Growth, Yield, Fruit Quality and Elemental Composition as Affected by Some Macronutrients Fertilization of 'Florida Prince' Peach Cultivar

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ABSTRACT : This study was carried out during the two successive seasons of both 2015 and 2016 on five years old 'Florida prince' trees (*Prunus persica L.*) budded on '*Nemagard*' peach rootstock, grown in sandy soil under drip irrigation system in a private orchard located at El-Nubaria region, El-Behira Governorate, Egypt. The aims of this research was to investigate the effect of some macronutrients fertilization as ammonium nitrate (NH_4NO_3), Potassium sulphate (K_2SO_4), and Calcium sulphate ($CaSO_4$) and their combinations on growth, yield, fruit quality and elemental composition of 'Florida prince' peach trees. The followed experimental design was randomized complete block design with five replicates. Results indicated that all fertilization treatments, significantly; increased vegetative growth (shoot length, shoot thickness and leaf area) characters as compared with the control plants during both seasons. Also, all treatments increased the yield (kg /tree) and fruit weight (g) as compared with the control plants. The highest yield and fruit weight were recorded with the combination of 560g NH_4NO_3 +280 g K_2SO_4+ 250 g $CaSO_4$ application treatments (97.02 and 103.65 kg, each in turn) as compared with the control (36.61 and 40.00 kg, respectively). Moreover, all nitrogen, potassium and calcium fertilization treatments; increased length (cm), diameter (cm), firmness (Ib/inch^2), total soluble solids (%), acidity (%), and total sugars (%) as compared with control ones during both seasons. On the other hand, A gradual elemental increases in nitrogen, potassium and calcium in leaf (%) were recorded with the macronutrients combinations as compared with the control plants.

Key words: 'Florida prince' Peach, Ammonium nitrate, Calcium sulphate, Potassium sulphate, macronutrients, yield, fruit quality, elemental content.

INTRODUCTION

The peach (*Prunus persica L.*) is most important stone fruits, due to its heavy loading dietetic value and as a rich source of carbohydrate, protein and vitamins, especially (A, B and C) and some mineral nutrients. According to FAO (2017), Egypt ranges third in the Arab production of peaches and the area cultivated with peach in Egypt is 58800 feddans, and the total production of peach fruits is 360723 tons.

Peach cv. 'Florida prince' is one of the early season cultivates that suffer from accelerated softened fruits, and therefore, the fruits exhibit short handling period which limits its commercial potential. This concept obligates fruit producer to harvest fruits minimum maturity. Meanwhile, there has been a special trend of tree peach fruits that a queried better flavor and juicy while has a retarded than loss of firmness.

Nitrogen is one of the most important nutrients in apple fertilization program. Considerable quantities of the nitrogen applied to soil are lost through leaching, volatilization and denitrification (Volk, 1961; Broadbent and Carlton,1978). Frequent applications and high quantities of N fertilizers are needed to maintain an adequate N level for optimum growth and fruit production. Also, nitrogen fertilization is a common practice to increase fruits size and yield, and maintain adequate tree vigor (Stiles and Reid, 1991). However, the effects of N fertilization are variable and some studies have shown little or no fruit size response to increasing rates of N fertilization (Goode and Higgs, 1977; Hipps *et al*., 1990 ; Neilsen *et al*., 1999).

Potassium is the most appropriate univalent cation for enzyme activation, not only because of high concentration, but also due to its mobility in plant (Mengel and Krikby, 1978). It is one of the essential elements in plant nutrition which is added regularly in fertilization programs. It is important for structure and promotes formation of ATP (plant energy), oxidative polyphosphorelation (Yagodin, 1984), synthesis of amino acid proteins (Russell, 1978) and has important role in stomata movement, pH stabilization, cell extension and it is needed for enlargement of fruit (Faust, 1989).

Calcium plays an important role in providing stability and mechanical strength to the cell structure of the fruit. Thus, the deficiency of calcium in the fruit leads to weakening of middle lamella due to which cells expand and burst. Moreover, Ca is known to stabilize cell membranes and in this way may prevent physiological disorders attributed to Ca can be directly supplied to the fruit, reducing excessive gibberellins levels by various means may be the better way to control such disorders (Wenxuan and Fanjing, 1996).

The aim of the present study is investigating the effect of N, K and Ca at different levels of fertilization on vegetative growth, yield, fruit quality and leaf and fruit mineral content of ‘Florida prince’ peach trees grown under sandy soil conditions.

MATERIALS AND METHODS

This investigation was carried out during the two successive seasons, 2015 and 2016 on five years old ‘Florida prince’ peach trees (*prunus persica L.*) budded on ‘*Nemagard*’ peach rootstock , planted 4 x 3 meters apart, grown in sandy soil under drip irrigation system in a private orchard at El-Nubaria, El-Behira Governortate, Egypt. Some physiochemical analysis of experimental soil was indicated in (Table 1).

Table (1). Some physical and chemical properties of the experimental soil

Parameter	0-30 cm	30-60 cm
Mechanical Analysis (%)		
Sand	96	98
Silt	--	--
Clay	4	2
Textural class	Sand	Sand
pH (1:1, water suspension)	8.24	8.53
EC (1:1,water extract), dS/m	0.32	0.30
$CaCO_3$ (%)	2.6	5
OM (%)	0.05	0.09
Soluble cations (meq/L)		
Ca^{2+}	2.72	3.06
Mg^{2+}	1.70	0.34
Na^{+}	1.85	1.63
K^{+}	0.32	0.22
Soluble anions (meq/L)		
HCO^{-}_{3}	4.86	8.1
Cl-	5.40	4.86
SO^{-}_{4}	1.45	1.77
Available nutrients (mg/kg)		
Nitrogen (N)	202.61	222.14
Phosphorus(P)	9.5	20
Potassium (K)	250	300

Seventy five uniform trees, more or less, were selected for this study and all of them were subjected to the same cultural practices during both successive seasons.

The treatments were as follows:

1. Control
2. Ammonium nitrate 490 g/ tree
3. Ammonium nitrate 560 g/ tree
4. Potassium sulphate 245 g/tree
5. Potassium sulphate 280 g/tree
6. Calcium sulphate 125 g/tree
7. Calcium sulphate 250 g/tree
8. Ammonium nitrate 490 g/ tree + Potassium sulphate 245 g/tree
9. Ammonium nitrate 490 g/ tree + Calcium sulphate 125 g/tree
10. Potassium sulphate 245 g/tree + Calcium sulphate 125 g/tree
11. Ammonium nitrate 560 g/ tree + Potassium sulphate 280 g/tree
12. Ammonium nitrate 560 g/ tree + Calcium sulphate 250 g/tree
13. Potassium sulphate 280 g/tree + Calcium sulphate 250 g/tree
14. Ammonium nitrate 490 g/tree + Potassium sulphate 245 g/tree + Calcium sulphate 125 g/tree
15. Ammonium nitrate 560 g/tree + Potassium sulphate 280 g/tree + Calcium sulphate 250 g/tree

Treatments were applied with Ammonium nitrate, Potassium sulphate and Calcium sulphate at two equal doses on the bud swelling and after fruit set. The previous treatments were applied and arranged in a randomized complete block design. Each treatment included five replicates with one tree for each replicate. The effect of the previous treatments was investigated via evaluating their influence on the following parameters:

1.Vegetative growth:

At the end of growing seasons, the selected shoots were measured for the average of shoot length (cm), shoot diameter (cm) using hand caliber and leaf area according to this formula, leaf area (cm^2) = 0.49 (length of leaf × width of leaf) + 19.69 (Ahmed and Morsy, 1999).

2. Yield (kg/tree):

The produced fruit yield on each replicate tree resulting from the applied treatments was expressed as number of fruits/tree and weight of fruits in kg/ tree which was attained at harvest stage in both seasons of the study.

3. Physical fruit characteristic

Sample of 10 fruits per tree from each replicate was collected randomly at late April in both seasons, and then transported quickly to the laboratory to determine the physical and chemical fruit characteristics:

Average fruit weight (g/ fruit), fruit samples were weighted and the average fruit weight for each replicate was calculated.
Average fruit length (L) and diameter (D), cm. were measured by using hand caliper to obtain fruit shape index (L/D) calculated mathematically as a ratio.
Fruit firmness was expressed as ($lb/inch^2$) according to (Magness and Taylor, 1982). Flesh firmness was measured in two opposite sides of the fruit using the Magness and Taylor Pressure.

4. Chemical fruit characteristics

Regarding the chemical fruit characteristics, sample of 10 fruits was picked randomly at harvest to determine the following parameters: Total soluble solids (TSS %); using a hand refractometer according to Chen and Mellenthin (1981). Total acidity (%) was determined as in fruit juice according to (AOAC,1985) Total sugars (%): was determined in fresh fruit samples according to Malik and Singh (1980).

Nitrogen, potassium and calcium concentrations were determined in leaves for both seasons by using 20 leaves / tree samples, which were taken from each treatment. The samples were washed with tap water and distilled water, and then oven dried at 70°C to constant weight and then ground. To determine the leaf elemental contents, ground powder of each sample was digested with H_2SO_4 and H_2O_2 according to Wolf (1982). In the digested material, nitrogen and phosphorus were determined, colorimetrically according to Evenhuis and DeWaard (1976) and Murphy and Riley (1962), respectively. Potassium was determined by flame photometer as described by Cheng and Bray (1951). Calcium leaf contents were determined by Perkin Elmer Atomic

Absorption Spectrophotometer according to Carter (1993). Suitable aliquots were taken for determination of some macro elements as in leaf materials. The concentrations of N, K and Ca were expressed as percent on weight basis.

5. Statistical analysis

Results of the measured parameters were subjected to computerized statistical analysis using RCBD for analysis of variance (ANOVA) and means of treatments were compared using L.S.D at 0.05 according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

1.Vegetative growth characters:

1.1 Shoot length (cm):

The results concerning the effect of soil fertilization with Ammonium nitrate, Potassium sulphate and Calcium sulphate single or mixed treatments on the shoot length (cm) of ‘Florida prince’ peach trees are listed in Table (2).

The average values of both experimental seasons indicated that soil fertilization with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatment, brought about the highest increment in shoot length (cm), followed by 560 g NH_4NO_3 treatment as compared with the control treatment during both seasons. The percentage increase of shoot length comparing to check plot may be due to the direct effects of increasing the rate of N application on ‘Costata’ persimmon trees increased shoot length, Abo El-Mageed (1992). Also, Abd El-Megeed *et al* (2011) reported that shoot length increased significantly with increasing the levels of N and K application.

1.2 Shoot thickness (cm):

Pertaining the results of shoot thickness (cm) of ‘Florida prince’ peach trees as affected by soil fertilization with Ammonium nitrate, Potassium sulphate and Calcium sulphate single or mixed treatments during both seasons listed in Table (2) revealed that all foliar application treatments, significantly ($p \leq 0.05$) increased shoot thickness as compared with the control during both seasons. Generally, soil fertilization with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250g $CaSO_4$ treatment, taken about the highest increment in shoot thickness, followed by 490 g NH_4NO_3 + 245 g K_2SO_4 + 125 g $CaSO_4$ treatment as compared with the control during both experimental seasons. The increment percentage of shoot thickness comparing to check plot may be taken place due to the direct effects of nitrogen fertilization in from of (Calcium ammonium Nitrate) at 125 or 250 kg/ha on the growth of the peach trees (Janjic,1979).

1.3 Leaf area (cm^2):

The effect of various applied treatments on leaf area of ‘Florida prince’ peach trees are tabulated in Table (2). The obtained results indicated that fertilization the trees with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatment, gave rise to the highest leaf area (47.89 and 47.56 cm^2) each in turn, followed by 560 g NH_4NO_3 + 280g K_2SO_4 application treatment (45.97 and 45.85 cm^2, serially), during both the seasons.

The increment percentage of leaf area comparing to check plot may be taken place due to the direct effects of K on increasing the leaf area and number of leaves might be attributed to its important role of encouraging photosynthesis and chlorophyll formation as producing more carbohydrates and amino acids, which aids in the formation of new cells (Soaad *et al* ., 2014).

Table (2). Effect of application with different nutrients rates on some morphological parameters of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	Shoot length (cm)		Shoot thickness (cm)		Leaf area (cm^2)	
	2015	2016	2015	2016	2015	2016
Control	34.17^{k}	34.57^{k}	0.58^{k}	0.59^{k}	32.22^{h}	33.19^{h}
490 g NH_4NO_3	49.05^{d}	49.51^{d}	0.61^{j}	0.62^{j}	37.63^{ef}	38.01^{f}
560 g NH_4NO_3	52.81^{b}	53.37^{b}	0.63^{i}	0.65^{i}	44.72^{bc}	42.68^{c}
245 g K_2SO_4	39.19i	39.53^{h}	0.77^{e}	0.79^{e}	38.35^{ef}	37.25^{f}
280 g K_2SO_4	42.30^{h}	42.65^{g}	0.82^{c}	0.84^{c}	43.63^{c}	43.48^{c}
125 g $CaSO_4$	35.67^{j}	34.95^{j}	0.66^{h}	0.67^{h}	$33.63g^{h}$	34.29^{g}
250 g $CaSO_4$	36.99^{j}	37.25^{i}	0.76^{ef}	0.77^{e}	41.39^{d}	40.26^{d}
490 g NH_4NO_3 + 245 g K_2SO_4	44.43^{ef}	44.60^{ef}	0.72^{g}	0.74^{g}	39.61^{de}	39.48^{de}
490 g NH_4NO_3 + 125 g $CaSO_4$	42.72^{gh}	42.84^{g}	0.67^{h}	0.68^{h}	33.67^{gh}	35.02^{g}
245 g K_2SO_4 +125 g $CaSO_4$	39.11^{i}	39.22^{h}	0.74^{fg}	0.75^{fg}	34.67^{g}	34.39^{g}
560 g NH_4NO_3 + 280 g K_2SO_4	45.51^{e}	45.68^{e}	0.75^{f}	0.78^{e}	45.97^{ab}	45.85^{b}
560 g NH_4NO_3 +250 g $CaSO_4$	43.96^{fg}	44.06^{f}	0.74^{f}	0.76^{f}	37.26^{f}	38.67^{f}
280 g K_2SO_4 + 250 g $CaSO_4$	42.36^{h}	42.52^{g}	0.79^{d}	0.80^{d}	43.52^{c}	43.49^{c}
490 g NH_4NO_3 + 245 g K_2SO_4 + 125g $CaSO_4$	50.53^{c}	50.87^{c}	0.87^{b}	0.88^{b}	38.22^{ef}	39.00^{e}
560 g NH_4NO_3 + 280 g K_2SO_4 + 250g $CaSO_4$	55.40^{a}	55.60^{a}	0.90^{a}	0.91^{a}	47.89^{a}	47.56^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

2. Yield components:

2.1 Number of fruits per tree:

The results of Table (3) representing the effect of the above mentioned treatments on number of fruits per tree of 'Florida prince' peach trees. In general, the obtained results indicated that all fertilization application treatments, significantly ($p \leq 0.05$) increased number of fruits per tree as compared with the control plants during both seasons. fertilization application with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatments, resulted in the highest increment in number of fruits per tree, followed by 560 g NH_4NO_3 treatment as compared with the control.

The increment percentage of number of fruits comparing to check plot may be occurred due to the direct effects of nitrogen fertilization on the carbohydrates fruit content of Cox's orange pippin apples. Also, Potassium is the most appropriate univalent cation for enzyme activation, not only because of high concentration, but also due to its mobility in plant (Mengel and Krikby,1978).

2.2 Fruit weight (g):

As for the effects of soil fertilization with Ammonium nitrate , Potassium sulphate and Calcium sulphate single or mixed treatments on the fruit weight (g) of 'Florida prince' peach trees during both seasons, results in Table (3) showed that all treatments, significantly ($p \leq 0.05$) increased fruit weight as compared with the control treatment.

Fertilization with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ application treatment in the second seasons or 560 g NH_4NO_3 + 280 g K_2SO_4 application treatment; while, in the first seasons gave rise to the highest fruit weights as 120.00 and 112.30 g; respectively followed by 280 g K_2SO_4 application treatment in the first season or 280 g K_2SO_4 + 250 g $CaSO_4$ application treatment in first seasons; led to the highest fruit weights as 110.00 and 108.45 g; respectively, during both 2015 and 2016 seasons.

The increment percentage of fruit weight comparing to check plot may attributed to the direct effects of Potassium sulphate; which gave the best results for fruit weight and size in peach **(**Mansour *et al.,*1986). Also, Dimitrovski *et al*. (1972) reported that the highest average fruit weight of peaches were produced with increasing the rate of NPK combination. And, Abd El-Megeed *et al* (2011) on 'le-conte' found that fruit weight (g) increased significantly with increasing the levels of N and K fertilization.

2.3 Yield (kg/tree):

In concerning with influence of ammonium nitrate, potassium sulphate and calcium sulphate single or mixed treatments on the weights per fruits (kg) of 'Florida prince' peach trees are listed in Table (3).

The average values of both experimental seasons indicated that treatments significantly ($p \leq 0.05$) increased yield (kg/tree) as compared with the control plants. It was evident that the soil fertilization with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatment, resulted in the highest increment in weight fruits per tree, followed by 280 g K_2SO_4 + 250 g $CaSO_4$ treatment as compared with the control during both seasons 2015 and 2016.

The increment percentage of weight fruits comparing to check plot may be taken place due to the direct effects of fruit size and yield increases in response to N fertilizers are sometimes off set by undesirable impacts on fruit color and quality (Fallahi *et al*.,1997; Raese and Drake,1997).

Table (3). Effect of application with different nutrients rates on yield and some physical fruit characteristics of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	Number of fruits/ tree		Fruit weight (g)		Yield kg/tree	
	2015	2016	2015	2016	2015	2016
Control	437.25k	457.00^{g}	83.40^{g}	88.00^{d}	36.61^{j}	40.00f
490 g NH_4NO_3	662.67^{ef}	680.33^{cd}	90.10e^{fg}	103.33^{bcd}	59.50^{fgh}	70.23^{bc}
560 g NH_4NO_3	775.50^{b}	750.00^{b}	95.00^{cdefg}	106.00^{abc}	73.64^{bcd}	79.72^{b}
245 g K_2SO_4	614.92^{h}	659.00^{cde}	97.70^{bcdef}	101.33^{bcd}	60.08^{ghi}	67.05^{c}
280 g K_2SO_4	624.38^{gh}	675.00^{cd}	106.30^{abc}	110.00^{ab}	66.35^{def}	74.25^{bc}
125 g $CaSO_4$	529.75^{j}	537.33^{f}	91.83^{efg}	95.33^{bcd}	48.65^{i}	51.36^{ef}
250 g $CaSO_4$	558.50^{i}	573.33^{f}	94.80^{cdefg}	92.00^{cd}	52.98^{hi}	52.75^{de}
490 g NH_4NO_3 + 245 g K_2SO_4	683.50^{e}	684.00^{c}	103.80^{abcde}	106.67^{abc}	70.94^{cde}	72.94^{bc}
490 g NH_4NO_3 +125 g $CaSO_4$	650.42^{fg}	645.00^{de}	97.10^{bcdefg}	103.67^{bcd}	63.20^{efg}	66.99^{c}
245 g K_2SO_4 + 125 g $CaSO_4$	631.81^{gh}	632.00^{e}	94.37^{defg}	101.33^{bcd}	59.64^{fgh}	64.07^{cd}
560 g NH_4NO_3 + 280 g K_2SO_4	686.57^{de}	691.00^{c}	112.30^{a}	100.67^{bcd}	77.10^{cb}	69.56^{bc}
560 g NH_4NO_3 +250 g $CaSO_4$	682.7^{5e}	684.33^{c}	98.75^{abcdef}	100.00^{bcd}	67.39^{def}	68.46^{bc}
280 g K_2SO_4 + 250 g $CaSO_4$	738.75^{c}	750.33^{b}	108.45^{abc}	98.00^{bcd}	80.14^{b}	73.48^{bc}
490 g NH_4NO_3 + 245 g K_2SO_4 + 125 g $CaSO_4$	713.17^{cd}	761.00^{b}	86.00^{fg}	92.67^{cd}	61.34^{fgh}	70.55^{bc}
560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$	876.26^{a}	864.00^{a}	110.65^{ab}	120.00^{a}	97.02^{a}	103.65^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

3. Fruit physical parameters:

3.1 Fruit length (cm):

As for the effect of various applied treatments on fruit length (cm) of 'Florida prince' peach trees was calculated and tabulated in Table (4). The results concerning the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate either singly or in combination treatments on the fruit length (cm) during both 2015 and 2016 seasons indicated that soil fertilization with 245 g K_2SO_4, resulted in the highest increment in fruit length, followed by 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatment as compared with the control during both seasons.

3.2 Fruit diameter (cm):

The results concerning the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate single or mixed treatments on the fruit diameter (cm) during both 2015 and 2016 seasons are presented in Table (4). A gradual increase in fruit diameter was observed with trees treated with 560g NH_4NO_3 + 250 g $CaSO_4$ application treatment (5.60 cm) and 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ (5.57 cm), followed by 245 g K_2SO_4

(5.39 cm) and 250 g $CaSO_4$ (5.39 cm) as compared with the control (4.77 cm), respectively during the second season. While, in the first season a gradual increase was observed with trees treated with 245 g K_2SO_4 (4.89 cm) and 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ (4.83 cm) followed by 560 g NH_4NO_3 + 280 g K_2SO_4 (4.73 cm) and application treatment 490 g NH_4NO_3 + 245 g K_2SO_4 (4.62 cm) respectively, as compared with the control plants (4.34 cm).

The increment percentage of fruit length and fruit diameter comparing to check plot may be happens due to the direct effects of theses foundations are in conformity with those mentioned by El-Sherif *et al*. (2008) on plum who indicated that foliar potassium application; increased fruit diameter and K (%) in both seasons.

3.3 Fruit firmness (lb/inch^2):

The results concerning the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate singly or in combinations treatments on the fruit firmness (lb/inch^2) of 'Florida prince' peach trees during both 2015 and 2016 seasons are listed in Table (4). The average values of both experimental seasons indicated that soil fertilization with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ treatment, resulted in the highest increment in fruit firmness , followed by 280 g K_2SO_4 treatment as compared with the control during both seasons 2015 and 2016. Similar results were reported by El-Naggar *et al.* (2005), who found that preharvest spraying of, calcium on seedless guava increased the fruit firmness as compared with the control plants.

Table (4). Effect of application with different nutrients rates on some physic fruit characteristics of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	Fruit Length (cm)		Fruit diameter (cm)		Fruit firmness (lb/inch^2)	
	2015	2016	2015	2016	2015	2016
Control	4.32^{c}	4.87^{c}	4.34^{b}	4.77^{d}	12.54^{h}	14.00^{f}
490 NH_4NO_3	4.42^{bc}	5.13^{abc}	4.54^{ab}	5.20^{bc}	17.21^{cd}	16.58^{ef}
560 NH_4NO_3	4.46^{bc}	5.10^{abc}	4.58^{ab}	5.29^{ab}	17.29^{cd}	15.83^{ef}
245 K_2SO_4	4.77^{a}	5.47^{ab}	4.89^{a}	5.39^{ab}	14.92^{efg}	17.92^{de}
280 K_2SO_4	4.43^{bc}	5.33^{abc}	4.47^{ab}	5.20^{bc}	17.88^{bc}	22.58^{bc}
125 $CaSO_4$	4.40^{bc}	5.47^{ab}	4.49^{ab}	5.38^{ab}	16.42^{cdef}	18.50^{de}
250 $CaSO_4$	4.34^{bc}	5.37^{abc}	4.47^{ab}	5.38^{ab}	16.83^{cd}	23.50^{b}
490 NH_4NO_3 +245 K_2SO_4	4.48^{abc}	5.37^{abc}	4.62^{ab}	5.30^{ab}	16.41^{cdef}	21.58^{bc}
490 NH_4NO_3 +125 $CaSO_4$	4.48^{abc}	5.48^{ab}	4.61^{ab}	5.37^{ab}	16.38^{cdef}	19.92^{cd}
245 K_2SO_4 +125 $CaSO_4$	4.37^{bc}	5.33^{abc}	4.48^{ab}	5.20^{bc}	15.92^{def}	17.92^{de}
560 NH_4NO_3+280K_2SO_4	4.56^{abc}	5.13^{abc}	4.73^{ab}	5.05^{bcd}	16.75^{cde}	16.83^{ef}
560 NH_4NO_3+250$CaSO_4$	4.36^{bc}	5.43^{ab}	4.53^{ab}	5.60^{a}	14.73^{fg}	17.92^{de}
280 K_2SO_4 +250 $CaSO_4$	4.52^{abc}	5.53^{a}	4.59^{ab}	5.32^{ab}	13.34^{gh}	18.17^{de}
490NH_4NO_3+245K_2SO_4 +125$CaSO_4$	4.46^{bc}	5.03^{bc}	4.52^{ab}	4.90^{cd}	19.67^{ab}	17.83^{de}
560NH_4NO_3 +280K_2SO_4 + 250 $CaSO_4$	4.62^{ab}	5.57^{abc}	4.83^{a}	5.57^{a}	21.29^{a}	27.75^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

4. Fruit chemical parameters:

4.1 Total soluble solids (%):

Concerning the influence of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate single or mixed treatments on the total soluble solids of ‘Florida prince’ peach trees are listed in Table (5) cleared that all treatments, significantly ($p \leq 0.05$) increased total soluble solids (%) as compared with the control plants during both seasons.

The increment percentage of total soluble solids was observed with trees treated soil fertilization with 245 g K_2SO_4 + 250 g $CaSO_4$ application treatment (9.50 %) and 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ and application treatment (9.38 %), followed by 245 g K_2So_4 treatment (9.33 %) and 490 g NH_4NO_3 + 245 g K_2SO_4 treatment (9.17%) as compared with the control (7.58%) during the first season, while in the second season; a gradual increase was observed with trees treated with soil fertilization with 560 g NH_4NO_3 +280 g K_2SO_4 + 250 g $CaSO_4$ application treatment (12.00%) and 245 g K_2SO_4 + 125 g $CaSO_4$ treatment (11.67%), followed by 490 g NH_4NO_3 + 125 g $CaSO_4$ (11.33 %) as compared with the control (9.00 %). The highest rate of potassium treatments (750 g K/tree/year) showed the highest T.S.S % followed, in a decreasing order by 250 g K/tree/year (Nageib *et al.*, 1990). Also, Soaad *et al.*(2014) found that all preharvest treatments at 1.5% on ‘Anna’ apple trees, (especially KNO_3) significantly; increased T.S.S.

4.2 Acidity (%):

In terms of the results concerning the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate singly or in combination treatments on the acidity (%) of ‘Florida prince’ peach trees are listed in Table (6). The revealed that results gained all treatments, significantly ($p \leq 0.05$) increase fruit juice acidity (%) as compared with the control plants during both 2015 and 2016 seasons.

The increment percentage in acidity (%) was observed with trees treated soil fertilization with 245 g K_2SO_4 + 125 g $CaSO_4$ application treatment (0.87 %) and 560 g NH_4NO_3 + 280 g K_2SO_4 application treatment (0.83 %), followed by 490 g NH_4NO_3 + 125 g $CaSO_4$ treatment (0.80%) and 280g K_2SO_4 (0.76%) as compared with the control (7.58 %) during both the first season, while in the second season a gradual increase was observed with trees treated with soil fertilization with 560g NH_4NO_3 + 280 g K_2SO_4 application treatment (0.86%) and 280 g K_2SO_4 treatment (0.82%), followed by 245 g K_2SO_4 + 125 g $CaSO_4$ application treatment (0.81 %) as compared with the control (0.42 %) during both the first season.

Abou-Aziz *et al*. (1987) agree with the present results and reported that potassium application decreased significantly acidity (%) in ‘Le-Conte’ pear fruits Also, Potassium application significantly decreased total titratable acidity of ‘Le-Cont’ pear fruits. Abd El-Megeed *et al*. (2011) reported that fruit juice acidity significantly decreased with increasing the levels of N and K fertilization.

4.3 Total sugars (%):

The results concerning the effect of soil fertilization with Ammonium nitrate , Potassium sulphate and Calcium sulphate single or mixed treatments on the total sugars (%) of ‘Florida prince’ peach trees during both 2015 and 2016 seasons are listed in Table (7). revealed that all application treatments, significantly (*p*≤ 0.05%) increased total sugars (%) as compared with the control during experimental seasons. A gradual increase of total sugars (%) was observed with trees treated with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ application treatment (8.94 %) and 560 g NH_4NO_3 + 250 g $CaSO_4$ treatment (8.83 %), followed by 125 g $CaSO_4$ (8.79 %) and 490 g NH_4NO_3 + 125 g $CaSO_4$ treatment (8.72 %) as compared with the control (7.12 %) during the first seasons (2015). While, in the second season (2016) a gradual increase was observed with trees treated with 560 g NH_4NO_3 + 280 g K_2SO_4 + 250 g $CaSO_4$ application treatment (8.94 %) and 280 g K_2SO_4 + 250 g $CaSO_4$ application treatment (8.90 %), followed by 125 g $CaSO_4$ treatment (8.77 %) and 560 g NH_4NO_3 + 250 g $CaSO_4$ treatment (8.76 %) as compared with the control during (7.16 %).

The increment percentage of total sugars comparing to check plot my be due to the direct effects of all Ca treatments significantly increased total sugar fruit content of ‘Anna’ apple fruit (Eliwa *et al* .,1999). Also, these foundations are in conformity with those mentioned by El-Sherif *et al*. (2008) on plum who indicated that foliar potassium application increased total sugar and K (%) in both seasons. also, Soaad *et al*, (2014) found that on ‘Anna’ apple fruits spraying at 1.5% KNO_3 gave the higher significant content of total sugars in fruit.

Table (5). Effect of application with different nutrients rates on some Chemical fruit characteristics of ‘Florida prince’ peach trees during 2015 and 2016 seasons

Treatments	TSS (%)		Acidity (%)		Total sugars (%)	
	2015	2016	2015	2016	2015	2016
Control	7.58^{c}	9.00^{d}	0.42^{e}	0.42i	7.12i	7.16^{d}
490 NH_4NO_3	8.48^{abc}	11.00^{abc}	0.45^{de}	0.43^{hi}	8.65^{bcd}	8.71^{ab}
560 NH_4NO_3	8.68^{abc}	10.00^{c}	0.71^{abc}	0.60^{efg}	8.03^{g}	7.84^{cd}
245 K_2SO_4	9.33^{a}	10.33^{c}	0.65^{bcd}	0.68^{def}	8.72^{abc}	8.58^{abc}
280 K_2SO_4	9.05^{ab}	10.33^{c}	0.76^{abc}	0.82^{ab}	8.56^{cdf}	8.45^{abc}
125 $CaSO_4$	8.70^{abc}	11.00^{abc}	0.61^{cde}	0.58^{fg}	8.79^{abc}	8.77^{a}
250 $CaSO_4$	8.50^{abc}	11.00^{abc}	0.69^{abc}	0.65^{def}	8.25^{fg}	8.21^{abc}
490 NH_4NO_3 + 245 K_2SO_4	9.17^{ab}	10.67^{bc}	0.67^{abc}	0.71^{cde}	8.44^{def}	8.55^{abc}
490 NH_4NO_3 + 125 $CaSO_4$	9.12^{ab}	11.33^{abc}	0.80^{abc}	0.81^{abc}	8.72^{abc}	8.66^{ab}
245 K_2SO_4 + 125 $CaSO_4$	9.50^{a}	11.67^{ab}	0.87^{a}	0.81^{abc}	8.48^{def}	8.49^{abc}
560 NH_4NO_3 + 280K_2SO_4	9.15^{ab}	11.00^{abc}	0.83^{ab}	0.86^{a}	8.37^{ef}	8.44^{abc}
560 NH_4NO_3 +250$CaSO_4$	8.83^{ab}	11.00^{abc}	0.74^{abc}	0.74^{bcd}	8.83^{ab}	8.76^{a}
280 K_2SO_4 + 250 $CaSO_4$	8.07^{bc}	11.00^{abc}	0.60^{cde}	0.54^{gh}	8.34^{ef}	8.90^{bcd}
490 NH_4NO_3 + 245 K_2SO_4 +125 $CaSO_4$	8.62^{abc}	10.67^{bc}	0.69^{abc}	0.73^{bcd}	7.77^{h}	7.91^{bcd}
560 NH_4NO_3 + 280 K_2SO_4 + 250$CaSO_4$	9.38^{a}	12.00^{a}	0.68^{abc}	0.72^{bcd}	8.94^{a}	8.94^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

5. Leaf macronutrients (N, K and Ca %) contents:

5.1. Nitrogen (%):

The results concerning the effect of soil fertilization with Ammonium nitrate, Potassium sulphate and Calcium sulphate either singly or in combination treatments on the Nitrogen (%) of ‘Florida prince’ peach trees during both 2015 and 2016 seasons are listed in Table (6). The results indicated that 560g NH_4NO_3+ 280g K_2SO_4+250g $CaSO_4$ applications mixed treatments, significantly ($p \leq$ 0.05%) increased leaf nitrogen (%) as compared with the control during both seasons. While, no significant difference were recorded among 490 g NH_4NO_3 + 245 g K_2SO_4 also, 490g NH_4NO_3 +125 g $CaSO_4$ fertilization application of compound. Also, significant differences were recorded among all other treatments as compared with the control during both seasons.

The percentage increase of nitrogen % comparing to check plot may be taken place due to the direct effects of the nitrogen fertilization in high levels caused an increase in leaf nitrogen of the apple leaves (Shim *et al.*, 1972). On the other extreme, Sharma and Singh (1982) studied the effect of nitrogen, phosphorus and potassium nutrition on peach trees, they found that high N rates increased leaf N but decreased leaf P and K whereas low N rates; resulted in low leaf N but high P and K. A linear positive correlation was observed between applied K and leaf N, P and K contents. Also, Abd El-Megeed *et al*. (2011) found that on ‘Canino’ apricot trees leaf mineral content N % increased with increasing the level of N application in the study.

5.2 Potassium (%):

Concerning the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate either singly or in combination treatments on the potassium (%) of ‘Florida prince’ peach trees are listed in Table (6). In general, the obtained results indicated that ammonium nitrate, potassium sulphate and calcium sulphate single or mixed treatments application, significantly ($p \leq 0.05$) increased leaf potassium (%) as compared treatment with the control plot during both seasons.

Kassem and El-Seginy (2002) found that potassium application on ‘Florda prince’ peach cultivar; increased leaf potassium during both seasons. On the other hand, El-Sherif *et al*. (2008) mentioned that potassium treatments increased K content on Golden Japanese persimmon revealed that N and K leaf content increased with K_2SO_4 fertilizer treatments. Also, Abd El-Megeed *et al.* (2011) reported that on ‘Canino’ apricot trees all potassium levels of application increased significantly leaf potassium (%) in leaf.

5.3 Calcium (%):

Results of the effect of soil fertilization with ammonium nitrate, potassium sulphate and calcium sulphate either singly or in combinations treatments on the Calcium (%) of ‘Florida prince’ peach trees during are listed in Table (6). The obtained results indicated that applications of ammonium nitrate, potassium sulphate and calcium sulphate either singly or combination treatments, significantly ($p \leq 0.05$) increased leaf calcium (%) as compared with the control plants during both seasons study. But no significant differences were recorded among the 490 g NH_4NO_3 + 280 g K_2SO_4 + 125 g $CaSO_4$ treatments upon application as compared with the control during 2015 seasons.

The increment percentage of calcium (%) comparing to check plot may be true due to the direct effects of applying nitrogen or phosphorus fertilizers to persimmon trees caused a significant increase in calcium content of the leaves and fruits as compared with control trees and the addition of 1.5 kg potassium sulphate per tree caused a significant decrease in the calcium content of the leaf and fruit during both seasons (Abd El-Megeed, 1992).

Table (6). Effect of application with different nutrients rates on some leaf macronutrient of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	N (%)		K (%)		Ca (%)	
	2015	2016	2015	2016	2015	2016
Control	1.02j	0.52l	1.50g	1.54i	1.20f	3.20e
490 NH_4NO_3	1.13i	1.14hi	2.12bc	1.81ghi	1.54e	3.38de
560 NH_4NO_3	1.40f	1.18fgh	2.18b	2.35cde	1.73d	3.58de
245 K_2SO_4	1.42f	1.32de	2.17b	2.00fgh	1.23f	3.34de
280 K_2SO_4	1.87a	1.40cd	2.28b	2.23def	1.92c	3.65d
125 $CaSO_4$	1.37f	1.02j	1.67f	2.26def	1.27f	4.50ab
250 $CaSO_4$	1.60d	1.04ij	1.73f	2.92b	2.18b	4.63a
490 NH_4NO_3 + 245K_2SO_4	1.08ij	1.13hij	1.94cde	2.10efg	1.55e	3.70cd
490 NH_4NO_3 +125$CaSO_4$	1.23h	0.86k	1.74f	1.74hi	1.75d	3.73cd
245 K_2SO_4 + 125 $CaSO_4$	1.14i	1.17gh	2.11bcd	2.45cd	1.58e	3.65d
560 NH_4NO_3 + 280K_2SO_4	1.71c	1.29def	2.22b	3.35a	1.88c	4.10bc
560 NH_4NO_3 +250$CaSO_4$	1.52e	1.51c	1.93de	2.20def	2.35a	4.45ab
280 K_2SO_4 + 250 $CaSO_4$	1.28gh	1.28efg	2.12bc	2.65bc	1.79cd	4.20ab
490NH_4NO_3 + 245 K_2SO_4 +125 $CaSO_4$	1.34fg	1.67b	1.79ef	2.13defg	1.19f	4.30ab
560NH_4NO_3 + 280 K_2SO_4 + 250$CaSO_4$	1.96a	1.91a	2.58a	3.68a	2.40a	4.45ab

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

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الملخص العربي

تأثير التسميد ببعض العناصر الكبرى على النمو , المحصول , جودة الثمار والمحتوى العنصري لأشجار الخوخ صنف ' فلوريدا برنس'

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أجريت هذه الدراسة خلال موسمى ٢٠١٥ و٢٠١٦ على أشجار الخوخ صنف 'فلوريدا برنس' مطعومة على أصل النيماجارد عمرها ٥ سنوات منزرعة فى تربة رملية تروى بنظام الرى بالتنقيط بمزرعة خاصة فى منطقة النوبارية بمحافظة البحيرة – مصر. بهدف دراسة تأثير التسميد ببعض العناصر الكبرى على النمو (طول وعرض الأفرخ والمساحة الورقية) , المحصول , جودة الثمار ومحتوى الأوراق من العناصرلأشجارالخوخ صنف 'فلوريدا برنس' وكان التصميم الإحصائى المستخدم هوالقطاعات العشوائية الكاملة وأظهرت النتائج أن جميع المعاملات السمادية أدت إلى زيادة معنوية فى النموالخضرى بالمقارنة بالكنترول خلال موسمى الدراسة. بالإضافة إلى ذلك أدى إستخدام ٥٦٠ جم/شجرة نترات الأمونيوم + ٢٨٠ جم/شجرة كبريتات البوتاسيوم + ٢٥٠ جم/شجرة كبريتات الكالسيوم إلى زيادة معنوية فى المحصول الكلى بالكجم (٩٧,٠٢ و ١٠٣,٦٥ كجم/ شجرة) مقارنة بالكنترول (٣٦,٦١ و ٤٠,٠٠ كجم/ شجرة) بالترتيب خلال موسمى الدراسة.

علاوة على ذلك أدت كل معاملات التسميد بالنيتروجين والبوتاسيوم والكالسيوم إلى زيادة معنوية فى طول وعرض وصلابة الثمار ونسبة المواد الصلبة الذائبة الكلية والحموضة ونسبة السكريات الكلية مقارنة بمعاملة الكنترول خلال موسمى الدراسة ٢٠١٥ و٢٠١٦ ومن ناحية أخرى أدت التداخلات إلى زيادة نسبة النيتروجين والبوتاسيوم والكالسيوم فى الأوراق مقارنة بمعاملة الكنترول.