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EFFECT OF SOIL MOISTURE REGIMES AND POTASSIUM APPLICATION ON GROWTH, YIELD AND FRUIT QUALITY OF "CANINO" APRICOT (*Prunus armeniaca* L.)

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ABSTRACT

A field experiment was conducted at El-Kanater Horticultural Research Station in the seasons of 2010 and 2011 to study the effect of three soil moisture levels (25, 50 and 75 % depletion i.e. wet, medium and dry) and three application of potassium unit i.e., 500, 1000 and 1500 g/tree. The obtained results indicated that water consumptive use (W.C.U.) ranged between 1255.5 and 934.4 mm in the first season from 1278.6 to 974.63 mm in the second one, corresponding to 5273.1 and 3924.5 m^3/fed. in the first season and 5370.1 to 4093.4 m^3/fed. in the second season, respectively. Increase of potassium application slightly decreased the water consumptive use (W.C.U.).

Monthly water use was low after dormancy, then increased to reach a maximum during July and August. The rates declined to reach minimum during October. Seasonal crop coefficient (Kc) was 0.79. The wet moisture stress level (75 % available water) increased all studied growth characters in the two successive seasons. The water use efficiency was 0.96 and 1.0 kg fruits/m^3 water consumed. It was markedly increased with increased potassium application.

Increasing soil moisture enhanced leaf area, fruit length, fruit weight, fruit size, while decreased total soluble solids, T.S.S./acid ratio and acidity. The wet moisture stress level (75 % available water) gave the higher yield.

INTRODUCTION

Apricot is one of the few temperate fruit trees not affected by overproduction. Most apricot trees are cultivated in Mediterranean countries, where drought periods are increasingly common, a fact which makes irrigation water the most limiting factor for apricot productivity. Although apricot is considered a drought resistant crop and exhibits some xenomorpic characteristics, such as the ability to endure water stress in the dry season and the loss of leaves in winter (Torrecillas *et al*., 1999) commercial apricot production depends on irrigation. For this reason, in this area the optimization of the use and efficiency of irrigation by means of deficit irrigation strategies that permit maximum yield whilst reducing water application is of great importance. In this sense, regulated deficit irrigation (RDI) may offer an approach to saving water in some woody crops by minimizing or eliminating negative impacts on yield and crop revenue (Chalmers *et al*., 1981; Domingo *et al*., 1996; Goldhamer, 1997). On the other hand, the world faces very serious global warming, which will produce a general warming and significantly increase the evaporative demand and the irrigation requirement for crops. For this reason, irrigation efficiency is becoming increasingly important in arid and semi-arid regions with limited water resources. Therefore, it is necessary to adopt specialized and efficient methods of irrigation, such as drip irrigation. In order to achieve the twin objectives of higher productivity and optimum use of water (Gercek *et al*., 2009). Hence, the effect of irrigation has been studied in various fruit species in relation to growth, fruit quality and yield (Proebsting *et al*., 1981; Caspari *et al*., 1994; Mpelasoka *et al*., 2001). According to Le *et al*., (1989) and Girona *et al*., (1997), timing of water deficits has important effects on productivity of fruit trees. On the other hand, excessive water may have adverse effects on fruit quality, since it increases vegetative growth, promoting nutritional imbalance and decreasing fruit dry mass. Consequently it is important to study the effect of regulated deficit irrigation RDI on apricot fruit quality at harvest. On the other had, fertilization is a significant factor of the cultural practices for the Agricultural production. In order to prepare fertilizer program, soil properties are as important as the cultivar and environmental conditions. Generally N, P and K are taken into consideration to prepare the program. Potassium has a special place because of its effects on the quality parameters, stress cropping and yield. The K content of apricot leaf is reported to vary from 2.26 – 4.28 % by Yalcinkaya *et al*., (1995) for the Salak and from 2.13- 3.31 by Eryuce *et al*., (2002) for Hacihaliloglu varieties. Aksoy *et al*., (1995) found that leaf K content change between the years as do the N, Ca and Mg. Das (1998) searched the relations between leaf and soil and uptake amounts for the same variety in this region. Potassium is absorbed by apricot trees in significant quantities (Huguet, 1988). There is no sufficient knowledge about the K and P effect on apricot growth and yield. Most of the researchers working on this area focused on N fertilization (Dimitrovski & Cevetkovic, 1981; Kotze & Villiers, 1991; Kotze & Joubert, 1992 and Sud & Bhutani, 1994).

So, this study aimed to determine the optimum soil moisture level and potassium fertilizer doses as well as their relationships and effects on growth, yield and fruit quality of apricot trees.

MATERIALS AND METHODS

The present investigation was carried out in two successive seasons of 2010 and 2011 in addition to a prepared season through 2009 at El-Kanater Horticultural Research Station, Qalubia Governorate, Egypt, on clay loamy soil using Apricot (*Prunus armeniaca* L.). The trees were 7 years old and planted at four meters apart. The main treatments were:

I_1: Irrigation when 25 % of available soil moisture was depleted (wet).
I_2: Irrigation when 50 % of available soil moisture was depleted (medium).
I_3: Irrigation when 75 % of available soil moisture was depleted (dry).

The sub-main treatments:

K_1 = 1500 gm. K_2O/tree.
K_2 = 1000 gm. K_2O/tree.
K_3 = 500 gm. K_2O/tree.

In the form of potassium sulphate divided in two doses in mid February and mid April as soil application. Irrigation treatments started after the trees received the winter irrigation at February, i.e., from swelling stage. Irrigation water was practiced when the moisture content reached the desired soil moisture level in each treatment.

For planning irrigation, soil moisture content was estimated gravimetrically at four depths; 0-15, 15-30, 30-45, 45-60 cm. and computed on oven dry basis, periodically every two days.

The experiment design was split plot (3 main plots irrigation x 3 subplots potassium fertilization) with 3 replicates for each treatment and 3 trees for each plot. The soil texture in El-Kanater was clay loam soil. Physical and chemical properties of the soil are illustrated in Table (1), the field capacity, the permanent wilting percentage, the available water and bulk density were determined as soil content shown in Table (2), while, Table (3) shows the meteorological data in the district, during the two seasons of the study.

Table (1): Physical and chemical properties of the soil.

Parameter	Value	Parameter	Value
Particle size distribution (%):		**EC (dS/m, soil paste extract)**	1.1
Clay %	31.4	(saturation percent)	67.5
Silt %	33.5	Cations and anions in soil paste extract (mmolc/L):	
Fine sand %	34	Na^+	4.1
Coarse sand %	1.1	K^+	0.41
Texture class	Clay loam	Ca^{++}	3.07
$CaCO_3$ g / kg	35.9	Mg++	2.63
Organic matter g / kg	17	$CO_3^=$	0
* Available K mg / kg	191.9	HCO_3^-	3.85
* Available P mg / kg	9.33	Cl^-	3.7
pH (1: 2.5 w/v soil water suspension)	7.9	$SO_4^=$	2.66

*** Extracts of NH_4 – acetate (for K), and sodium bicarbonate (for P).**

Table (2): Field capacity wilting point, available water and bulk density of soil at various depths.

Depths	Field capacity (F.C.) % by weight	Wilting point (WP) % by weight	Available water (AW) % by weight	Bulk density (BD) g./cm^3
0-15	37.9	18.1	19.8	1.27
15-30	36.1	17.6	18.5	1.30
30-45	33.5	16.9	16.6	1.31
45-60	32.5	16.2	16.3	1.34

FC: moisture at 33 kPa moisture tension. WP: moisture at 1.5 MPa moisture tension. AW = FC – WP.

Characters studied:

A- Water relations parameters:

Actual evapotranspiration (C.U.) was estimated from the soil sampling and calculated according to technique used by the Ministry of Agriculture, Egypt, using the formula:

$$C.U. = D \times Bd \times \frac{Q_2 - Q_1}{100}$$

Where:
D = the irrigation soil depth; Bd = bulk density of soil (g./cm^3); Q_2 = the percentage of soil moisture two days after irrigation; Q_1 = the percentage of soil moisture before next irrigation.

Soil samples for moisture determination were taken from each 15 cm depth from the upper 60 cm layer by a regular augur. The samples were immediately weighed and dried in an electric oven to a constant weight at 105 °C. Percentage of soil moisture content at the four depths was calculated on oven dry basis. The amount of water consumed in each irrigation was obtained from the difference between soil content after irrigation and before the next one.

1. Seasonal water consumptive use:

The seasonal water use values were obtained from the sum of water consumptive use for all irrigation per treatment, from February until October in each season.

2. Monthly evapotranspiration:

Monthly values were obtained from daily water use multiplied by the number of days in one month.

3. Water use efficiency (W.U.E.):

The production of apricot fruits by one cubic meter of irrigation water (fruit yield in kg/feddan/m^3 water consumed/feddan), as affected by different treatments was calculated by the following equation (Vites, 1965):

$$W.U.E = \frac{\text{Fruits yield (kg)/feddan}}{\text{Seasonal ET } (m^3\text{/water consumed})\text{ /feddan}}$$

Table (3): Meteorological data for the district during 2010 and 2011 seasons.

Season	2010							2011						
Month	**T. max**	**T. min.**	**W.S**	**R.H**	**S.S**	**S.R**	**R.F**	**T. max**	**T. min.**	**W.S**	**R.H**	**S.S**	**S.R**	**R.F**
Feb.	25.0	11.5	1.5	57.7	11.0	354	6.1	22.9	11.3	1.3	56.7	11.0	354	0.7
Mar	27.1	13.9	1.9	60.0	11.8	441	0.0	24.8	11.9	1.8	57.3	11.8	441	0.4
Apr	29.6	16.0	1.8	52.3	12.8	419	0.0	28.4	18.5	1.4	51.0	12.8	519	0.4
May	33.9	19.2	1.7	49.0	13.5	585	0.0	32.8	18.7	1.7	50.3	13.5	585	0.1
Jun	37.0	22.7	1.6	51.3	13.9	627	0.0	35.2	21.7	2.0	54.7	13.9	627	0.0
Jul	36.3	23.9	1.8	67.0	13.8	613	0.0	37.3	23.5	1.9	58.7	13.8	613	0.0
Aug	38.3	25.3	1.8	60.7	13.1	577	0.0	3.5	23.9	1.6	61.5	13.2	577	0.0
Sep	35.8	23.5	2.1	59.0	12.2	512	0.0	35.5	22.7	0.9	58.0	12.2	512	0.0
Oct	33.8	21.5	1.9	59.0	11.3	417	0.0	33.0	20.3	1.0	59.3	11.3	417	0.0

Where: T. max., T. min. = maximum and minimum temperatures °C; W.S.= wind speed (m/see); R.H. = relative humidity (%); S.S. = actual sun shine (hour); S.R. = solar radiation (cal/cm^2/day). RF = rainfall (mm/month).
[Data were obtained from the agrometeorological Unit at SWERI, ARC]

4. Apricot trees evapotranspiration estimated by Penman Monteith formula (ET crop).

Penman Monteith method was used to calculate ET crop for apricot trees in the district during 2010 and 2011 seasons of study using CROPWAT model (Smith 1991).

$$ETo = \frac{0.408\ \Delta(Rn - G) + \gamma\ [900/(T + 273]\ U_2\ (e_s - e_a)}{\Delta + \gamma\ (1 + 0.34\ U_2)}$$

ETo = reference evapotranspiration, mm/day
Rn = net radiation (MJm-2d-1)
G = soil heat flux (MJm-2d-1)
Δ = slope vapor pressure and temperature curve (kPa°C-1)
γ = psychrometric constant (kPa °C-1).
U2 = wind speed at 2 m height (ms-1).
es-ea = vapor pressure deficit (kPa).
T = mean daily air temperature at 2 m height (°C).

5. Crop coefficient:

Crop coefficient (KC) value was used for quantifying crop water use. It was calculated from the equation: KC = ETc / ETo; where ETc is ETe/ETo the actual water consumptive use and ETo is the reference (potential evapotranspiration). The ETo value was calculated using the atmospheric conditions data prevailing at El-Kanater district.

B. Vegetative growth measurements:

Some growth parameters were studied. Through determining both the average shoot length, number of leaves per shoot and leaf area.

C. Fruiting parameters:

Average yield per tree for each treatment was determined at harvesting time during the two seasons of study.

7.1. Fruit quality:

Samples of twenty fruits from each replicate at harvest were randomly collected and the following characters were determined as follows:

7.1.1. Physical properties:

Fruit weight, fruit size, length, diameter and firmness ($Ib/inch^2$) by using pressure tester.

7.1.2. Chemical properties:

Total soluble solids in fruit juice was determined using hand refractometer, fruit juice acidity was measured according to A.O.A.C. (1985) and Vogel (1968).

D. Leaf nutrient composition:

Leaf samples were collected then washed with tap water followed by distilled water to remove any residues that might affect the results (Labanauskas 1966), fresh weight was determined and oven dried at 70 °C till a constant weight then weighed and ground for analysis.

E. Methods of analysis:

9.1. Soil physical analysis:

Particle size distribution was conducted using the pipette method according to **Piper (1950)**. Soil moisture constant was determined using the pressure membrane apparatus, considering the saturation percent "SP" at KPa tension, field capacity "FC" at 33 KPa (0.33 bar) tension and wilting point difference between FC and WP (Stackman 1966).

9.2. Soil chemical analysis:

1- Salinity of soil saturation extraction was measured in terms of electric conductivity (EC) in dS/m.

2- Cationic and anionic composition of the saturation extract of the soil were determined according to the standard methods described by **Jackson (1973)**.

- Ca^{++} and Mg^{++} were measured by titration with versenate and Na^{+} and K^{+} were measured by flame photometer.
- CO_3^{--} and HCO_3^{-} were measured by titration with HCL.
- SO_4^{--} was calculated by subtraction.

1- Soil pH was determined in the soil water suspension (1: 2.5 w/v soil water) using a glass-electrode pH meter.

9.3. Plant analysis:

Total nitrogen was determined by the micro-kjeldahl method Pregl (1945). Total phosphorus was determined in concentrated acid digest and measured using a spectrophotometer (Spectronic 20) to the method described by Murphy and Reily (1962). Total potassium content was determined in the acid digest using Atomic Absorption Spectrophotometer method for plant analysis are cited in Jackson and Ulrish (1959) and Chapman and Pratt (1961).

F- Statistical analysis

All the obtained data during this study were statistical analyzed using the analysis of variance according to Snedecor and Cochran (1980) means were compared L.S.D. multiple test at 0.05 level.

RESULTS AND DISCUSSION

1- Seasonal water consumptive use:

Evapotranspiration is the combination of two processes; evaporation and transpiration. Evaporation is the direct vaporization of water from the soil surface and/or from plant surfaces. Transpiration is the flow of water vapor from the interior of the plant to the atmosphere (Jones *et al*., 1984).

Seasonal water consumptive use (i.e. w.c.u. or ETa.) by apricot trees was gradually decreased as water stress increased, in both seasons. As it registered 1255.5, 1172.0 and 940.2 mm. in the first season and 1278.6, 1199.00 and 974.6 mm. in the second one for wet, medium and dry water regime levels, respectively, corresponding to 5273.1. 4922.4 and 3948.8 m^3/fed., in the first season, and 5370.1, 5035.8 and 4093.4 m^3 water/fed., in the second season, respectively. Table (4) showed that such result might be reasonable, since more frequent irrigation period provide high evaporation opportunity from the relatively wet rather than dry soil surface (Doorenbos & Pritt, 1984; Devit *et al*., 1994 and Levitt *et al*., 1995). Abdalla *et at.* (1990) found that, the highest CU occurred when irrigation was done upon reaching a moisture of 70 to 80 % of the field capacity.

Table (4): Seasonal water consumptive use (mm.) for apricot trees as affected by soil moisture regimes and potassium application.

Potassium application / Depletion available water %	K_1	K_2	K_3	Average
	Season 2010			
I_1	1245.3	1256.5	1264.7	1255.5
I_2	1157.2	1175.1	1183.7	1172.0
I_3	911.2	946.1	963.4	940.2
Average	1104.6	1125.9	1137.3	
	Season 2011			
I_1	1243.5	1290.6	1301.6	1278.6
I_2	1193.8	1197.9	1205.3	1199.0
I_3	959.6	972.8	991.5	974.6
Average	1132.3	1153.8	1166.1	

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

2- Monthly water consumptive use:

Daily water consumptive use by apricot trees was the lowest at winter months under the different treatments Fig. 1. It began to rise during end of March, then. ET value gradually increased to reach its maximum at early summer during July. This might be due to the increase in growth during summer months afterwards, temperature increment or both. The daily consumptive use. again, gradually decreased. Such pattern was attained by apricot trees, regardless of factors studies (water regime or Potassium treatments). Weagand (1962) pointed out that, the drying rate of bare soil is positively related to the water content and relatively related to lime, and that a drying front advances into the soil linearly. Ibrahim (1981) concluded that the increase in evapotranspiration by maintaining soil moisture at a high level is attributed to excess available water in the root zone .

4. Water use efficiency:

Water use efficiency, is used to show the Kg. fruit yield production per unit area over water unit required in evapotranspirtion. It appears from Fig. 2 that this trait was markedly profitable under the medium soil moisture stress level (50%), as it registered 1.0 and 0.96 Kg. fruit yield/m^3 of irrigation water in the first and second seasons, respectively. Whereas the dry treatment produced the least value 0.86 and 0.83 Kg. fruit yield/m^3 irrigation water in both season successively. This means that apricot trees favors medium watering and high production prefers medium soil moisture than lower and high watering. It is also clear that, under dry conditions (I_3) increasing K_1 fertilization successfully increased water use efficiency (1.01 and 0.96 kg/m^3) than K_2 or K_3 (0.76 and 0.74 kg/m^3) through both seasons, respectively.

Fig. 1. Monthly water consumptive use (Eta in mm) by apricot trees under different water regime levels.

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).

K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

Fig. 2. Water use efficiency (kg fruit/m^3 water) for apricot trees as affected by soil moisture regime and potassium applications.

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).

K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

5- Crop coefficient (Kc):

Crop coefficient was calculated as the ratio of the previous two measurements throughout its growth cycle. The values were calculated according to the daily potential evapotranspiration estimated by Penman Monteith method using CROPWAT model (Smith 1991) and water consumptive use obtained from medium soil moisture level combined with K_l potassium treatment, to estimate the amount of water required to meet evapotranspiration of apricot trees. Data in Table (5) revealed that mean seasonal crop coefficient of Apricot trees was 0.79 during the two seasons attained its highest value (0.82), in July. Then, it gradually decreased until it reached its lowest value at March (0.75). Doorenbos & Pruitt (1984) and Levitt *et al*., (1995) on different crops suggested that Kc values would provide a method of adjusting the water use rates to compensate for variation in climatic conditions at influence evaporative demand.

Table (5): Actual and Potential ET (mm/day) for apricot trees during the two seasons of study.

	Season	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Actual ET mm/day	2010	3.01	4.25	5.03	6.00	6.00	5.46	4.65	3.60
	2011	3.17	4.35	5.23	6.05	5.89	5.53	4.71	3.65
Mean		3.09	4.30	5.13	6.03	5.94	5.50	4.68	3.62
Potential ET mm/day	2010	3.80	5.10	5.90	7.60	7.40	6.60	6.10	4.50
	2011	4.40	5.60	6.70	7.30	7.10	7.00	6.10	5.20
Mean		4.10	5.35	6.30	7.45	7.25	6.80	6.10	4.85
Kc		0.75	0.80	0.81	0.81	0.82	0.81	0.77	0.75

Some vegetative growth and fruiting parameters:

1. Vegetative growth:

Results of Table 6 showed that, growth parameters decreased with reduction in both irrigation and potassium rate.

1.1- Shoot, length and No. leaves/shoot:

The main effect of irrigation treatments showed that I_1, I_2 and I_3 gave shoot length of (63.28-64.50). (57.21-60.07) and (45.88 -49.48) cm in both seasons, respectively indicating that regardless of application, more water was associated with increased shoot length. However, the highest shoots was given by K_1 and the lowest was by K_3. The same trend was observed with number of leaves/shoot 31.76, 28.98 and 24.53 for I_1, I_2 and I_3 in 2010 season, respectively.

1.2- Leaf area:

Data in Table (6) significantly showed longer apricot leaves parallel to increased irrigation water rate and K application rate through the two studied seasons but the differences did not attain to significant between K_1 and K_2 in the 1st season as well as K_2 and K_3 in the 2nd season. The interaction between irrigation rate and K rate markedly showed that wet irrigation rate (I_1) significantly increased leaf area under different potassium rates while medium and dry irrigation rate (I_2 & I_3) significantly increased leaf area with K_1 than both K_2 and K_3.

Table (6): Effect of soil moisture regimes, potassium application and their interaction between them on shoot length (cm), number of leaves/shoot and leaf area (cm^2) during 2010 and 2011 seasons.

Potassium application / Depletion available water %	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	Shoot length (cm)							
	2010 season				**2011 season**			
I_1	64.43	63.00	62.40	63.28	67.40	65.00	61.10	64.50
I_2	60.30	57.20	54.13	57.21	65.33	59.13	55.73	60.07
I_3	50.00	46.10	41.53	45.88	54.23	48.87	45.33	49.48
Average (B)	58.24	55.43	52.69	-	62.30	57.70	54.10	-
L.S.D. at 5 %								
Irrigation (A)	2.52				2.35			
Potassium (B)	2.52				2.35			
A x B	4.37				4.063			
	No. of leaves/shoot							
I_1	34.33	31.53	29.40	31.76	33.13	31.60	29.20	31.31
I_2	29.47	29.13	28.33	28.98	30.27	29.40	28.00	29.22
I_3	25.60	25.03	22.97	24.53	26.13	25.77	24.27	25.39
Average (B)	29.80	28.57	26.90	-	29.84	28.92	27.16	-
L.S.D. at 5 %								
Irrigation (A)	1.410				1.762			
Potassium (B)	1.410				1.762			
A x B	2.439				3.052			
	Leaf area (cm^2)							
I_1	55.93	55.36	55.22	55.5	55.23	54.03	53.27	54.18
I_2	54.92	54.47	50.01	53.13	53.17	51.0	50.30	51.49
I_3	45.10	43.69	42.50	43.78	45.03	42.27	40.30	42.53
Average (B)	51.98	51.17	49.26	-	51.14	49.10	47.96	-
L.S.D. at 5 %								
Irrigation (A)	1.010				1.240			
Potassium (B)	1.010				1.240			
A x B	1.751				2.147			

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).;
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

2- Yield components:

Yield components Tables (7 & 8) include fruit set %, fruit yield per tree and per feddan as well as number of fruits per tree. However, the present results showed a slight increase of fruit set percentage parallel to the increment of irrigation rate from I_3 (7.99 and 7.00 %) to I_2 (8.30 and 7.39 %) to I_1 (8.55 and 7.69 %) as well as go with the increment of potassium application from K_3 (7.58 and 7.15 %) to K_2 (8.48 and 7.46 %) to K_1 (8.77 and 7.47 %). Meanwhile, better interaction was noticed with wet and medium irrigation rates under high K rate in 2010 and 2011 seasons of study, respectively.

Concerning fruit yield/tree or feddan the data revealed clear decrease in fruit yield with the decrease of irrigation rate from wet to medium to dry.

The same pattern of decrease was noticed with the decrease of potassium from 1500 to 1000 to 500 gm K_2O/tree. So apricot trees produced the highest fruit yield under wet irrigation rate and high K interaction.

Table (7): Effect of soil moisture regimes, potassium application and their interaction between them on fruit set (%),yield (kg/tree) and (ton/fed.) during 2010 and 2011 seasons.

Potassium application / Depletion available water %	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	Fruit set (%)							
	2010 season				2011 season			
I_1	8.92	8.89	7.82	8.55	7.86	7.82	7.40	7.69
I_2	8.83	8.53	7.53	8.30	7.44	7.46	7.26	7.39
I_3	8.54	8.02	7.39	7.99	7.11	7.10	6.80	7.00
Average (B)	8.77	8.48	7.58	-	7.47	7.46	7.15	-
L.S.D. at 5 %								
Irrigation (A)	0.176				0.170			
Potassium (B)	0.176				0.170			
A x B	0.305				0.295			
	Yield (kg/tree)							
I_1	27.26	25.59	25.20	26.15	27.90	26.77	25.07	26.58
I_2	25.44	25.08	22.60	24.39	25.90	24.98	23.80	24.89
I_3	19.84	18.82	17.15	18.60	20.02	18.59	16.16	18.26
Average (B)	24.10	23.16	21.81	-	24.61	23.45	21.67	-
L.S.D. at 5 %								
Irrigation (A)	1.53				1.904			
Potassium (B)	1.53				1.904			
A x B	2.44				3.298			
	Yield (ton/fed.)							
I_1	5.72	5.37	5.38	5.49	5.86	5.62	5.27	5.58
I_2	5.34	5.27	4.76	5.12	5.44	5.25	5.00	5.23
I_3	4.17	3.95	3.60	3.91	4.20	3.91	3.39	3.83
Average (B)	5.08	4.86	4.58	-	5.17	4.92	4.55	-
L.S.D. at 5 %								
Irrigation (A)	0.251				0.302			
Potassium (B)	0.251				0.302			
A x B	0.435				0.522			

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

Meanwhile, wet irrigation rate significantly increased number of fruits/tree (728 and 756) in the two seasons of study, respectively compared with the other two irrigation rates. Also, high potassium level significantly increased number of fruits/tree (693 and 732). So the highest number of fruits/tree were achieved with the interaction wet irrigation with high K level (750 and 767) through 2010 and 2011 seasons, respectively. Such finding may prove that adequate water supply for apricot trees is an important factor for maximizing its production. Kramer (1977) stated that water stress reduced photosynthesis by closure of stomata which decrease the supply of CO_2. Also, water stress the capacity of the protoplasm to carry on photosynthesis. Bielorai *et* *al*., (1984) and Goren *et al*., (1994) found that low water application produced a lower yield.

On the other hand, potassium application at K_1 significantly increased fruits number per tree than potassium soil application, while the significances did not touch the potassium treatment when yield was determined as kg./tree. These results were true in both seasons of study. The obtained data are in lime with those of Sobral *et al*., (2000) on orange trees. They suggested that potassium application increased fruit weight and yield per tree.

3. Physical and chemical properties:

3.1- Physical fruit properties:

Physical fruit properties included fruit weight (g.) and size (cm^3), firmness (Ib/inch^2 and dimensions (Tables 8 & 9). Wet and medium irrigation treatments included similar fruit weight in 2010 season (36.22 and 35.36 g.).

Table (8): Effect of soil moisture regimes, potassium application and their interaction between them on number of fruit/tree, fruit weight (g.) and fruit volume (cm^3) during 2010 and 2011 seasons.

Potassium application / Depletion available water %	Number of fruit/tree							
	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	2010 season				2011 season			
I_1	750	700	733	728	767	750	750	756
I_2	700	699	667	689	760	750a	730	747
I_3	630	610	600	613	670	650	650	657
Average (B)	693	670	667	-	732	717	710	-
L.S.D. at 5 %								
Irrigation (A)	10.8				11.3			
Potassium (B)	10.8				11.3			
A x B	18.5				19.6			
	Fruit weight (g.)							
I_1	37.43	36.48	34.73	36.22	36.40	36.00	33.53	35.31
I_2	36.17	35.87	34.03	35.36	34.07	33.38	32.00	33.15
I_3	31.47	30.83	28.47	30.26	30.00	28.60	24.87	27.82
Average (B)	35.02	34.39	32.41	-	33.49	32.66	30.13	-
L.S.D. at 5 %								
Irrigation (A)	1.352				1.265			
Potassium (B)	1.352				1.265			
A x B	2.341				2.191			
	Fruit volume (cm^3)							
I_1	37.0	36.0	34.0	35.7	38.00	36.10	33.70	35.90
I_2	34.0	33.7	32.0	33.2	35.07	34.10	32.53	33.90
I_3	29.0	29.0	28.3	28.8	29.57	28.70	25.30	27.90
Average (B)	33.3	32.9	31.4	-	34.20	32.90	30.50	-
L.S.D. at 5 %								
Irrigation (A)	1.33				1.21			
Potassium (B)	1.33				1.21			
A x B	2.31				2.09			

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

So high and medium potassium applications produced similar fruit weight (K_1 and K_2) through the two studied seasons. Then, dry irrigation rate

(I_3) and low K treatment significantly reduced fruit weight. Hence, the highest fruit weight was achieved by the interaction I_1K_1, I_1K_2 and I_2K_2 while the lowest fruit weight was produced with I_3K_3.

Fruit size significantly decreased when irrigation rate decreased from wet (35.7 and 35.9 cm^3) as well as potassium application was decreased. So, the largest fruits were produced by the interaction I_1K_1 (37.0 and 38.0 cm^3) in the two seasons of study, respectively.

Table (9): Effect of soil moisture regimes, potassium application and their interaction between them on fruit firmness (Ib/inch^2), fruit length (cm.) and fruit diameter (cm) during 2010 and 2011 seasons.

Potassium application / Depletion available water %	Fruit firmness (Ib/inch^2)							
	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	2010 season				2011 season			
I_1	10.30	9.83	8.30	9.48	11.25	10.33	9.50	10.30
I_2	10.14	9.50	8.20	9.28	11.17	10.25	9.33	10.25
I_3	10.20	9.00	8.00	9.07	11.00	10.00	9.17	10.06
Average (B)	10.21	9.44	8.17	-	11.14	10.19	9.33	
L.S.D. at 5 %								
Irrigation (A)		0.310				0.255		
Potassium (B)		0.310				0.255		
A x B		0.536				0.441		
	Fruit length (cm.)							
I_1	4.30	4.26	4.25	4.27	4.17	4.13	4.10	4.13
I_2	4.26	4.25	4.23	4.25	4.17	4.12	4.10	4.13
I_3	4.02	3.97	3.86	3.95	3.84	3.63	3.70	3.72
Average (B)	4.19	4.16	4.11	-	4.06	3.97	3.97	
L.S.D. at 5 %								
Irrigation (A)		0.084				0.071		
Potassium (B)		0.084				0.071		
A x B		0.145				0.122		
	Fruit diameter (cm.)							
I_1	4.04	4.04	3.99	4.03	4.02	4.00	3.95	3.99
I_2	4.00	4.03	3.97	4.00	4.03	3.97	3.97	3.99
I_3	3.93	3.88	3.83	3.88	3.70	3.59	3.64	3.64
Average (B)	3.99	3.98	3.93	-	3.92	3.85	3.85	
L.S.D. at 5 %								
Irrigation (A)		0.055				0.045		
Potassium (B)		0.055				0.045		
A x B		0.095				0.077		

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

Fruit firmness also significantly decreased as irrigation rate decreased from wet (10.21 and 11.14 Ib/inch^2) to medium (9.44 and 10.19 Ib/inch^2) to dry (8.17 and 9.33 Ib/inch^2) in 2010 and 2011 seasons, respectively. There was significant decrease of fruit firmness when high K level (K_1) decreased to medium K level (K_2) while no significant differences were noticed between medium and low potassium rates. The interaction effect showed K_1, K_2 and K_3 in the same irrigation rate.

Fruit dimensions (length and diameter) have the same trend where significantly decreased with dry irrigation rate (3.88 and 3.64 cm as well as 3.95 and 3.72 cm) while there were not significant differences between wet and medium irrigation rates (I_1 and I_2), respectively. Also, there were not significant differences between K_2 and K_3 treatments. However, there was not differences between K treatments within the same irrigation rate.

3.2- Chemical fruit properties:

Total soluble solids: There was quite evident that dry moisture treatments (I_3) significantly produced fruits rich in juice total soluble solid content (12.0 & 11.22 %) as compared with those produced by medium (11.72 & 10.56 %) and wet (11.17 & 10.33 %) soil moisture treatments in the first and second seasons, respectively. Furthermore, potassium application significantly succeeded in enhancing fruit T.S.S. Moreover, Table (10) revealed that the interaction between soil moisture content and potassium application exerted that wet soil moisture with K_1 potassium in the first studying season proved to be the most effective combination in enhancing fruit total soluble solids content. The differences between this treatment and the others reached to significant level in most cases.

Table (10): Effect of soil moisture regimes, potassium application and their interaction between them on total soluble solids (TSS) %, total acidity (%) and TSS/acid ratio during 2010 and 2011 seasons.

Potassium application / Depletion available water %	Total soluble solids (TSS) %							
	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	2010 season				2011 season			
I_1	12.50	11.00	10.00	11.17	10.50	10.50	10.00	10.33
I_2	12.33	11.50	11.33	11.72	10.83	10.83	10.00	10.56
I_3	12.50	12.00	11.50	12.00	11.67	11.50	10.50	11.22
Average (B)	12.44	11.50	10.94	-	11.00	10.94	10.17	-
L.S.D. at 5 %								
Irrigation (A)		0.297				0.230		
Potassium (B)		0.297				0.230		
A x B		0.514				0.399		
	Total acidity (%)							
I_1	0.913	0.950	1.080	0.981	0.937	0.950	0.997	0.961
I_2	1.021	1.007	1.163	1.064	0.937	0.997	1.093	1.009
I_3	0.913	0.817	1.010	0.913	0.913	0.937	0.987	0.946
Average (B)	0.949	0.924	1.087	-	0.929	0.961	1.026	-
L.S.D. at 5 %								
Irrigation (A)		0.095				0.071		
Potassium (B)		0.095				0.071		
A x B		0.164				0.122		
	TSS/acid ratio							
I_1	13.69	11.51	9.26	11.49	11.21	11.05	10.03	10.76
I_2	12.09	11.42	9.74	11.08	11.56	10.86	9.15	10.19
I_3	13.69	14.69	11.39	13.26	12.78	12.27	10.64	11.90
Average (B)	13.16	12.54	10.13	-	11.85	11.39	9.94	-
L.S.D. at 5 %								
Irrigation (A)		0.664				0.615		
Potassium (B)		0.664				0.615		
A x B		1.149				1.066		

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

Total acidity content: Table (10) pointed out that in the fist and second seasons, dry soil moisture treatment decreased but with no significance fruit total acidity content than both medium and wet soil moisture treatments.

As for the interaction between irrigation regimes and potassium application, data demonstrate that medium soil moisture treatments with K_3 in the first and second seasons had the upper hand on increasing fruit total acidity content of apricot trees.

T.S.S./acid ratio: It is obvious from Table (10) that fruits produced under tested irrigation regimes I_1 and I_3 during 2010 and 2011 seasons induced statistically similar effect while lowest with I_2 on fruit TSS/acid ratio. Furthermore, the lowest ratio was that of K_3 as follows 10.13 and 9.94, respectively. There was an interaction caused by K fertilization; under conditions of I_2, K_3 (9.74 and 9.15).

4. Leaf mineral composition:

Table (11) showed data of apricot leaf mineral composition (NPK). The present results showed significant increase in leaf N content in the two seasons of study with wet treatment (1.93 & 1.83 %) as well as leaf P in the second season only (0.29 %) than both medium and dry treatments. Contrary, leaf K content was significantly higher with dry irrigation treatment (1.460 & 1.473%).

Table (11): Effect of soil moisture regimes, potassium application and their interaction between them on nitrogen (%),phosphorus (%) and potassium (%) during 2010 and 2011 seasons.

Potassium application / Depletion available water %	K_1	K_2	K_3	Average (A)	K_1	K_2	K_3	Average (A)
	Nitrogen (%)							
	2010 season				2011 season			
I_1	2.00	1.90	1.90	1.93	1.90	1.80	1.80	1.83
I_2	1.93	1.90	1.80	1.88	1.83	1.80	1.70	1.78
I_3	1.90	1.80	1.80	1.83	1.80	1.73	1.70	1.74
Average (B)	1.94	1.87	1.83	-	1.84	1.78	1.73	-
L.S.D. at 5 %								
Irrigation (A)	0.077				0.084			
Potassium (B)	0.077				0.084			
A x B	0.134				0.145			
	Phosphorus (%)							
I_1	0.300	0.297	0.260	0.286	0.310	0.297	0.263	0.290
I_2	0.307	0.280	0.257	0.281	0.300	0.280	0.257	0.279
I_3	0.297	0.300	0.240	0.279	0.303	0.293	0.250	0.282
Average (B)	0.301	0.292	0.252	-	0.304	0.290	0.257	-
L.S.D. at 5 %								
Irrigation (A)	0.010				0.010			
Potassium (B)	0.010				0.010			
A x B	0.017				0.017			
	Potassium (%)							
I_1	1.52	1.37	1.22	1.37	1.50	1.37	1.24	1.37
I_2	1.55	1.40	1.30	1.42	1.57	1.41	1.30	1.43
I_3	1.62	1.45	1.30	1.46	1.64	1.47	1.31	1.47
Average (B)	1.56	1.41	1.27	-	1.57	1.41	1.29	-
L.S.D. at 5 %								
Irrigation (A)	0.063				0.045			
Potassium (B)	0.063				0.045			
A x B	0.110				0.077			

I_1: Irrigation when 25 % of available soil moisture was depleted (wet), I_2: Irrigation when 50 % of available soil moisture was depleted (medium) and I_3: Irrigation when 75 % of available soil moisture was depleted (dry).
K_1 = 1500 gm. K_2O/tree; K_2 = 1000 gm. K_2O/tree; K_3 = 500 gm. K_2O/tree.

Concerning potassium treatments, data revealed that, high K rate significantly increased leaf N content (1.94 & 1.84 %) than the other two K rates. While, P and K leaf content significantly decreased as K rate decreased. So, the highest leaf mineral composition was noticed with the interaction wet irrigation rate at high K rate (I_1K_1 = 2.0 1.9 % N as well as 0.30 & 0.31 % P) but from the interaction dry irrigation rate at high K rate (I_3K_1 = 1.62 and 1.64 % K) through the two successive seasons, respectively.

Present results are in conformity with those being previously reported by Awasthi *et al*., (1997); Jianguo *et al*., (1998) on apple; Fernandez *et al*., (1996) and Liu *et al*., (1998) on olive; Nassef (2000); and Kabeel (2004) on peach; Eissa (2003) and Shadda *et al*., (2005) on apricot trees.

REFERENCES

Abdalla, I. M.; Shafashak, Nadia, S.; Abo-Sedera, F.A. and Abd El-Rahman, L. A. (1990). Effect of water regime and level on NPK fertilization on carrot. I. vegetative growth and its chemical composition. Annals of Agric. Sc., Moshtohor, 28 (4): 2517-2528.

Aksoy, U.; Kara, S.; Misirli, A.; Can, H. Z. and Seferoglu, G. (1995). Effect of potassium nitrate and hydrogen cyanamide on apricot. Acta Hortulturae No. 384. Tenth International Symposium on Apricot Culture Ed. Gulcan, R, Aksoy, U. Izmir-Turkey Sept. 1993.

Association of Official Agricultural Chemists (A.O.A.C) (1985): “Official Methods of Analysis” Benjamin Franklin Station, Washington, D.C., U.S.A., 495-510.

Awasthi, R.P.; Kath, N. S. and Dev, G. (1997). Influence of rate and method of potassium application on growth, yield, fruit quality and leaf mineral status of apple. Hort. Abst., 67 (11): 9178.

Bielorai, H.; Dasberg, S.; Erner, Y. and Brum, M. (1984). The effect of various soil moisture regimes and fertilizer levels on citrus yield response under partial wetting of the root zone. Proceedings of the International Society Citrus culture. 2, 585-589.

Caspari, H. W.; Behboudian, M. H. and Chalmers, D. J. (1994). Water use, growth and fruit yield of "Hosui" Asian pears under deficit irrigation. J. Am. Soc. Hort. Sci.,119: 383-388.

Chalmers, D. J.; P. D. Mitchell and L. VanHeek (1981). Control of peach tree growth and productivity by regulated water supply, tree density and summer pruning. Jour. Amer. Soc. Hort. Sci., 106 (3): 307-312.

Chapman, H. D. and F. Pratt (1961): Methods of Analysis for Soils, Plants and Water. Univ. of Calif.. 35 (5): 6-7.

Das, S. (1998). Malatya yöresi kayisi bahçelerinde toprak-bitki ilşkileri E.U.F.B.E. Toprak ABD. (Ph thesis). Bornova-IZMIR.

Devit, D.A.; R.L. Marris and D.S. Neuman (1994). Evapotranspiration and growth response of three woody ornamental species placed under varying irrigation regimes. J. Amer. Soc. Hort. Sci., 119: 452.

Domingo, R.; Ruiz-Sa`nchez, M. C.; Sa`nchez-Blanco, M. J. and Torrecillas, A. (1996). Water relations, growth and yield of Fino lemon trees under regulated deficit irrigation. Irrig. Sci., 16: 115-123.

Doorenbos, J. and Pritt, W.O. (1984). Guidelines for Predicting Crop Water Requirements. Irr. and Drainage Paper 24, 2nd ed. FAO, Rome, Italy.
Dimitrovski, T. and D. Cevetkovic (1981). The effect of NPK on growth, yield and quality of the apricot fruit. Acta. Hortic., 85: 481-489.
Eissa-Fawzia, M. (2003). Use of some biostimulants in activation of soil microflora for yield and fruit quality improvement of "Canino" apricot. J. Agric. Res. Tanta Univ., 29 (1) 175-194.
Eryuce, N.; Yagmur, B. and Colak, S. (2002). Nutrient status of Malatya Region apricot orchards. 13th International fertilizer Symposium. Gaziosmanpaşa University in Tokat-Turkey, pp. 406-410.
Fernandez, R.; Duemas and J. A. Guterrez (1996). Response of olive trees to foliar application of humic acid. Scientia Hort., 66: 191-199.
Gercek, S.; Boydak, E.; Okant, M. and Dikilitas, M. (2009). Water pillow irrigation compared to furrow irrigation for soybean production in a semi-arid area. Agric. Water Mange., 96 (1): 87-92.
Goldhamer, D. A. (1997). Regulated deficit irrigation of fruit and nut trees. Int. Water Irrg. Rev., 17: 14-19.
Goren, R.; Huberman, M. and Riov, J. (1994). Effect of gibberellin and girdling on the yield of Nova (Clementine x Orlando tangelo) and Niva (Valencia x Wilkin). Proceeding of the International Society of Citriculture, 1: 493-499.
Girona, J.; Marsal, J.; Mata, M.; Arbones, A. and Miravete, C. (1997). Evaluation of almond (*Prunus amygdalus* L.) seasonal sensitivity to water stress. Acta Hortic., 449: 489-496.
Huguet, C. (1988). Fertilization: Evoluation des connaissances. Arboriculture Fruitiere, 406: 14-16.
Ibrahim, M.A (1981). Evaluation of different methods for calculating potential evopotranspiration in north Delta region. Ph .D. thesis, Fac. Agri. Alex. Univ.
Jackson, M. L. (1973). Soil Chemical Analysis. Prentice–Hall of India, New Delhi.
Jackson, M. L. and A. Ulrich (1959). Analytical methods for use in plant analysis. Coll. Of Agric. Exp. State Bull.766: 35 pp.
Jianguo, Yu.; Yu. Shuiying; Z. Yujuan and S. Yingchang (1998). Influence of humic acid on the physiological and biochemical indexes of apple trees. Forest. Res., 11 (6): 623-628.
Jones, J. W.; Allen, L. H.; Shin, S. F.; Rogers, J. S.; Hammond, L. S.; Smajstrala, A. G. and Martsolf, J D. (1984). Estimated and measured evapotranspiration for Florida climate, crops and soils. Agricultural Experiment Station. Institute of Food and Agricultural Sciences, Univ. of Florida, Gainesville. U.S.A.
Kabeel, H. (2004). Influence of different rates of nitrogen and potassium on vegetative growth, fruiting aspects, fruit characteristics and leaf mineral composition of "Meet-Ghamr" peach trees. Minufiya, J. Agric., Res., 29 (4): 215-234.
Kotze, W. A. G. and J. Villiers (1991). Uptake of ^{15}N labeled ammonium and nitrate by apple, apricot and nectarine trees. J. S. Afr. Soc. Hortic. Sci., 1: 89-91.

Kotze, W. A. G. and M. Joubert (1992). Effect of different organic materials for soil improvement mulching and fertilization on the performance of apricot trees. J. S. Afr. Soc. Hortic., Sci., 2: 31-35.

Kramer, P. J. (1977). Plant and soil relationships. A modern Synthesis Mc GRAW-Hill pub., Company LTD New Delhi.

Labanauskas, C. K. (1966). Effect of orange leaf washing techniques on removal of surface contaminants and nutrient losses. Proc. Amer. Soc. Hort. Sci., 89: 201-210.

Le, SH; Huguet, J.G.; Schoch, P.G. and Orlando, P. (1989). Responses of peach tree growth and cropping to soil water deficit at various phonological states of fruit development. J. Hortic., Sci., 64: 541-552.

Levitt, D. G.; Simpson, T. R. and Tipton, J. L. (1995). Water use of two landscapes tree species in Tucson. J. Amer. Soc. Hort., Sci., 120, 409.

Liu, C.; R. J. Cooper and D.C. Bowman (1998). Humic acid application effects photosynthesis, root development and nutrient content of creeping bentgrass. Hort. Sci., 33 (6):1023-1025.

Murphy, J. and J.P. Riely (1962). A modified single method for the determination of phosphorus in natural water. Anal. Chem. Acta, 27:31-36.

Mpelasoka, B. S.; Behboudian, M. H. and Mills T. M. (2001). Effects of deficit irrigation on fruit maturity and quality of "Braeburn" apple. Sci., Hortic., 90: 279-290.

Nasef, A. A. H. (2000). physiological studies on the effect of mineral fertilization on growth and fruiting of “Le-Conte” pear trees. M. Sc. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ.

Piper, C.S. (1950). Soil and Plant analysis. Inter. Sci. Publ., New York, p.368.

Pregl, E. (1945). Quantitative organic microanalysis 4th ed. Chundril, London.

Proebsting, E. L.; J. E. Middleton and M. O. Mohan (1981). Performance of bearing cherry and prune trees under very low irrigation rates. Jour. Amer. Soc. Hort. Sci., 106 (2): 243-246.

Shaddad, G.; A. Khalil and M. A. Fathi (`). Improving growth, yield and fruit quality of "Canino" apricot by using bio, mineral and humic fertilizers. Minufiy J. Agric. Res., 30 (1): 317-328.

Smith, N. (1991). "CROPWAT" model for Eto calculation using Penman Monteith Method. FAO, Rome , Italy.

Sud, G. and V. P. Bhutani (1994). Effects of autumn sprays of urea on the nutrient status of apricot. Hortic. J., 7: 83-88.

Snedecor, G. W. and Cochran, W. G. (1980). Statistical methods. The 7th ed the Iowa state Univ. Press Iowa, U.S.A. P. 593.

Sobral, L.; Souza, L. F. da-S.; Magalhaes, A.F.-de-J.; Silva, JUB and Leal, M.-de-LS (2000). Responses of orange trees to nitrogen, phosphorus and potassium fertilization in a yellow latsol of the coastal plateau. Agropecuaria, Brasileira, 35: 307-312.

Stackman, W.P. (1966). Determination of pore Size by the air bubbling pressure method proceeding unesce Symp on water in the unsaturated zone 366- 372.

Torrecillas, A.; Galego, R.; Perez-Pastor, A. and Ruiz-Sanchez, M.C. (1999). Gas exchanfe and water relations of young apricot plants under drought conditions. J. Agric. Sci., 132: 445-452.

Vites, F.G., (1965). Increasing water use efficiency by soil management. Amer. Soc. Agron., Madison,
Vogel, A. (1968): A Text Book of Quantitative Inorganic Analysis. Longmans, New York, pp. 1216.Wisc. pp: 259-274.
Weagand, G. L. (1962). Drying pattern of a sandyclay loam in relation to optimal depth of seeding. Agron. J. 54: 473-476.
Yalcinkaya, E; Uslu, S. and Pektekin, T. (1995). Apricot adaptation in Malatya Acta Horticulturae No. 384. Tenth International Symposium on Apricot Culture. Ed. Gulcan, R. Aksoy, U. Izmir-Turkey 20-24 September 1993.

تأثير المحتوى الرطوبى للتربة وكمية عنصر البوتاسيوم على نمو ومحصول وصفات جودة ثمار المشمش "كانينو"

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تم إجراء هذه التجربة فى محطة بحوث البساتين بالقناطر الخيرية خلال موسمى ٢٠١٠، ٢٠١١ لدراسة تأثير ٣ مستويات للمحتوى الرطوبى للتربة (عند نقص محتوى التربة بنسبة ٢٥، ٥٠، ٧٥ %) رطب، متوسط، جاف وكذلك تأثير ٣ معدلات تسميد بعنصر البوتاسيوم (٥٠٠، ١٠٠٠، ١٥٠٠ جم/شجرة) على النمو والمحصول وجودة ثمار المشمش المنزرع فى أراضى طميية.

أظهرت النتائج أن معدل استهلاك الماء تراوح بين ٩٣٤.٤ – ١٢٥٥.٥ ملليمتر فى الموسم الأول و ٩٧٤.٦٣ – ١٢٧٨.٦ ملليمتر فى الموسم الثانى أى ما يعادل ٣٩٢٤.٥ – ٥٢٧٣.١ م^3/ الفدان فى الموسم الأول و ٤٠٩٣.٤ – ٥٣٧٠.١ م^3/ الفدان فى الموسم الثانى، كما أن زيادة التسميد بالبوتاسيوم قلل بنسبة بسيطة معدل استهلاك المياه.

معدل استهلاك المياه الشهرى كان منخفضاً بعد خروج الأشجار من السكون ثم زاد حتى وصل لأعلى نسبة خلال شهرى يوليو وأغسطس ثم نقص حتى وصل أقل نسبة خلال شهر أكتوبر. معامل المحصول للمشمش (Kc) = ٠.٧٩ حيث وجد أن معاملة الرى الرطب (٧٥ % ماء متاح) زادت كل صفات النمو والمحصول فى موسمى الدراسة. وكانت كفاءة استخدام ماء الرى ٠.٩٦ – ١.٠ كجم ثمار لكل متر مكعب ماء رى كما زادت هذه الكفاءة بزيادة معدل التسميد البوتاسى.

زيادة رطوبة التربة زادت مساحة الورقة وأبعاد الثمرة وحجمها ومحصول الثمار لكنها قللت نسبة المواد الصلبة الذائبة الكلية والحموضة والنسبة بينهما.

قام بتحكيم البحث

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