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Improving Growth and Productivity of Pomegranate Fruit Trees Planted On Sandy Dunes Slopes at Baloza District (N. Sinai) Using Different Methods of Drip Irrigation, Organic Fertilization, and Soil Mulching

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Abstract: *This study was carried out during the two successive seasons of 2012 and 2013 at Baloza Experimental Station, Desert Research Center, North Sinai Governorate, Egypt, on Manfalouty pomegranate (cv.) shrubs planted on the slops of sandy dune. All the area subjected to the same agriculture practice. The study aimed to plan such model of farm management for planting the sand dune slops. The experimental work depended on modifying some traditional methods of irrigation, fertilization and protecting soil surface from erosion and water loss. Two irrigation systems (surface and sub surface drip irrigation) with organic fertilization (control 1 (without), compost and goat manure) and soil mulching (control 2 (without), plastic sheets and rice straw) were the main treatments applied to achieve the aim of the work and evaluate the improvement or that highly economic value fruit. The obtained results cleared that, sub surface drip irrigation was better than surface drip irrigation system. In addition, using plastic sheet as a mulching and compost as organic fertilization under sub surface drip irrigation gave the high leaf area, leaf chlorophyll, number of leaves/shoot, shoot length, number of followers / shoot***,** *fruit set %, total yield, fruit length, fruit diameter, fruit weight, grains weight, TSS , total sugar content and vitamin C in both seasons. On the other side, surface drip irrigation without any organic fertilization and soil mulching gave the highest total acidity.*
Key words: *irrigation systems, Manfalouty cultivar, organic fertilization, pomegranate, sand dune fixation, soil conditioners, soil mulching.*

I. Introduction

Pomegranate *(Punica granatum* L.) is one of the family Punicaceae plants and is mainly belongs to semi-arid mild-temperate to subtropical climates. Pomegranate orchards are now grown in many regions of the world, particularly in the Mediterranean Basin, where high quality fruits are obtained **[Stover and Mercure, (2007) and Holland et al., (2009)].** Manfalouty is considered as one of the most important pomegranate cultivar grown successfully in Egypt.

Sand dunes are of the problems which seriously affecting the agricultural activities even the area it self. In Egypt sand dunes cover about 16% of the whole country. Sandy dunes slopes could be cultivated using some materials (such as mulching materials, and some soil conditioners) help protecting from water loss. Morphologically sand dunes are subdivided into sand seas (ergs), isolated dunes and dune fields and sandy plains. In Egypt, sand encroachment causes hazards to farmlands, highways, population centre and other infrastructures **(Misak and Draz 1997).**

Developed irrigation systems are very important for saving irrigation water which is the most limiting and most precious resources for agriculture today **(Helweg, 1989)**. Drip irrigation systems are having an important priority in new the reclaimed area. Surface and subsurface drip irrigation methods can play a significant role in overcoming the scarcity of water mostly in water shortage areas. **Talat et al (2012).** The drip irrigation is reported to perform better in light sandy soils and water scarcity regions under deep ground water table conditions, but the performance of the drip irrigation should be tested under adverse conditions of shallow water table and heavy soils. Subsurface drip irrigation allows uniform soil moisture, minimize the evaporative loss and delivery water directly to the plant root zone which increases use efficiency and yield **(Douh et al., 2013)**. In addition, **Talat et al., (2012)** found that yield of date palms was increased by 45 and 48% under sub surface irrigation as compared with surface drip irrigation. **Bryla, et al., (2003)** studied the effects of furrow, microjet, surface drip, and sub surface drip irrigation on vegetative growth and early production of `Crimson Lady' peach [*Prunus persica* (L.) Batsch] trees. In addition, he stated that overall performance showed that trees irrigated by surface and subsurface drip were significantly larger and produced higher yields, than trees irrigated by microjets.

Desert soils suffer mainly from the shortage in water. So, several soil management practices are adopted to restrict water losses and to maximize the output of limited water resources. One of the most important and effective measures for controlling soil water and improving thermal regime is soil mulching to protect the soil surface. Also, it is frequently applied around plants to conserve soil water, modify the soil environment, reduce heat losses in winter and enhance plant growth. **(Monteith, 1973)**. Mulch is a protective cover placed over the soil surface. Mulch can play an important role for sustainable fruit production. Beneficial aspects of plastic mulch include conservation of moisture, controls weeds and moderate soil temperature for better root growth and higher crop yield [**Ramakrishna, et al (2006), and Sudadi et al,. (2007)].** Plastic mulches reduce the amount of water lost from the soil due to evaporation. This means less water will be needed for irrigation. Plastic mulches also aid in evenly distributing moisture to the soil which reduces plant stress. Plastic mulches prevent sunlight from reaching the soil so it can inhibit most annual and perennial weeds, **(Tarara, 2000). Albert et al. (2010)** reported that mulching have significantly influence on pH and nutrient content. The highest fruit yield of Pineapple (*Ananas comosus*. L. Merr) was recorded with polythene treatment. **Janaki and Hkmsk (2009) and El Mardi et al., (2007)** mentioned that mulching the soil with plastic cover gave the highest fruit length, diameter and yield in date palm (Khalas). **EI-Kosary, et al., (2009)** added that plastic mulch had enhanced the fruit characteristics of Zaghloul date palm.

Drip irrigation systems was found to result in 30 to 70% water savings in various orchard crops and vegetables along with 10 to 60% increases in yield as compared to conventional methods of irrigation. It is prudent to make efficient use of water and bring more area under irrigation through available water resources. This can be achieved by introducing advanced methods of irrigation and improved water management practices **(Zaman et al., 2001).** Drip irrigation in combination with mulch is one of the best irrigation methods, which can improve the water management practice significantly. Surface mulches have been used to improve soil water retention, reduce soil temperature and reduce wind velocity at the soil surface and arid lands **(Kay, 1978; Jalota and Prihar, 1998).** Surface mulches can also improve water penetration by impeding runoff and protecting the soil from raindrop splash and reducing soil crusting **(Munshower, 1994).** In addition, **Tiwari et al., (2014)** recorded that plastic mulch and drip irrigation increase yield in Sapota (*Achras zapota*) as compared with ring basin irrigation.

Growing plants in the newly reclaimed soils is faced by various problems, such as cultivars, fertilization, low amounts of available nutrients and low organic matter content as well as poor hydrophilic, chemical and biological properties. The best means of maintaining soil fertility and productivity could be through periodic addition of organic manures such as compost and goat manure, which can secure sustainable nutrients as the needs of the plants for growth and thrive. The slow release of nutrients from organic fertilizers and trace elements content increase the suitability of organic fertilizers as a sandy soil amendments which improve soil structure and fertility, controlling soil ph and provide the plants with mineral needs, that is not mostly found in most chemical formulations. In addition, organic manures have been shown largely improve in soil physical conditions such as moisture retention, aggregate soil stability capacity and crop performance. **(Hati et al 2006).** Manure and compost increase soil organic matter, improve soil structure, increase the water-holding capacity of coarse-textured sandy soils, improve drainage in fine-textured clay soils, provide a source of slow release nutrients, reduce wind and water erosion, and promotes growth of earthworms and other beneficial soil organisms. Most vegetable crops return small amounts of crop residues to the soil, so manure, compost, and other organic amendments help maintain soil organic matter levels. Organic manures are able to enhance soil microbial activity and improve the enzyme activity by increasing soil microbial biomass **(Ren et al., 1996; Sun et al., 2003; Lu et al., 2005).** Compost is one of the most effective ways of applying organic matter to soils and improving organic carbon levels. Composts are used to increase crop productivity and yields, and their use is usually associated with improving soil structure and enhancing soil fertility, increasing soil microbial populations and activity and the improvement of moisture-holding capacity of the soil **(Arancon, et al., 2004).**

As mentioned before, sand dunes are one of the most negative environmental phenomena that facing all the economic activities including agriculture even domestication it self. Moreover, planting sand dunes is one of the most important ways for sand dune fixation. On the other hand, planting sand dunes slopes with fruit trees is one of untraditional farming systems especially under the Egyptian environments. So, this trail is aiming to plan such model of farm management for planting fruit orchard on sand dunes slopes the experiment work depended on modifying the traditional method of irrigation and fertilization by protecting the soil surface from erosion, and save most of sub surface moisture from loss. The final gall is to overcome the early deterioration of pomegranate orchard planted on a sand dune slope, and improve growth and productivity of the pants.

II. Materials and Methods

This study was conducted during the two successive seasons of 2012 and 2013 at Baloza Experimental Station, Desert Research Center, North Sinai Governorate, Egypt, on pomegranate shrubs (*Punica granatum* L.) of Manfalouty cultivar. Trees under investigation were grown in a sandy soil (Table 1). Planting space was 4 × 4 m apart. The experiment was designed as spilt spilt plot design. Three replicates were used for each treatment and every replicate was represented by three trees with (2x3x3) in a factorial arrangement of treatments with the following factors and levels: main factor irrigation systems (sub surface drip or surface drip), sub main organic fertilization (control 1 (without), compost (10 kg/tree) and goat manure (10 kg/ tree) (Table 2) and sub sub main mulching (control 2 (without), plastic sheet and rice straw).

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

Particle size distribution			Texture soil	Ec dsm^{-1}	pH	Available nutrients (Cation)					Available nutrients (Anion)			
Sand	Silt	Clay				Na %	P %	K %	Ca meg/l	Mg meg/l	CO3	HCO3 meg/l	Cl^-	So^{--}_4
90	5	5	sandy	1.37	8.20	4.78	0.42	0.54	3.65	4.40	-	3.85	3.3	6.5

Table 2: Some chemical properties of goat manure and compost.

properties	Goat manure	Compost El Neel
Organic matter %	68.2	30.70
Total N %	2.56	1.66
Total P %	2.40	0.44
Total K %	2.27	1.56
C : N	19	18.70

The following parameters were measured for both seasons:

1-Leaf Area (cm^2): Was determined by using the leaf area meter CL203.

2-Average total chlorophyll content

Total chlorophyll content (in fresh leaves) was measured on the third leaf from the base at the end of August in field by using Minolta meter SPAD-502.

3-Number of leaves per shoot

Leaves developed on the new shoots were also counted at the end of growing season in September.

4-Length of the new developed shoots (cm)

Ten of one year old shoots was collected from around the canopy representing the four main directions were tagged for measuring new developed shoots length at the end of growing season in September.

5- Number of followers / shoot and fruit set %

Number of followers / shoot was counted at balloon stage and fruit set % was counted two weeks after full bloom. Fruit set % was calculated according to the formula: Fruit set % = number of set fruits ÷ total number of flowers (balloon stage) x 100

6- Fruit parameters (fruit physical characteristics)

Fruits sample was taken at the harvest time to be used for determining the physical properties (i.e., fruit length (cm), fruit diameter (cm), fruit weight (g), grains weight (g), juice percentage and peel thickness (mm).

7- Fruit quality (fruit chemical characteristics)

a sample of 8 ripe fruits of each tree were taken at the harvest time to be used for determining the chemical properties i.e., (T.S.S.%) that measured by using a hand refractometer and the acidity % as citric acid content using fresh juice with titration against 0.1 Na OH. The total sugars content, and content of vitamin C according to **A.O.A.C (1985)** were determined.

Statistical analysis

The data were subjected to analysis of variance and Duncan's multiple range tests was used to differentiate means as described by **Duncan (1955)**.

III. Results and Discussion

Leaf area, leaf chlorophyll, number of leaves / shoot and shoot length

Results in Table (3 and 4) showed that leaf area, leaf chlorophyll, number of leaves / shoot and shoot length was significantly affected by all treatments in both seasons. It is obvious that subsurface drip irrigation system increased leaf area, leaf chlorophyll, number of leaves / shoots and shoots length in both seasons as compared with surface drip irrigation. In addition, adding compost as an organic fertilization gave the highest leaf area, leaf chlorophyll, number of leaves /shoot and shoot length in both seasons. Furthermore, mulching the soil with plastic cover gave the best leaf area, leaf chlorophyll, number of leaves / shoots and shoots length as compared with control.

On the other hand, the interactions between irrigation system and organic fertilization show that compost under sub surface drip irrigation gave the highest leaf area (4.91 in first season and 5.29 cm^2 in second seasons), leaf chlorophyll (54.56 in first season and 55.05% in second seasons), number of leaves / shoot (27.62 in first season and 27.57 in second seasons) and shoot length (27.78 in first season and 27.79 cm in second seasons respectively).

In addition, the interaction between plastic cover and sub surface drip irrigation system was the best than surface drip irrigation without mulching in both seasons.

However, the interactions between compost and mulching with plastic cover gave the highest value in these parameters compared with control in both seasons.

Moreover the interactions between irrigation system, organic fertilization and soil mulching clear that added compost and mulching the soil with plastic cover under sub surface drip irrigation gave the best leaf area (5.60 cm^2 in first season and 6.09cm^2 in second seasons), leaf chlorophyll (61.45 in first season and 62.12% in second seasons), number of leaves / shoot (30.19 in first season and 30.20 in second seasons) and shoot length (30.41 in first season and 30.33 cm in second seasons). On the other hand, surface drip irrigation without fertilization and mulching gave the less leaf area, leaf chlorophyll, number of leaves / shoot and shoot length in both seasons.

These results are in harmony with those obtained by **Bryla, et al (2003)** who found that sub surface drip irrigation improve vegetative growth of newly planted `Crimson Lady' peach [*Prunus persica* (L.) Batsch] trees. **Tiwari et al., (2014)** recorded that plastic mulch and drip irrigation increase growth parameters in Sapota (*Achras zapota*) as compared with ring basin irrigation. In addition**, Safar and Ahmed (2012)** found that adding compost gave the highest leaf area and shoot length of Picual olive trees.

Table 3. Effect of irrigation systems, organic fertilization and soil mulching on leaf area and leaf chlorophyll of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons.

Treatments	Leaf area (cm2)		Leaf chlorophyll%	
	2012	2013	2012	2013
Effect of drip irrigation systems				
sub surface	3.95a	4.09a	46.88a	47.15a
surface	3.50b	3.54b	43.50b	43.70b
Effect of organic fertilization				
control 1 (without)	2.85c	2.89c	38.68c	38.77c
compost	4.59a	4.82a	51.92b	52.31a
goat manure	3.73b	3.74b	44.97a	45.18b
Effect of soil mulching				
control 2 (without)	2.79c	2.80c	38.44c	38.68c
plastic sheet	4.32a	4.42a	49.44a	49.83a
rice straw	4.07b	4.21b	47.68b	47.76b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	3.05e	3.12e	39.99e	40.04e
sub surface+ compost	4.91a	5.29a	54.56a	55.05a
sub surface + goat manure	3.88c	3.85c	46.08c	46.35c
surface + control1	2.66f	2.66f	37.35f	37.51f
surface + compost	4.28b	4.34b	49.27b	49.57b
surface + goat manure	3.58d	3.09d	43.86d	44.01d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	3.02e	3.01e	39.45e	39.79e
sub surface + plastic sheet	4.57a	4.78a	51.68a	52.19a
sub surface + rice straw	4.25b	4.48b	49.51b	49.46b
surface + control2	2.55f	2.59f	37.44f	37.56f
surface + plastic sheet	4.07c	4.11c	47.19c	47.48c
surface + rice straw	3.98d	3.93d	45.86d	46.05d
Effect of organic fertilization and soil mulching				
control 1 + control 2	2.29i	2.32i	36.26i	36.48i
compost + control 2	3.26f	3.32f	40.23f	40.58f
goat manure + control 2	3.01g	3.04g	39.54g	39.26g
control 1 + plastic sheet	3.46e	3.50e	41.78e	42.06e
compost + plastic sheet	5.31a	5.61a	58.36a	58.90a
goat manure + plastic sheet	5.02b	5.34b	55.60 b	55.97b
control 1+ rice straw	2.62h	2.58h	37.29 h	37.49h
compost + rice straw	4.39c	4.40c	49.72 c	50.02c
goat manure + rice straw	4.18d	4.25d	47.91d	48.04d

Effect of drip irrigation systems, organic fertilization and soil mulching

drip irrigation systems	organic fertilization	soil mulching	Leaf area (cm2)		Leaf chlorophyll%	
			2012	2013	2012	2013
sub surface	control 1	control 2	2.46m	2.50m	36.52pq	36.85p
	control 1	plastic sheet	3.55h	3.66i	42.23j	42.60j

	control 1	rice straw	3.17i	3.20j	41.24k	40.67k
	compost	control 2	3.92g	3.93h	44.34i	44.88i
	compost	plastic sheet	5.60a	6.09a	61.45a	62.12a
	compost	rice straw	5.22b	5.86b	57.89b	58.14b
	goat manure	control 2	2.72l	2.60m	37.48no	37.65no
	goat manure	plastic sheet	4.56e	4.58e	51.36e	51.84e
	goat manure	rice straw	4.35f	4.38f	49.40f	49.57f
surface	control 1	control 2	2.14n	2.14n	36.00q	36.12q
	control 1	plastic sheet	2.97jk	2.98kl	38.23m	38.55m
	control 1	rice straw	2.85kl	2.87l	37.83mn	37.85n
	compost	control 2	3.00j	3.07jk	39.23l	39.24l
	compost	plastic sheet	5.01c	5.12c	55.27c	55.67c
	compost	rice straw	4.81d	4.82d	53.32d	53.80d
	goat manure	control 2	2.52m	2.56m	37.09op	37.33o
	goat manure	plastic sheet	4.21f	4.22fg	48.07g	48.21g
	goat manure	rice straw	4.01g	4.11g	46.42h	46.50h

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Table 4. Effect of irrigation systems, organic fertilization and soil mulching on number of leaves / shoot and shoot length of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons.

Treatments	Number of leaves / shoot		Shoot length (cm)	
	2012	2013	2012	2013
Effect of drip irrigation systems				
sub surface	24.22a	24.31a	24.32a	24.40a
surface	22.79b	22.87b	22.85b	23.02b
Effect of organic fertilization				
control 1 (without)	20.23c	20.35c	20.44c	20.62c
compost	26.90a	26.95a	26.91a	27.01a
goat manure	23.39b	23.47b	23.41b	23.51b
Effect of soil mulching				
control 2 (without)	19.94c	20.07c	20.26c	20.36c
plastic sheet	25.69a	25.86a	25.61a	25.72a
rice straw	24.89b	24.84b	24.88b	25.05b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	21.10e	21.25e	21.25e	21.43e
sub surface+ compost	27.62a	27.57a	27.78a	27.79a
sub surface + goat manure	23.95c	24.04c	23.93c	24.00c
surface + control1	19.35f	19.46f	19.63f	19.81f
surface + compost	26.18b	26.23b	26.04b	26.24b
surface + goat manure	22.84d	22.91d	22.88d	23.02d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	20.67e	20.79e	20.95e	21.04e
sub surface + plastic sheet	26.48a	26.60a	26.45a	26.50a
sub surface + rice straw	25.51b	25.55b	25.53b	25.66b
surface + control2	19.21f	19.35f	19.57f	19.68f
surface + plastic sheet	24.90c	25.12c	24.76c	24.94c
surface + rice straw	24.26d	24.14d	24.23d	24.44d
Effect of organic fertilization and soil mulching				
control 1 + control 2	17.46i	17.58i	18.20i	18.35i
compost + control 2	21.90f	22.10f	21.85f	22.13f
goat manure + control 2	21.31g	21.39g	21.28g	21.38g
control 1 + plastic sheet	22.75e	22.84e	22.86e	22.91e
compost + plastic sheet	29.49a	29.53a	29.36a	29.43a
goat manure + plastic sheet	28.47b	28.46b	28.50b	28.70b
control 1+ rice straw	19.62h	19.80h	19.72h	19.83h
compost + rice straw	25.68c	25.94c	25.62c	25.61c
goat manure + rice straw	24.88d	24.68d	24.87d	25.09d

Effect of drip irrigation systems, organic fertilization and soil mulching

drip irrigation systems	Organic fertilization	soil mulching	Number of leaves / shoot		Shoot length (cm)	
			2012	2013	2012	2013
sub surface	control 1	control 2	18.41m	18.61l	19.08l	19.17l
	control 1	plastic sheet	22.57h	22.77g	22.52h	22.95g
	control 1	rice straw	22.33g	22.36gh	22.14h	22.16h
	compost	control 2	23.57	23.70f	23.75g	23.84f
	compost	plastic sheet	30.19a	30.20a	30.41a	30.33a
	compost	rice straw	29.09b	29.07b	29.18b	29.19b
	goat manure	control 2	20.04k	20.07j	20.03jk	20.12jk
	goat manure	plastic sheet	26.69d	26.82d	26.47d	26.22d
	goat manure	rice straw	25.13e	25.23e	25.28e	25.65d

surface	control 1	control 2	16.52n	16.55m	17.31m	17.53m
	control 1	plastic sheet	21.23j	21.42i	21.18i	21.31i
	control 1	rice straw	20.29k	20.42j	20.41j	20.60j
	compost	control 2	21.92i	21.98h	21.97h	21.99h
	compost	plastic sheet	28.79b	28.86b	28.31c	28.53c
	compost	rice straw	27.85c	27.85c	27.82c	28.21c
	goat manure	control 2	19.21l	19.52k	19.41kl	19.53kl
	goat manure	plastic sheet	24.67f	25.07e	24.77ef	25.00e
	goat manure	rice straw	24.63f	24.14f	24.47f	24.52e

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Number of followers / shoot and fruit set %

Data in Table (5) showed that fruit set was significantly affected by all treatments in both seasons. It is obvious that subsurface drip irrigation system increased number of followers / shoot and fruit set % as compared with surface drip irrigation. In addition, compost gave the highest fruit set% in both seasons. Furthermore, mulching the soil with plastic cover gave the best fruit set % as compared with control.

On the other hand, the interactions between irrigation systems and organic fertilization show that compost under sub surface drip irrigation gave the highest number of followers / shoot and fruit set % in both seasons.

In addition, the interaction between irrigation systems and soil mulching show that number of followers / shoot and fruit set % increased with plastic cover under sub surface drip irrigation system as compared with surface drip irritation without mulching in both seasons.

However, the interactions between compost and mulching with plastic cover gave the highest number of followers / shoot and fruit set % compared with control in both seasons.

Moreover the interactions between irrigation system, organic fertilization and soil mulching clear that compost and mulching the soil with plastic cover under sub surface drip irrigation gave the best number of followers / shoot (4.99 in first season and 5.00 in second seasons) and the highest fruit set (34.75 in first season and 35.00% in second seasons). In addition, there is no significant difference between compost and mulching the soil with plastic cover or rice straw under sub surface drip irrigation in fruit set at second seasons (34.74% in the second seasons). On the other hand, surface drip irrigation without fertilization and mulching gave the lowest fruit set % in both seasons**.**

These results are in harmony with those obtained by **Bryla, et al (2003)** who found that sub surface drip irrigation improve vegetative growth of newly planted `Crimson Lady' peach [*Prunus persica* (L.) Batsch] trees. **Tiwari et al., (2014)** recorded that plastic mulch and drip irrigation increase growth parameters in Sapota (*Achras zapota*) as compared with ring basin irrigation. **Abd-Elaal et al., (2007)** who founded that compost improving berry set in Superior grapevines in both seasons.

Table 5. Effect of irrigation systems, organic fertilization and soil mulching on number of followers / shoot and fruit set % of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons**.**

Treatments	Number of followers / shoot		Fruit set %	
	2012	2013	2012	2013
Effect of drip irrigation systems				
sub surface	3.10a	3.23a	28.42a	28.73a
surface	2.68b	2.78b	26.74b	27.02b
Effect of organic fertilization				
control 1 (without)	2.09c	2.14c	23.85c	24.09c
compost	3.74a	3.91a	31.33a	31.71a
goat manure	2.84b	2.95b	27.56b	27.83b
Effect of soil mulching				
control 2 (without)	2.05c	2.12c	23.42c	23.64c
plastic sheet	3.45a	3.55a	29.99a	30.30a
rice straw	3.17b	3.33b	29.33b	29.69b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	2.30e	2.32e	24.54e	24.82e
sub surface+ compost	4.01a	4.17a	32.21a	32.52a
sub surface + goat manure	3.00c	3.18c	28.51c	28.83c
surface + control1	1.89f	1.95f	23.16f	23.35f
surface + compost	3.48b	3.64b	30.44b	30.90b
surface + goat manure	2.67d	2.72d	26.61d	26.83d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	2.20e	2.28e	24.20e	24.43e
sub surface + plastic sheet	3.77a	3.84a	30.76a	31.16a
sub surface + rice straw	3.33b	3.56b	30.29b	30.59b
surface + control2	1.89f	1.95f	22.64f	22.85f
surface + plastic sheet	3.13c	3.26c	29.20c	29.43c

surface + rice straw			3.01d	3.10d	28.37d	28.80d
Effect of organic fertilization and soil mulching						
control 1 + control 2			1.73h	1.74i	20.73i	20.91i
compost + control 2			2.31ef	2.39f	25.62f	25.92f
goat manure + control 2			2.24f	2.27g	25.21g	25.44g
control 1 + plastic sheet			2.42e	2.57e	26.67e	26.85e
compost + plastic sheet			4.60a	4.73a	34.09a	34.41a
goat manure + plastic sheet			4.20b	4.42b	33.22b	33.87b
control 1+ rice straw			1.99g	2.04h	22.86h	23.17h
compost + rice straw			3.44c	3.52c	30.25c	30.56c
goat manure + rice straw			3.07d	3.30d	29.56d	29.77d
Effect of drip irrigation systems, organic fertilization and soil mulching						
drip irrigation systems	**organic fertilization**	**soil mulching**	**Number of followers / shoot**		**Fruit set %**	
			2012	**2013**	**2012**	**2013**
sub surface	control 1	control 2	1.98j	1.96m	21.46o	21.70o
	control 1	plastic sheet	2.51fg	2.59i	26.15j	26.59i
	control 1	rice straw	2.41gh	2.42j	26.00j	26.18j
	compost	control 2	2.63f	2.80h	27.58i	27.83h
	compost	plastic sheet	4.99a	5.00a	34.75a	35.00a
	compost	rice straw	4.39b	4.71b	34.31b	34.74a
	goat manure	control 2	2.00ij	2.07lm	23.56m	23.77m
	goat manure	plastic sheet	3.80c	3.92e	31.38e	31.89d
	goat manure	rice straw	3.20d	3.55f	30.57f	30.84e
surface	control 1	control 2	1.49k	1.53n	20.00p	20.11p
	control 1	plastic sheet	2.11ij	2.19kl	25.08k	25.25k
	control 1	rice straw	2.07ij	2.12lm	24.42l	24.69l
	compost	control 2	2.21hi	2.34jk	25.76j	25.88j
	compost	plastic sheet	4.22b	4.46c	33.42c	33.81b
	compost	rice straw	4.01c	4.13d	32.13d	33.00c
	goat manure	control 2	1.99ij	2.00m	22.15n	22.56n
	goat manure	plastic sheet	3.07de	3.12g	29.12g	29.22f
	goat manure	rice straw	2.95e	3.05g	28.55h	28.70g

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Fruit parameters (fruit physical characteristics)

It could be noticed from tables (6 and 7) that all treatments are significantly increased fruit length, diameter, weight and grains weight than the control in both seasons. Subsurface drip irrigation system increased fruit length, diameter, weight and grains weight in both seasons as compared with surface drip irrigation. In addition, compost gave the highest fruit length, diameter, weight and grains weight in both seasons. Furthermore, mulching the soil with plastic cover gave the best fruit length, diameter, weight and grains weight as compared with control.

On the other hand, the interactions between compost and sub surface drip irrigation gave the highest fruit length (8.20 in the 1st and 8.26 cm in the 2nd season), fruit diameter (9.30 in first season and 9.58 cm in second seasons respectively), fruit weight (404.21 in the 1st and 405.03g in the 2nd season) and grains weight (315.52 in first season and 317.37 g in second seasons respectively).

Moreover, the interaction between plastic cover and sub surface drip irrigation was the best effect in fruit length, diameter, weight and grains weight than surface drip irritation without mulching in both seasons.

In addition, the interactions between compost and mulching with plastic cover gave the highest fruit length, diameter, weight and grains weight as compared with control in both seasons.

Moreover the interactions between compost and mulching the soil with plastic cover under sub surface drip irrigation gave the best fruit length, diameter, weight and grains weight in both seasons. On the other hand, surface drip irrigation without fertilization and mulching gave the less fruit length, diameter, weight and grains weight in both seasons**.**

These results are in parallel with those obtained by **Bryla, et al., (2003)** who founded that sub surface drip irrigation improve vegetative growth of newly planted `Crimson Lady' peach [*Prunus persica* (L.) Batsch] trees. In addition, **(Abd-ELaal et al., 2007)** recorded that the compost increasing cluster weight, berry weight and dimensions on superior grapevines.

Table 6. Effect of irrigation systems, organic fertilization and soil mulching on fruit length and fruit diameter of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons**.**

Treatments	Fruit length (cm)		Fruit diameter (cm)	
	2012	2013	2012	2013
Effect of drip irrigation systems				
sub surface	7.88a	7.93a	8.77a	8.91a
surface	7.71b	7.76b	8.55b	8.57b
Effect of organic fertilization				
control 1 (without)	7.50c	7.54c	8.14c	8.17c
compost	8.10a	8.16a	9.21a	9.38a
goat manure	7.80b	7.84b	8.63b	8.69b
Effect of soil mulching				
control 2 (without)	7.46c	7.49c	7.97c	8.02c
plastic sheet	8.01a	8.05a	9.08a	9.16a
rice straw	7.93b	7.99b	8.93b	9.05b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	7.64e	7.63e	8.29e	8.35e
sub surface+ compost	8.20a	8.26a	9.30a	9.58a
sub surface + goat manure	7.82c	7.88c	8.70c	8.80c
surface + control1	7.37f	7.44f	7.99f	7.98f
surface + compost	8.01b	8.06b	9.11b	9.18b
surface + goat manure	7.78d	7.79d	8.55d	8.56d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	7.55e	7.58e	8.07e	8.15[
sub surface + plastic sheet	8.10a	8.14a	9.17a	9.32a
sub surface + rice straw	8.00b	8.05b	9.06b	9.27b
surface + control2	7.36f	7.40f	7.87f	7.90f
surface + plastic sheet	7.93c	7.97c	8.98c	9.00c
surface + rice straw	7.86d	7.92d	8.81d	8.82d
Effect of organic fertilization and soil mulching				
control 1 + control 2	7.15h	7.21g	7.27i	7.33i
compost + control 2	7.73e	7.73e	8.64f	8.65f
goat manure + control 2	7.64f	7.67e	8.51g	8.52g
control 1 + plastic sheet	7.79d	7.80d	8.70e	8.76e
compost + plastic sheet	8.32a	8.40a	9.53a	9.74a
goat manure + plastic sheet	8.20b	8.28b	9.38b	9.64b
control 1+ rice straw	7.43g	7.47f	7.94h	7.97h
compost + rice straw	7.99c	8.04c	9.04c	9.08c
goat manure + rice straw	7.97c	8.00c	8.91d	8.98d

Effect of drip irrigation systems, organic fertilization and soil mulching

drip irrigation systems	organic fertilization	soil mulching	Fruit length		Fruit diameter	
			2012	2013	2012	2013
sub surface	control 1	control 2	7.30m	7.31m	7.42p	7.51p
	control 1	plastic sheet	7.85g	7.83g	8.75i	8.80i
	control 1	rice straw	7.76h	7.76gh	8.72j	8.75j
	compost	control 2	7.89g	7.91f	8.80h	8.82h
	compost	plastic sheet	8.43a	8.50a	9.65a	9.97a
	compost	rice straw	8.27b	8.37b	9.45b	9.96a
	goat manure	control 2	7.45l	7.51k	8.00m	8.10n
	goat manure	plastic sheet	8.01e	8.10d	9.11e	9.18d
	goat manure	rice straw	7.99ef	8.03de	9.00f	9.11e
surface	control 1	control 2	7.00n	7.10n	7.13q	7.14q
	control 1	plastic sheet	7.60j	7.62ij	8.53l	8.50l
	control 1	rice straw	7.51k	7.59jk	8.30m	8.29m
	compost	control 2	7.69i	7.69hi	8.61k	8.70k
	compost	plastic sheet	8.20c	8.30b	9.42c	9.51b
	compost	rice straw	8.13d	8.20c	9.32d	9.31c
	goat manure	control 2	7.41l	7.42l	7.87o	7.84o
	goat manure	plastic sheet	7.98ef	7.98ef	8.98g	8.98f
	goat manure	rice straw	7.94f	7.96ef	8.81h	8.85g

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Table 7. Effect of irrigation systems, organic fertilization and soil mulching on fruit weight and grains weight of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons.

Treatments	Fruit weight(g)		Grains weight (g)	
	2012	2013	2012	2013
Effect of drip irrigation systems				
sub surface	385.95a	388.22a	287.88a	290.33a
surface	377.17b	379.83b	268.97b	274.70b

Effect of organic fertilization				
control 1 (without)	362.59c	366.37c	250.00c	255.23c
compost	400.06a	401.07a	305.62a	310.24a
goat manure	382.03b	384.64b	219.63b	282.06b
Effect of soil mulching				
control 2 (without)	359.33c	364.31c	239.49c	244.68c
plastic sheet	394.79a	395.69a	300.83a	304.95a
rice straw	390.56b	392.07b	294.94b	297.91b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	367.37e	371.22e	265.19e	268.04e
sub surface+ compost	404.21a	405.03a	315.52a	317.37a
sub surface + goat manure	386.26c	388.43c	282.91c	285.57c
surface + control1	357.81f	361.52f	234.81f	242.42f
surface + compost	395.91b	397.10b	295.72b	303.10b
surface + goat manure	377.81d	380.86d	276.36d	278.56d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	363.44e	368.28e	248.86e	251.99e
sub surface + plastic sheet	399.33a	399.89a	311.38a	312.67a
sub surface + rice straw	395.07b	396.50b	303.39b	306.32b
surface + control2	355.23f	360.35f	230.12f	237.37f
surface + plastic sheet	390.25c	391.48c	290.27c	297.23c
surface + rice straw	386.05d	387.64d	286.50d	289.49c
Effect of organic fertilization and soil mulching				
control 1 + control 2	342.62i	350.45i	212.33i	215.23i
compost + control 2	375.18f	375.91f	274.62f	282.70f
goat manure + control 2	369.95g	372.75g	263.07g	267.76g
control 1 + plastic sheet	377.44e	379.59e	280.44e	288.12e
compost + plastic sheet	413.97a	414.10a	320.43a	322.77a
goat manure + plastic sheet	408.81b	409.51b	316.00b	319.82b
control 1+ rice straw	357.94h	362.90h	225.70h	230.68h
compost + rice straw	395.25c	397.07c	307.43c	309.37c
goat manure + rice straw	392.91d	393.96d	305.77d	306.14d

Effect of drip irrigation systems, organic fertilization and soil mulching

drip irrigation systems	**organic fertilization**	**soil mulching**	**Fruit weight (g)**		**Grains weight(g)**	
			2012	**2013**	**2012**	**2013**
sub surface	control 1	control 2	346.34q	355.59q	219.33q	219.54q
	control 1	plastic sheet	380.32j	380.46j	298.32j	299.25j
	control 1	rice straw	375.44k	377.62k	280.93k	285.33k
	compost	control 2	382.56i	383.69i	300.00i	301.28i
	compost	plastic sheet	417.67a	418.00a	325.74a	326.33a
	compost	rice straw	412.41b	413.39b	320.83b	324.49b
	goat manure	control 2	361.43o	365.57o	230.24o	235.14o
	goat manure	plastic sheet	400.00e	401.22e	310.07e	312.41f
	goat manure	rice straw	397.35f	398.49f	308.41f	309.14f
surface	control 1	control 2	338.90r	345.32r	208.32r	210.93r
	control 1	plastic sheet	370.05m	371.35m	250.91m	266.16m
	control 1	rice straw	364.47n	367.87n	245.21n	250.18n
	compost	control 2	372.32l	375.49l	260.88l	274.96l
	compost	plastic sheet	410.20c	410.19c	315.12c	319.20c
	compost	rice straw	405.21d	405.63d	311.17d	315.15d
	goat manure	control 2	354.49p	360.24p	221.17p	226.21p
	goat manure	plastic sheet	390.49g	392.92g	304.79g	306.32g
	goat manure	rice straw	388.47h	389.42h	303.12h	303.14h

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Fruit quality (fruit chemical characteristics)

It could be noticed from (8 and 9) that all treatments significantly increased TSS%, total sugar content and vitamin C mg/100g than the control in both seasons. Sub surface drip irrigation system increased TSS, total sugar, vitamin C and decrease total acidity in both seasons as compared with surface drip irrigation. In addition, compost gave the highest TSS, total sugar content, vitamin C in both seasons. Furthermore, mulching the soil with plastic cover gave the best fruit TSS, total sugar content, vitamin C and the lowest total acidity.

On the other hand, the interactions between compost and sub surface drip irrigation gave the highest TSS (17.15 in the 1st and 17.23% in the 2nd season), total sugar content (13.94 in first season and 14.07% in second seasons respectively), vitamin C (16.61 mg/100g in both seasons) and the lowest total acidity (1.12 in the 1st and 1.09% in the 2nd season).

While, the interaction between plastic cover and sub surface drip irrigation was the best effect in TSS, total sugar content, total acidity and vitamin C than surface drip irritation without mulching in both seasons.

In addition, the interactions between compost and mulching with plastic cover gave the highest TSS, total sugar content, vitamin C and the lowest total acidity in both seasons.

Moreover the interactions between compost and mulching the soil with plastic cover or rice straw under sub surface drip irrigation gave the best TSS and total sugar content in the first season, but in the second season, plastic cover under sub surface drip irrigation with compost fertilization gave the best TSS and total sugar content. In addition, there was non significant deference between plastic cover and rise straw under sub surface drip irrigation with compost fertilization in vitamin C in both seasons. Furthermore, compost and mulching the soil with rice straw under sub surface drip irrigation gave the lowest total acidity in first season but there was non significant deference between rice straw and plastic cover under sub surface drip irrigation with compost fertilization in total acidity. On the other hand, surface drip irrigation without fertilization and mulching gave less TSS, total sugar content, vitamin C and increase total acidity in both seasons**.**

These results are in harmony with those obtained by **Bryla, et al., (2003)** founded that sub surface drip irrigation improve vegetative growth of newly planted `Crimson Lady' peach [*Prunus persica* (L.) Batsch] trees. In addition, **(Abd-ELaal et al., 2007)** recorded that the compost increases percentage of total soluble solids while decreasing the total acidity of the juice on superior grapevines.

Table 8. Effect of irrigation systems, organic fertilization and soil mulching on TSS% and total sugar content of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons**.**

Treatments			**TSS%**		**Total sugar %**	
			2012	**2013**	**2012**	**2013**
Effect of drip irrigation systems						
sub surface			16.53a	16.61a	13.27a	13.38a
surface			16.23b	16.33b	12.97b	13.04b
Effect of organic fertilization						
control 1 (without)			15.76c	15.86c	12.97c	12.48c
compost			16.99a	17.03a	13.80a	13.91a
goat manure			16.40b	16.51b	13.15b	13.24b
Effect of soil mulching						
control 2 (without)			15.67c	15.81c	12.41c	12.50c
plastic sheet			16.80a	16.85a	13.55a	13.67a
rice straw			16.68b	16.74b	13.39b	13.50b
Effect of drip irrigation systems and organic fertilization						
sub surface + control1			15.96e	16.03e	12.55e	12.66e
sub surface+ compost			17.15a	17.23a	13.94a	14.07a
sub surface + goat manure			16.49c	16.57c	13.30c	13.40cb
surface + control1			15.55f	15.70f	12.27f	12.30f
surface + compost			16.83b	16.64b	13.65b	13.75c
surface + goat manure			16.31d	16.45d	13.00d	13.08d
Effect of drip irrigation systems and soil mulching						
sub surface + control2			15.85e	15.96e	12.57e	12.63e
sub surface + plastic sheet			16.92a	17.00a	13.72a	13.88a
sub surface + rice straw			16.83b	16.86b	13.51b	13.63b
surface + control2			15.50f	15.65f	12.26f	12.31f
surface + plastic sheet			16.68c	16.70c	13.39c	13.46c
surface + rice straw			16.52d	16.62d	13.27d	13.36d
Effect of organic fertilization and soil mulching						
control 1 + control 2			15.07i	15.21i	12.13h	12.16i
compost + control 2			16.16f	16.25f	12.58f	12.70f
goat manure + control 2			16.05g	16.13g	12.53f	12.58g
control 1 + plastic sheet			16.28e	16.40e	12.78e	12.89e
compost + plastic sheet			17.41a	17.41a	14.36a	14.48a
goat manure + plastic sheet			17.28b	17.29b	14.25b	14.37b
control 1+ rice straw			15.68h	15.81h	12.33g	1236h
compost + rice straw			16.83c	16.90c	13.73c	13.83c
goat manure + rice straw			16.71d	16.82d	13.40d	13.53d
Effect of drip irrigation systems, organic fertilization and soil mulching						
drip irrigation systems	**organic fertilization**	**soil mulching**	**TSS%**		**Total sugar %**	
			2012	**2013**	**2012**	**2013**
sub surface	control 1	control 2	15.35m	15.36p	12.25j	12.27p
	control 1	plastic sheet	16.33fg	16.46i	12.74g	12.98j
	control 1	rice straw	16.21gh	16.28j	12.66g	12.74k
	compost	control 2	16.45ef	16.66h	13.10f	12.23i
	compost	plastic sheet	17.56a	17.56a	14.41a	14.55a
	compost	rice straw	17.44a	17.46b	14.32a	14.43b
	goat manure	control 2	15.75k	15.86n	12.35hij	12.37m
	goat manure	plastic sheet	16.87d	16.99e	14.00c	14.11e
	goat manure	rice straw	16.85d	16.86f	13.55d	13.71f

surface	control 1	control 2	14.78n	15.07q	12.00k	12.05q
	control 1	plastic sheet	16.00ij	16.05l	12.42hi	12.42m
	control 1	rice straw	15.88jk	15.98m	12.41hi	12.42m
	compost	control 2	16.11hi	16.13k	12.47h	12.54l
	compost	plastic sheet	17.26b	17.26c	14.30a	14.40c
	compost	rice straw	17.12c	17.12d	14.18b	14.31d
	goat manure	control 2	15.60l	15.76o	12.31ij	12.35o
	goat manure	plastic sheet	16.78d	16.80g	13.45d	13.55g
	goat manure	rice straw	16.56e	16.77g	13.24e	13.35h

Means having the same letter (s) in each column or interaction are not significantly different at 5% level.

Table 9. Effect of irrigation systems, organic fertilization and soil mulching on total acidity and vitamin C of Manfalouty cv. pomegranate trees during 2012 and 2013 seasons.

Treatments	Total acidity %		Vitamin C mg/100g	
	2012	**2013**	**2012**	**2013**
Effect of drip irrigation systems				
sub surface	1.24b	1.22b	15.97a	16.02a
surface	1.29a	1.29a	15.53b	15.63b
Effect of organic fertilization				
Control 1(without)	1.38a	1.39a	14.94c	15.04c
compost	1.15c	1.12c	16.44a	16.48a
goat manure	1.26b	1.25b	15.87b	15.97b
Effect of soil mulching				
control 2 (without)	1.39a	1.40a	14.69c	14.84c
plastic sheet	1.20c	1.17c	16.31a	16.35a
rice straw	1.21b	1.20b	16.24b	16.30b
Effect of drip irrigation systems and organic fertilization				
sub surface + control1	1.34b	1.36b	15.31e	15.40e
sub surface+ compost	1.12f	1.09f	16.61a	16.61a
sub surface + goat manure	1.25d	1.23d	15.98c	16.06c
surface + control1	1.41a	1.43a	14.57f	14.68f
surface + compost	1.18e	1.16e	16.26b	16.35b
surface + goat manure	1.28c	1.28c	15.76d	15.87d
Effect of drip irrigation systems and soil mulching				
sub surface + control2	1.36b	1.37b	14.90d	15.00d
sub surface + plastic sheet	1.18e	1.13f	16.53a	16.53a
sub surface + rice straw	1.17e	1.17e	16.46a	16.53a
surface + control2	1.41a	1.43a	14.48e	14.67e
surface + plastic sheet	1.21d	1.22d	16.10b	16.17b
surface + rice straw	1.24c	1.23c	16.02c	16.06c
Effect of organic fertilization and soil mulching				
control 1 + control 2	1.53a	1.54a	14.04f	14.16g
compost + control 2	1.29d	1.31d	15.44d	15.50e
goat manure + control 2	1.31c	1.33c	15.36d	15.46e
control 1 + plastic sheet	1.29d	1.29e	15.60c	15.71d
compost + plastic sheet	1.08f	1.04h	16.89a	16.89a
goat manure + plastic sheet	1.09f	1.05h	16.82a	16.84a
control 1+ rice straw	1.35b	1.37b	14.44e	14.64f
compost + rice straw	1.22e	1.17g	16.62b	16.66b
goat manure + rice straw	1.23e	1.22f	16.55b	16.59c

Effect of drip irrigation systems, organic fertilization and soil mulching

drip irrigation systems	organic fertilization	soil mulching	Total acidity%		Vitamin C mg/100g	
			2012	**2013**	**2012**	**2013**
sub surface	control 1	control 2	1.48b	1.49b	14.22j	14.32m
	control 1	plastic sheet	1.27e	1.28g	15.87e	15.88g
	control 1	rice straw	1.28e	1.30f	15.84e	15.99f
	compost	control 2	1.26ef	1.25h	15.95e	15.91g
	compost	plastic sheet	1.07k	1.00m	17.00a	17.00a
	compost	rice straw	1.03l	1.01m	16.88ab	16.93a
	goat manure	control 2	1.34c	1.37c	14.54i	14.78k
	goat manure	plastic sheet	1.20h	1.11k	16.72c	16.72bc
	goat manure	rice straw	1.21h	1.20j	16.67c	16.69c
surface	control 1	control 2	1.58a	1.59a	13.85k	14.00n
	control 1	plastic sheet	1.31d	1.34d	15.00g	15.11i
	control 1	rice straw	1.34c	1.36cd	14.87h	14.92j
	compost	control 2	1.31d	1.32e	15.25f	15.51h
	compost	plastic sheet	1.09j	1.08l	16.78bc	16.79b
	compost	rice straw	1.14i	1.09l	16.75c	16.76bc
	goat manure	control 2	1.35c	1.37c	14.34j	14.51l
	goat manure	plastic sheet	1.23g	1.23i	16.51d	16.61d
	goat manure	rice straw	1.25fg	1.24hi	16.43d	16.50e

Means having the same letter (s) in each column or interaction are not significantly different at 5% level

IV. Conclusion

From the present study, it can be concluded that sub surface drip irrigation system with compost as fertilization and mulching the soil with plastic cover improved leaf area, leaf chlorophyll, number of leaves/shoot, shoot length, number of followers / shoot, fruit set %, fruit length, fruit diameter, fruit weight, grains weight, TSS, total sugar and vitamin C in both seasons. On the other side, surface drip irrigation without any organic fertilization and soil mulching gave the highest total acidity as compared with all treatments used on Manfalouty cv. pomegranate cultivar at Baloza Experimental Station, Desert Research Center, North Sinai Governorate, Egypt.

Reference

[1]. A. O. A. C., (1985). Official methods of analysis. Association of Official Agricultural Chemists,14th ed: Benjamin Franklin station Washington, DC, USA, pp: 490-510.

[2]. Abd-ElaaI, A. H; Basma M. S. and Ghada Sh. Sh. (2007). Response of Superior Grapevines to Application of Filter Mud, Compost El-Nile and Green Manure J. Agric. Sd. Mansoura Univ., 32 (12): 10300 – 10309.

[3]. Abou El-Wafa, M. (2002). Effect of Some Treatments on Drought Resistance of Transplants of Some Pomegranate Cultivars. M.Sc. Thesis, Hort. Dept. Fac. Agric., Cairo Univ. Egypt, pp: 132.

[4]. Albert T. ; KKarp, M. ; Starast and Paal T. (2010). The effect of mulching and pruning on the vegetative growth and yield of the half-high blueberry. Agron Res 8 (1): 759-769.

[5]. Arancon, N. Q.; Edward, C. A.; Atiyeh, R. M. and Metzger, J. D. (2004). Effect of vermicompost produced from cattle manure, food waste and paper waste on the growth and yield of peppers in the field. Pedobiologia, 49, 297- 306.

[6]. Bryla, D. R.; Trout, T. J. and Ayars, J. E. (2003). Growth and production of young peach trees irrigated by furrow, microjet, surface drip, or subsurface drip systems. Hort. Science, 38(6), pp.1112-1116.

[7]. Douh B.; Boujelben A.; Khila S. and Bel Haj Mguidiche A. (2013). Effect of Subsurface Drip Irrigation System Depth on Soil Water Content Distribution at Different Depths and Different Times after Irrigation. Larhyss Journal, 13, pp. 7-16.

[8]. Duncan, D. B. (1955). Multiple range and multiple F Test. Biometrics, 11: 1-42.

[9]. EI-Kosary S.; Bakr E. I.; Hussein I. A. and Sheren A. E. (2009). Effect of Soil Moisture Depletion and Mulching of Cv. Zaghloul Date Palm (*Phoenix Dactylifera* L.) Fruiting Under Desert Conditions. Mansoura University Journal of Agricultural Sciences, 34: 3, 3437- 3452.

[10]. El Mardi, M. O.; Al Said, F. Al.; Sakit, C. B.; Al Kharusi, L. M.; Al Rahbi, I. N. and Al Mahrazi, K. (2007). Effect of pollination method, fertilizer and mulch treatments on the physical and chemical characteristics of date palm (*Phoenix dactylifera* L.). Fruit 1: Physical characteristics. Acta Horticulture 736: III International Date Palm Conference.

[11]. Hati K. M.; Mandal K. G.; Misra A. K, Gosh P. K. and Bandyopadhyay K. K. (2006). Effect of inorganic fertilizer and farmyard manure on soil physical properties, root distribution and water-use efficiency of soybean in Vertisols of central India. Bioresour. Technol. 16: 2182 – 2188

[12]. Helweg, O. J. (1989). Evaluating the traveling trickle center pivot., ICID-Bulletin 38:1, 13-20.

[13]. Holland, D.; Hatib, K. and Bar-Yàakov, I., (2009). Pomegranate: Botany, horticulture, breeding. Horticultural Reviews 35, 127–191.

[14]. Jalota S. K. and Prihar S. S. (1998). Reducing soil water evaporation with Tillage and Mulching. Iowa State University Press, Ames.IA.142P.

[15]. Janaki A. and Hkmsk H. (2009). Impact of Mulching on Soil Moisture, Plant Growth and Yield of Mauritius Pineapple (*Ananas comosus.* L. Merr) Journal of Food and Agriculture . Vol 2, No 1 15-21.

[16]. Kay, B. L. (1998). Mulching and chemical stabilizers for land reclamation in dry regions. pp 467-483. In. F. W. Schaller and P. sutten, editors. Reclamation of Drastically Distributed lands. Am. Soc. Agronomy Madison. WI.

[17]. Lu W.G.; Huang Q.W. and Shen Q. R. (2005). The effect of organic fertilizer and organic-inorganic fertilizer application on soil enzymes activities during watermelon growing period. Journal of Nanjing Agricultural. 28; 68-71

[18]. Misak R. F. and M. Y. Draz (1997). Sand drift control of selected coastal and desert dunes in Egypt: case studies. Journal of Arid Environments 35: 17–28.

[19]. Monteith, (1973) In " principles of environmental physics". Edward Arnold, Ltd., London, U.K.

[20]. Munshower F. F. (1994). Practical hand book of disturbed land revegetation lewis. Publishers. Boca. Raton. FL.

[21]. Ramakrishna A. ;Tam H. M. ;Wani S. P. and Long T. D. (2006). Effect of mulch on soil temperature, moisture, weed infestation and yield of groundnut in northern Vietnam. Field Crop Res 95: 115–125.

[22]. Ren Z. G.; Chen Y. S. and Tang F. Q. (1996). Effect of inorganic fertilizer combined with organic manure on the micro flora and enzyme activities in paddy soil. Plant Nutrition and Fertilizer Science 2, 279-283.

[23]. Safar H. AL-Kahtani and Ahmed M. A. (2012). Effect of Different Mixtures of Organic Fertilizers on Vegetative Growth, Flowering, Fruiting and Leaf Mineral Content of Picual Olive Trees American-Eurasian J. Agric. & Environ. Sci., 12 (8): 1105-1112.

[24]. Stover, E. and Mercure, E. W. (2007). The Pomegranate: a new look at the fruit of paradise. HortScience 42, 1088–1092.

[25]. Sudadi Y. N.; Hidayati S. F. and Sumani M. N. (2007). Ketersediaan K dan hasil kedelai (*Glycine max* L. Cerril) pada tanah vertisol yang diberi mulsa dan pupuk kandang. J I Tanah Lingk 7 (1): 8-12 (in Indonesian).

[26]. Sun R. L.; Zhao B. Q. and Zhu L. S. (2003) Effects of long-term fertilization on soil enzyme activities and its role in adjusting-controlling soil fertilit. Plant Nutrition and Fertilizer Science 9, 406-410.

[27]. Talat F. A.; Hashim N. H.; Abdul Razzaq G. and Sheikh A. A. (2012) Performance assessment of surface and subsurface drip irrigation system for date palm fruit trees. African Journal of Agricultural Research Vol. 7(10), pp. 1542-1549.

[28]. Tarara J. M. (2000) Micro climate modification with plastic mulch. Hort Science 35: 169-180

[29]. Tiwari K. N.; Mukesh K.; Santosh D. T.; Vikas K. S.; Maji M. K. and Karan A. K.(2014) Influence of Drip Irrigation and Plastic Mulch on Yield of Sapota (*Achras zapota*) and Soil Nutrients. Irrigate Drainage Sys Eng Volume 3: 1-8.

[30]. Zaman W. U.; Arshad M. and Saleem K. (2001). Distribution of nitrate –nitrogen in the soil profile under different irrigation methods. International, J. Agri. Biol., 2: 208-9.