Effect of Soil conditioners and Irrigation Levels on Growth and Productivity of Pomegranate Trees in the New Reclaimed Region

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ABSTRACT

This investigation was carried out during 2010 and 2011 growing seasons on ten years old Arabi pomegranate trees, grown in sandy soil under drip irrigation in a private farm located at Alexandria-Matrouh road (about 80Km from Alex.). The experiment was designed to study the effects of different rates from soil conditioners, Hundz soil, (0.0,0.5 and 10Kg /tree) or mixture from (Nile fertile + K_2SO_4) [Zero, (2Kg + 500gm) and (1Kg + 250gm)] under irrigation levels at 50, 75 and 100% of the recommended water level (5.5, 8.25 and 11m^3 /tree /year) as well as their interactions on growth, leaf component, flowering, fruiting, yield and fruit quality during both seasons. The results indicated that the highest irrigation level of 11m^3 /tree /year enhanced vegetative growth, fruit set, yield as well as leaf NPK content and fruit quality (fruit weight, diameter, length, TSS, anthocyanine and V.C.) while fruit acidity and tannins content decreased. Moreover, application of either Hundz soil at rate of 10kg /tree or the mixture of (NF + K_2SO_4) at highest rate (2Kg + 500gm) gave significantly the highest mean values of the above mentioned characters during the two seasons. Comparing with trees irrigated with11m^3/tree/year level, adding Hundz soil at 10Kg /tree under irrigation treatment 8.25m^3/tree /year gave similar effect on improving all growth characters, fruit set, yield and fruit quality except fruit diameter and V.C. Similar results were found with high rate of the mixture (2Kg NF+500gm K_2SO_4) with the same level of irrigation on all characters except acidity. Date also indicated that the application of Hz soil combined with mixture of (NF+K_2SO_4) at both highest levels for each of them and irrigated with moderate irrigation level 8.25m^3 /tree /year gave best growth and produced higher fruit quality as compared with trees irrigated with 100% from recommended water level. Similar effects of combinations between high rate of both Hundz soil and the mixture of Nilefertile + K_2SO_4 under least irrigation treatments 5.5 m^3 /tree/year on the previous characters of fruit. Data indicated generally that the best treatment combination was gained from using highest irrigation level (11m^3 /tree /year) and 10Kg /tree Hundz soil + 2Kg /tree Nile Fertile + 500gm K_2SO_4which resulted in the highest values for all vegetative growth characters, leaf N P K, chlorophyll and RWC, yield and all fruit quality except leaf proline, juice tannins and acidity in both seasons. It could be recommended to apply 2Kg /tree Hundz soil combined with 2Kg NF + 500 gm K_2SO_4 with irrigation level of 11m^3 /tree /year to obtain highest production with good quality of pomegranate fruits as well as to apply 2Kg /tree Hundz soil with 2Kg NF + 500 K_2SO_4 under irrigation 8.25m^3 /tree /year or 5.5m^3 /tree /year for saving about 25% – 50% of water to achieve the same yield and fruit quality according to the availability of water, especially in the new reclaimed area.

INTRODUCTION

Water is one of the most important components in the biological function (Salisbury and Ross, 1985). Increasing water use efficiency, fruit management, production and saving irrigation water are important tasks (Devid *et al.,* 1999). Of all the materials used by fruit trees, water seems to be taken up in the largest amounts (Chopade, 2001). Cultivation on arid sandy soil requires large quantities of water. The low water holding capacity of this soil causes rapid infiltration and deep percolation below the root zone (Beaumont, 1993). For production a high crops especially on the sandy soils, the physical-chemical properties of these soils must be modified. The addition of conditioners to such soils enhanced their properties, leading to decrease water infiltration rate, increasing the efficiency of the used water and fertilizers (Laila- Ali *et al.,* 2009).

Recently, the global demand for clean agriculture free from chemical, like fertilizers, pesticides, synthetic soil conditioners, etc., is of much concern at moment to protect the ecosystem from their adverse effects hence, natural soil conditioners are the most effective agents in stabilizing soil organic matter (El-Aggory and Abd El-Rasoul, 2002).Also, Khalifa *et al.,* (1997) suggested that natural soil conditioners increased soil hydraulic conductivity and water diffusivity of sandy soil whereas Laila-Ali *et al.,* (2009) found that applying the combinations of organic source and soil natural conditioners increase yield of wheat plant.

Thus, Hundz soil is a natural soil conditioner that is made out of dry compressed cellulose and recycles agricultural material, shaped in grains and varies in size (0.2-2.0mm)that is capable of penetrating through the sand grains, forming a new media ideal for growing plants, has a balanced pH of 6.8-7.2, water holding capacity of 300% naturally, which will change sandy soil water capacity and does not absorb heat, so water evaporation is dramatically minimized. Hundzsoil retains water longer than regular soil, so plants develop healthy root system. Hundz soil is certified from Soil, Water and Environment Res., Institute, ARC, Giza Egypt.

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The second soil conditioner is Nilefertile which contains many components as sulfur fertilizer mixture (SFM) in a fine powder form, produced by Giza Technology Co. (Egypt) to be a good substitute for Nile mud (Abd-Allah, 1997). It's containing elemental sulfur (32%)as an acidulous material which is oxidized slowly to sulfuric acid, after its application to soil, thio bacillus ,thio oxidants, autotrophic bacteria and different S-Oxidizing bacteria, which effective especially under alkaline conditions,Bentonite clay or mudstone (18%) as a water absorbent material, a mixture of ground rocks and minerals (45%) that are rich in fertilizer elements:P,K,Mg,Fe ,Ca and Mn and five percent of urea as a source of nitrogen.

As water supply is limited, loss of turgor and wilting are typical symptoms of potassium deficiency and this may be related to the role of K in stomatal regulation which is the major mechanism controlling the water regime of higher plants. In addition, potassium maintains higher tissue water content even under shortage of water (Lindhauer, 1985). Potassium is essential for the synthesis of amino acids, thus plants don't grow well in the absence of potassium (Edmond et al., 1975).A large number of enzymes is either completely dependent on or stimulated by K (Suelter, 1970).

So, the aim of the present study was designed to improve the main characteristics of sandy soil and to increase water use efficiency of pomegranate trees subjected to different irrigation frequencies and different levels of soil conditioners Handz soil, Nilefertile and K_2SO_4on vegetative growth and fruit quality parameters. Also, to determine whether Handz soil can reduce irrigation frequencies without negative effect on yield and fruit quality.

MATERIALS AND METHODS

The present study was carried out during 2010 and 2011 successive seasons on ten years old Arabi pomegranate trees (*granatumPunica L.*), grown in sandy soil of a private farm located at Alex.-Matrouh road (about 80Km from Alex.).Trees under investigation were uniform in shape and size as possible, spaced at 5x5 meters apart and irrigated with drip irrigation. The physical and chemical properties of the experimental soil are presented in Table (1). The trees were annually fertilized with 15m3 / feddan of organic manure (sheep manure) in December of each year with 1.0 Kg/ tree calcium superphosphate(15.5% P_2O_2).Also, 2.0 Kg/ tree ammonium sulphate (20.6% N) and 1.0 Kg/tree of potassium sulphate (48% K_2O)were added in three equal doses at February, April and June. The following treatments were applied:

1-Irrigations frequencies were divided into three levels; 50%, 75% and 100% of the recommended rate of irrigations according to the recommendations of the Ministry of Agriculture as follows:

I_1: 50% of the recommended rate of irrigation (5.5m^3 /tree /year)= 924m^3 /feddan /year.

I_2: 75% of the recommended rate of irrigation (8.25m^3 /tree /year) = 1389m^3 /feddan /year.

I_3: 100% of the recommended rate of irrigation (11.0m^3 /tree /year) = 1848m^3 /feddan/ year.

Irrigation treatments varied with the change of the developmental stage of the plant.

2-Hundz soil (HN) conditioner was used at three levels:

HN_0: No addition (control treatment)

HN_1: 5 Kg / tree Hundz soil

HN_2:10 Kg / tree Hundz soil

Hundz soil was applied to the soil under drip irrigation lines in January of each year. The chemical analysis of Hundz soil is shown in Table(2)

3- A mixture of Nilefertile + K_2SO_4 was applied together to the wet surface under drip irrigation line at three equal doses at March, May and July of both seasons at three rates:

MX_0: without any addition (control treatment)

MX_1: 1 Kg of Nilefertile + 250gm K_2SO_4 /tree

MX_2: 2 Kg of Nilefertile + 500gm K_2SO_4 /tree

The experimental design was a split-split-plots system in a randomized complete block design (RCBD) with three replications. The experiment consisted of twenty seven treatments; which representing the combinations among the three factors; the first one was the three irrigation levels which arranged as the main plots (I_1, I_2 and I_3). The second one was Hundz soil levels (HN_0, HN_1 and HN_2)were considered as the sub-plot, while the third factor was three levels of the mixture of Nile fertile + K_2SO_4(MX_0, MX_1 and MX_2) were placed as sub - sub plots.

The following parameters were used to evaluate the tested treatments:

1- vegetative growth

In each season of study (on early April) four uniform branches were selected on each tree and tagged at their cardinal points. The average number of new shoots in each of the branches was counted. The length (cm) and diameter (cm) were measured as well as number of leaves/ shoot were counted. Ten leaves were collected randomly from the first mature leaves from the tip of the previously tagged shoots and their areas (cm^2) were measured.

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

Soil depth (cm)	pH	EC ds/m^{-1}	$caco_3$ %	O.M %	Soluble Cations meq/L				Soluble Anionss meq/L			Partical distribution %			Soil	Field Capacity %	wilting point %	Avaliable water %	Bulk Density (gm/cm^3)
					K^+	Na^+	Mg^{2+}	ca^{2+}	CL_2^-	SO_4^-	HCO_3^-	sand	silt	clay	Texture				
0 - 30	8.1	0.75	3.5	0.53	0.1	2.9	0.6	1.3	3	1	0.9	93.4	2.2	4.4	sandy	9.2	1.9	7.3	1.49
30 - 60	8.2	0.65	2.8	0.49	0.1	1.3	0.4	0.7	1.2	0.7	0.6	93	2.2	4.8	sandy	8.8	1.6	7.2	1.51
60 - 90	8.2	0.61	2.7	0.35	0.1	1.5	0.3	0.9	1.4	0.7	0.7	92	2.6	5.4	sandy	7.9	1.3	6.6	1.56

Table 2. Some physical and chemical properties of Hundz soil (Conditioner)

Hunds Soil	Density (Kg/m3)	pH	EC^{-1}	SP	Total N %	Total P %	Total K %	Organic matter %	Carbon %	Ash %	C/N ratio
	255	7.2	1.4	278	1.28	0.077	0.11	87.16	45.33	21.84	01:35.4

2-Leaf chemical composition

2.1. Leaf chlorophyll and minerals content

A sample of twenty mature leaves was randomly collected from the middle part of non-fruiting shoots of each replicate tree in May of both seasons to determined total leaf chlorophyll according to the method described by Yadava (1986) using Minolta Chlorophyll Meter Spad.502 (Minolta Camera, LTD Japan). The previous selected fresh leaves were washed with tap water, thereafter with distilled water and dried under a constant temperature 70°C in an electric oven. Each sample of dried leaves was ground to powder using porcelin mortar to avoid contamination. A sample of 0.3gm from the ground leaves was digested using H_2O_2 and H_2SO_4 according to Evenhuis and Dewaard (1980).Aliquots were then taken for mineral determination. Total nitrogen and phosphorus were determined colorimetrically according to Evenhuis (1976)and Murphy and Riley (1962), respectively. Potassium was determined against a standard using flame photometer following Chapman and Pratt, (1961). The concentrations of NPK were expressed as a percentage on dry weight bases.

2.2. Determinationof free leaf proline content

A sample of 0.5gm from the dried mature leaves was homogenized in 10ml sulphosalicylic acid (3.5%) and centrifuged for 5 minutes at 300 rpm and decanted then filtered through What-man no.2 filter paper. The supernatant was diluted and injected in Beckman Amino Acid Analyzer 1/9CL. The proline concentration was determined from standard curve and calculated on dry weight basis according to Singh *et al.,* (1973).

2.3. The leaf relative water content(RWC): was calculated as the method described by Smart and Bingham (1974). Ten mature leaves were taken from each replicate, cleaned with tissue paper and their fresh weight was immediately recorded. The turgid weight of these leaves was recorded after floating in water in covered petridish for 24 hours at 4°C. Thereafter, the leaves were weighted and then dried at 70°C to a constant weight and their dry weights were recorded. The leaf relative water content (RWC) was calculated from the following equation:

$$RWC = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Turgid weight} - \text{Dry weight}} \times 100$$

3-Flowering, fruit set percentages and yield

The total number of flowers per shoot on each tagged branch was counted at full bloom. The numbers of set fruits on the same branches were recorded to calculate fruit set percentage according to the following equation

Fruit set % = (No. of developing fruits ⁄ total number of flowers) × 100.Total yield (kg) of each replicate tree was determined at fruit maturity stage at the 2nd week of August.

4-Fruit quality

Samples of six fruits from each replicate at harvest time (mid-August) were taken to determine fruit weight (gm), length (cm), diameter (cm) and volume (cm^3). In juice of each fruit sample, total soluble solids (TSS) percentage was determined by a hand refractometer and percentage of acidity was measured according to A.O.A.C. (1995).Vitamin C was determined by the titration with dichlorophenol indophenol blue dye and expressed as mg vitamin C/ 100ml juice. Also, total anthocyanin percentage in fruit juice was determined as described by Hsia *et al.,* (1965). Tannins content was measured in the juice by the method described by Winton and Winton, (1945).

Data were statistically analyzed using Co-Stat CoHort Software computer program for statistics (1986). The differences among the means of experimental treatments were separated by LSD test for interpretation of results as explained by Steel and Torrie (1980).

RERSULTS AND DISCUSSION

1-Main effects of different factors on the studied characters

The results of the main effects of the different studied factors;i.e.,soil conditioner(Hundz soil), irrigation frequency and mixture of Nilefertile +K_2SO_4 on vegetative growth,fruiting,yield,leaves chemical composition and fruit quality of pomegranate trees are shown in Tables 3 to7.

1-Vegetative growth characters

Concerning the main effects of the three studied factors;i.e.three irrigation levels, three Hundz soil rates and three levels of the mixture of Nilefertile +K_2SO_4 on vegetative growth characters (shoot length,diameter,no. of leaves /shoot,no. of shoots/main branch and leaf area) of pomegranate trees, the results generally illustrated that the comparisons among the mean values of the studied characters for each factor appeared to be significant, in both growing seasons(Table3).

The obtained results concerning the main effect of irrigation levels illustrated generally that the highest vegetative growth parameters resulted from the highest irrigation level I_3 (11m^3/tree/year). Meantime, I_2(8.25m^3/tree/year) gave similar effect like I_3 on

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Table 3. Effect of irrigation frequency ,Hundz soil and Mixture of Nile fertile + K2SO4 on vegetative growth parameters of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Shoot length (cm)		Shoot diameter (cm)		No. of leaves / shoot		No. of new shoots / branch		leaf area (cm^2)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation levels m^3/tree/year										
I_1	12.65b	12.77b	1.41b	1.63c	16.38b	18.01b	9.34a	11.10b	49.7b	5.15b
I_2	12.86a	12.99a	1.61a	1.86b	18.07ab	22.17a	9.81a	12.86a	51.8a	5.36a
I_3	12.98a	13.11a	1.71a	2.02a	21.45a	23.85a	10.37a	13.23a	52.7a	5.47a
Hundz soil kg/tree										
HN_0	12.48b	12.61b	1.47b	1.73b	17.71b	20.4b	9.50b	11.59b	47.9b	4.98b
HN_1	12.86ab	12.99ab	1.57ab	1.87a	18.88ab	21.73a	9.82ab	12.71a	5.18ab	5.37ab
HN_2	13.14a	13.28a	1.67a	1.90a	19.96a	22.5a	10.19a	12.89a	5.45a	5.63a
Nile fertile + K_2SO_4 Kg/tree										
MX_0	12.46c	12.59c	1.35c	1.55c	16.18c	18.02c	7.8c	11.07c	4.78c	4.96c
MX_1	12.90b	13.03b	1.59b	1.86b	19.21b	21.45b	10.02b	12.66b	5.21b	5.40b
MX_2	13.12a	13.26a	1.77a	2.10a	21.15a	24.55a	10.71a	13.46a	5.43a	5.62a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ using revised LSD test at 0.05 level vegetative growth parameters except for shoot diameter in the second season.However, there was insignificant difference between different levels of irrigation on number of new shoots⁄ mainbranch in the 1st season only.Generally, increasing irrigation levels enhanced vegetative growth of pomegranateby increasing shoot length, number of leaves per shoot and leaf area. It can be explained that water stress decreased the cytokinin transport from roots to shoots and increased the amount of leaf abscisic acid. These change in hormone balance caused a reduction in cell growth and leaf expansion. These results agree with those obtained by El-Iraqy *et al.,* (2006) on guava and Khattab *et al.,*(2010)on pomegranate, as they stated that vegetative growth parameters were markedly increased by increasing irrigation rates.

With respect to the main effects of Hundz soil (soil conditioner) on vegetative growth parameters, the results in Table(3) showed that gradual increment of Hundz soil application up to10Kg⁄ tree resulted in a significantincreasesof vegetative growth, compared to control, in both seasons. The obtained resultssuggested generally that improvingthe morphological characters of pomegranate trees after application of Hundz soil may be due to increasecation exchange capacity and mineral nutrients, which in turn encouraged the plant growth. In this respect Kay-Shoemake *et al.,*(2000)found that application of soil conditioner (polyacrylamide PAM)increased the availability of nutrients, especially N via enhancing the activity of soil enzymes (urease and amidase), which involved in N cycling. Besides, the influence of PAM on reducing the leached amount of NH4 and NO3 (Bres and Weston, 1993), especially under the higher intervals of irrigation. Thus, the biosynthesis of proteins DNA and RNA would be enhanced leading to more initiation and division of the apical meristem cells; consequently, the plant height could be increased. Similar trend of results was found by Hoda -Khalil(2005) and Eman-Abd - Ella (2006).

As for theeffect of application of both Nilefertile NF + K_2SO_4on the vegetative growth characters, the results in Table (3) showedthat using different levels of Nilefertile + K_2SO_4 significant improving all the vegetative growth characters comparing to the control treatment in both seasons. The maximum values of shoot length, diameter, number of shoots per main branch, number of leaves / shoot and leaf areawere recorded on the trees receivedNilefertile (NF_2) at 2 Kg/tree + K_2SO_4 at 500gm/tree compared with those of either control or (1Kg/tree NF + 250gm K_2SO_4/tree) in the two seasons. The Stimulative effects of K_2SO_4 on growth parameters maybe due to that kis essential for the synthesis of amino acids, thus plants don't grow well in the absence of K (Edmond *et al.,* 1975). Also, it is very important in the plant photosynthesis process and helping plants metabolize their food to get energy. It is involved in many aspects of plant physiology (Marschner, 1995).The positive effect ofNilefertile application on vegetative growth parameters may be due to it contains elemental sulfer (acidulous material) which is oxidized slowly to sulfuric acid after its application to soil. Also, it contains different S-Oxidizing bacteria so it reduced soil pH and increased nutrient availability. Moreover, sulfur is a part of every living cell and required for synthesis of certain amino acids. In this respectit is worthy to note that Abbas (1999),Sherin - Attia (2002) and Wael (2005) found that NF significantly enhanced vegetative growth of olive trees

2-Leaf chemical composition

Data in Table (4) illustrated the main effects of irrigation frequency, Hundz soil and mixture of Nilefertile + K_2SO_4 on leaf chemical composition i.e. leaf N, P, K, total chlorophyll, proline and relative water content in both seasons.

The obtained results concerning the main effects of irrigation frequency revealed that, high irrigation level I_3 (11m^3/tree/year) as well as moderate level of irrigation I_2 induced the highest leaf N, P, K, total chlorophyll and relative water content in both seasons with one exception for P in the first one. The increase of leaf N, P, K content with increasing irrigation rate was previously reported by Hussein (2004) on pear, Chauhan *et al.,*(2005) on apple,and Khattab *et al.,*(2010) on pomegranate as they found that N, P, K contents were increased under the condition of high irrigation treatment. Reduction in leaf element contents with reducing irrigation amount is explained by a substantial decrease in transpiration rates and impaired active transport and membrane permeability, resulting in a reduced root absorbing power of nutrients.

Regarding leaf proline content, irrigation at 5.5 m^3/tree /year produced the highest proline content over other irrigation levelsin both seasons. Accumulation of proline amino acid in plant parts during water stress is important for absorption and might serve as a storage compound for reduced carbon and nitrogen during stress. El-said *et al*., (1993) and Hoda- Khalil (2005) on olive revealed that proline accumulation in olive leaves was affected by different water regimes.

Date in Table (4) showed the main effects of soil conditioner, Handz soil on leaf chemical components. Increasing Handz soil up to 10Kg /tree was associated with detected increments in leaf component except leaf

Table 4. Effect of irrigation frequency ,Hundz soil and Mixture of Nile fertile + K_2SO_4 on some leaf components of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	N %		P %		K %		Chlorophyll (mg/cm^2)		Proline mg/g dry weight		Relative Water Content (RWC)%	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation levels m^3/tree/year												
I_1	1.46 b	1.52 b	0.184 a	0.192 b	1.14 b	1.15 b	4.67 b	4.74 b	13.28 a	12.81 a	76.48 b	76.98 b
I_2	1.70 a	1.75 a	0.189 a	0.198 a	1.29 a	1.31 a	4.88 a	4.96 a	13.09 b	12.60 b	89.24 a	91.16 a
I_3	1.85 a	1.91 a	0.194 a	0.203 a	1.39 a	1.39 a	4.99 a	5.10 a	12.92 b	13.38 b	91.55 a	93.07 a
Hundz soil kg/tree												
HN_0	1.57 b	1.62 b	0.186 b	0.195 b	1.21 b	1.21 b	4.50 b	4.58 b	13.19 a	12.70 a	84.68 b	85.69 b
HN_1	1.70 a	1.76 a	0.189 ab	0.198 ab	1.23 b	1.27 a	4.88 ab	4.97 ab	13.09 ab	12.62 b	85.76 b	87.81 a
HN_2	1.75 a	1.79 a	0.193 a	0.202 a	1.36 a	1.37 a	5.15 a	5.24 a	13.02 b	12.48 b	86.83 a	88.02 a
Nile fertile + K_2SO_4 Kg/tree												
MX_0	1.39 c	1.45 c	0.179 c	0.188 c	1.07 c	1.09 c	4.48 c	4.57 c	13.38 a	12.88 a	83.04 b	83.59 c
MX_1	1.69 b	1.75 b	0.191 b	0.200 b	1.28 b	1.28 b	4.92 b	5.02 b	13.09 b	12.60 b	86.20 a	87.29 b
MX_2	1.93 a	1.99 a	0.198 a	0.207 a	1.45 a	1.47 a	5.14 a	5.20 a	12.83 c	12.32 c	88.03 a	90.32 a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ using revised LSD test at 0.05 level proline which showed an opposite trend.Application of Handz soil at rate of 10Kg /tree gave significantly higher mean values of N, P, K, chlorophyll and (RWC) in both seasons. HN_1 treatment gave similar trend of effect on leaf N inboth seasons as well as K and relative water content in the second one. Data also indicated that the untreated trees gave the maximum values of leaf proline in both seasons. These results may be due to that soil conditioner reduced the leached amounts of N as NH_4^+ and less as NO_3^-, serves as a nitrogen source and improves the conditions of soil which enhanced the decomposition of organic matter (Wallace and Wallace, 1986) with increasing the activity of soil enzymes such as urease and amidase (Kay- Shoemake *et al.,* 2000), thus N availability and translocation would be increased consequently the N% in the leaves could be increased. Similar trend of results was stated by Silberbush *et al.,* (1993) who reported that large amount of water absorbed by (PAM) soil conditions material (80%-85%) stored in vacuoles within its matrix. Diffusion of water into the soil solution would render water available to plant. Undoubtedly, increasing available soil moisture would ultimately increase nutrients absorption and translocation by plant.

Data in table (4)clearly indicated that increasing the rates of the mixture up to 2Kg /tree Nilefertile + 500gm /tree K_2SO_4 led to progressive significant increases in the value of leaf N, P, K and total chlorophyll in both seasons and relative water content in the second season, compared with the control. Similar trend was obtained on relative water content as a result of application of 1Kg /tree Nilefertile + 250gm /tree K_2SO_4 in the first season. In the meantime, leaf proline showed an opposite trend where control treatment gave the highest percentage than other treatments in both seasons. Gething (1986)reported that K supply to the plants affect nitrogen efficiency, but there is an evidence of a more direct connection between the two elements, that K ion acts as a carrier for nitrate from the root to the leaf, where proteins are synthesized. Also, K ion, being very mobile, promotes the uptake of the nitrate by the root. These results are similar to those of Mohammed and Mohammed (2010) on apples. Moreover,Abbas, (1999) reported that application of Nilefertile to soil increased olive leafN,P, K and chlorophyll and decreased proline content. Also, Wael (2005) found that olive leaf content of N, P and K were increased by increasing levels of NF.

3-Flowering, Fruiting and Yield

The results of main effects of irrigation frequency, Hundz soil and mixture of Nilefertile + K_2SO_4 on number of flower/ shoot, fruit set percentage and yield are presented in Table (5). The obtained results indicated that the highest mean value of number of flowers /shoot, fruit set percentage and yield were associated with highest rate of irrigation level at $11m^3$/tree/year compared to I_1 (5.5 m^3/tree /year), in both seasons. In the meantime, I_2 (8.25 m^3 /tree /day) hada similar effect as I_3 on this respect. No significant differences were found between I_3 and I_2 on fruit set percentage and yield in both seasons. Such results are in harmony with Hussein (2004) on pear and Khattab *et al.,*(2010) on pomegranate who found that, increasing the amount of applied water increased flower number per shoot, fruit setting and yield.

Concerning the main effects of Hundz soil onpreviously mentioned parameters, the results in Table (5) illustrated generally that application of Hundz soilat 10Kg/treereflectedsignificant increasing effects on the mean values of the previous characters than other treatments in both seasons. Hundz soil has ahigh cation exchange capacity and hence it willaffect soil nutritional capacity and the supply of nutrients to plants. Also, it has a high water absorbing capacity thus will affect positively the yield (Wafaa El-Etr, 2001) .These results are in correspondence with those obtained by Saddik and Laila –Ali et al., (2009) who found that the yield of peanut and carrot increased significantly by natural amendments application compared to non-treated one.

Regarding the application of Nilefertile + K_2SO_4 levels on no. of flowers /shoot, fruit set percentage and yield (Kg /tree)the data in Table(5) indicated that the mean values of each studied character were high enough to be significant in both seasons. The results revealed that increasing mixture of Nilefertile and K_2SO_4 up to 2kg /tree and 500gm /tree respectively (MX_3) gave maximum values ofthe studied characters. The superiority of the highest level of the mixture might be referred to application of K_2SO_4 which activates more enzyme systems, aids in photosynthesis, promote water uptake, regulates nutrients translocation in plant, favors carbohydrate transport and increases yield (Marschner, 1995). Similar results were obtained by El-Iraqy *et al.,* (2006), on guava and Mohammed and Mohammed (2010) on Apple.

The favorable influences of Nilefertile application on fruit set and yield could be related to the vital role of a mixture of ground rocks and minerals (45%) in increasing the availability of nutrient supply, improving the efficiency of macro-elements as well as its ability to meet some micro-elements requirements of crop, which in turn, should be reflected on production of high yield. Furthermore, NF contains elemental sulfer (32%) which is oxidized slowly to sulfuric acid, after its application to soil, below the drip lines, that prevented salt

Table 5. Effect of irrigation frequency ,Hundz soil and Mixture of Nile fertile + K_2SO_4 on flowering, fruiting and yield of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Flowers number /shoot		Fruit Set %		Yield Kg/tree	
	2010	2011	2010	2011	2010	2011
Irrigation levels m^3/tree/year						
I_1	3.68 b	3.96 b	51.42 b	54.29 b	27.70 b	29.80 b
I_2	3.89 a	4.18 a	56.01 a	58.40 ab	29.76 a	31.84 a
I_3	3.99 a	4.29 a	58.85 a	61.19 a	30.79 a	32.74 a
Hundz soil kg/tree						
HN_0	3.51 c	3.80 c	49.49 c	52.11 c	25.97 b	28.07 c
HN_1	3.89 b	4.18 b	56.22 b	58.94 b	29.76 ab	31.83 b
HN_2	4.17 a	4.46 a	60.57 a	62.83 a	32.52 a	34.47 a
Nile fertile + K_2SO_4 Kg/tree						
MX_0	3.49 c	3.79 c	49.23 c	51.87 c	25.78 c	27.84 c
MX_1	3.93 b	4.23 b	56.98 b	59.61 b	30.13 b	32.30 b
MX_2	4.14 a	4.43 a	60.07 a	62.39 a	32.33 a	34.22 a

Values followed by similar letter(s), within a comparable group of means , do not significantly differ, using revised LSD test at 0.05 level accumulation around the roots and sustained the yield.The results are in line with those of Wael (2005) who found that increasing level of NF significantly enhanced olive fruit set and yield.

4-Fruit Physical Properties

Effect of irrigation levels on fruit weight, dimensions and fruit size are illustrated in Table (6). Fruit physical properties gradually increased with increasing irrigation levels in both seasons.Data also indicated that moderate irrigation level (I_2) enhanced fruit physical properties like high irrigation level I_3 however the differences between two irrigation were not big enough to be signification. These resultsare in line with those obtained by Kandil and El-Feky (2006) on apricot and Khattab *et al.,* (2010) on pomegranate as they concluded that fruit physical properties were improved when subjected to the highest irrigation rate.

Data in Table (6) showed that the highest fruit weight, length and diameter were obtained by application of 10Kg /tree Hundz soil. Significant differences were found between (HN_2) the highest level and the control (HN_0) on fruit physical characteristics in both seasons. Fitzpatrick, (1986) found that Humus (soil conditioners) is capable to absorb large quantities of water; thus increasing the water holding capacity of the soil and therefore crop production.

As for the main effect of application of mixture of Nilefertile + K_2SO_4 the data in table (6) indicated that the highest fruit weight length and diameter were obtained by the addition of 2Kg NF + 500gm K_2SO_4 (MX_3). On the other hand, the least significant values of the fruit physical properties were obtained by the lowest level of the fertilizer mixture (MX_0). No significant differences were found between high level of (NF + K_2SO_4) and the moderate level of (Mx_2) on fruit length in 2^{nd} season and diameter in the 1^{st}one. These results are coincided with El-Iraqy *etal*.,(2006) on guava and Mohammed and Mohammed (2010) on apples as they found that fruit weight and dimensions increased by increasing K levels.

5-Fruit Chemical Composition:

The main effects of different irrigation frequency levels on fruit chemical composition, (total soluble solids, anthocyanin, V.C., acidity and tannins are shown in Table (7).

Data clarified the presence of significant increment in fruit juice total soluble solids, anthocyanin and V.C. as a result of increasing irrigation frequency levels. High irrigation level I_3 (11m^3 /tree /year) recorded the highest values of fruit juice anthocyanin in seasons as well as TSS and V.C in the second one. Irrigation level of 8.25m^3 /tree /year behaved the same analogous effect on the previous fruit characteristics. However, in the first season, no significant differences were found between irrigation levels on TSS and V.C. High irrigation level (11m3 /tree /year) decreased significantly acidity and tannins content of pomegranate fruit compared to the rest of treatments during both seasons. The results are in line with those obtained by Lawand and Patil (1996) and Khattab *et al.,* (2010) on pomegranates; they stated that the highest fruit acidity was observed with the lowest irrigation level. Also, El-Khoreiby and Salem (1989) and El-Iraqy *et al.,* (2006) indicated that increasing soil moisture content increased V.C. content as well as decreased tannins content of guava . On the contrary, Khattab *et al.,*(2010) found that anthocyanin content decreased by increasing irrigation levels in pomegranate juice.

Concerning the main effects of application of Hundz soil on fruit chemical composition, the results reflected that Hundz soil at highest rate (10Kg /tree) increased fruit juice TSS and anthocyanin in both seasons. However this trend of increment did not reach the significance level for V.C in the 2^{nd}season. Fruit acidity and tannins were significantly decreased as application ofHundz soil increased. Addition high rate of Hundz soil (10Kg /tree) significantly gave the lowest percent than either of treatment HN_0 or HN_1in both seasons.

The results of the main effects of Nilefertile + K_2SO_4 levels on fruit chemical composition i.e. TSS, anthocyanin and V.C illustrated generally that the comparisons among the mean values of each studied character were high enough to be significant, in both seasons except TSS in the 1^{st}season which reflected no significant differences between $MX_2$and MX_1.The results showed also that the application of 2Kg /tree Nilefertile + 500gm /tree K_2SO_4 was most favorable treatment that gave significant highest mean values of the previous characteristicsin both seasons. However, fruit acidity and tannins content were significantly decreased by application of high rate of Nilefertile and K_2SO_4 in both seasons. The results are in harmony with El-Iraqy*et al.,*(2006) on guava and Mohamed and Mohamed (2010) on apple. They found that K fertilization positively affected fruit chemical composition.

2-First-order interactions effects

2.1. Vegetative growth

Results in Table (8) illustrated the effects of the first-order interactions (Irrigation levels ×Hundz soil, Irrigation levels × mixture from (Nilefertile + K_2SO_4)

Table 6. Effect of irrigation frequency ,Hundz soil and Mixture of Nile fertile + K_2SO_4 on some fruit physical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Fruit Weight (gm)		Fruit length (cm)		Fruit Diameter (cm)		Fruit Volume (cm^3)	
	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation levels m^3/tree/year								
I_1	264.82 b	269.68 b	7.66 b	8.01 b	8.56 b	8.86 b	293.30b	312.03b
I_2	286.92 ab	300.90 a	8.08 a	8.46 ab	8.80 a	9.07 a	313.83ab	332.89ab
I_3	315.51 a	320.14 a	8.38 a	8.82 a	8.91 a	9.23 a	324.45a	343.64a
Hundz soil kg/tree								
HN_0	278.06 b	279.27 b	7.73 b	8.21 b	8.69 b	8.92 b	276.35b	295.25b
HN_1	288.66 b	297.68 a	8.03 ab	8.49 a	8.75 ab	9.08 a	313.94ab	332.85ab
HN_2	300.54 a	313.78 a	8.37 a	8.59 a	8.82 a	9.16 a	341.45a	360.46a
Nile fertile + K_2SO_4 Kg/tree								
MX_0	260.54 c	268.12 c	7.41 c	7.61 b	8.50 b	8.76 c	274.12c	293.90c
MX_1	294.26 b	295.49 b	7.92 b	8.65 a	8.81 a	9.06 b	282.98b	338.44b
MX_2	312.46 a	327.11 a	8.80 a	9.02 a	8.96 a	9.34 a	338.93a	356.20a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ , using revised LSD test at 0.05 level

Table 7. Effect of irrigation frequency, Hundz soil and Mixture of Nile fertile + K_2SO_4 on some fruit chemical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	TSS %		Anthocyanine %		V.C mg vc/100ml juice		Acidity %		Tannins %	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation levels m^3/tree/year										
I_1	15.29 a	16.24 b	0.380 b	0388 b	23.63 a	23.97 b	0.88 a	0.96 a	2.28 a	2.14 a
I_2	15.94 a	17.95 a	0.401 a	0.409 a	23.78 a	24.35 ab	0.81 a	0.86 ab	2.12 a	1.98 a
I_3	16.48 a	18.16 a	0.411 a	0.419 a	24.17 a	24.84 a	0.77 b	0.78 b	1.88 b	1.75 b
Hundz soil kg/tree										
HN_0	15.49 b	16.71 b	0.363 b	0.371 b	23.37 b	24.24 a	0.86 a	0.92 a	2.18 a	2.04 a
HN_1	15.89 ab	17.74 ab	0.401 ab	0.408 ab	23.92 a	24.44 a	0.82 b	0.85 b	2.13 a	1.99 a
HN_2	16.32 a	17.90 a	0.428 a	0.436 a	24.29 a	24.48 a	0.77 b	0.83 b	1.97 b	1.84 b
Nile fertile + K_2SO_4 Kg/tree										
MX_0	14.77 b	16.02 c	0.361 c	0.369 c	23.49 b	23.64 c	0.88 a	0.91 a	2.35 a	2.21 a
MX_1	16.11 a	17.81 b	0.404 b	0.413 b	23.89 ab	24.51 b	0.78 b	0.85 b	2.12 b	1.98 a
MX_2	16.82 a	18.52 a	0.426 a	0.434 a	24.19 a	25.01 a	0.78 b	0.83 b	1.82 c	1.68 b

Values followed by similar letter(s), within a comparable group of means, do not significantly differ, using revised LSD test at 0.05 level

Table 8. First- order interaction effects of the three studied factors; Hundz soil, irrigation frequency and mixture of Nile fertile + K_2SO_4 on some vegetative growth characters of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Shoot Length (cm)		Shoot diameter (cm)		No.of leaves /shoot		No.of new shoots / branch		Leaf area (cm^2)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation X Hundz										
I_1 X HN_0	12.40 e	12.53 e	1.33 de	1.57 d	15.51 g	17.16 e	9.07 e	9.38 e	4.72 e	4.90e
I_1 X HN_1	12.59 c	12.72 d	1.40 d	1.63 c	16.55 f	18.28 d	9.41 d	11.94 d	4.91 d	5.10d
I_1 X HN_2	12.97 bc	13.07 c	1.50 c	1.69 c	17.09 e	18.59 cd	9.54 d	11.99 d	5.29 bc	5.44c
I_2 X HN_0	12.48 de	12.61 de	1.49 c	1.64 c	17.98 d	20.32 c	9.47 d	12.63 c	4.80 de	4.96de
I_2 X HN_1	12.96 bc	13.09 c	1.63 b	1.98 b	18.43 c	22.62 b	9.73 c	12.93 bc	6.28 c	5.47bc
I_2 X HN_2	13.13 ab	13.27 ab	1.67 ab	1.96 b	19.71 b	23.56 ab	10.24 b	13.03 b	5.45 ab	5.65ab
I_3 X HN_0	12.57 c	12.69 d	1.62 b	1.99 b	19.64 b	22.63 b	9.98 bc	12.75 c	4.84 d	5.07d
I_3 X HN_1	13.04 ab	13.16 ab	1.67 ab	2.02 ab	21.65 ab	24.36 ab	10.32 b	13.26 b	5.34 b	5.54b
I_3 X HN_2	13.32 a	13.49 a	1.85 a	2.06 a	23.07 a	24.61 a	10.80 a	13.68 a	5.63 a	5.80a
Irrigation X Mixture										
I_1 X MX_0	12.29 e	12.41 e	1.14 e	1.45 e	13.60 e	15.38 e	8.55 e	9.64 f	4.61 f	4.77f
I_1 X MX_1	12.72 c	12.86 c	1.48 d	1.61 d	17.33 d	16.49 d	9.34 d	11.15 e	5.04 d	5.24d
I_1 X MX_2	12.95 bc	13.05 bc	1.61 e	1.83 c	18.22 c	22.17 c	10.14 c	12.52 e	5.27 c	5.43c
I_2 X MX_0	12.50 d	12.64 d	1.45 d	1.52 d	16.45 d	18.62 d	8.52 e	11.41 e	4.82 e	5.02e
I_2 X MX_1	12.95 bc	13.08 bc	1.56 c	1.87 c	18.35 c	22.70 c	10.02 c	13.37 b	5.27 c	5.43c
I_2 X MX_2	13.12 ab	13.25 ab	1.22 ab	2.18 ab	21.32 b	25.18 b	10.91 ab	13.78 ab	5.44 ab	5.64ab
I_3 X MX_0	12.60 cd	12.72 cd	1.46 d	1.69 d	18.49 c	20.07 c	9.29 d	12.16 d	4.91 e	5.10e
I_3 X MX_1	13.03 b	13.14 b	1.75 b	2.09 b	21.96 b	25.16 b	10.72 ab	13.45 ab	5.33 bc	5.53bc
I_3 X MX_2	13.30 a	13.48 a	1.93 a	2.29 a	23.91 a	26.32 a	11.16 a	14.07 a	5.58 a	5.79a
Hundz X Mixture										
HN_0 X MX_0	12.27 f	12.38 e	1.33 e	1.44 e	15.62 f	17.13 b	8.51 e	10.53 f	4.58 e	4.77e
HN_0 X MX_1	12.52 e	12.65 d	1.44 d	1.71 e	17.88 ed	19.02 d	9.60 d	11.67 e	4.83 d	5.00d
HN_0 X MX_2	12.66 d	12.79 d	1.66 bc	2.04 ab	19.62 e	23.96 b	10.41 b	12.56 d	4.94 d	5.16d
HN_1 X MX_0	12.34 e	12.47 e	1.34 e	1.59 d	16.29 e	18.30 e	8.82 de	11.35 e	4.65 de	4.86de
HN_1 X MX_1	12.96 e	13.16 c	1.61 c	1.94 b	18.95 e	22.40 c	10.06 e	13.08 c	5.28 c	5.48c
HN_1 X MX_2	13.29 ab	13.40 ab	1.78 ab	2.09 ab	21.39 ab	24.50 ab	10.58 ab	13.70 ab	5.60 ab	5.78ab
HN_2 X MX_0	12.79 c	12.91 c	1.37 de	1.63 c	16.63 de	18.63 e	9.02 d	11.34 e	5.10 c	5.26c
HN_2 X MX_1	13.21 ab	13.33 b	1.73 b	1.92 b	20.81 b	22.93 c	10.41 b	13.22 b	5.52 b	5.72b
HN_2 X MX_2	13.42 a	13.59 a	1.91 a	2.17 a	22.43 a	25.20 a	11.15 a	14.11 a	5.74 a	5.91a

Values followed by similar letter(s) , within a comparable group of means, do not significantly differ, using revised LSD test at 0.05 level and Hundz soil × (Nilefertile + K_2SO_4) on vegetative growth characters of Arabi pomegranate trees.

The effects of interactions between irrigation levels and Hundz soil on the characters of shoot length, diameter, number of leaves/ shoot as well as number of shoots/ main branch and leaf area were found to be significant in both seasons when compared with control treatment of any level of irrigation. The combination between high irrigation level 11m^3 /tree/ year and Hundz soil at high rate 10Kg/tree (I_3×HN_2) reflected the best interaction, which gave significantly the highest mean values of all vegetative growth characters in both seasons followed by the application of highest rate of Hundz soil (10Kg /tree) combined with the second level of irrigation frequency 8.25m^3/tree /year(I_2× HN_2)which gave higher significant mean values for all the studied vegetative growth parameterscomparied with100% of the recommended irrigation level (I_3× HN0) in both seasons. Similar results were obtained with Hundz soil application at rate of 5Kg /tree in combination with irrigation level 8.25m^3/tree/year (I_2× HN_1) in all parameters with exceptions, for number of leaves /shoot and number of new shoots /branch in the 1st season. On the other hand, the least vegetative growth characters were obtained when pomegranate trees irrigated with lowest irrigation level (I_1× HN_0) in both seasons. Such results might be contributed to increase available water holding capacity hydraulic conductivity and water diffusivity of sandy soil due to the application of soil conditioner which reflected to the plant growth (Im, 1982).

The interaction effects between irrigation levels and mixture from Nile fertile + K_2SO_4 treatments are presented in Table (8). The results reflected generally that the application of high rate mixture (2Kg +500gm K_2SO_4) combined with higher irrigation level (11m^3 /tree /year) was favorable for the plant trees to express their performance on all vegetative growth characters. Data also indicated that the combination between second irrigation level (I_2) with either application of the mixture at high or low rate (I_2× MX_1orMX_2) had similar trend of effects on vegetative growth characters like trees which irrigated with 11m^3/tree/year without Nilefertile + K_2SO_4 (I_3× MX_0) with one exception for no.of leaves/shoot in the1st season. Reversely, the least level of irrigation combined with the least rate of mixture of Nile fertile + K_2SO_4 (I_1× MX_0) decreased significantly all vegetative growth parameters. This may be due to that K nutrition maintains high tissue water content under shortage of water (lindhauer, 1985). These data are coincided with El-Iraqy *et al.,* (2006) on guava.

Regarding the interaction effects between Hundz soil and Nile fertile + K_2SO_4 mixture on vegetative growth characters, the results in Table (8) reflected generally that the comparisons among the mean values for the vegetative growth characters are affected by these factors appeared to be significant in both seasons. The obtained results illustrated that Hundz soil application at rate of 10kg /tree combined with Nile fertile + K_2SO_4 at higher rate reflected the best interaction treatment since it gave the highest mean values for all the studied vegetative growth characters in both seasons. Theseresults reflected partial agreement with those obtained by Wallace and Wallace (1986)who found that applying soil conditioner (PAM) to organic source gave additive effect on growth of tomato and wheat plants and increasing water holding capacity of PAM treated soil reducing the frequency and total amount of irrigation required for several crops. Similarly Abbas (1999)found that using sulfer fertilizer mixture (Nilefertile) increased some growth parameter of olive seedlings due to it prevent salt accumulation around the roots and sustained the growth and yield of cucumber and onion (Badr, 1992).

2.2. Leaf chemical composition

Data in Table (9) indicated the first order interaction effects between irrigation levels × Hundz soil, irrigation levels × mixture from Nile fertile + K_2SO_4 and Hundz soil × mixture of Nile fertile on leaf chemical composition; i.e. N, P, K, Chlorophyll, proline and relative water content in both seasons.

Concerning the interaction effects between irrigation levels and Hundz soil rates, data indicated that values of leaf N, P, K, chlorophyll and RWC for the combination between highest levels of Hundz soil with highest level irrigation (I_3× HN_2) were significantly higher than those of all other treatment combinations in both seasons. Whereas, leaf proline showed opposite trend, the date also indicated that combination treatment between 8.25m^3/tree /year and HZ soil at highest rate (I_2 × HN_2) gave the same characteristics results when compared with 100% of the recommended irrigation level (I_3 x × HN_0) in both seasons. These results are in line with those of Hoda- Khalil (2005) who found that application of soil conditioner (PAM) increased leaf N, P, K and chlorophyll as well as decreased proline content of olive seedling.

Regarding the interaction effects between irrigation levels and mixture of (Nile fertile + K_2SO_4) on leaf chemical composition, the obtained results indicated that the treatment combination between highest irrigation level combined with the application of Nile fertile + K_2SO_4 at highest rate (I_3 × MX_2) gave the highest values

Table 9. First-order interaction effects of the three studied factors; Hundz soil, irrigation frequency and mixture of (Nile fertile + K_2SO_4) on leaf N,P,K, Chlorophyll, proline and relative water contents of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	N%		P%		K%		Chlorophyl (mg/cm^2)		Proline (mg/g dry weight)		Relative Water Content (RWC) %	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation X Hundz Soil												
I_1 X HN_0	1.41e	1.46e	0.181d	0.189d	1.05e	1.04e	4.42e	4.48e	13.35a	12.89a	75.61e	76.15e
I_1 X HN_1	1.46d	1.52d	0.185cb	0.194bd	1.12d	1.15d	4.61d	4.68d	13.26b	12.85ab	76.66d	77.18d
I_1 X HN_2	1.52c	1.58c	0.186b	0.195bc	1.32bc	1.37b	4.99c	5.05c	13.24b	12.70b	77.16d	77.59d
I_2 X HN_0	1.47d	1.52d	0.185cb	0.195bc	1.23c	1.26c	4.50de	4.58e	13.25b	12.75b	88.72c	89.35c
I_2 X HN_1	1.81b	1.86b	0.188b	0.197b	1.33bc	1.38b	4.98c	5.05c	13.10c	12.64c	89.85c	91.59c
I_2 X HN_2	1.82b	1.88ab	0.193ab	0.202ab	1.39b	1.38b	5.15b	5.24b	12.93d	12.42c	90.15bc	92.53bc
I_3 X HN_0	1.82b	1.87b	0.190b	0.199b	1.33bc	1.35bc	4.58d	4.68d	12.98c	12.46c	89.72b	91.57b
I_3 X HN_1	1.85ab	1.90ab	0.194ab	0.203ab	1.35bc	1.37b	5.04bc	5.16b	12.92d	12.37d	91.76ab	93.72ab
I_3 X HN_2	1.89a	1.95a	0.199a	0.208a	1.47a	1.46a	5.32a	5.42a	12.86e	12.32	93.17a	93.93a
Irrigation X Mixture												
I_1 X MX_0	1.29f	1.34f	0.176d	0.184d	0.86e	0.90e	4.31e	4.39e	13.55a	13.08a	73.70e	74.58e
I_1 X MX_1	1.44e	1.50f	0.184c	0.193c	1.20cd	1.20d	4.74c	4.81c	13.35b	12.87b	77.41d	75.36d
I_1 X MX_2	1.66cd	1.72cd	0.192b	0.201b	1.34b	1.35b	4.97bc	5.01bc	12.95cd	12.48c	78.33d	80.99d
I_2 X MX_0	1.36f	1.42ef	0.176d	0.186d	1.16d	1.18d	4.52d	4.60d	13.47ab	12.97ab	86.86c	87.57c
I_2 X MX_1	1.71c	1.77c	0.191b	0.200b	1.21cd	1.22c	4.97bc	5.05bc	13.03c	12.56cd	89.13b	91.71b
I_2 X MX_2	2.02b	2.08b	0.200ab	0.209ab	1.49ab	1.52ab	5.14ab	5.22ab	12.79e	12.28d	91.74ab	94.20ab
I_3 X MX_0	1.52de	1.58de	0.183c	0.192c	1.18cd	1.22c	4.61d	4.72d	13.12bc	12.58c	88.56c	88.64c
I_3 X MX_1	1.92b	1.97b	0.198ab	0.207ab	1.45ab	1.43ab	5.06b	5.18b	12.90d	12.37d	92.07ab	94.80ab
I_3 X MX_2	2.12a	2.18a	0.202a	0.211a	1.54a	1.54a	5.31a	5.37a	12.74e	12.20e	94.01a	95.77a
Hundz X Mixture												
HN_0 X MX_0	1.28e	1.34e	0.176d	0.185d	1.05e	1.06e	4.28f	4.36f	13.46a	12.96a	82.66d	82.80d
HN_0 X MX_1	1.54c	1.60c	0.187bc	0.196bc	1.21c	1.20c	4.57d	4.66d	13.21b	12.72b	84.99b	84.77b
HN_0 X MX_2	1.87b	1.92b	0.195b	0.204b	1.38b	1.39b	4.67d	4.72d	12.92b	12.42b	86.39ab	89.51ab
HN_1 X MX_0	1.42d	1.48d	0.179c	0.188c	1.06d	1.10d	4.35e	4.45e	13.36ab	12.86ab	83.06cd	83.73cd
HN_1 X MX_1	1.77bc	1.82bc	0.193b	0.200b	1.21c	1.25c	4.98b	5.07c	13.09c	12.63c	85.73b	88.26ab
HN_1 X MX_2	1.92ab	1.99ab	0.194b	0.205b	1.43b	1.46b	5.30ab	5.38ab	12.83d	12.36d	88.48a	90.50a
HN_2 X MX_0	1.47cd	1.52cd	0.180c	0.190c	1.10cd	1.14cd	4.80c	4.89c	13.31ab	12.80ab	83.40c	84.27c
HN_2 X MX_1	1.76bc	1.81bc	0.195b	0.204b	1.44b	1.40b	5.22b	5.32b	12.98c	12.45b	87.88ab	88.83ab
HN_2 X MX_2	2.01a	2.07a	0.203a	0.212a	1.56a	1.57a	5.43a	5.50a	12.74d	12.19e	89.20a	90.95a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ, using revised LSD test at 0.05 level

of all the studied leaf chemical composition, except leaf proline which showed opposite trend in both seasons. On the contrary, the lowest values between the previously mentioned interaction treatments were found with trees irrigated with 50% of the recommended irrigation level solely. In the meantime, irrigation trees with 8.25m^3 /tree /year combined with application of Nile fertile + K_2SO_4 at both higher rates (MX_1) or (MX_2) gave best results as compared with 100% of the recommend level of irrigation 11m^3 /tree /year ($I_3 \times MX_0$) in both seasons.

Regarding the interaction effects, between the different rates of Hundz soil and the mixture of (Nile fertile +K_2SO_4) on leaf chemical components are represented in Table (9), the application of Hundz soil at the highest rate 10Kg /tree combined with the highest level from the mixture (2Kg + 500gm /tree) caused a significant increase in leaf N, P, K, chlorophyll and RWC as well as decreased leaf proline as compared with other treatments in both seasons. Meantime, application of the above combination treatments enhanced leaf components as compared with treatments which contain HN soil alone or treatment without any additions ($HN_0 \times F_0$) in both seasons, these results may be due to the additive effect between soil conditioners which increase water holding capacity, enhance nutrient efficiency and encourage soil microflora in sandy soils (Azzam*et al.,* 1987). Also Hilal *et al.,* (1997) reported that application of sulfur fertilizer mixture (SFM) to the salinity soil led to reduce soil pH and provide oxidizing conditions for the benefit of plant roots development, with corresponding improvement of water and nutrient utilization.While, Abbas (1999) found that using (SFM) increased leaf N, P, K and chlorophyll and decreasedproline of olive. Moreover,Wael (2005) found that increasing level of K and NF enhanced leaf minerals content of olive trees.

2.3. Flowering, Fruiting and Yield

The First order interaction effects among the irrigation levels, Hundz soil and mixture from (Nile fertile and K_2SO_4) on number of flowers /shoot, fruit setpercentage and yield of pomegranate trees are presented in Table (10).

As for the effects between Hundz soil and irrigation levels, the results indicated that the application of the highest rate of Hundz soil 10Kg /tree combined with high irrigation level (11m^3 /tree /year) gave the most favorable interaction effect ($I_3\times HN_2$), which showed the significant highest mean values for all the above studied parameter in both seasons. Similar, interaction effect was found between HN soil at both rates combined with either mediumor lower irrigation level 8.25m^3 or 5.5m^3/tree /year on number of flower /shoot, fruit set % and yield when compared with trees irrigated with control treatment 11m^3 /tree /year only ($I_3\times HN_0$) with one exception for fruit set %with treatment ($I_1\times HN_1$) in both seasons. On the other hand, 5.5m^3 /tree /year level of irrigation without Hundz soil presented the lowest values of the previous mentioned characters in both seasons. The results are in line with Fitzpatrick, (1986) who found that application of Humus is capable of absorbing large quanties of water; thus increasing the water holding capacity of the soil and therefore crop production.

The effects of interactions between irrigation levels and different rates of Nile fertile + K_2SO_4 rates on the number of flowers /shoot, fruit set % and yield of pomegranate trees were found to be significant in the two seasons, as shown in Table (10). The highest level of irrigation combined with the mixture at higher rate (I_3 x MX_2) showed the highest values of no. of flower /shoot, fruit set % and yield, whereas, the control of the lowest irrigation level without NF or K_2SO_4 ($I_1\times MX_0$) exhibited the least values in both seasons. In the meantime, combination between both levels of the mixture with 8.25m^3/tree/year level (I_2) or 5.5m^3/tree/year (I_1) gave almost the same effect on the above characters when compared with the control of the recommended irrigationlevel ($I_3\times MX_0$) with one exception for fruit set percent. Such results generally reflected agreement with those reported by El-Iraqy *etal.,* (2006) on guavaand Khattab *et al*., (2010) on pomegranate. Theyfound that highest numbers of flowers ⁄ shoot were obtained when trees received high rate of K combined with high level of irrigation. Furthermore, Badr (1992) found that mixing sulfur fertilizer mixture (Nile fertile) below the drip lines prevented salt accumulation around the roots and sustained the yield of both cucumber and onion.

As related to the interaction effect between Hundz soil and Nilefertile + K_2SO_4, results in Table (10) indicated that application of 10Kg /tree Hundz soil combined with 2Kg NF + 500gm K_2SO_4 ($HN_2\times MX_2$) was favorable for plants to express their best performance on no. of flower /shoot ,fruit set and yield as compared with others treatments in both seasons. Data also indicated that higher concentration of Hundz soil combined with lower rate of Nile fertile + K_2SO_4 ($HN_2\times MX_1$) gave similar trend of effect like combination between higher rate of mixture and lower rate of HZ_1 ($HZ_1\times MX_2$) on the above characters in both seasons. The results are in line with Wael (2005) who found that fruit set and yield of olive trees enhanced with application of NF Whereas, Laila – Ali *et al.,* (2009) who found that the combination treatment between organic and inorganic conditioners increased wheat yield.

Table 10. First-order interaction effects of the three studied factors; Hundz soil, irrigation frequency and mixture of (Nile fertile + K_2SO_4) on flowering , fruiting and yield of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Fruit Set %		Yield (Kg/tree)		Flower number/shoot	
	2010	2011	2010	2011	2010	2011
Irrigation X Hundz Soil						
I_1 X HN_0	45.75e	48.89e	25.17e	27.27e	3.43d	3.71d
I_1 X HN_1	50.42d	53.76d	27.07c	29.16d	3.62c	3.91c
I_1 X HN_2	58.07c	60.22c	30.87b	32.96c	4.00b	4.29b
I_2 X HN_0	49.15e	51.54e	26.00d	28.10e	3.51cd	3.81cd
I_2 X HN_1	58.41c	60.85e	30.80b	32.89c	3.99b	4.28b
I_2 X HN_2	60.47ab	62.80ab	32.47ab	34.50ab	4.16ab	4.46ab
I_3 X HN_0	53.55d	55.89d	26.73c	28.83d	3.59c	3.88c
I_3 X HN_1	59.83b	62.23b	31.40ab	33.44b	4.05b	4.35b
I_3 X HN_2	63.18a	65.46a	34.23a	35.95a	4.34a	4.63a
Irrigation X Mixture						
I_1 X MX_0	44.39g	47.50f	24.07e	26.17e	3.32e	3.61e
I_1 X MX_1	52.78e	55.88d	28.37c	30.46c	3.75c	4.04c
I_1 X MX_2	57.08c	59.48c	30.67b	32.76b	3.98b	4.26b
I_2 X MX_0	48.20f	51.07e	26.23d	28.26d	3.53d	3.83d
I_2 X MX_1	59.39bc	61.34b	30.67b	32.77b	3.98b	4.27b
I_2 X MX_2	60.45b	62.79ab	32.37ab	34.46ab	4.15ab	4.44ab
I_3 X MX_0	55.10d	57.05d	27.03c	29.10c	3.62c	3.91c
I_3 X MX_1	58.78b	61.62b	31.37b	33.68b	4.04b	4.37b
I_3 X MX_2	62.67a	64.91a	33.97a	35.44a	4.29a	4.58a
Hundz X Mixture						
HN_0 X MX_0	45.83g	48.45g	23.80f	25.90f	3.29e	3.60e
HN_0 X MX_1	49.80e	52.63e	26.40d	28.77d	3.58d	3.87d
HN_0 X MX_2	52.83d	55.24d	27.70d	29.53d	3.65d	3.94d
HN_1 X MX_0	47.47f	50.77f	24.53e	26.63e	3.36e	3.65e
HN_1 X MX_1	58.74c	61.61c	30.77c	32.83c	3.99c	4.28c
HN_1 X MX_2	62.46ab	64.46ab	33.97ab	36.03ab	4.31b	4.60b
HN_2 X MX_0	54.40d	56.40d	29.00c	31.00c	3.81cd	4.11cd
HN_2 X MX_1	62.41ab	64.60ab	33.23ab	35.30ab	4.23b	4.53b
HN_2 X MX_2	62.67a	67.48a	35.33a	37.10a	4.45a	4.73a

Values followed by similar letter(s) , within a comparable group of means, do not significantly differ , using revised LSD test at 0.05 level

Table 11. First-order interaction effects of the three studied factors; Hundz soil, irrigation frequency and mixture of (Nile fertile + K_2SO_4) on some fruit physical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	Fruit Weight (gm)		Fruit Length (cm)		Fruit diameter (cm)		Fruit Volume (cm^3)	
	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation X Hundz Soil								
I_1 X HN_0	256.00 f	250.30 f	7.58 de	7.78 f	8.48 e	8.76 e	268.0 e	286.3 e
I_1 X HN_1	266.53 ef	260.43 e	7.61 de	8.11 e	8.55 d	8.87 cd	286.9 d	306.1 d
I_1 X HN_2	271.93 e	298.30 c	7.77 d	8.13 e	8.65 cd	8.95 c	324.9 c	343.7 c
I_2 X HN_0	280.80 d	282.23 d	7.75 d	8.27 d	8.75 c	8.84 cd	276.4 e	295.9 e
I_2 X HN_1	281.90 d	305.83 bc	7.97 c	8.52 c	8.80 bc	9.15 b	324.3 c	341.7 c
I_2 X HN_2	298.07 e	314.63 b	8.53 b	8.59 c	8.84 b	9.22 ab	340.8 ab	361.1 ab
I_3 X HN_0	297.37 c	305.27 bc	7.86 cd	8.58 c	8.86 b	9.15 b	284.1 d	303.5 d
I_3 X HN_1	317.53 b	326.77 a	8.50 b	8.85 b	8.90 ab	9.25 ab	330.6 b	350.7 b
I_3 X HN_2	331.63 a	328.40 a	8.80 a	9.03 a	8.98 a	9.30 a	358.6 a	376.6 a
Irrigation X Mixture								
I_1 X MX_0	236.97 f	266.13 c	7.39 e	7.29 f	8.28 e	8.66 d	256.9 f	277.0 e
I_1 X MX_1	274.30 d	242.53 e	7.40 ed	8.18 d	8.63 d	8.81 c	300.0 d	319.9 c
I_1 X MX_2	283.20 c	300.37 b	8.23 b	8.56 c	8.76 c	9.11 cb	322.9 c	339.2 b
I_2 X MX_0	258.80 e	265.23 c	7.34 a	7.64 e	8.60 d	8.72 d	278.5 e	298.3 d
I_2 X MX_1	287.83 c	306.70 b	7.99 c	8.74 c	8.86 c	9.10 cb	322.9 c	342.5 b
I_2 X MX_2	314.13 b	330.77 ab	8.92 b	8.99 b	8.93 ab	8.72 d	340.0 b	357.8 ab
I_3 X MX_0	285.87 c	273.00 c	7.53 d	7.91 d	8.61 d	8.89 c	286.9 e	306.3 c
I_3 X MX_1	320.63 b	337.23 ab	8.37 b	9.03 b	8.96 ab	9.29 b	332.6 b	352.9 ab
I_3 X MX_2	340.03 a	350.20 a	9.26 a	9.51 a	9.17 a	9.52 a	353.8 a	371.6 a
Hundz X Mixture								
HN_0 X MX_0	253.83 f	250.33 e	7.27 e	7.52 e	8.48 c	8.62 d	254.6 e	273.7 f
HN_0 X MX_1	283.17 d	269.20 d	7.35 d	8.39 c	8.75 b	8.91 c	283.2 d	303.3 e
HN_0 X MX_2	297.17 c	318.27 b	8.57 b	8.73 b	8.86 ab	9.22 b	290.8 d	308.7 e
HN_1 X MX_0	260.53 e	258.70 e	7.40 d	7.62 e	8.49 c	8.79 c	261.6 e	282.1 f
HN_1 X MX_1	290.53 cd	305.63 c	7.92 c	8.74 b	8.81 b	9.11 b	323.9 b	303.8 c
HN_1 X MX_2	314.90 b	328.70 ab	8.77 ab	9.11 ab	8.95 ab	9.37 ab	356.3 ab	372.7 b
HN_2 X MX_0	267.27 e	295.33 c	7.55 d	7.7 ab	8.52 c	8.86 c	306.2 c	325.9 d
HN_2 X MX_1	309.07 b	311.63 b	8.49 b	8.83 b	8.88 b	9.18 b	348.5 b	369.2 b
HN_2 X MX_2	325.30 a	334.37 a	9.06 a	9.23 a	9.06 a	9.43 a	369.7 a	387.2 a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ , using revised LSD test at 0.05 level

Table12. First-order interaction effects of the three studied factors; Hundz soil, irrigation frequency and mixture of (Nile fertile + K_2SO_4) on some fruit chemical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Treatments	TSS %		Anthocyanin %		V.C mg.vc/100ml juice		Acidity %		Tannins %	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation X Hundz Soil										
I_1 X HN_0	14.81f	14.68f	0.355e	0.363e	23.32e	23.80f	0.96a	1.01a	2.36a	2.22a
I_1 X HN_1	15.40e	17.02e	0.374d	0.382d	23.90c	24.10e	0.86b	0.96b	2.28b	2.14ab
I_1 X HN_2	15.66d	17.03e	0.412c	0.419c	23.66d	24.02e	0.80c	0.92c	2.21c	2.08b
I_2 X HN_0	15.61d	17.74d	0.363c	0.371e	23.38e	24.26d	0.83d	0.94c	2.22c	2.08b
I_2 X HN_1	15.86c	18.04e	0.411c	0.420c	23.45d	24.38c	0.80c	0.83d	2.24c	2.09b
I_2 X HN_2	16.33b	18.07e	0.428b	0.436b	24.52ab	24.39c	0.78e	0.81d	1.90e	1.76d
I_3 X HN_0	16.07bc	17.75d	0.371d	0.379d	23.41d	24.65b	0.81c	0.81d	1.95d	1.81c
I_3 X HN_1	16.41b	18.16b	0.417c	0.425c	24.39b	24.84ab	0.78e	0.77e	1.89e	1.75d
I_3 X HN_2	16.96a	18.61a	0.445a	0.453a	24.69a	25.02a	0.71f	0.75e	1.80f	1.68e
Irrigation X Mixture										
I_1 X MX_0	14.23f	14.80f	0.344f	0.351f	23.84f	23.27f	0.91a	1.03a	2.55a	2.41a
I_1 X MX_1	15.41d	16.31e	0.387d	0.395d	23.54d	24.10d	0.86b	0.94b	2.35b	2.21b
I_1 X MX_2	16.22c	17.62c	0.410c	0.418bc	23.50d	24.55c	0.86b	0.92b	1.95c	1.81d
I_2 X MX_0	14.70e	16.43e	0.365e	0.374	23.23e	23.65e	0.89ab	0.91b	2.44b	2.30ab
I_2 X MX_1	16.11c	18.60b	0.410c	0.418bc	23.88c	24.41c	0.77c	0.85c	2.13c	1.99c
I_2 X MX_2	17.00ab	18.82ab	0.427b	0.435ab	24.24b	24.98b	0.75c	0.81c	1.78e	1.64fe
I_3 X MX_0	15.38d	16.83d	0.374d	0.381e	23.42c	23.98d	0.85b	0.80c	2.05c	1.93dc
I_3 X MX_1	16.81b	18.55b	0.417c	0.425b	24.26b	25.02b	0.72c	0.77d	1.87d	1.73e
I_3 X MX_2	17.25a	19.12a	0.443a	0.450a	24.82a	25.50a	0.74c	0.76d	1.72e	1.58f
Hundz X Mixture										
HN_0 X MX_0	14.31f	15.42f	0.341e	0.349f	23.17f	23.58e	0.93a	0.96a	2.43a	2.29a
HN_0 X MX_1	15.69d	16.90d	0.367de	0.375e	23.41e	24.41c	0.78d	0.90b	2.18e	2.04c
HN_0 X MX_2	16.49bc	17.82cb	0.380d	0.389d	23.53d	24.72b	0.89b	0.89b	1.92d	1.78d
HN_1 X MX_0	14.85f	16.33e	0.348e	0.357f	23.58d	23.69d	0.89b	0.89b	2.35ab	2.21d
HN_1 X MX_1	16.15c	18.20b	0.411c	0.419c	23.99c	24.54c	0.81c	0.86c	2.20c	2.06c
HN_1 X MX_2	16.67b	18.70ab	0.443b	0.451ab	24.18b	25.09ab	0.74d	0.81d	1.85d	1.71d
HN_2 X MX_0	15.14e	16.31e	0.393d	0.400d	23.74c	23.64d	0.84bc	0.88b	2.26b	2.14b
HN_2 X MX_1	16.50b	18.30b	0.45b	0.444b	24.28b	23.58c	0.75d	0.81d	1.97d	1.83d
HN_2 X MX_2	17.31a	19.05a	0.456a	0.463a	24.85a	25.22a	0.71e	0.79e	1.68e	1.54e

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ, using revised LSD test at 0.05 level

Table 13. Effect of second order interaction between irrigation frequency, Hundz soil and mixture of Nile fertile + K_2SO_4 on some vegetative growth of Arabi pomegranate trees during 2010 and 2011 growing seasons

Irrigation levels m^3/tree/year	Hundz Soil (HN) (kg/tree)	Nile fertile + K_2SO_4 Mixture (Kg/tree)	Shoot length (cm) 2010	Shoot length (cm) 2011	Shoot length (cm) 2010	Shoot length (cm) 2011	No. of leaves/shoot 2010	No. of leaves/shoot 2011	No. of leaves/shoot 2010	No. of leaves/shoot 2011	Leaf Area (cm^2) 2010	Leaf Area (cm^2) 2011
I_1 50% of recommended irrigation level = 5.5	HN_0	MX_0	12.13 k	12.25 k	1.10 h	1.27 h	8.52 gi	8.19 k	13.00 k	14.46 h	4.45 k	4.65 k
		MX_1	12.41 hk	12.57 hk	1.36 eh	1.58 fh	8.81 fi	9.20 jk	16.62 hk	15.42 fh	4.73 hk	4.93 hk
		MX_2	12.65 dk	12.76 dk	1.52 bg	1.85 bg	9.88 bh	10.75 gj	16.88 dk	21.61 ah	4.97 dk	5.12 dk
	HN_1	MX_0	12.23 jk	12.35 jk	1.11 h	1.49 gh	8.71 gi	10.42 hj	14.20 jk	16.09 eh	4.55 jk	4.75 jk
		MX_1	12.59 fk	12.74 fk	1.47 cg	1.59 fh	9.46 ci	12.09 dh	17.40 fk	16.66 dh	4.91 fk	5.11 fk
		MX_2	12.94 bh	13.07 bh	1.61 bf	1.80 bh	12.07 bg	13.30 ad	18.06 bh	22.08 ah	5.26 bh	5.44 bk
	HN_2	MX_0	12.50 gk	12.62 gk	1.20 gh	1.58 fh	8.41 hi	10.30 ij	13.59 gk	15.59 eh	4.82 gk	4.92 gk
		MX_1	13.16 ae	13.27 ae	1.60 bf	1.67 dh	9.74 ci	12.15 cg	17.96 ae	17.38 ch	5.47 ae	5.67 ae
		MX_2	13.26 ac	13.33 ac	1.70 bd	1.83 bg	12.46 ae	13.52 ad	19.73 ac	22.81 ah	5.57 ac	5.73 ac
I_2 75% of recommended irrigation level = 8.25	HN_0	MX_0	12.29 jk	12.42 jk	1.43 dh	1.32 h	8.24 i	11.30 fi	15.95 jk	17.26 dh	4.61 jk	4.81 jk
		MX_1	12.54 gk	12.65 gk	1.31 be	1.58 fh	8.57 ci	13.19 ar	17.66 gk	19.06 bh	4.86 gk	4.94 gk
		MX_2	12.62 ek	12.75 ek	1.72 bd	2.03 af	10.61 ad	13.41 ad	20.33 ek	24.65 ag	4.93 ek	5.14 ek
	HN_1	MX_0	12.35 ik	12.49 ik	1.46 cg	1.59 fh	8.41 hi	11.42 fi	16.26 jk	18.56 bh	4.67 ik	4.87 ik
		MX_1	13.11 bd	13.23 bd	1.66 fh	2.11 ae	10.07 bg	13.52 ad	17.76 bd	24.22 ah	5.43 bd	5.62 bd
		MX_2	13.42 ac	13.54 ac	1.88 bc	2.23 ac	10.71 ad	13.86 ac	21.26 ac	25.07 af	5.74 ac	5.93 ac
	HN_2	MX_0	12.87 ci	13.00 ci	1.46 cg	1.66 dh	8.91 ei	11.52 ei	17.13 ci	20.05 bh	5.19 ci	5.38 ci
		MX_1	13.19 ad	13.35 ad	1.70 bd	1.92 ag	10.41 af	13.41 ad	19.63 ad	24.83 af	5.51 ad	5.73 ad
		MX_2	13.32 ac	13.46 ac	1.85 ab	2.29 ab	11.40 ab	14.07 ab	22.36 ac	25.81 ae	5.64 ac	5.84 ac
I_3 100% of recommended irrigation level = 11	HN_0	MX_0	12.38 ik	12.48 ik	1.46 cg	1.74 ch	8.77 gi	12.09 dh	17.90 ik	19.68 bh	4.69 ik	4.86 ik
		MX_1	12.62 dj	12.73 dj	1.66 be	1.98 ag	10.43 ae	12.63 bf	19.36 aj	22.58 ah	4.91 dj	5.12 dj
		MX_2	12.71 ek	12.85 ek	1.74 bd	2.24 ac	10.74 ad	13.52 ad	21.66 ek	25.62 ae	4.93 ek	5.23 ek
	HN_1	MX_0	12.44 gk	12.57 gk	1.45 cg	1.69 dh	9.35 di	12.20 cg	18.40 gk	19.26 bh	4.74 gk	4.95 gk
		MX_1	13.19 ad	13.32 ad	1.70 bd	2.12 ae	10.66 ad	13.63 ad	21.70 ad	27.31 ad	5.49 ad	5.70 ad
		MX_2	13.50 ab	13.60 ab	1.86 ab	2.24 ac	10.96 ac	13.95 ab	24.86 ac	27.36 ac	5.80 ab	5.98 ab
	HN_2	MX_0	12.99 bg	13.11 bg	1.46 cg	1.64 eh	9.74 ci	12.20 cg	19.16 bg	19.26 bh	5.29 bg	5.49 bg
		MX_1	13.29 ac	13.38 ac	1.89 ab	2.16 ad	11.07 ac	14.09 ab	24.83 ac	27.58 ab	5.59 ac	5.76 ac
		MX_2	13.68 a	13.98 a	2.19 a	2.39 a	11.79 a	14.74 a	25.21 a	27.98 a	6.00 a	6.16 a

Values followed by similar letter(s), within a comparable group of means , do not significantly differ , using revised LSD test at 0.05 level
Parameters ofArabi pomegranate trees during 2010 and 2011 growing seasons .

Table14. Effect of second order interaction between irrigation frequency, Hundz soil and mixture of Nile fertile + K_2SO_4 on some leaf chemical composition of Arabi pomegranate trees during 2010 and 2011 growing seasons

Irrigation levels	Hundz Soil (HN)	Nile fertile + K_2SO_4 Mixture	N%		P %		K %		Cholophyll mg/cm^2		Proline mg/g dry weight		RWC %	
m^3/tree/year	(kg/tree)	(Kg/tree)	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
I_1 50% of recommended irrigation level = 5.5	HN_0	MX_0	1.13 h	1.18 h	0.176 gi	0.182 i	0.82 h	0.85 h	4.15 k	4.23 k	13.68 a	13.19 a	73.11 k	73.55 h
		MX_1	1.41 fh	1.47 fh	0.179 fi	0.188 fi	1.08 eh	1.03 fh	4.43 hk	4.51 hk	13.45 ad	13.00 ad	76.74 ik	74.51 gh
		MX_2	1.68 bg	1.73 bg	0.189 bh	0.198 bh	1.24 bg	1.23 ch	4.67 dk	4.70 dk	12.93 eh	12.48 dh	76.97 ik	80.40 ch
	HN_1	MX_0	1.32 gh	1.38 gh	0.178 gi	0.187 gi	0.83 h	0.87 h	4.25 jk	4.33 jk	13.48 ac	13.03 ac	74.31 jk	75.08 fh
		MX_1	1.42 fh	1.47 fh	0.185 ci	0.194 ci	1.19 cg	1.21 dh	4.61 fk	4.69 fk	13.39 ae	12.96 ae	77.51 hk	75.35 dh
		MX_2	1.63 bh	1.71 bh	0.191 bg	0.200 bg	1.33 bf	1.36 bg	4.96 bh	5.02 bh	12.90 dh	12.55 bh	78.17 gk	81.11 ah
	HN_2	MX_0	1.41 fh	1.47 fh	0.175 hi	0.184 hi	0.94 gh	0.97 gh	4.52 gk	4.60 gk	13.48 ac	13.01 ac	73.68 jk	75.12 eh
		MX_1	1.50 dh	1.55 dh	0.188 ci	0.197 ci	1.34 bf	1.36 bg	5.17 ae	5.25 ae	13.21 ag	12.66 ag	77.97 hk	76.21 dh
		MX_2	1.66 bg	1.71 bg	0.195 ae	0.204 ae	1.45 bd	1.47 ae	5.27 ac	5.31 ad	13.03 ch	12.42 dh	79.84 gk	81.46 ah
I_2 75% of recommended irrigation level = 8.25	HN_0	MX_0	1.15 h	1.21 h	0.173 i	0.185 gi	1.12 dh	1.14 fh	4.31 jk	4.39 jk	13.58 ab	13.08 ab	86.96 ek	86.25 bh
		MX_1	1.41 fh	1.47 fh	0.186 ci	0.195 ci	1.16 cg	1.20 eh	4.56 gk	4.64 gk	13.21 ag	12.71 ag	88.77 ci	88.09 bh
		MX_2	1.86 af	1.91 af	0.197 ad	0.206 ad	1.42 bd	1.45 ae	4.63 ek	4.71 ek	12.95 dh	12.45 eh	90.44 ae	93.71 af
	HN_1	MX_0	1.42 fh	1.47 fh	0.175 hi	0.184 hi	1.18 cg	1.20 eh	4.37 ik	4.45 ik	13.50 ac	13.01 ac	85.37 fk	87.45 bh
		MX_1	1.94 ae	1.99 ae	0.191 bg	0.200 bg	1.03 fh	1.13 fh	5.13 bd	5.20 bd	13.00 dh	12.60 bg	86.87 ek	93.22 af
		MX_2	2.06 ac	2.12 ac	0.193 ad	0.207 ad	1.49 bc	1.51 ac	5.44 ac	5.51 ac	12.80 gh	12.30 fh	92.31 ad	94.10 ae
	HN_2	MX_0	1.49 dh	1.58 dh	0.180 ei	0.189 ei	1.18 eg	1.21 dh	4.89 ci	4.97 ci	13.32 af	12.81 af	87.24 dk	89.00 ah
		MX_1	1.75 ag	1.84 ag	0.195 ae	0.204 ae	1.42 bd	1.32 bh	5.21 ad	5.32 ad	12.87 fh	12.36 fh	90.74 ae	93.81 af
		MX_2	2.12 ab	2.21 ab	0.205 ab	0.214 ab	1.56 ab	1.60 ab	5.34 ac	5.43 ac	12.61 h	12.10 h	92.47 ac	94.78 ae
I_3 100% of recommended irrigation level = 11	HN_0	MX_0	1.57 ch	1.63 ch	0.178 gi	0.187 gi	1.18 cg	1.20 eh	4.39 ik	4.47 ik	13.12 bg	12.60 bg	87.91 dk	88.59 ah
		MX_1	1.81 ag	1.86 ag	0.195 ae	0.204 ae	1.37 be	1.38 ag	4.71 dj	4.84 dj	12.96 dh	12.44 dh	89.47 bd	91.70 ag
		MX_2	2.07 ac	2.12 ac	0.198 ad	0.207 ad	1.45 bd	1.48 ad	4.72 dj	4.74 ek	12.87 fh	12.33 fh	91.77 ad	94.42 ae
	HN_1	MX_0	1.52 dh	1.58 dh	.0184 di	0.193 di	1.17 cg	1.22 dh	4.44 gk	4.57 gk	13.09 bh	12.55 bh	88.51 ci	88.65 ah
		MX_1	1.95 ae	2.00 ae	0.197 ad	0.206 ad	1.42 bd	1.40 af	5.19 ad	5.32 ad	12.88 fh	12.34 fh	91.81 ad	96.22 ad
		MX_2	2.07 ac	2.13 ac	0.200 ac	0.209 ac	1.47 bd	1.50 ac	5.51 ab	5.60 ab	12.78 gh	12.23 gh	94.97 ab	96.28 ac
	HN_2	MX_0	1.47 eh	1.52 eh	0.188 ci	0.197 ci	1.18 cg	1.23 ch	5.00 bg	5.11 bg	13.14 bg	12.59 bg	89.27 bg	88.69 ah
		MX_1	1.99 ad	2.04 ad	0.201 ac	0.210 ac	1.55 ab	1.51 ac	5.29 ac	5.38 ac	12.87 fh	12.32 fh	94.94 ab	96.48 ab
		MX_2	2.22 a	2.28 a	0.208 a	0.217 a	1.69 a	1.65 a	5.69 a	5.77 a	12.58 h	12.05 h	95.30 a	96.61 a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ, ausing revised LSD test at 0.05 level

Table 15. Effect of second order interaction between irrigation frequency, Hundz soil and mixture of Nile fertile + K_2SO_4 on flowering, fruit set and yield of Arabi pomegranate trees during 2010 and 2011 growing seasons

Irrigation levels m^3/tree/year	Hundz Soil (HN) (kg/tree)	Nile fertile + K_2SO_4 Mixture (Kg/tree)	No. of Flowers/ Shoot 2010	No. of Flowers/ Shoot 2011	Fruit Set % 2010	Fruit Set % 2011	Yield Kg/tree 2010	Yield Kg/tree 2011
I_1 50% of recommended irrigation level = 5.5	HN_0	MX_0	3.16 k	3.45k	41.05 k	44.21 k	22.50 k	24.61 k
		MX_1	3.44 hk	3.73hk	45.11 ik	48.30 hk	25.3 hk	27.40 hk
		MX_2	3.68 dk	3.96dk	51.09 gk	54.16 dj	27.7 dk	29.90 dk
	HN_1	MX_0	3.26 jk	3.55jk	42.12 jk	46.11 jk	23.5 jk	25.59 jk
		MX_1	3.62 fk	3.91fk	52.13 fk	56.13 ci	27.1 fk	29.20 fk
		MX_2	3.97 bh	4.26bh	57.02 bh	59.05 bg	30.6 bh	32.70 bh
	HN_2	MX_0	3.53 gk	3.83gk	50.00 hk	52.19 fk	26.2 gk	28.30 gk
		MX_1	4.18 ae	4.47ae	61.10 ad	63.22 ae	32.7 ae	34.79 ae
		MX_2	4.28 ac	4.56ac	63.12 ac	65.24 ac	33.7 ac	35.78ac
I_2 75% of recommended irrigation level = 8.25	HN_0	MX_0	3.32 jk	3.63jk	44.21 jk	47.03 ik	24.1 jk	26.19jk
		MX_1	3.57 gk	3.86gk	51.14 gk	53.45 ek	26.6 gk	28.70gk
		MX_2	3.64 ek	3.93ek	52.11 fk	54.15 dj	27.3 ek	29.40ek
	HN_1	MX_0	3.38 ik	3.66ik	46.19 ik	50.17 gk	24.7 ik	26.79ik
		MX_1	4.14 bd	4.43bd	63.89 ac	65.26 ac	32.3 bd	34.40bd
		MX_2	4.45 ac	4.75ac	65.16 ab	67.11 ab	35.4 ac	37.49ac
	HN_2	MX_0	3.90 c	4.21c	54.20 dj	56.00 dk	29.9 ci	31.79ci
		MX_1	4.22 ad	4.52ad	63.14 ac	65.31 ac	33.1 ad	35.20ad
		MX_2	4.35 ac	4.64ac	64.07 ac	67.10 ab	34.4 ac	36.5ac
I_3 100% of recommended irrigation level = 11	HN_0	MX_0	3.40 ik	3.71ik	52.22 fk	54.12 dj	24.8 ik	26.89ik
		MX_1	3.72 dj	4.01dj	53.14 ek	56.15 ci	27.3 dj	30.21dj
		MX_2	3.64 ek	3.93ek	55.30 ci	57.41 bh	28.1 ek	29.4ek
	HN_1	MX_0	3.45 gk	3.74gk	54.09 dk	56.04 dk	25.4 hk	27.50hk
		MX_1	4.20 ad	4.5ad	60.21 bd	63.43 ad	32.9 ad	34.90ad
		MX_2	4.51 ab	4.8ab	65.19 ab	67.22 ab	35.9 ab	37.91bg
	HN_2	MX_0	4.00 bg	4.29bg	59.00 bg	61.00 bd	30.9 bg	32.91ab
		MX_1	4.30 ac	4.61ac	63.0 ae	65.28 ac	33.9 ac	35.92ac
		MX_2	4.71 a	5a	67.53 a	70.11 a	37.9 a	39.01a

Values followed by similar letter(s), within a comparable group of means , do not significantly differ, using revised LSD test at 0.05 level

Table 16. Effect of second order interaction between irrigation frequency, Hundz soil and mixture of Nile fertile + K_2SO_4 on some fruit physical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Irrigation levels m^3/tree/year	Hundz Soil (HN) (kg/tree)	Mixture of Nile fertile + K_2SO_4 (Kg/tree)	Fruit weight (gm) 2010	Fruit weight (gm) 2011	Fruit length (cm) 2010	Fruit length (cm) 2011	Fruit diameter (cm) 2010	Fruit diameter (cm) 2011	Fruit volume (cm^3) 2010	Fruit volume (cm^3) 2011
I_1 50% of recommended irrigation level = 5.5	HN_0	MX_0	231k	223.6h	7.32 bc	7.24 g	8.25 h	8.50 h	241.1k	261.2k
		MX_1	267.3dk	233.2fh	7.24 ac	8.00 bg	8.51 eh	8.78 eh	269.4hk	289.5hk
		MX_2	269.7jk	294.1gh	8.19 ac	8.11 bg	8.67 bg	9.00 bg	293.6dk	308.1dk
	HN_1	MX_0	243fk	239.9eh	7.33 ac	7.33 fg	8.26 h	8.69 gh	251.2jk	271.3jk
		MX_1	275bh	241.6dh	7.29 ac	8.22 bg	8.62 cg	8.79 fh	287.6fk	307fk
		MX_2	281.6gk	299.8ah	8.22 ac	8.78 a	8.76 bf	9.14 bh	322bh	340.1bh
	HN_2	MX_0	236.9ae	334.9dh	7.38 bc	7.29 fg	8.34 gh	8.78 fh	278.5gk	298.6gk
		MX_1	280.6ac	252.8ch	7.66 bc	8.31 cg	8.75 bf	8.87 dh	343.1ae	363.2ae
		MX_2	298.3jk	307.2ah	8.27 ac	8.80 af	8.85 bd	9.20 bg	353.2ac	369.3ac
I_2 75% of recommended irrigation level = 8.25	HN_0	MX_0	250.5gk	251.6dh	7.38 bc	7.44 eg	8.58 dh	8.52 h	257.3jk	277.4jk
		MX_1	287.6ek	269.6bh	7.27 bc	8.50 ag	8.81 be	8.78 fh	282.5gk	300gk
		MX_2	304.3jk	325.5ag	8.61 ac	8.88 ae	8.87 bd	9.23 af	289.4ek	310ek
	HN_1	MX_0	253.6bd	264.6bh	7.31 bc	7.66 cg	8.61 cg	8.79 fh	263.3ik	283.4ik
		MX_1	278.6ac	323.2ah	7.77 ac	8.89 ag	8.86 fh	9.22 af	339.1bd	358.3bd
		MX_2	313.5ci	329.7af	8.83 ac	9.00 ad	8.93 bc	9.43 ac	370.4ac	383.4ac
	HN_2	MX_0	272.ad	279.5ah	7.33 bc	7.83 dg	8.61 cg	8.86 dh	315ci	334.2ci
		MX_1	297.3ac	327.3af	8.94 ac	8.84 ag	8.91 bd	9.31 ae	347.2ad	369ad
		MX_2	324.6ik	337.1ae	9.31 ab	9.11 ad	9.00 ab	9.49 ab	360.3ac	380ac
I_3 100% of recommended irrigation level = 11	HN_0	MX_0	280ik	275.8bh	7.11 c	7.87 bg	8.61 cg	8.84 ch	265.3ik	282.4ik
		MX_1	294.6aj	304.8ah	7.55 ac	8.66 ag	8.93 be	9.18 ag	297.6dj	320.1dj
		MX_2	317.5ek	335.2ae	8.91 ac	9.21 ac	9.04 bd	9.44 ac	289.5ek	308.1ek
	HN_1	MX_0	285gk	271.6bh	7.55 ac	7.88 cg	8.60 cg	8.89 dh	270.4gk	291.5gk
		MX_1	318ad	352.1ad	8.69 ac	9.11 ad	8.95 bd	9.32 ae	345.1ad	366.2ad
		MX_2	349.6ac	356.6ac	9.27 ab	9.55 ab	9.15 bd	9.54 ac	376.4ab	394.5ab
	HN_2	MX_0	292.6bg	271.6bh	7.94 ac	7.99 cg	8.61 cg	8.94 eh	325bg	345.1bg
		MX_1	349.3ac	354.8ab	8.86 ac	9.33 ac	8.99 ab	9.36 ad	355.2ac	372.4ac
		MX_2	353a	358.8a	9.61 a	9.78 a	9.33 a	9.59 a	395.6a	412.3a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ , using revised LSD test at 0.05 level

Table17. Effect of second order interaction between irrigation frequency, Hundz soil and mixture of Nile fertile + K_2SO_4 on some fruit chemical properties of Arabi pomegranate trees during 2010 and 2011 growing seasons

Irrigation levels m^3/tree/year	Hundz Soil (HN) (kg/tree)	Mixture of Nile fertile + K_2SO_4 (Kg/tree)	TSS % 2010	TSS % 2011	Acidity % 2010	Acidity % 2011	Anthocyanine % 2010	Anthocyanine % 2011	V.C mg vc/100ml juice 2010	V.C mg vc/100ml juice 2011	Tannins % 2010	Tannins % 2011
I_1 50% of recommended irrigation level = 5.5	HN_0	MX_0	13.59 gi	13.43 k	0.99 k	1.05 c	0.328 k	0.336 k	23.24g	23.21g	2.65h	2.51h
		MX_1	14.88 fi	14.62 jk	0.93 jk	0.98 c	0.356 hk	0.364 hk	23.63bg	24.10bg	2.42fh	2.28fh
		MX_2	15.95 bh	15.99 gi	0.97 hk	0.99 c	0.386 dk	0.389 dk	23.08bg	24.10bg	2.00bg	1.86bg
	HN_1	MX_0	14.50 gi	15.63 hj	0.90 jk	1.03 c	0.338 jk	0.346 jk	24.11fg	23.32fg	2.50gh	2.36gh
		MX_1	15.53 ci	17.11 dh	0.85 gk	0.95 bc	0.374 fk	0.383 fk	23.72bg	24.21bg	2.38eh	2.24eh
		MX_2	16.16 bg	18.32 ae	0.83 bh	0.89 c	0.409 bh	0.417 bh	23.88af	24.77af	1.95ah	1.81ah
	HN_2	MX_0	14.60 hi	15.33 ij	0.83 fk	1.00 c	0.365 gk	0.370 gk	24.16fg	23.28fg	2.50h	2.36gh
		MX_1	15.83 ci	17.21 cg	0.80 bd	0.88 ac	0.430 ae	0.438 ae	23.27cg	23.99cg	2.24dh	2.16dh
		MX_2	16.55 ae	18.54 ae	0.78 ad	0.87 ac	0.446 ac	0.448 ac	23.55af	24.79af	1.90af	1.76af
I_2 75% of recommended irrigation level = 8.25	HN_0	MX_0	14.48 i	16.13 dh	0.92 jk	1.00 c	0.344 jk	0.352 jk	23.27eg	23.43eg	2.55h	2.41h
		MX_1	15.66 ci	18.43 ae	0.72 ad	0.92 bc	0.369 gk	0.378 gk	23.16ag	24.49ag	2.18dh	2.04dh
		MX_2	16.70 ad	18.65 ad	0.85 gk	0.89 bc	0.376 ek	0.384 ek	23.72ae	24.87ae	1.92ag	1.78ag
	HN_1	MX_0	14.62 hi	16.34 cg	0.90 ik	0.87 ac	0.350 ik	0.359 ik	23.20ae	23.88ae	2.49fh	2.35fh
		MX_1	16.16 bg	18.71 ad	0.81 bd	0.85 ac	0.426 bd	0.434 bd	23.66ag	18.31ag	2.37eh	2.23eh
		MX_2	16.80 ad	18.88 ae	0.76 ac	0.78 ab	0.457 ac	0.466 ac	23.50ad	24.96ad	1.85ae	1.71ae
	HN_2	MX_0	15.00 ei	16.63 cg	0.87 ci	0.87 ac	0.402 ci	0.411 ci	23.22dg	23.65dg	2.29dh	2.15dh
		MX_1	16.50 ae	18.65 ad	0.78 ad	0.79 ab	0.434 ad	0.442 ad	24.83ag	24.43ag	1.84ad	1.70ad
		MX_2	17.50 ab	18.94 ab	0.70 ac	0.76 a	0.447 ac	0.454 ac	25.5ad	25.10ad	1.58ab	1.44ab
I_3 100% of recommended irrigation level = 11	HN_0	MX_0	14.86 gi	16.71 fi	0.87 ik	0.83 ac	0.352 ik	0.359 ik	23.00bg	24.10bg	2.09ch	1.95ch
		MX_1	16.52 ae	17.66 bf	0.70 dj	0.79 ab	0.376 dj	0.384 dj	23.44ag	24.65ag	1.93ag	1.79ag
		MX_2	16.83 ad	18.81 ad	0.86 ac	0.80 ab	0.384 ek	0.393 ek	23.80ac	25.20ac	1.84ad	1.70ad
	HN_1	MX_0	15.44 di	16.81 fi	0.87 gk	0.78 ab	0.357 gk	0.365 gk	23.44cg	23.87cg	2.06bh	1.92bh
		MX_1	16.75 ad	18.77 ad	0.78 ad	0.77 a	0.432 ad	0.439 ad	24.58ad	25.10ad	1.85ae	1.71ae
		MX_2	17.05 ac	18.89 ab	0.70 ac	0.75 a	0.463 al	0.470 ab	25.16ab	25.54ab	1.75ac	1.61ac
	HN_2	MX_0	15.83 ci	16.96 ei	0.81 bd	0.78 ab	0.412 bg	0.420 bg	23.83cg	23.98cg	2.00bg	1.91bg
		MX_1	17.16 ac	19.22 ab	0.68 ab	0.75 a	0.442 ac	0.451 ac	24.75ac	25.32ac	1.84ad	1.70ad
		MX_2	17.88 a	19.66 a	0.65 ai	0.73 a	0.482 a	0.488 a	25.50a	25.77a	1.56a	1.42a

Values followed by similar letter(s) , within a comparable group of means , do not significantly differ, using revised LSD test at 0.05 level

2.4. Fruit quality properties

The results of the first-order interaction effects of irrigation frequency, Hundz soil and (Nile fertile + K_2SO_4)on fruit physical and chemical properties of pomegranate are shown in Tables (11 and 12).

As related to the interaction effect, highest irrigation level 11m^3 /tree /year) combined with the highest rate of Hundz soil (10Kg /tree) or combined with highest rate of mixture Nile fertile + K_2SO_4 (2Kg + 500gm) caused a significant increase in fruit weight, dimensions, TSS, anthocyanin and V.C. and decreased acidity and tannins content. Reversely, 5.5m^3 /tree /year level of irrigation without application of HN (I^1× HN_0) or NF + K_2SO_4 (I_1× MX_0) gave the least significant values of the above mentioned characters in both seasons. Similar trend of response was obtained with the combination between 8.25m^3 /tree /yearand HN at higher rate (I_2 × HN_2) in enhancing fruit physical and chemical properties except fruit diameter in the 1st season and V.C in the 2nd one. Similarly, combination treatment (I_2× MX_1) or (I_2 × MX_2) gave higher fruit quality except acidity and tannin content in both seasons as comparing with 100% of the recommended irrigation solely.The results clarified the beneficial effect of such soil conditioners in increasing hydraulic conductivity and water diffusivity of sandy soils which reflected on yield and fruit quality(Laila - Ali *et al*., 2009).

The interaction effects between HZ soil and the mixture from(NF + K_2SO_4) on fruit physical and chemical properties are presented in Tables (11 & 12). The statistical analysis of the obtained data revealed that the treatment combinations had significant effects on fruit quality in both seasons. The Application of 10Kg /tree HN soil combined with 2Kg NF + 500gm K_2SO_4 was favorable for trees to express their best performance on fruit physical and chemical characters. Laila – Ali *et al.,* (2009) found that the combination treatments between organic and inorganic soil conditioners increased weight of wheat grains.

3-Second-order interaction effects:

The results presented in Tables (13 to 17) illustrated the effects of the second-order interactions among irrigation levels, Hundz soil and the mixture of Nile fertile + K_2SO_4 on vegetative growth leaf chemical composition, flowering, fruiting, yield and fruit quality of pomegranate trees in 2010 and 2011 seasons.

Data indicated generally that the differences among the mean values of the various treatment combinations of pomegranate growth and productivity were found significant. The best treatment combination was gained from using the highest irrigation level (11m^3 /tree /year) and 10Kg /tree Hundz soil plus 2Kg /tree Nile Fertile + 500gm K_2SO_4 (I_3× HN_2× MX_2) which resulted in the highest mean values for all vegetative growth characters, leaf N P K, chlorophyll and RWC, yield and all fruit quality except leaf proline, juice tannins and acidity in both seasons. Date also indicated that the application of Hzsoil combined with mixture of (NF+K_2SO_4) at both highest levels for each of them and irrigated with moderate irrigation level 8.25m^3/tree/year gave best growth and produced higher fruit quality as compared with tree irrigated with 100% from recommendedwater level without soil conditioners (I_3 × HZ_0× MX_0). Similar effects of interactions between the application of HN_2 and MX_2 under least irrigation treatments 5.5 m^3 /tree/year on the previous characters of fruit.Those results could be attributed to the role of organic or and inorganic soil conditioners in mineralenrichment,active organic compounds and bio substances which have the ability to chelate nutrients as available strategic storehouse and in turn reflected positively on development of crop yield and its components.

CONCLUSION

As a conclusion, pomegranate trees growth, flowering, fruit characteristics were improved in some treatments, especially the low level of irrigation when combined with soil conditioners Hundz soil or NF + K_2SO_4.

Eventually, it can be recommended that for planting pomegranate trees in the new reclaimed area to add 2 Kg/tree combined with 2 Kg Nilefertile + K_2SO_4 under irrigation level 8.25m^3/tree/year.

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ا لمخص العر

تأث سنات التربة و مستويات الرى على و وانتاجية أشجار الرمان مناطق الاستصلاح ا ديثة

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أجريت هذه الدراسه خلال مو ى٢٠١٠-٢٠١١ على أشجار الرمان صنف عر عمرها ١٠ سنوات وم رعه أرض رمليه ت نظام الرى بالتنقيط زرعه خاصه بطريق الأسكندرية-مطروح بدف دراسه تأث ات كل من ثلاثه مستويات تلفة من الرى وهى ٥٠ % أو ٧٥% أو ١٠٠% من ا عدل ا وصى به أو ثلاثه مستويات من سن التربه هاترسويل (بدون سن أو ٥ أو ١٠ كجم/ شجره) أو ثلاثه مستويات من ا خلوط (نيل فرتيل + ك يتات البوتاسيوم) وهى بدون سن أو (٢كجم + ½ كجم) أو (١كجم +¼كجم) وكذلك تتبع تأث التداخلات ب مستويات العوامل الثلاث ا دروسه على بعض صفات النمو ا ضرى والزهرى ومكونات الأوراق وصفات جودة الثمار وا صول خلال مو ى الدراسة وقد أوضحت الدراسه النتائج التاليه.

- أدت أضافه معاملة سن التربه هانزسويل عدل١٠كجم /شجرة أو لوط من النيل فرتيل مع ك يتات البوتاسيوم عدل (٢كجم+ ٢/١ كجم)/شجرة أو معاملة الرى ١١متر٣/شجره/ السنه ا زياده معنويه النمو ا ضرى والزهرى وا صول وكذلك س مواصفات الثمار(وزنا وطو ا وقطرها) وكذلك زيادة تواها من ا واد الصلبه الكليه وفيتام ج والأنثوثيان ونقص تواها من ا موضه والتان .
- أدت أضافة سن التربه عدل ١٠كجم/شجره مع مستوى الرى ٨.٢٥متر٣/شجره/سنه ا زياده معنويه معظم قياسات النمو ا ضرى ومكونات الأوراق والثمار وكذلك ا صول ومواصفات الثمار ما عدا قطر الثمار و تواها من فيتام ج بينما أدت أضافة معامل النيل فرتيل عدل ٢ كجم + ½ كجم ك يتات البوتاسيوم ا نفس معدل الرى ا ـس يـع الصفات ا دروسه ماعدا ا موضه وذلك عند ا قارنه بـ الرى ستوى ١٠٠% ماء فقط بدون أضافات.
- أدى اضافة سن التربه عدل١٠كجم/شجره أو ٥ كجم/شجره مع ٢كجم نيل فرتيل+ ½كجم ك يتات البوتاسيوم أو (١كجم نيل فرتيل+ ¼كجم ك يتات البوتاسيوم) ت نظام الرى ٨.٢٥متر٣/شجره/سنه ا سن النمو وا صول وصفات الثمار وذلك مقارنه عامله كنترول مستوى الرى ١١متر٣/شجره/سنه.
- أدى اضافة سن التربه هانزسويل عدل ١٠كجم/شجره مع لوط من ٢كجم نيل فرتيل + ½ كجم ك يتات البوتاسيوم ت نظام رى ٥.٥متر٣/شجره/سنه ا زياده النمو وصفات الثمار وا صول وذلك با قارنه عاملة الكنترول ت مستوى رى ١١متر٣/شجره/سنه.
- بصفه عامه أضافه سن التربه هانزسويل عدل ١٠كجم/ شجره مع ٢ كجم نيل فرتيل + ½ كجم ك تيات البوتاسيوم ت نظام الرى ١١متر٣/شجره/سنه أعطى أحسن و وأعلى صول وجوده للثمار.

وعلى ذلك كن التوصيه بأضافة ١٠كجم هانزسويل مع ٢كجم نيل فرتيل مع ½ كجم ك يتات البوتاسيوم مع مستوى رى ١١متر٣/شجره/سنه للحصول على أعلى انتاجيه وجوده للثمار. بينما يوصى من وجهه نظر توف ا اء وأستخدامه بأضافة نفس ا عدلات السابقه ولكن مع معدل الرى٨.٢٥ متر٣/شجره/سنه أو ٥,٥ متر٣/ شجرة/ سنة وذلك لتحس قدرة الأرض على الأحتفاظ با اء وبالتا كن توف ه للأراضى حديثة الأستصلاح.