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EFFECT OF NITROGEN AND POTASSIUM FERTILIZATION ON NUTRITIONAL STATUS AND FRUIT QUALITY OF CITRUS TREES IN CASE OF CONVERTING IRRIGATION SYSTEM FROM FLOOD TO PRESSURIZED IRRIGATION SYSTEMS

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ABSTRACT: Two field experiments were conducted at Salheya area, Sharkia Governorate, Egypt during two seasons (2015 and 2016) to study the effect of N, K fertilization and irrigation systems on citrus trees (*Citrus sinenis*), in case of converting irrigation system from flood to pressurized irrigation systems. Two N rates (800 and 1000g N/tree/year) and K (330 and 500 g K/tree/year) in the experiment 1 using 8 pressurized irrigation systems beside flood irrigation. Three N rates (800, 1000 and 1200 g N/tree/year) and K (330,500 and 660 g K/tree/year) in experiment 2 under 6 irrigation systems using equal water amounts for all converted trees (25 m^3/tree/year) by using small valves, and flood irrigation. 800 g N/tree/year and 330 g K/tree/year gave the highest N content in leaves in trees converted from flood to two lines dripper (S7), Highest K content in leaves was obtained by treatment of 1000 g N and 500 gK/tree/year under non converted trees (flood). In experiment 1, highest content of total soluble solids (TSS) was obtained by 800 g N and 500 g K under trees converted from flood to Micro Jet in circle shape (S5), and the highest acidity pH was obtained by treatment of 1000 g N and 500 g K under trees converted from flood to S7. In experiment 2 the highest N content in leaves was obtained by treatment of 1200 g N/tree/year and 660 g K/tree/year in converted trees to (S5) and the highest content of K in leaves was obtained by treatment of 1200 g N/tree/year and 330g K/tree in converted trees to T. dripper in square shape (S4). Application of 1000 g N/tree/year with 500 g K/ tree/year gave the highest percentage of TSS, and the highest percentage of total acidity was obtained due to adding of 1200 g N combined with 330 g K/tree/year in converted trees from flood to (S5).

Key words: Citrus, nitrogen, potassium, irrigation systems.

INTRODUCTION

Fertilization is most important for citrus yield and quality specially when converting the irrigation system from flood to pressurized irrigation. Nitrogen and potassium are the main nutrients needed for citrus trees. The balance between N and K is important (Monga *et al*., 2004). Nitrogen is important nutrient for growth and productivity because it is a constituent of proteins, nucleic acid, vitamins, hormones and many other important substens. Nitrogen and potassium minimize the negative effect of converting irrigation system from flood to pressurized irrigation.

Roth *et al*. (1995) reported that mature orange trees can be converted to pressurized irrigation systems with minimal effect on fruit yield and quality. There is relationship between water requirement and fertility. Wolf (1999) reported that water requirement to produce a unit weight of a crop can be reduced by adequate nutrition. Adding sufficient fertilizers can reduce water requirements to produce a unit of crop (Ibrahim, 2006).

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In old citrus orchards irrigation was done with high water amounts ranging from 8000-8500m^3 fad.$^{-1}$ (or 19000 to 20000 m^3 ha^{-1}) (25 times/year) whereas the actual water requirements range between 3000-4000 m^3 fad.$^{-1}$ or 7200 to 9500 m^3 ha^{-1}. On the other hand, in sandy soils that irrigated by flood system, water amount used ranging from 10000-12000 m^3 fad.$^{-1}$, (42000 to 50400 m^3 ha^{-1}), whereas the actual water requirements range between 5000-6000m^3 fad.$^{-1}$, (21000 to 25200 m^{3}ha^{-1}). Nakhlla *et al.* (1998) reported that the optimal annual fertilizer and irrigation rates for 7-year-old trees were 90 kg N + 4500 m^3 irrigation water/fad., (Parsons, 1993). In arid and semiarid regions, citrus tree roots are usually concentrated in areas where irrigation water is applied. In general, more than 70% of the root system should be irrigated for mature trees in well-drained, sandy soils (Bielorai, 1982; Smajstrla and Koo, 1984; Koo and Smajstrla, 1985).

The current study aims at assessing the status of orange trees up on changing the irrigation from flood system to pressurized systems. Fruit quality and other parameters will be studied.

MATERIALS AND METHODS

Two field experiments were carried out on a sandy soil at Salheya area, Sharkia Governorate, Egypt during two successive seasons of 2015, 2016 on 15- years-old Washington navel orange. These experiments were conducted to study the effect of N and K fertilization and the change in irrigation system on nutrients content in orange leaves and some chemical properties of fruit juice, in the case of converting citrus irrigation system from flood irrigation (which using large amount of water and covered large area) into pressurized irrigation system through increasing the efficiency of nitrogen, potassium fertilization and irrigation water of fruit orchards.

Representative soil samples were collected under tree canopy, within 100 cm from tree trunk and vertically at 0 -20, 20 – 40 and 40 – 60 cm. Samples were analyzed for chemical and physical characteristics. *i.e.*, soil texture, soil (pH) and soil salinity.

Each experiment was a randomizes complete block, factorial (3-factors). Factors and treatments for experiment 1 are: factor 1: N-rate; two rates N1 and N2. Factor 2: K Rate: two rate K1 and K2, factor 3: irrigation system: nine systems from S1 to S9. Factors and treatment of experiment 2 are: factor 1: N rate; three rates, N1 to N3. Factor 2: K rates: K1 to K3. Factor 3: irrigation systems: six systems from S1 to S6. Assignations of treatments were as follows: In experiment 1, two N rates: (800 and 1000 g N / tree /year) and the two K rates :(330 and 500 g K/tree/year) the irrigation systems were: Micro Sprinkler (S1), Adjustable Sprinkler (S2), Micro jet in square shape (S3), T. dripper in square shape (S4), Micro jet in circle shape (S5), T. dripper in circle shape (S6), two lateral lines along tree rows (S7), open lines for each tree (S8) and flood irrigation (S9) which is the (non-converted system), Unequal flow of each system was controlled by using small valves.

Experiment 2 included Three N rates (800, 1000 and 1200 g N/tree/year/) and three K rates (330, 500 and 660 g K/tree/year), six irrigation systems which were : Micro Sprinkler (S1), Micro jet in circle shape (S2), T. dripper in circle shape (S3), Adjustable Sprinkler (S4), two lateral lines along tree rows (S5). Equal water amount of 25m^3/tree/year was used for all converted trees by using small valves, and Flood irrigation (S6) as standard. Fig. 1 shows details of each irrigation system.

Table 1. Physical and chemical properties of the orchard soil

Depth (cm)	Particle size (%)			Textural class	pH	EC dSm^{-1}	N content mg kg^{-1}		Ions mmol$_c$ l^{-1}								
	Sand	Silt	Clay				NO_3^-	NH_4^+	Ca^{++}	Mg^{++}	Na^+	K^+	CO_3^{--}	HCO_3^-	SO_4^{--}	Cl^-
0 – 20	75.7	20.5	3.8	**L S *S	8.50	0.74	33	84	2.5	1.45	3.25	0.65	0	3.66	1.32	2.87
20-40	98.9	0.6	0.5	*S	8.53	0.41	60	44	1.68	0.95	1.33	0.32	0	2.33	0.70	1.25
40-60	99.3	0.0	0.3	*S	8.39	0.33	56	44	1.15	0.85	1.25	0.15	0	1.17	1.00	1.23

** L.S = Lomy sand * S = sand

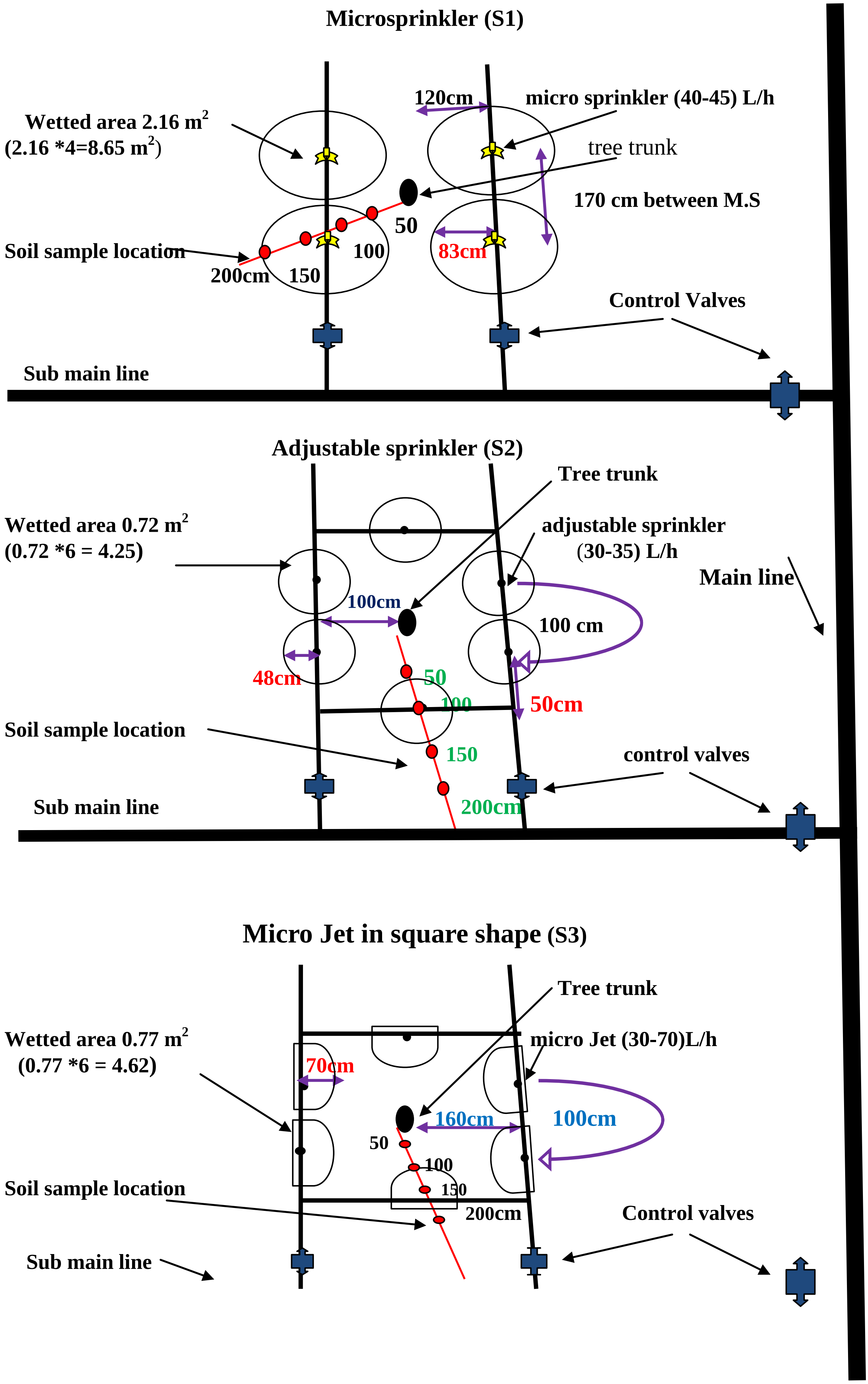
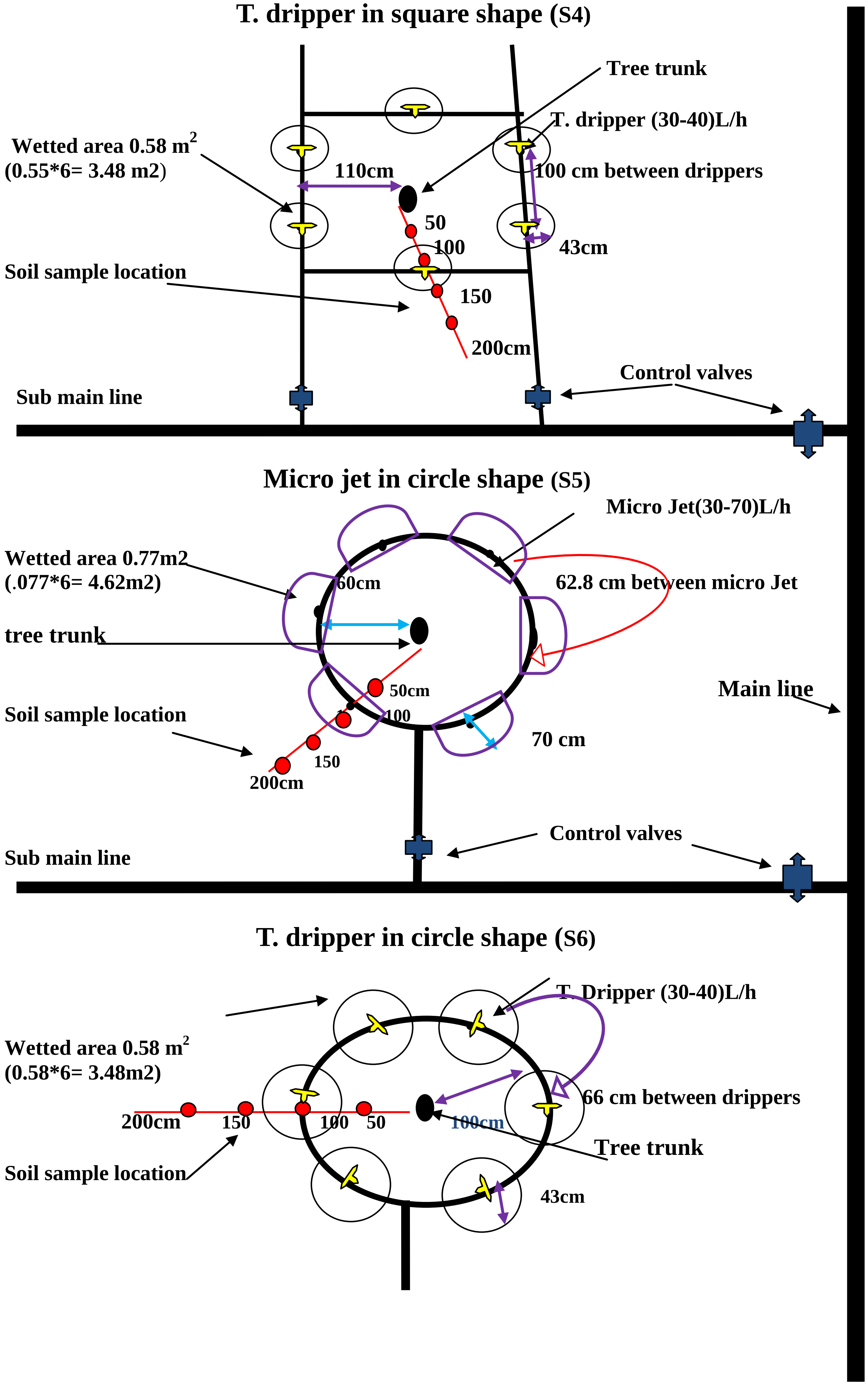


Fig .1. Diagram of the irrigation systems in the experiment



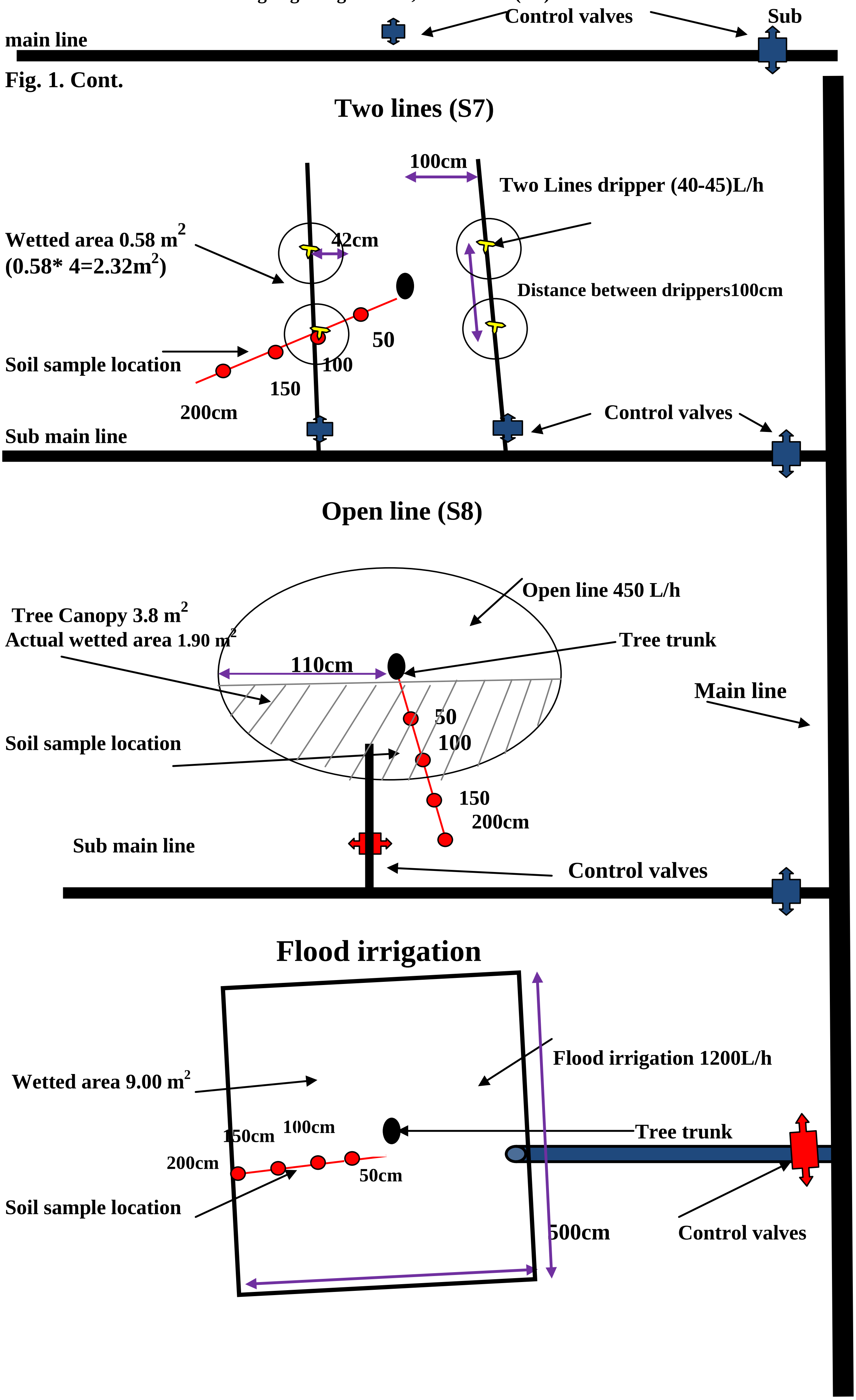

main line
Control valves
Sub
Two lines (S7)
100cm
Two Lines dripper (40-45)L/h
Wetted area 0.58 m2
(0.58* 4=2.32m2)
42cm
Distance between drippers100cm
50
100
150
200cm
Soil sample location
Control valves
Sub main line
Open line (S8)
Open line 450 L/h
Tree Canopy 3.8 m2
Actual wetted area 1.90 m2
Tree trunk
110cm
Main line
50
100
150
200cm
Soil sample location
Sub main line
Control valves
Flood irrigation
Flood irrigation 1200L/h
Wetted area 9.00 m2
150cm
100cm
Tree trunk
200cm
50cm
Soil sample location
500cm
Control valves

Fig. 1. Cont.

400 cm

Fig. 1. Cont.

Therefore, treatments of experiment 1 were 2 "N"×2 "K"×9 Irrigation systems with 3 replicates (108 plots). In experiment 2 they were : 3"N" × 3" K "× 6 irrigation systems with 3 replicates (162 plot).

Leaf sampling

Samples of mature leaves of the previous spring flush proceeding were taken on September 2015 and September 2016. The fresh leaves were dried at 70^{o}C till constant weight and then ground. 0.2 g of the finely ground leaves of each replicate was wet digested using the method described by Kitson and Mellon (1964).

At harvesting, 10 fruits were randomly collected from each plot to determine the acidity and total soluble solids (TSS).

Leaf analyses

In general, the considered mineral nutrients in leaves were determined as follows:

- Nitrogen in orange leaves was determined using micro kjeldahl.
- Determination of potassium by using flame-photometer.

Fruit analyses

1. Total soluble solids percentage (TSS %) was determined in fruit juice using a hand refractometer
2. Titration acidity in fruit juice was determined as citric acid by titration against 0.1 N sodium hydroxide solution and the total acidity percentage was calculated by equation, Total acidity = [(NaOH × 0.1 × 0.064)/juice volume] × 100 (AOAC, 1990).

Soil analyses

1- Particle size distribution was carried out by international pipette method described by Piper (1950).

2- Soil reaction (pH) in (1:2.5) water suspension by pH meter.

3- (EC dS/m^{-1}) were determined in soil paste according to Jackson (1967).

4- Soluble ions in soil extract (1:2.5 soil: water *W/V*) according to methods described by Jackson (1967).

5- Available nitrogen in soil was extracted by 1% KCl solution, and determined by Kjeldahl method.

6- Available potassium was extracted by 1.0 N ammonium acetate solution extract (1:2.5) according to Jackson (1967).

Statistical analyses

The obtained data were tabulated and statically analyzed and the individual comparison means were carried out using New LSD.

RESULTS AND DISCUSSION

Nitrogen Content in Orange Leaves

Results presented in Table 2, show that, nitrogen concentration in orange leaves was clearly affected by applying different rates of nitrogen and potassium through different irrigation systems in case of converting flood irrigation to pressurized irrigation systems. The percentage of nitrogen in leaves ranged between 1.79% (by N1 K1 S1) -3.09% (by N1 K2 S2) in experiment 1 and 1.71% (by N3 K3 S3) - 2.29% (by N3 K3 S5) in experiment 2. Thus the highest N in leaves was obtained by 800 g N and 330 gK/tree/year under converted trees into two lines along tree row in experiment 1 and 1200 g N/tree/year and 660 g K/tree/year in converted trees to two lines along tree row in experiment 2. On the other hand, the lowest percent of N in leaves was obtained by the treatment 800g N/tree/year, 330 g K/tree/year in converted trees to micro sprinkler (S1) in experiment 1 and 1200 g N, 660 g K/tree/year under trees of micro jet in circle shape (S2) in experiment 2. The results showed that there are many factors affecting N in leaves not the amount of nitrogen applied only, but were strongly related to the application method (Khalil *et al*., 2000; El-Wazzan *et al.*, 2001), who added that distribution of water irrigation and nitrogen fertilizer on large area under tree canopy improved roots distribution and nitrogen uptake.

Studying the effect of nitrogen fertilization

Results showed that increasing nitrogen application from 800 to 1000 g N/tree/year in experiment 1 increased N content in converted trees into S 2, S 3, S 4, S 6 and S 8 by 2.46, 22.13, 2.59, 16.41 and 18.58% while under converted trees into S 1, S 5 and S 7 there were decreases by 12.61, 13.14 and 3.63%. In experiment 2, increasing nitrogen rate from 800 to 1000 g N/tree/year caused a slight increase in nitrogen content in leaves by 1.63 and 9.09% for S 3 and S 4 systems, respectively. Increasing N from 1000 to 1200 g/tree/year, nitrogen content in leaves were increased by 3.13, 11.76, 28.43 and 3.03% in all converted trees, except converted trees from flood to S1 wherein it decreases by 5.52%. These results are in harmony with those obtained by Sabbah *et al.* (1997), Kannan *et al.* (2002), Monga *et al.* (2004), El-Otmani *et al.* (2004), Wassel *et al.* (2007), Khan *et al*. (2009), Quinones *et al.* (2009), Baughallel *et al.* (2011) and El-Wabeol and Eid (2011) who found that increasing the N rates and number of doses increased N concentration in the leaves.

Concerning potassium fertilization, the results showed that increasing potassium rates from 330 to 500 g K/tree/year in experiment 1 gave increases in nitrogen content in leaves by 49.72, 12.93, 6.87, 19.63, 2.19, 3.77 and 12.93% in S1, S2, S3, S4, S6, S7, S8 and S9, respectively, as for converted trees from flood to S 5 which was not affected. In experiment 2 increasing K rate from 330 to 500 g K/tree/year caused increases in nitrogen leaves by 2.12, 0.53, 0.51 and 1.52% in all converted trees except trees converted from flood to S2, there was slight decreases by 0.52%. Also, increasing K rate from 500 to 660 g K/tree/year decreased N leaves by 4.17, 5.29 and 1.02% in converted trees to S2, S3 and S4, respectively. In S1 and S5 there are increases by 3.63 and 3.98%, respectively.

Studying the effect of converting citrus irrigation system from flood to pressurized irrigation on nitrogen content in leaves, due to the differences of water and nitrogen fertilizer distribution in the ground under trees canopy, the results in the first experiment showed that there are increases in nitrogen leaves by 5.11, 15.32, 8.94, 17.87, 26.81and 5.11% in all converted trees except converted trees from flood to S1 there was decreases in nitrogen leaves by 5.11%, while converted trees from flood to S4 were not affected. Whereas in experiment 2 converting irrigation system from flood to tested irrigation decreased nitrogen concentration in orange leaves by 26.79, 28.30, 30.19, 26.04 and 23.40% in all converted trees from flood to pressurized irrigation systems. The obtained results are in harmony with those reported by Shirgure *et al*. (2003) and Prerak (2011). They found that leaf nutrient status was significantly higher with microjet 180 degrees.

Interaction between nitrogen and potassium with irrigation system the results showed that increasing potassium rate from 330 to 500 g K/ tree with application of 800 g nitrogen in experiment 1 caused significant increases in nitrogen concentration in orange leaves by 66.48, 28.04, 15.93, 29.70, 15.13, 3.69 and 11.21% in all converted trees except S5 where there was decreases by 8.39%, and increasing K rate from 330 to 500 g K/tree/year under application the second rate (1000g N/tree/year) increased nitrogen content in orange leaves by 32.96, 10.62, 10.62, 4.20 and 14.40 in converted trees to S1, S4, S 5, S7 and S8 ,respectively, but converted trees to S 2 and S3 nitrogen content in leaves were not affected. Also in experiment 2 increasing potassium rate from 330 to 500 g K/tree under application of 800 g N/tree/year increased leaves nitrogen content by 22.41, 6.25, 1.62 and 9.60% in all converted trees except S 5 there is decreases by 8.13%. While increasing potassium rate from 500 to 660 g K/tree/year under the same rate of nitrogen (800 g N/tree/ year) caused decreases in N leaves by 7.51, 7.35, 5.32 and 1.55% in all converted trees except S 5 there is increases by 6.25% whereas under application of the second rate of nitrogen (1000 g N/tree/year), increasing potassium rate from 330 to 500 g K/tree/year decreased nitrogen concentration in orange leaves by 11.33, 4.08, 0.53and 2.88% in all converted trees except converted trees from flood to S5 there was increases in nitrogen content in leaves by 13.90%. In addition, increasing potassium rate from 500 to 660 g K/tree/year under the same rate of nitrogen increased N leaves by12.78, 2.13, 0.53% in all converted trees except S5 there was a decreases in N leaves by 8.45%. Under application the third level of nitrogen (1200 g N/ tree), increasing potassium rate from 330 to 500 g K/tree/year caused negative effect on concentration of nitrogen in orange leaves by 2.62, 2.63 and 3.43% in converted trees to S1, S2 and S4. Also increasing K rate from 500 to 660 g K/tree/year decreased N leaves in all converted trees by

7.57, 9.95 and 2.54% in converted trees to S2, S3 and S4, respectively. Whereas converted trees to S1 and S5 there were increases in N leaves content by 6.99 and 15.08%, respectively.

Table 2. Effect of N, K and irrigation system on nitrogen content in leaves of Washington navel orange trees

a: Experiment 1

N rates g/tree/year (A)	K rates g/tree/year (B)	Type of irrigation system (c)								
		Micro sprinkler (S1)	Adjustable sprinkler (S2)	Micro Jet in square shape (S3)	T. dripper in square shape (S4)	Micro jet in circle shape (S5)	T. dripper in circle shape (S6)	Two lines dripper (S7)	Open lines (S8)	Flood irrigation (S9)
800	**330**	1.79	2.14	2.26	2.02	2.86	2.38	2.98	2.14	2.02
	500	2.98	2.74	2.62	2.62	2.62	2.74	3.09	2.38	2.26
Mean		2.38	2.44	2.44	2.32	2.74	2.56	3.03	2.26	2.14
1000	**330**	1.79	2.50	2.98	2.26	2.26	3.09	2.86	2.50	2.50
	500	2.38	2.50	2.98	2.50	2.50	2.86	2.98	2.86	2.62
Mean		2.08	2.50	2.98	2.38	2.38	2.98	2.92	2.68	2.56
					Mean of K					
K	**330**	1.79	2.32	2.62	2.14	2.56	2.74	2.92	2.32	2.26
	500	2.68	2.62	2.80	2.56	2.56	2.80	3.03	2.62	2.44
G. Mean		**2.23**	**2.47**	**2.71**	**2.35**	**2.56**	**2.77**	**2.98**	**2.47**	**2.35**
LSD		A 0.24	B NS	C 0.20	AB 0.36	AC 0.28		BC 0.28		ABC NS

b: Experiment 2

N rates g/tree/year (A)	K rates g/tree/year (B)	Type of irrigation system (c)					
		Micro sprinkler (S1)	Micro jet in circle shape (S2)	T. dripper in circle shape (S3)	Adjustable sprinkler (S4)	Two lines dripper (S5)	Flood irrigation (S6)
	330	1.74	1.92	1.85	1.77	2.09	2.58
800	**500**	2.13	2.04	1.88	1.94	1.92	2.71
	660	1.97	1.89	1.78	1.91	2.04	2.62
Mean		**1.95**	**1.95**	**1.84**	**1.87**	**2.02**	**2.64**
	330	2.03	1.96	1.88	2.08	1.87	2.69
1000	**500**	1.80	1.88	1.87	2.02	2.13	2.69
	660	2.03	1.92	1.88	2.02	1.95	2.69
Mean		**1.95**	**1.92**	**1.87**	**2.04**	**1.98**	**2.69**
	330	1.91	1.90	1.91	2.04	1.98	2.58
1200	**500**	1.86	1.85	1.91	1.97	1.99	2.64
	660	1.99	1.71	1.72	1.92	2.29	2.64
Mean		**1.92**	**1.82**	**1.85**	**1.98**	**2.09**	**2.62**
				Mean of K			
K	**330**	1.89	1.93	1.88	1.96	1.98	2.62
	500	1.93	1.92	1.89	1.97	2.01	2.68
	660	2.00	1.84	1.79	1.95	2.09	2.65

G. Mean		**1.94**	**1.90**	**1.85**	**1.96**	**2.03**	**2.65**
LSD	A 0.40	B 0.02	C 0.041	AB 0.041	AC 0.07	BC 0.07	ABC 0.12

Potassium Content in Orang Leaves

Results presented in Table 3, show that potassium concentration in orange leaves was clearly affected by applying different rates of nitrogen and potassium on Washington novel orange in the case of converting irrigation system from flood to pressurized irrigation systems. The highest percentage of K in orange leaves was obtained by the treatment of 1000 g N and 500 g K/tree/year under non converted trees (flood) in the first experiment and 1200 g N/tree/year and 330 g K/tree/year in converted trees from flood to adjustable sprinkler (S 4) in the second experiment. On the other hand, the lowest percentages of K (%) in leaves was obtained by the treatment of 800 g N/tree/year, 330 g K/tree/year in converted trees from flood to Micro Jet in circle shape (S5) in the first experiment and 1200 g N, 500 g K/tree/year under trees converted from flood to S 3 in the second experiment.

Studying the effect of nitrogen fertilization, the results in Table 3 showed that increasing nitrogen application from 800 to 1000 g N/tree/year in experiment 1, decreased potassium content in orange leaves by 4.35, 0.81, 1.96, 4.52 and 4.03% in converted trees from flood into S 1, S 2, S 3, S 7 and S 8, respectively. Under converted trees into S 4, S 5 and S 6 there was increases in potassium content in the leaves by 7, 78 and 4.55%, respectively. In experiment 2, increasing nitrogen application from 800 to 1000 g N/tree/year increased potassium percentage in orange leaves by 4.71, 6.25, 20.00 and 1.37% in all converted trees except that converted to S 3 which decreases by 11.54 %, In addition, increasing nitrogen rate from 1000 to 1200 g N/tree, caused decreases in potassium content in orange leaves by 9.41, 5.80, 4.76 and 4.05% in all converted trees, except S1 wheren potassium percentage in orange leaves was not affected. These results are in harmony with those obtained by Baughallel *et al.* (2011) who showed that the percentages of N in the leaves were increased in proportion to the amount of N added while the percentage of P and K were decreased.

Concerning potassium fertilization, the results showed that increasing potassium rates from 330 to 500 g K/tree/year in experiment 1 resulted in gradual increases in potassium content in leaves by 6.90, 11.21, 45.68, 5.92 and 4.73% in all converted trees except S 3, S 5 and S 8 where there were decreases by 8.49, 4.35 and 5.60%, respectively. In experiment 2, increasing K rate from 330 to 500 g K/tree/year, decreased potassium content in leaves by 2.41, 5.56, 20.69 and 1.28% in all converted trees except trees converted to S1 where there was increases by 11.11%. While increasing K rate from 500 to 660 g K/tree/year increased K percentage in orange leaves by 3.33, 4.41 and 13.04% in converted trees to S 1, S 3 and S 4, respectively. On the other hand, in S 2 and S 5 there were decreases by 2.47 and 18.18%, respectively.

The results in experiment 1 showed that converted citrus irrigation system from flood to pressurized irrigation effect on potassium content leaves, due to the difference of water and potassium fertilizer distribution in roots area under trees canopy, so the general mean of potassium concentration in orange leaves recorded decreases by 46.75, 27.22, 40.24, 40.83, 73.37, 7.10, 10.65 and 28.40% in all converted trees. In experiment 2, the general mean of K percentage in orange leaves recorded increases by 15.79, 6.58and 2.63% in converted trees from flood to S1, S2 and S4, respectively, whereas converted trees from flood to S3 and S5 showed decreases in potassium leaves by 6.58 and 3.95%, respectively.

Studying the interaction between nitrogen and potassium with irrigation system, the results showed that increasing potassium rate from 330 to 500 g K/tree/year with application of 800 g N/tree/year in experiment 1, increased potassium concentration in orange leaves by 47.30, 48.48, 0.98, 12.20, 8.78 and 38.46% in all converted trees except S4 and S8 where there was decreases by 52.58 and 3.97%, respectively. In addition increasing potassium rate from 330 to 500 g K/tree/year under the second rate of nitrogen (1000 g/tree/year) decreased potassium concentration in orange leaves by 24.00, 17.16, 16.51, 17.65, 21.21 and 8.06% in all converted trees except converted trees to S 4 and S 6 in which potassium (%) in leaves was increased. In experiment 2, increasing potassium rate from

330 to 500 g K/tree/year under application of 800 g N/tree increased K (%) in leaves by 10.39, 1.30 and 1.59% in all converted trees except S2 and S5 which showed decreases by 11.49 and 26.37%, respectively. On the other hand increasing potassium rate from 500 to 660 g K/

Table 3. Effect of N, K and irrigation system on potassium content in leaves of Washington navel orange trees

s: Experiment 1

N rates g/tree/ year (A)	K rates g/tree/ year (B)	Type of irrigation system (c)								
		Micro sprinkler (S1)	Adjustable sprinkler (S2)	Micro jet in square shape (S3)	T. dripper in square shape (S4)	Micro jet in circle shape (S5)	T. dripper in circle shape (S6)	Two lines dripper (S7)	Open lines (S8)	Flood irrigation (S9)
800	**330**	0.74	0.99	1.02	0.97	0.41	1.48	1.30	1.26	1.20
	500	1.09	1.47	1.03	0.46	0.46	1.61	1.80	1.21	1.74
Mean		0.92	1.23	1.02	0.72	0.44	1.54	1.55	1.24	1.47
1000	**330**	1.00	1.34	1.09	0.65	0.51	1.57	1.65	1.24	1.91
	500	0.76	1.11	0.91	1.91	0.42	1.61	1.30	1.14	1.91
Mean		0.88	1.22	1.00	1.28	0.46	1.59	1.48	1.19	1.91
Mean of K										
K	**330**	0.87	1.16	1.06	0.81	0.46	1.52	1.48	1.25	1.56
	500	0.93	1.29	0.97	1.18	0.44	1.61	1.55	1.18	1.82
G. Mean		0.90	1.23	1.01	1.00	0.45	1.57	1.51	1.21	1.69
LSD	A 0.047	B 0.021	C 0.13	AB 0.030	AC 0.18	BC 0.18	ABC 0.26			

b: Experiment 2

N rates g/tree/ year (A)	K rates g/tree/ year (B)	Type of irrigation system (c)					
		Micro sprinkler (S1)	Micro jet in circle shape (S2)	T. dripper in circle shape (S3)	Adjustable sprinkler (S4)	Two lines dripper (S5)	Flood irrigation (S6)
	330	0.77	0.87	0.77	0.63	0.91	0.75
800	**500**	0.85	0.77	0.78	0.64	0.67	0.77
	660	0.94	0.78	0.78	0.85	0.59	0.76
Mean		0.85	0.80	0.78	0.70	0.73	0.76
	330	0.76	0.82	0.63	0.99	0.72	0.67
1000	**500**	0.93	0.89	0.72	0.81	0.83	0.75
	660	0.97	0.83	0.72	0.72	0.66	0.74
Mean		0.89	0.85	0.69	0.84	0.74	0.72
	330	0.90	0.79	0.75	0.99	0.70	0.85
1200	**500**	0.91	0.76	0.55	0.63	0.81	0.77
	660	0.86	0.76	0.64	0.79	0.63	0.75
Mean		0.89	0.77	0.65	0.80	0.71	0.79
Mean of K							
K	**330**	0.81	0.83	0.72	0.87	0.78	0.76
	500	0.90	0.81	0.68	0.69	0.77	0.76

	660		0.93	0.79	0.71	0.78	0.63	0.75
G. Mean			0.88	0.81	0.71	0.78	0.73	0.76
LSD	A 0.043	B 0.021	C 0.039	AB 0.036	AC 0.06	BC 0.06		ABC 0.11

tree/year under the same rate of nitrogen (800 g N/tree/ year) increased leaves K by 10.59, 1.30 and 32.81% in converted trees to S 1, S 2 and S 4, respectively. While converted trees to S5 caused decreases by 11.94%, respectively. Also, with the second rate of nitrogen (1000 g N/tree /year), increasing potassium rate from 330 to 500 g K/tree/year, increased potassium concentration in orange leaves by 22.37, 8.54, 14.29 and 15.28% in all converted trees except S4, where the concentration of potassium in orange leaves was decreased by 18.18% whereas increasing K rate from 500 to 660 g K/tree/year under the same rate of nitrogen (1000 g N/tree/ year), decreased potassium percentage in leaves of converted trees to S 2, S 4 and S 5 by 6.74, 11.11 and 20.48%, respectively. But in converted trees from flood to S 1 there are slight increase by 4.30. Under the third rate of nitrogen (1200 g N/tree/year), increasing potassium rate from 330 to 500 g K/tree/year decreased potassium concentration in orange leaves by 3.80, 26.67 and 36.36% in converted trees from flood to S2, S3 and S4, respectively while converted trees to S 1 and S5, there were increases valued 1.11 and 15.71%, respectively. Also, increasing potassium rate from 500 to 660 g K/tree/year, decreased potassium leaves in S1 and S5 by 5.49 and 22.22%, respectively. Also there were increases in K leaves amounted 16.36 and 25.40% in converted trees to S 3 and S 4, respectively. The results showed that there were increases in K leaves by 16.58 and 24% in converted trees to S3 and S 4, respectively.

Some Chemical Properties of Fruit's Juice

Total soluble solids (TSS %)

Results presented in Table 4, show the effect of application different rates of nitrogen and potassium on total soluble solids (TSS) in orange fruit juice when converting citrus irrigation from flood to pressurized irrigation systems. The percentage of TSS in orange juice ranged between (11.00 -13.67) in the two experiments. The greatest percentage of TSS was obtained by the treatment of 800 g N and 500 g K/tree/year under trees converted from flood to S 5 in the first experiment, and 1000 g N/tree/year with 500 g K/tree/year in experiment 2. On the other hand, the lowest value was obtained by treatment of 1000 g N and 330 g K/tree/year under non converted trees (flood irrigation) in experiment 1 and 1200 g N with 330 g K/tree/ year under non converted trees (flood irrigation) in experiment 2.

Regarding the effect of increasing nitrogen rate, the results showed that, increasing nitrogen rate from 800 to 1000 g N/tree/year in experiment 1 caused significant decreases in TSS by 4.60, 4.43, 7.03, 9.00, 7.43, 7.32, 4.38 and 2.10% in all converted trees from flood to tested pressurized irrigation. Meanwhile, increasing nitrogen rate from 800 to 1000 g N/ tree in experiment 2, decreased TSS by 4.69, 1.70 and 2.55% under converted trees from flood to S1, S4 and S5, respectively. On the other hand, the trees which were converted to S2 and S3 were increased by 0.84 and 4.38%, respectively. Also further more in case of increasing nitrogen rate from 1000 to 1200 g N/tree/year, the percentage TSS in orange juice was decreased by 0.48, 4.63, 5.49 and 1.26% in all converted trees; except trees converted to S 5 where slight increase in TSS by1.35% was recorded.

Concerning potassium fertilization, the results showed that increasing potassium rates from 330 to 500 g K/tree/year in experiment 1, increased TSS by 2.01, 3.34, 2.00, 5.55, 3.2 and 5.13% in all converted trees from flood to pressurized irrigation systems except converted trees to S 5 and S 6 that not affected by potassium increases. Whereas, in experiment 2 increasing potassium rate from 330 to 500 g K/tree/year caused significant increases in percentage of TSS in orange juice by 1.87, 3.08, 7.25, 1.27 and 2.60% in all converted trees and increasing K rate from 500 to 660 g K/tree/year, increased the percentage of TSS by 2.15 and 1.73% in converted trees from flood to S 1 and S 4, respectively. In contrast, converted trees to S 3 and S 5 indicated decreases in TSS percentage by 4.25 and 2.54%, respectively.

Regarding to the effect of irrigation systems, the results in experiment 1 cleared that converting citrus irrigation system from flood to different irrigation systems caused increases in TSS percentage in orange juice by 9.81, 12.00, 10.60, 8.76, 14.54, 15.32, 13.49 and 3.24 % in all converted trees. Also, in experiment 2 converting irrigation system from flood to tested pressurized irrigation caused increases in TSS percentage in orange juice by 8.64, 11.75, 9.68, 10.11 and 10.46% in all converted trees, compared with non-converted trees (flood) as standard commonly the percentage of TSS in orange juice was markedly affected by irrigation system and water distribution .These results confirm those of Khalil *et al*. (2000) and Mostert *et al.* (2000) working on several citrus species and reported that the levels of TSS decreased in the treatments that used more water, mainly due to a dilution effect.

Studying the interaction between nitrogen and potassium under converted trees from flood to different pressurized irrigation systems, the results showed that increasing potassium rate from 330 to 500 g K/tree/year with application of 800 g N/tree/year in experiment 1, increased, TSS percentage by 2.60, 3.90, 1.31, 8.00, 1.26, 1.21and 4.28% in all converted trees except trees converted from flood to S6, where there was no effect. Increasing potassium rate from 330 to 500 g K/tree under application of 1000 g N/tree/ year, increased TSS by 1.31, 2.76, 2.75, 2.83, 5.43 and 5.91% in all converted trees except converted trees from flood to S5 where there was decrease in TSS by1.34%. In experiment 2, increasing potassium rate from 330 to 660 g K /tree under application of 800 g N/tree/year caused significant increases in TSS by 2.60, 1.31, 8.00, 1.33 and 1.21% in all cases, but increasing potassium rate from 500 to 660 g K/tree under 800 g N/tree/year, caused increase in TSS by 2.54% in converted trees to S1 whereas the trees which converted to S2, S3 and S5 revealed decreases in TSS by 1.29, 13.56 and 7.50%, Also increasing potassium rate from 330 to 500 g K /tree under application of the second level of nitrogen (1000 g N/tree/year) increased TSS in orange fruits by 1.31, 9.49, 13.92, 1.36 and 1.36% in all converted trees. Whereas increasing K rate from 500 to 660 g K/tree/year caused increases in TSS by 2.76, 1.26 and 2.60% in converted trees to S1, S2 and S3, respectively but converted trees to S3 and S5 were not affected. Furthermore, under application the highest level of nitrogen (1200 g N/tree/year), increasing potassium rate from 330 to 500 g K/ tree/year increased TSS percentage by 1.31, 1.38, and 5.43% in converted trees to S1, S4 and S5, respectively, while converted trees to S 2 caused decreases in TSS by 1.34%. Increasing potassium rate from 500 to 660 g K/tree under the same rate of nitrogen increased TSS by1.38, 1.38 and 2.64% in converted trees to S1, S3 and S4, whereas converted tree from flood to S2 and S5, TSS in fruit juice was not affected.

Total acidity (%) in fruit juice

Table 5, show the values of total acidity in fruit juice as affected by application of different rates of nitrogen and potassium through converted irrigation system from flood to pressurized irrigation systems. The acidity of orange juice ranged between 0.42 - 0.68% in experiment 1, and 0.42 – 0.71% in experiment 2. The highest percentage of acidity was obtained by treatment of 1000 g N and 500 g K/tree/year under trees converted from flood to S 7 in experiment 1, and 1200 g N with 330 g K/tree/ year in experiment 2. On the other hand, the lowest value was obtained by treatment of 800 g N and 500 g K/ tree under non converted trees (flood irrigation) in experiment 1 and 1200 g N with 660 g K/tree/year under non converted trees (flood irrigation) in experiment 2.

Regarding the effect of nitrogen application on total acidity in fruit juice, the results showed that increasing nitrogen rate from 800 to 1000 g N/tree/year in experiment 1 caused significant increases in total acidity by 6.90, 16.36, 5.45, 3.77, 1.79, 5.56, 1.52 and 4.08% in all converted trees from flood to tested pressurized irrigation. In addition, increasing nitrogen application rate from 800 to 1000 g N /tree in experiment 2 increased acidity by 7.02, 4.92, 1.67 and 1.64% in all converted trees, except converted trees to S4 where the total acidity in fruit juice was not affected. On the other hand, increasing nitrogen rate from 1000 to 1200 g N/tree/year, increased percentage of acidity in orange juice by 1.64, 3.28 and 12.90% in converted trees from flood to S1, S3 and S5 whereas trees converted to S2 and S4, the total acidity in fruit juice was not affected.

Concerning potassium fertilization, increasing potassium rates from 330 to 500 g K/tree/year in experiment 1 decreased total acidity by 13.85, 1.67, 3.45and 3.57% in converted trees from flood to S1, S2, S5 and S6, respectively, while converted trees to S3, S4 and S8, the total acidity in fruit juice was not affected by potassium increases. In experiment 2, increasing potassium rate from 330 to 500 g K/tree/year decreased percentage of total acidity in orange juice by 1.64, 1.56, 1.61, 5.97 and 1.54% in all converted trees. Also, increasing K rate from 500 to 660 g K/tree/year, decreased the percentage of acidity by 3.33, 1.59, 1.64 and 4.76% in all converted trees except converted trees in S5 was not affected.

Table 4. Effect of N, K and irrigation system on TSS percentage in fruit juice Washington navel orange trees

a: Experiment 1

N rates g/tree/ year (A)	K rates g/tree/ year (B)	Type of irrigation system (c)								
		Micro sprinkler (S1)	Adjustable sprinkler (S2)	Micro jet in square shape (S3)	T. dripper in square shape (S4)	Micro jet in circle shape (S5)	T. dripper in circle shape (S6)	Two lines dripper (S7)	Open lines (S8)	Flood irrigation (S9)
800	330	12.67	12.83	13.00	12.50	13.50	13.67	13.17	11.67	11.50
	500	13.00	13.33	13.17	13.50	13.67	13.67	13.33	12.17	11.67
Mean		12.83	13.08	13.08	13.00	13.58	13.67	13.25	11.92	11.58
1000	330	12.17	12.33	12.00	11.67	12.67	12.67	12.33	11.33	11.00
	500	12.33	12.67	12.33	12.00	12.50	12.67	13.00	12.00	11.50
Mean		12.25	12.50	12.17	11.83	12.58	12.67	12.67	11.67	11.25
Mean of K										
K	330	12.42	12.58	12.50	12.08	13.08	13.17	12.75	11.50	11.25
	500	12.67	13.00	12.75	12.75	13.08	13.17	13.17	12.08	11.58
G. Mean		12.54	12.79	12.63	12.42	13.08	13.17	12.96	11.79	11.42
LSD		A 0.19	B 0.15	C NS	AB 0.21	AC 0.72		BC 0.72		ABC 1.02

b: Experiment 2

N rates g/tree/ year (A)	K rates g/tree/ year (B)	Type of irrigation system (c)					
		Micro sprinkler (S1)	Micro jet in circle shape (S2)	T. dripper in circle shape (S3)	Adjustable sprinkler (S4)	Two lines dripper (S5)	Flood irrigation (S6)
	330	12.67	13.00	12.50	12.83	13.17	11.67
800	500	13.00	13.17	13.50	13.00	13.33	12.17
	660	13.33	13.00	11.67	13.00	12.33	11.33
Mean		13.00	13.06	12.56	12.94	12.94	11.72
	330	12.17	12.33	12.00	12.50	12.50	12.00
1000	500	12.33	13.50	13.67	12.67	12.67	11.50
	660	12.67	13.67	13.67	13.00	12.67	11.67
Mean		12.39	13.17	13.11	12.72	12.61	11.72
	330	12.17	12.67	12.33	12.33	12.33	11.00
1200	500	12.33	12.50	12.33	12.50	13.00	11.50
	660	12.50	12.50	12.50	12.83	13.00	11.33
Mean		12.33	12.56	12.39	12.56	12.78	11.28
Mean of K							
K	330	12.33	12.67	12.28	12.56	12.67	11.56

	500	12.56	13.06	13.17	12.72	13.00	11.72
	660	12.83	13.06	12.61	12.94	12.67	11.44
G. Mean		12.57	12.93	12.69	12.74	12.78	11.57
LSD	A 0.26	B 0.23	C 0.27	AB 0.40	AC 0.47	BC 0.47	ABC 0.83

With regard to the effect of irrigation system, the results in experiment 1 cleared that, converting citrus irrigation system from flood to pressurized irrigation systems caused significant increases in acidity of orange juice by 30.43, 30.43, 21.74, 17.39, 23.91, 19.57, 43.48 and 8.70% under all tested trees compared with non-converted trees. Also in experiment 2, converting irrigation system from flood to pressurized irrigation systems increased total acidity in fruit juice by 27.66, 34.04, 29.79, 34.04 and 36.17% in all converted trees, compared with non-converted trees (flood) as standard.

Studying the interaction between nitrogen and potassium in case of converting irrigation system for citrus trees, results showed that in experiment 1, increasing potassium rate from 330 to 500 g K/tree/year with application of the first level of nitrogen (800 g N/tree/year) caused significant decreases in total acidity percentage by 15.87, 3.57, 1.82, 1.85, 3.51, 5.45, 1.52 and 4.00% in all converted trees. Whereas increasing potassium rate from 330 to 500 g K /tree under application of the second level of nitrogen (1000 g N/tree/year) increased acidity by 1.56, 3.51, 3.70, 3.03 and 1.96% in all converted trees except S1, S5 and S6 where there were decreases in acidity by13.43, 3.45 and 3.45%. While in experiment 2, increasing potassium rate from 330 to 500 g K /tree under application of 800 g N/tree/year caused slight decreases in total acidity by 3.33, 1.64, 1.67, 4.62 and 3.23% in all converted trees. Also, increasing potassium rate from 500 to 660 g K/tree/year under the same rate of nitrogen, caused low decreases in acidity by 6.90 and 1.61% in converted trees to S1 and S4, while S2 and S3 not affected by increasing K rate. Also increasing potassium rate from 330 to 500 g K/tree/year under application the second level of nitrogen (1000 g N/tree/year) caused decreases in total acidity in fruit juice by 1.61, 1.54, 3.17, 7.35 and 1.59% in all converted trees. Increasing potassium rate from 500 to 660 g K/tree/year with the second level of nitrogen, decreased the total acidity by 1.64, 1.56, 3.28, 6.35 and 1.61% in all converted trees. Also, under application the highest level of nitrogen (1200 g N/tree/year) with increasing potassium rate from 330 to 500 g K/tree/year, decreased total acidity percentage in fruit juice by 3.17, 1.54, 1.59, 7.35 and 1.41% in all converted trees. Furthermore, increasing potassium rate from 500 to 660 g K/tree/year with the highest level of nitrogen (1200 g N/tree/year) decreased acidity by 1.56 and 6.35% in converted trees to S2 and S4, while in converted trees to S1, S3 and S5, the total acidity in fruit juice was not affected by increasing potassium rate specially in the case of application the highest level of nitrogen.

Table 5. Effect of N, K and irrigation system on acidity in fruit juice (%) of Washington navel orange trees

a: Experiment 1

N rates g/tree/ year (A)	**K rates g/tree/ year (B)**	**Type of irrigation system (c)**								
		Micro sprinkler (S1)	**Adjustable sprinkler (S2)**	**Micro jet in square shape (S3)**	**T. dripper in square shape (S4)**	**Micro jet in circle shape (S5)**	**T. dripper in circle shape (S6)**	**Two lines dripper (S7)**	**Open lines (S8)**	**Flood irrigation (S9)**
800	**330**	0.66	0.66	0.61	0.60	0.64	0.61	0.72	0.50	0.46
	500	0.59	0.60	0.60	0.59	0.63	0.59	0.70	0.48	0.42
Mean		0.63	0.63	0.61	0.60	0.64	0.60	0.71	0.49	0.44
1000	**330**	0.70	0.70	0.63	0.61	0.65	0.63	0.73	0.51	0.50
	500	0.66	0.71	0.65	0.63	0.64	0.63	0.75	0.52	0.44
Mean		0.68	0.70	0.64	0.62	0.64	0.63	0.74	0.51	0.47

		Mean of K								
K	**330**	0.68	0.68	0.62	0.61	0.65	0.62	0.73	0.50	0.48
	500	0.63	0.66	0.63	0.61	0.63	0.61	0.73	0.50	0.43
G. Mean		0.65	0.67	0.62	0.61	0.64	0.62	0.73	0.50	0.46

b: Experiment 2

N rates g/tree/ year (A)	K rates g/tree/ year (B)	Type of irrigation system (c)					
		Micro sprinkler (S1)	Micro jet in circle shape (S2)	T. dripper in circle shape (S3)	Adjustable sprinkler (S4)	Two lines dripper (S5)	Flood irrigation (S6)
	330	0.60	0.61	0.60	0.65	0.62	0.50
800	**500**	0.58	0.60	0.59	0.62	0.60	0.48
	660	0.54	0.60	0.59	0.61	0.61	0.48
Mean		**0.57**	**0.61**	**0.60**	**0.63**	**0.61**	**0.49**
	330	0.62	0.65	0.63	0.68	0.63	0.52
1000	**500**	0.61	0.64	0.61	0.63	0.62	0.46
	660	0.60	0.63	0.59	0.59	0.61	0.42
Mean		**0.61**	**0.64**	**0.61**	**0.63**	**0.62**	**0.47**
	330	0.63	0.65	0.63	0.68	0.71	0.50
1200	**500**	0.61	0.64	0.62	0.63	0.70	0.46
	660	0.61	0.63	0.62	0.59	0.70	0.45
Mean		**0.62**	**0.64**	**0.63**	**0.63**	**0.70**	**0.47**
				Mean of K			
	330	0.61	0.64	0.62	0.67	0.65	0.51
K	**500**	0.60	0.63	0.61	0.63	0.64	0.46
	660	0.58	0.62	0.60	0.60	0.64	0.45
G. Mean		**0.60**	**0.63**	**0.61**	**0.63**	**0.64**	**0.47**

REFERENCES

AOAC (1990). Association of Offical Agricultural Chemists 13th Ed. Published by the AOAC, P.O. Box 540, Washington 4 DC, USA.

Baughallel, F., M. Mhamdi and H. Hajlaoui (2011). Response of young citrus trees to NPK fertilization under greenhouse and field condition.

Bielorai, H. (1982). The effect of partial wetting of the root zone on yield and water use efficiency in a drip and sprinkler irrigated mature grapefruit grove. Irr. Sci., 3: 89– 100.

El-Otmani, M., A. Ait-Oubahou, F.Z. Taibi, B. Imoufid and M. El-Hila (2004). Problem foliar-applied urea and efficient way to increases fruit set, fruit size and yield of Clementine mandarin. Proc. Int. Soc. Citr., 11 (2): 215-218.

El-Wabeol, F.H. and M.A. Eid (2011). The response of monliearing navel orange trees for mineral and organic nitrogen fertilization treatments and K-humate addition. J. Ame. Sci., 7 (5) : 1023-1032 .

El-Wazzan, R.A., A.A. Khalil and H.A. Kouka (2001). Responses of mature Valencia orange trees to three methods of pressurized irrigation under South El-Tahreer conditions. Bull. Fac. Agric. Cairo Univ., 52(1):151-165.

Ibrahim, S.M. (2006). Management of balanced fertilization for some crops in sandy and calcareous soils and its role in relieving drought and salinity conditions. Ph.D. Theses, Benha Univ., Egypt.

Jackson, M.L. (1967). Soil Chemical Analysis, Prentice Hall, Ic., Englewood Califf, New Jersey.

Kannan, T., S.N. Singh and H.S. Rattanpal (2002). Effect of foliar and soil application of urea on dry matter production, chlorophyll content and NPK status of citrus nursery plants. Indian J. Citri., (1): 38-42.

Khalil, A.A., M.W.A. Hassan and R.A. El-Wazzan (2000). Responses of mature Navel orange trees to three methods of flood irrigation under North El-Tahreer conditions. Bull. Fac. Agric., Cairo Univ., 51 (3): 349-364.

Khan, A.S., A.U. Malik, M.A. Pervez, B.A. Saleem, I.A. Rajwana, T. Shaheen and R. Anwar (2009). Foliar application of low-biuret urea and fruit canopy position in the tree influence the leaf nitrogen status and physic- chemical characteristics of Kinnow mandarin (*Citrus reticulata* Blnco). Pakistan J. Bot., 41(1): 73-85.

Kitson, R.E. and M.G. Mellon (1964). Colorimetric determination of phosphorus as molybdivanado phosphoric acid. 1nd-Eng. Chem., Anal., Ed., 16: 379-383.

Koo, R.C.J. and A.G. Smajstrla (1985). Trickle irrigation of citrus on sandy soils in a humid region. Drip trickle irrigation in action, 1: 212-219.

Monga, P.K., V.K. Vij Harish. Kumar and J.N Sharma (2004). Effect of N,P and K on the yield and fruit quality of Kinnow mandarin. Indian J. Hort., 6159 (4): 302-304.

Mostert, P.G., J.L. van Zyl, M.P. de Proft and M.N.J. Verhoyn (2000). Gains in citrus fruit quality through regulated irrigation. Acta Hort., 516: 123-130.

Nakhlla, F.G., L.F. Guindy and M.H. Saad-Allah (1998). Response of Navel orange trees growing in sandy soil to various irrigation and nitrogen fertilization regimes. Bulletin of Fac. Agric., Cairo Univ., 49 (1): 99-128.

Parsons, L. (1993). Management of micro-irrigation systems for citrus. Far Eastern Agric. May-June: 20-21 (Comp. Search).

Piper, C.S. (1950). Soil and Plant Analyses. I. Tetscince Puplishers Inc. New York.

Prerak, B. (2011). Plant tissue analysis of 'Nagpur' mandarin (*Citrus reticulate* Blanco) orchards in Jhalawar district of Rajasthan. Acta Hort., 919 :99-105.

Quinones, A., B. Martinez-Alcantara, U. Chi-Bacab and F. Legaz (2009). Improvement of N fertilization by using the nitrification inhibitor DMpp in drip- irrigated citrus trees. Spanish J. Agric. Res., 7 (1): 190-199.

Roth, R.L., C.A. Sanchez and B.R. Gardner (1995). Growth and yield of mature "Valencia" oranges converted to pressurized irrigation systems. Ame. Soc. Agric. Eng., 11 (1): 101-105.

Sabbah, S.M., M.A. Bacha and M.A. El-Hammady (1997). Effect of source and rate of nitrogen fertilization on yield, fruit ouality and leaf mineral composition of Valencia orange trees grown in Riyadh, Saudi Arabia. J. King Saud Univ. Agric. Sci., 9: 141-152.

Shirgure, P.S., A.K. Srivastava and S. Shyam (2003). Evaluating micro-irrigation systems in Nagpur mandarin (*Citrus reticulata* Blanco) under the sub-humid tropical climate of Central India. Tropical Agric., 80 (2): 91-96.

Smajstrla, A.G. and R.C.J. Koo (1984). Effects of trickle irrigation methods and amounts of water applied on citrus yields. Proc. Florida State Hort. Soc., 97: 3-7.

Wassel, A.H., F.F. Ahmed, M.A. Ragab and M.M. Ragab (2007). Effect of nitrogen fertigation and drip irrigation on fruit setting, number and quality of fruits of Balady mandarin trees. Afr. Crop Sci. Soc. Conf., El-Minia, Egypt, 27 (31): 503-511.

Wolf, B. (1999). Placement of organic matter as mulch. In: B.Wolf (ed.), The fertile triangle: the interrelationship of air, water and nutrients in maximizing soil productivity, PP.134, 47, Food products press, an Imprint of the Haworth press, Inc., publishers.

تأثير التسميد النيتروجينى والبوتاسى على الحالة الغذائية وجودة الثمار لأشجار الموالح فى حالة تغيير نظام الرى من الغمر إلى نظم رى تحت ضغط

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أقيمت تجربتان حقليتان على اشجار البرتقال المزروعة في الأراضي الرملية والتى تم تحويل نظام الرى فيها من الرى بالغمر إلى نظم الرى تحت ضغط بمنطقة الصالحيه خلال موسميين متتاليين (٢٠١٥,٢٠١٦) لدراسة تأثير التسميد النيتروجينى والبوتاسى على مستوى بعض العناصر فى أوراق الموالح وبعض الصفات الكميائيه للثمار وذلك فى حالة تغيير نظام الرى التقليدى (الغمر) الذى يستهلك كميات كبيره من الماء إلى نظم رى تحت ضغط لزياده كفاءة استخدام الماء والأسمده، تم إضافة معدلين من التسميد النيتروجينى (٨٠٠ و ١٠٠٠ جرام نيتروجين للشجرة/العام) ومعدلين من التسميد البوتاسى (٣٣٠و٥٠٠ جرام بوتاسيوم للشجرة/العام) فى التجربة الأولى، وثلاث معدلات من التسميد النيتروجينى (٨٠٠، ١٠٠٠ ، ١٢٠٠ جرام نيتروجين للشجرة/ العام) بالإضافة إلى ثلاث معدلات من التسميد البوتاسى (٣٣٠و٥٠٠و٦٦٠ جرام بوتاسيوم للشجرة/العام) فى التجربه الثانية، تم إضافة المعدلات السماديه خلال مياه الرى بنظام الرسمده للاشجار المحوله الى انظمة الرى تحت ضغط وهى الرشاش الدوار – رشاش تحكم – رشاش ميكروجت فى شكل مربع حول الشجره – نقاط T فى شكل مربع- ميكروجت فى شكل دائره- نقاط T فى شكل دائره- خرطوم مفتوح – نظام التنقيط العادى بالاضافه الى مجموعه من الاشجار غير المحولة التى تروى بالغمر للمقارنه وذلك فى الموسم الأول، و٦ انظمه فى الموسم الثانى وهى الرشاش الدوار- ميكروجت فى شكل دائره– نقاط T فى شكل دائره – رشاش تحكم – التنقيط العادى – الأشجار غير المحوله للمقارنة، تم اضافة الاسمده من خلال نظام الرى على ٨٠ جرعه خلال العام وكانت النتائج المتحصل عليها كالتالى، استخدام معدل التسميد النيتروجين ٨٠٠ جرام نيتروجين مع ٣٣٠ جرام بوتاسيوم للشجرة/العام أعطى أعلى تركيز للنتروجين في الأوراق فى الاشجار المحوله من الرى بالغمر الى نظام التنقيط فى التجربه الاولى، أعلى قيمه لنسبة البوتاسيوم فى الأوراق تم التحصل عليها من اضافه ١٠٠٠جرام نيتروجين للشجره و٥٠٠جرام بوتاسيوم للشجره فى الأشجار الغير محوله التى تروى بالغمر، اعلى تركيز للمواد الصلبه الذائبه كان من المعاملة ٨٠٠ جرام نيتروجين و٥٠٠جرام بوتاسيوم للشجره فى الاشجار المحوله من رى غمر الى ميكروجيت شكل دائره حول الشجرة، اعلى تركيز لنسبة الحموضه فى عصير الثمار كان عند المعاملة ١٠٠٠جرام نيتروجين للشجره و ٥٠٠جرام بوتاسيوم للشجرة، بينما فى التجربه الثانيه كانت النتائج كالتالى: أعلى قيمه لتركيز النيتروجين فى الأوراق ظهر بإستخدام المعاملة ١٢٠٠ جرام نيتروجين للشجرة/العام و اضافة ٦٦٠ جرام بوتاسيوم للشجره فى الاشجار المحوله من غمر الى رى بالتنقيط، اعلى تركيز للبوتاسيوم فى الأوراق كان عند المعاملة ١٢٠٠ جرام نيتروجين و ٣٣٠ جرام بوتاسيوم للشجرة/العام فى الشجار المحوله من غمر الى رشاش التحكم، أظهرت النتائج أن تطبيق معدل التسميد النيتروجينى (١٠٠٠ جرام نيتروجين للشجرة) و٥٠٠ جرام بوتاسيوم للشجره اعطى أعلى تركيز للمواد الصلبة الذائبه فى عصير الثمار فى المحولة من رى غمر الى رى بالتنقيط، أعلى تركيز لنسبة الحموضه تم التحصل عليها من المعاملة ١٢٠٠ جرام نيتروجين و ٣٣٠ جرام بوتاسيوم للشجرة/العام فى الأشجار المحوله من غمر إلى رى بالتنقيط، من خلال نتائج هذه الدراسة لكى يتم تحويل نظام رى الموالح من غمر الى نظم رى حديثه نوصى بالآتى: استخدام معدل التسميد النيتروجينى ١٠٠٠جرام نيتروجين للشجرة/ العام والتسميد البوتاسى ٥٠٠جرام بوتاسيوم للشجرة و٢٥م^{3} ماء للشجرة/ العام خلال نظام الرى بالرشاش الدقيق الذى يغطى حوالى ٨٠% من مساحة انتشار الجذور ويتم التسميد على ٨٠ جرعه خلال السنه لتقليل الفاقد ورفع كفاءة استخدام السماد.

المحكمون :