nitrogen fertilization.

Concerning the effect of irrigation levels, data presented in Table 5 revealed that fruit length, diameter, weight and volume tended to increase by increasing the amount of applied water, while fruit firmness was decreased by increasing irrigation water in both seasons. The 15.42 and 13.41 m^3 water/tree/year gave the highest values of fruit length, diameter, weight and volume without significant difference between them in both seasons. However, applying 15.42 m^3 resulted in the lowest values of fruit firmness in both seasons. Similar results were reported by El-Sayed and El-Hagarey (2014) and Moursi and Soliman (2015) who concluded that, increasing irrigation rate improved physical fruit quality in terms of fruit length, width, weight and volume of Florida prince and Early Grand peaches. Also, Ali (2006) found that fruit size was decreased by decreasing irrigation water.

In addition, a significant interaction effect between the irrigation and nitrogen fertilization rate was obtained. The combination treatments of (700 gm N/tree/year × 15.42 m^3 water/tree/year), (700 gm N/tree/year × 13.41 m^3 water/tree/year), (600 gm N/tree/year × 15.42 m^3 water/tree/year) and (600 gm N/tree/year × 13.41 m^3 water/tree/year) gave the highest values of fruit length, diameter, weight and volume without significant difference among them in both seasons, while these resulted in decreasing fruit firmness in both seasons. However, the least values of fruit firmness were obtained by applying 500 gm N/tree/year × 9.41 m^3 water/tree/year. The results are in agreement with those of El-Kosary et al., (2013) and Rufat et al., (2010) on peaches.

5.2. Chemical characters:

It is clear from the data in Table (6) that, increasing nitrogen rates caused significant increase in the percentages of SSC, acidity and anthocyanin content in both seasons. SSC/acid ratio significantly decreased by nitrogen treatments. These results are in line with those obtained by Wrona (2004) and Youssef et al., (1985). In this respect, Kandil et al., (2010) noted that application of N fertilizers at 500, 750 and 1000 g/tree/year increasing total soluble solids and reducing total acidity Mit-Ghamr peach fruits.

Table 6: Effect of irrigation and nitrogen rates on chemical fruit characters of Florida prince peach trees.

Treatments		TSS %		Acidity %		TSS/acid Ratio		Total anthocyanin mg/100g fresh fruit	
Nitrogen gm/tree/year	**Irrigation water m^3/tree/year**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
	9.41	12.1	12.2	0.95	0.94	12.8	13.0	4.65	4.78
500	11.55	11.9	11.8	0.86	0.87	13.8	13.6	4.38	4.60
	13.41	11.2	11.3	0.83	0.85	13.5	13.3	3.74	3.72
	15.42	10.3	10.2	0.82	0.86	12.7	11.9	3.20	3.25
	9.41	12.3	12.5	0.97	0.96	12.7	13.1	4.78	4.86
600	11.55	11.8	11.9	0.87	0.90	13.5	13.2	4.47	4.63
	13.41	11.3	11.4	0.85	0.88	13.4	13.0	3.83	3.81
	15.42	10.6	10.2	0.82	0.84	12.9	12.2	3.25	3.30
	9.41	12.5	12.6	0.99	0.97	12.6	13.0	4.84	4.94
700	11.55	11.8	11.9	0.93	0.94	12.8	12.6	4.56	4.62
	13.41	11.4	11.5	0.86	0.88	13.3	13.0	3.84	3.88
	15.42	10.7	10.1	0.85	0.88	12.6	11.6	3.34	3.34
Average nitrogen									
500		11.4	11.4	0.68	0.88	13.2	13.0	3.99	4.09
600		11.5	11.5	0.88	0.89	13.1	12.9	4.08	4.15
700		11.6	11.5	0.91	0.92	12.8	12.5	4.15	4.19
Average irrigation									
9.41		13.3	12.4	0.97	0.96	12.7	13.0	4.75	4.86
11.55		11.8	11.8	0.89	0.90	13.4	13.1	4.47	4.62
13.41		11.3	11.4	0.85	0.87	13.4	13.1	3.80	3.80
15.42		10.5	10.2	0.83	0.86	12.7	11.9	3.26	3.29
New L,S.D. at 5%									
Nitrogen		0.04	0.03	0.009	0.007	0.14	0.12	0.015	0.015
Irrigation		0.03	0.02	0.012	0.006	0.24	0.09	0.021	0.016
Interaction		0.05	0.05	0.031	0.012	0.40	0.15	0.047	0.030

As for the effect of irrigation levels on fruit juice quality, it is clear from Table 6 that, 15.42 m^3 water/tree/year tended to significantly decrease TSS, acidity and anthocyanin contents compared to the other levels in both seasons. TSS/acid ratio did not show any consistent trend although this variable was high significant in both seasons. The present results are confirmed by Sotiropoulos et al., (2010) on clingstone peach cultivar. In this respect, Khattab et al., (2011b) found that increasing irrigation levels TSS, acidity and anthocyanin decreased of pomegranate juice.

Concerning the interaction between nitrogen rates and irrigation levels, it is clear a significant interaction effect on juice fruit content was observed in both seasons. The highest values of SSC, acidity and anthocyanin belonged to the treatments (700 gm N/tree/year × 9.41 m^3 water/tree/year), (600 gm N/tree/year × 9.41 m^3 water/tree/year) and (500 gm N/tree/year × 9.41 m^3 water/tree/year) respectively, whereas the lowest values belonged to the high rates of nitrogen and irrigation levels (700 gm N/tree/year × 15.42 m^3 water/tree/year). The results are in agreement with those of, Rufat et al., (2010) and El-Kosary et al., (2013) on peaches.

CONCLUSION

The combination (600 gm. N x 13.41 m^3 water/tree/year) would be preferred and saves 13% of irrigation water and 14.28% nitrogen as compared with all other combinations. It might be recommended for peach trees grown under similar conditions

REFERENCES

Ab El-Razek, E. and M.M.S. Saleh (**2012**). Improve and fruit quality of Florida prince peach trees using foliar and soil applications of amino acids. Egypt. Middle-East J. Sci. Res., **12 (8)**: 1165 - 1172.

Abd El-Samad, C.A.; M.E. Morsi and T.A. Yehia (**2006**). Effects of organic fertilization and irrigation levels on water use, growth and productivity of pear trees. Egypt. J. of Appl. Sci., **21(12 B)**: 695- 712.

Abrisqueta, I.; L.M. Tapia; W. Conejero; M.I. Sanchez-Toribio; J.M. Abrisqueta; J.Vera and M.C.Ruiz-Sanchez (**2010**). Response of early peach (Prunus persica L.) trees to deficit irrigation. Spanish J. Agric; Res., **8(S2)**: 830 – 839.

Alaoui, S.M.; A. Abouatallah; R. Salghi; Z. Amahmid; J. Bettouche; A. Zarrouk and B. Hammouti (**2013**). Impact assessment of deficit irrigation on yield and fruit quality in peach orchard. Der Pharma Chemica, **5(3)**: 236 – 243.

Ali, A.; S. Perveen; S.N.M. Shah; Z. Zhang; F. Wahid; M. Shah; S. Bibi and A. Majid (**2014**). Effect of foliar application of micronutrients on fruit quality of peach. Amer. J. of plant science, **5**: 1258 – 1264.

Ali, M.M. (**2006**). Effect of different irrigation rates and emitter distance on vegetative growth, fruiting and water use efficiency (WUE) for Florida prince peach cultivar trees. Egypt J. Appl. Sci., **21**: 184 – 204.

Almaliotis, D., I. Therios, M. Karatassiou (**1997**). Effect of nitrogen fertilization on growth, leaf nutrient concentration and photosynthesis in three peach cultivars. ISHS Acta Horticulturae : II International Symposium on Irrigation of Horticultural Crops. 449 .73

Association of Official Agricultural Chemists (**1995**). Official Methods of Analysis (A.O.A.C.) 14th Benjamin Franklin Station, Washington D.C. U.S.A.

Bybordi, A. (**2013**). Quantitative and qualitative effects of nutrient application and irrigation methods an apricot. Middle-East J. Sci. Res., **14 (3)**: 423 - 431.

Chatzitheodorou, I.T.; T.E. Sotiropoulos and G.I. Mouhtaridou (**2004**). Effect of nitrogen, phosphorus, potassium fertilization and manure on fruit quality of the peach cultivars Spring Time and Red Haven. Agronomy Research **2(2)**: 135 – 143.

El- Kosary, S.; M,A. Abdel-Mohsen; S. El-Merghany and A.M. Badran (**2013**). Enhancing the productivity of Early Grande peaches under northern Sini conditions via supplemental irrigation and organic fertilization. J. Hort. Sci.,& Ornamental plants, **5(2)**: 77 – 88.

El- Sayed, O. and M.E. El-Hagarey (**2014**). Evaluation of Ultra-low drip irrigation and relationship between moisture and salts and peach (Prunus persica) yield. J. of Amer. Sci., **10(8)**: 12 – 28.

El-Shewy, A.A. and A.I. Abdel-Khalek (**2014**). Physiological studies on the effect of foliar sprays with some micronutrients on leaf mineral contents, yield and fruit quality of Florida prince and Desert Red peach trees. Trends in Hort. Res., **4(1)**: 20 – 30.

Evenhuis, B. and P.W. DeWaard (**1980**). Principles and practices in plant analysis. FAO soils Bull., **38**: 152-163.

Girona, J.; M. Mata; A. Arbones; S. Alegre; J. Rufat and J. Marsal (**2003**). Peach tree response to single and combined regulated deficit irrigation regimes under shallow soils. J. Amer. Soc. Hort. Sci., **128(3)**: 432- 440.

Hernandez, F.B.T.; J.C. Modesto; M.A. Suzuki and L.S. Correa (**1994**). Effect of irrigation and nitrogen levels on qualitative and nutritional aspects of fig trees (*Ficus carica L*). Sci. Agric. Piracicaba, **51(2)**: 292 – 297.

Hsia, C.L.; B.S. Luh and C.O. Chickester (**1965**). Anthocyanin in fresh tone peaches. J. Food Sci., **30**: 5 – 12.

Ibrahim, A.M. and G.A. Abd El-Samad (**2009**). Effect of different irrigation regimes and partial substitution of N-mineral by organic manures on water use, growth and productivity of pomegranate trees. Europ. J. Sci. Res., **38(2)**: 199 – 218.

Jackson, M.L. (**1973**). Soil and chemical analysis. Prentice- Hall. Engle-Wood Cliffs, USA.

Kandil, E.A.; A.I.F. Fawzi and M.F.M. Shahin (**2010**). The effect of slow nitrogen fertilizers on growth, nutrient status and fruiting of Mit Ghamr peach trees. J. Amer. Sci., **6(2)**: 195 – 201.

Khattab, M.M.; A.E. Shaban; A.H. El-Shrief and A.S. E. Mohamed (**2011a**). Growth and productivity of pomegranate trees under different irrigation levels I: Vegetative growth and fruiting. J. Hort. Sci.& Ornamental plants, **3(2)**: 194 – 198.

Khattab, M.M.; A.E. Shaban; A.H. El-Shrief and A.S. E. Mohamed (**2011b**). Growth and productivity of pomegranate trees under different irrigation levels II: Fruit quality. J. Hort. Sci. & Ornamental plants, **3(3)**: 259 – 264.

Khattab, M.M.; A.E. Shaban; A.H. El-Shrief and A.S. E. Mohamed (**2011c**). Growth and productivity of pomegranate trees under different irrigation levels III: Leaf pigments, proline and mineral content. J. Hort. Sci. & Ornamental plants, **3(3)**: 265 – 269.

Lobit, P.; P. Soing; M. Genard and R. Habib (**2001**). Effects of timing of nitrogen fertilization on shoot development in peach (*Prunus persica*) trees. Tress Physiol. **20**: 34 – 42.

Marschner, H. (**1995**). Mineral nutrition of higher plants, 2nd edition. Academic Press, London. 889 pp.

Mehanna, H.T.; R.G. Stino; I. Saad El -Den and A.H. Gad El- Hak (**2012**). The influence of deficit irrigation on growth and productivity of manzanillo olive cultivar in desert land. J. Hort. Sci. & Ornamental plants, **4(2)**: 115 – 124.

Melgar, J.C.; J. M. Dunlop and J.P. Syvertsen (**2010**). Growth and physiological responses of the citrus rootstock swingle citrumelo seedlings to partial root zone drying and deficit irrigation. J. Agric. Sci., pp 1-10

Mercier, V.; C. Bussi; F. Lescourret and M. Genard (**2009**). Effects of different irrigation regimes applied during the final stage of rapid growth on an early maturing peach cultivar. Irrig. Sci., **27(4)**: 297 – 306.

Mikhael, G.B. and A.A. Mady (**2007**). Effect of some drip irrigation and mulching treatments on II. Yield, fruit quality and water use efficiency of Anna apple trees grown in new reclaimed soils. Minufiya J. Agric. Res., **32**: 121 – 127.

Mirabdulbaghi, M. and M. Pishbeen (**2012**). Effect of different forms and levels of nitrogen on vegetative growth and leaf nutrient status of nursery seedlings rootstocks of peach. American Journal of plant Nutrition and fertilization Technology, **2(2)**: 32 – 44.

Moran, R. and D. Porath (**1980**). Chlorophyll determination in intact tissues using N, N dimethyl formamide. Plant Physiol., **65**: 478-479.

Moursi, E.A. and M.A.M. Soliman (**2015**). Effect of water regime on yield, fruit quality and some water relations of peach under conditions of heavy clay soils. Alex. J. Agric. Res., **60(2)**: 77 – 86.

Murphy, J. and J.P. Riely (**1962**). A modified single dilution method for determination of phosphate in natural water. Ann. Chemi. Acta, **27**: 31 – 36.

Ogawa, J.M., Zehr, E.I., Bird, G.W., Ritchie, D.F., Uriu, K. and Uyemoto, J. K. (eds) (**1995**). Compendium of Stone Fruit Diseases. APS Press, St Paul, Minnesota (USA). 98 pp.

Pergl, F. (**1945**). Quantitative organic micro analysis. 4th ed. J.A. Churchill, L.T.D. London.

Rufat, J.; A. Arbones; P. Villar; X. Domingo; M. Pascual and J.M. Villar (**2010**). Effects of irrigation and nitrogen fertilization on growth, yield and fruit quality parameters of peaches for processing. Acta Horticulturae, **868**: 87 – 94.

Rufat, J.; X. Domingo; A. Arbones; M. Pascual and J.M. Villar (**2011**). Interaction between water and nitrogen management in peaches for processing. Irrig. Sci., **29(4)**: 321 – 329.

Shah, S.A.; W. Mohammad; S.M. Shah; R. Elahi; A. Ali and A.B. Haroon (**2014**). Integrated effect of organic and inorganic nitrogen on peach fruit yield and orchard fertility. Agric. Sci. Res. J. **4(4)**: 78 - 82.

Snedecor, W. and W.G. Cochran (**1967**). Statistical methods. 6th ed. The Iowa College Press.

Sotiropoulos, T.; D. Kalfountzos; I. Aleksiou; S. Kotsopoulos and N. Koutinas (**2010**). Response of a Clingstone peach cultivar to regulated deficit irrigation. Sci. Agric. Piracicaba Braz., **67(2)**:164 – 169.

Stino, R.G.; T.A. Fayed; M.M. Ali and S.A. Alaa (**2010**). Enhancing fruit quality of Florida prince peaches by some foliar treatments. J. Hort. Sci. & Ornamental plants **2(1)**: 38 – 45.

Strand, L. (**1999**). Integrated Pest Management for Stone Fruits. University of California. 264 pp.

Wrona, D. (**2004**). Effect of nitrogen fertilization on growth, cropping and fruit quality of Sampion apple trees during 9 years after planting. Folia Hort., **16(1)**: 55 – 60.

Youssef, N. M. A.; T. A. Nasr; M. A. Bacha and M. A. Shaheen (**1985**). Effect of nitrogen fertilization on growth, flowering and fruiting of local orange (*Citrus sinensis Osbeck*) in Riyadh, Saudi Arabia. J. Coll. Agric., King Saud Univ., **7 (1)**: 153 – 172.

Zayan, M. A.; A.F. El-Sammak; S. M. Zeerban and A.R. El-Shereif (**2002**). Physiological responses of some grapevine varieties to drought conditions. 2th Conf. Hort. Sci., Kafr El-Sheikh, Tanta Univ., **28(3/II)**: 782-796.

الملخص العربى

تاثير معاملات الري والتسميد النيتروجينى على النمو والمحصول و جودة الثمار فى أشجار الخوخ صنف فلوريدا برنس

محمد على محمد سليمان [١]، حسن أبو الفتوح عناب[٢]وعلى السيد زغلول[٣]

قسم الفاكهة متساقطة الأوراق[١]، قسم الموالح[١]، قسم تداول ثمار الفاكهة[٣]

معهد بحوث البساتين– مركز البحوث الزراعية– الجيزة– مصر

اجريت هذه الدراسة خلال موسمي ٢٠١٤ و٢٠١٥ وذلك لدراسة تأثير ثلاث معدلات من النيتروجين معدلات ٥٠٠ او ٦٠٠ او ٧٠٠ جرام/شجرة/سنة والري فى أربع مستويات هم ٩,٤١ و١١,٥٥ و١٣,٤١ و١٥,٤٢ متر مكعب/شجرة/سنة على النمو والمحصول وجودة الثمار فى أشجار الخوخ صنف فلوريدا برنس. وقد بينت النتائج أن:

١- أدى التسميد النيتروجينى والري الى زيادة معنوية فى النمو الخضري للأشجار والمتمثل فى طول الفرع وعدد الأوراق على الفرع والمساحة الورقية والوزن النوعي للورقة.

٢- تأثر كل من المحصول كوزن (كجم/شجرة) ومحتوى الورقة من الكلوروفيل والنيتروجين والفوسفور والبوتاسيوم بشكل إيجابي بالتسميد النيتروجينى والري والتوليفات فيما بينهم.

٣- حدثت زيادة معنوية فى وزن الثمرة وحجم الثمرة وطول وقطر الثمرة وذلك بزيادة معدلات النيتروجين من ٥٠٠ الى ٧٠٠ جرام/شجرة/سنة والري من ٩,٤١ الى ١٥,٤٢ متر مكعب/شجرة/سنة.

٤- صلابة الثمرة وTSS والحموضة والانثوسيانين زادت بشكل معنوي بزيادة التسميد النيتروجينى وحدث بهم نقص مع زيادة الري، فى حين أن نسبة TSS الى الحموضة لم تتأثر بالمعاملات.

٥- من خلال مناقشة نتائج هذه الدراسة يمكن أن نوصي باستخدام المعاملة ١٣,٤١ متر مكعب للشجرة سنويا مع إضافة السماد النيتروجينى بمعدل ٦٠٠ جرام لكل شجرة في السنة، لتأثيرها الإيجابي على الأشجار وتوفيرها ١٣٪ من مياه الري وتأثيرها الاجابى على النمو الخضري والمحصول وجودة الثمار.