

**Effect of Supplemental Irrigation and Organic
Fertilization on Vegetative Growth, Yield and Fruit
Quality of Early Grand Peach under
North Sinai Conditions**

By

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B.Sc. Agric. Sci. (Hort. Sci.), Fac. Agric., Minoufia Univ., Egypt, 2007

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ABSTRACT

This study was carried out during two successive seasons (2009/2010 and 2010/2011) on ten years old of Early Grand peach trees. All trees are grown in a sandy soil that budded on bitter almond rootstock planted at 5 x 5 meters under rainfall irrigation conditions. Fifty four experimental trees, that grown in a private orchard at El Hosinat, Rafah, North Sinai Gov., Egypt, were chosen of normal growth and uniformly in shape and size to apply this study. The experimental design was spilt plot design, whereas, the main plot was subjected to supplemental irrigation treatments (rainfall only, 10 mm + rainfall and 20 mm + rainfall per feddan) and the sub-main plot was organic fertilizer treatments (0, 25 and 50 Kg/tree of olive solid waste). The present investigation aimed to examine the effect of supplemental irrigation and organic fertilizer treatments on vegetative growth, yield, physical and chemical fruit characteristics. Also, to maximize the productivity with high fruit quality of Early Grand peach cultivar under rainfall conditions.

The obtained results cleared that both supplemental irrigation and organic fertilization significantly enhanced the most vegetative growth and yield of Early Grand peaches. In addition, 20 mm supplemental irrigation with 50 kg/fed. organic fertilization produced the highest vegetative growth (trunk circumference, new formed shoots number, length, leaf area, total leaf chlorophyll content and the nutritional state.), yield and fruit quality, as well as fruit weight, size, length, diameter, TSS% and total sugars.

In conclusion, no significant differences were found, in the most characteristics under study, due to using 50 kg/tree organic with 10 or with 20 mm water/fed. over rainfall in the two seasons. So, the recommendation of this study is fertilizing Early Grand peach by 50kg/tree olive solid waste with adding 10mm/feddan additional water, that is the best treatment under Northern Sinai rainfall conditions.

Keywords: Supplemental irrigation - Organic Fertilization - Early Grand – Peach – Growth – Yield - Fruit Quality - North Sinai Conditions.

INTRODUCTION

Egypt lies mostly in the sub-tropical zone between 22° to 30° latitudes; chilling hours are varying between 150-300 hours in the most production areas. Commercial production of temperate zone fruits started at the beginning of the twenty-century around 1913 when Suez Canal Company or American school at Assiut introduced low chilling pears, plums and peaches (The agriculture development system project of Egypt, ministry of agriculture, 1979).

Peach tree (*Prunus persica*) is native to family Rosaceae. It is one of the most successful deciduous fruits. Peach cultivated in China for approximately 4000 years, and then moved to the current producing countries. Peach harvested areas increased rapidly from year to year. Nowadays the cultivated area of peaches is 80609 fed, that represented 5.9 % of total cultivated area of fruit trees in Egypt. Fruitful area is 78613 fed. which produced 273256 ton as equal 3.47 ton/fed. Egypt peach cultivated area extension from season to season and this is due to its highly economic value, exporting potential and introducing new low chilling cultivars, (The Statistics of the Ministry of Agriculture and land Reclamation Egypt, 2010).

North Sinai is one of the most important peach areas in Egypt, whereas 77% of peach cultivated area is located in North Sinai. In the other hand, North Sinai is recording the lowest yield per fed., compared with other governorates. Furthermore, yield is reduced seasonally from 3.14 ton\fed. in 2007 to 1.64 ton\fed. in 2010 (Table 1) and this may be attributed to firstly to insufficient mineral or organic fertilization (Kassem and Marzouk, 2002), secondly to deficit of water and decrease of rains

whereas annual rainfall is in average of 200 mm, while, about 593–647mm of water per year are required to produce a reasonable crop of peach (Girona *et al.*, 2005). Hence, annual rainfall does not match the crop requirement, added to that, high temperature and climatic changes. (Data determined by meteorological station in North Sinai research station). Also, it may attribute to difficult of agriculture process such as irrigation and fertilization especially under rainfall conditions.

Table 1. Area production of peach in Egypt (2010)

Governorate	Cultivated area (fed.)	Fruitful area (fed.)	Production (ton)	Yield (ton/fed.)
North Sinai	62159	61869	101651	1.64
Nubaria	10563	10563	121654	11.5
Behera	2524	2520	24575	9.75
Menoufia	1348	832	5537	6.65
Ismailia	1235	764	4112	5.38

(The Statistics of the Ministry of Agriculture and land Reclamation Egypt)

Irrigation affects soil water availability and consequently, plant water status, shoot growth, productivity and fruit size (Naor, 1999). Moreover, the humid and sub-humid zones, irrigation have been used for some time to supplement rainfall as a tactical measure during drought spells to stabilize production. This practice has been called supplemental irrigation (Cabelguenne *et al.*, 1995). Also, emphasize that irrigation is essential for sufficient food production in the future (Dyson, 1999). Whereas, the arid and semi- arid zones, fruit production is a direct function of irrigation (Abd El-samad *et al.*, 2006 and Naor *et al.*, 2008). That is

reflecting the vital role of supplemental irrigation on yield and fruit quality of peach especially under rainfall conditions.

There is a general agreement that nutrition is one of the most effective factors affecting tree growth, yield, and fruit quality (Kassem and Marzouk, 2002). In order to make agriculture sustainable, it is necessary to implement a balanced and responsible use of organic agriculture and the other available natural resource (Estrada, 2004). In addition most of the Egyptian soils are sandy and poor in organic matters which have low cation exchange and low water holding capacity. Organic agriculture is an ecological management system that promotes and enhances biodiversity, biological cycles and soil biological activates. However, Vogtman and Fricke (1989) reported that the organic fertilizer contains high organic matter and high macro and micro nutrients which help to improve soil physical and chemical characteristics.

Therefore, the main target of this study is to examine the effect of supplemental irrigation and organic fertilizer treatments on vegetative growth, physical and chemical fruit characteristics. Also, to maximize Early Grand peach trees productivity under North Sinai rainfall conditions.

REVIEW OF LITERATURE

Irrigation and Fertilization affects tree growth, vigor, productivity and fruit quality of peach tree. The previous studies have a wide view on the beneficial effects of supplemental irrigation and organic fertilization on fruit trees, the available literature will be arranged under the following headings:

- 1. The effect of supplemental irrigation and organic fertilization treatments on vegetative growth**
 - a. Trunk circumference (TC)**

Generally, peach tree trunk cross-sectional area (TCA) was reduced under deficit irrigation treatments. Girona *et al.* (1993) observed that regulated deficit irrigation treatment caused an 8% reduction on peach tree trunk growth relative to the control. Whereas, supplemental irrigation tended to decrease the reduction of (TC) under the case of deficit irrigation. In this respect Layne *et al.* (2002) indicate that supplemental irrigation substantially increased trunk cross-sectional area (TCA) of cv. Red globe peach trees relative to the non irrigated treatment because of insufficient annual rainfall. Also, Abrisqueta *et al.* (2010), in a study on cv. Florida star peach, found that trunk cross sectional area was reduced by 35% under deficit irrigation treatments with respect to the control. However, in almond, Girona *et al.* (2005) found that accumulated growth of trunk cross-sectional area from 1990 to 1993 indicated a significant reduction in growth for regulated deficit irrigation trees during the kernel-filing period. Furthermore, Mayi and Adieb (2010) revealed that pistachio transplants

treated with two levels of water resulted in a significant increase in stem diameter (6.13cm) at 25% of soil available water depleted as compared to 50% of soil available water depleted.

Moreover, olive solid waste (OSW), which is a product by olive oil extraction, can be considering an organic fertilizer source (Anonymous, 2001). The effect of organic fertilizer on TC was demonstrated by Fayed (2005a), who reported that trunk diameter was increased by applied peach cv. Desert red with organic manure. This result was greater in the second season than in the first season. This may be due to the accumulated effect of organic manure in the soil. Also, it may be due to their effect on improving soil properties. In addition, trunk circumference of peach (cv. Florida prince) increased by increasing organic fertilizer, Bahaa (2007). Moreover, increase TC of apple trees as a result of composted municipal solid waste (MSW) application relative to the control which received mineral fertilizer (El Motaium, 2007). Recently, the highest significant value of Trunk Circumference naval orange trees was recorded with organic fertilization plus humic acid treatment and organic fertilization plus EM comparing to mineral fertilization treatments (Barakat *et al.*, 2012).

b. Newly formed shoots number

Vegetative growth system of peach was affected by decreasing the amount of irrigation water. Decreased irrigation during stage II (pit hardening) to 60%ETc (Boland *et al.*, 1993) and 70% Etc (Rufat, *et al.*, 2010), significantly reduced vegetative growth of peach trees. Similar results was found by Al-Desouki *et al.* (2009) who reported that supplemental irrigation had increased vegetative growth of fig trees (*Ficus*

carica) grown under rained conditions of the western coastal zone Matrouh Governorate. In the same line, shoots number/transplant of Ne plus ultra almond was statistically increased when the transplants were irrigated by 75% of field capacity as compared with the other irrigation regime during both seasons of study (Mohy, 2011).

Increases in shoots number per peach tree is depended on nitrogen availability in the period that followed bud break. In this respect, a deficiency of nutrients on peach orchard can lead to problems with vegetative growth or tree health (Johnson, 2008). Supplied soil with organic fertilizer increased soil macro and micro nutrients (Vogtman and Fricke,1989). Treated the soil of apple seedlings with different organic manure sources, resulted of increasing the soil contents of growth regulators (IAA and cytokinins) and enhanced plant growth (Li *et al.*,1998). In this respect, Sahain *et al.* (2007) observed that Bokashi treatments recorded the highest number of new shoots/ main branch and new shoot length of Anna apple trees compared to untreated trees in both seasons. Furthermore, the highest effect of fertilization treatments on number of shoot per tree was attributed to 50% and 100% compost + Yeast + Azospirillum treatments in the second season, on young apricot trees (Stino *et al.*, 2009).

c. New formed shoot length

Generally, Drought-stress reduces growth and metabolism, (Pe´ rez-Pe´ rez et al., 2008a). So, Florida star peach trees under regulated deficit irrigation showing a slight lower in annual shoot elongation values than observed in the control treatment (Abrisqueta *et al.*, 2010). Moreover,

Sotiropoulos *et al.* (2010), in a study on peach, found that regulated deficit irrigation during stage II of fruit developing reduced shoot length inside the canopy peach trees. In this respect, Mohy (2011) concluded that, there was a positive relation between net increasing shoot length of Ne plus ultra almond and amount of water through irrigation.

Shoot elongation at the beginning of growth in deciduous fruit trees depends on nitrogen previously stored in roots, trunk and shoots (Kliwer and Cook, 1971). In a comparison between the effects of different fertilization sources on peach trees, Fayed (2005a) found that compost fertilizer recorded the same shoot length as the chemical fertilizer effect. While, Bahaa (2007) showed that new shoot length of Florida Prince peach was significantly increased affecting by organic treatments compared with the chemical fertilizers.

Also, fertilizing Banaty grapevines with sewage sludge or filter mud increased effectively the main shoot length compared to control ones (El-Morsy, 1997). Furthermore, Stino *et al.* (2009) showed that the highest shoot length was obtained with 150% compost compared to 100% compost +Yeast + Azospirillum treatment, whereas, control (100% NPK) was the lowest result on young apricot trees. Similar results were found on Apple by Fayed (2005c) and grapes by El-Shenawy and Fayed (2005a). In this trend, combined application of compost at 45 kg/tree +Bio-fertilizer at 20g/tree + Mg SO₄ at 1.5%, gave the highest shoot length of "Le-Conte" pear cv. compared to control in both seasons (Fawzi *et al.*, 2010). Moreover, Mohammed *et al.* (2010) reported that, the interaction between (compost) and stimulators (bio-fertilization, humic acid and compost tea)

was recorded the highest significant value of new shoot length (39.63 cm) compared with other organic treatments of Le-Conte pear trees.

d. Leaf area

Leaf is the site of carbohydrate manufacturing. So, orchard managers have often found supplemental irrigation to be beneficial it, even in locations with high rainfall, (Layne and Tan, 1984). In arid regions without supplemental irrigation, peach trees tend to die faster than other fruit trees unless they are pruned severely to reduce leaf area and crop load (Proebsting and Middleton, 1980).

Furthermore, Mayi and Adieb (2010) revealed that pistachio transplants treated with two levels of water resulted in a significant increase in leaf area (31.77cm^2) at 25% of soil available water depleted as compared to 50%. In this trend, decreased water amount applied by used irrigation regime from 75% up to 25% of field capacity significantly decreased average leaf area (cm^2) of Ne plus ultra almond as compared with control which was irrigated with 100% of field capacity. Control irrigation treatment gave the highest average of leaf area (cm^2) (Mohy, 2011).

However, there are linear correlations between nutritional elements especially NPK and leaf area. This may be due to role of N in synthesis of amino acids and protein, as well as the role of P and K in cell division (Tisdale *et al.*, 1985). Moreover, Florida Prince peach leaf area was significantly affected by fertilization dose of organic and bio-organic fertilization treatments (Bahaa, 2007). Reducing inorganic N from 100 to 50 % with increasing levels of humic acid from 40 to 80 ml/ tree/ year and *Spirulina platensis* Algae from 5 to 25 ml/ tree/ year significantly enhanced

Florida Prince peach leaf area comparing with using N completely via inorganic form (El- Khawaga, 2011).

Moreover, organic manure improved leaf area of apple compared with control treatment. It was notable that effect of organic fertilizers increased in the 2nd season compared with the first one, this may be attributed to accumulative effect of organic fertilizers (Fayed, 2005c). However, it is evident that organic fertilizer, humic acid and compost tea treatments significantly increased leaf area compared with control treatment in the two seasons. Also, leaf area in the second season was higher than that in the first one on Le-Conte pear trees (Mohammed *et al.*, 2010). Similar results were found by Fawzi *et al.* (2010) on "Le-Conte" pear cv.

In this respect, El-Morshedy (1997) reported that increasing chicken manure rate resulted in remarkable increasing in leaf area of sour orange seedlings. In addition to that, The increasing in leaf area of 'Grand naine' banana plants as a result to adding different rates of phosphorus fertilizers during 1st and 2nd seasons could be due to their effects on producing new tissues, which resulted from increasing cell divisions and cell enlargements, Ezz *et al.* (2011). Furthermore, organic fertilization at high level was favorable for improving leaf area and that reflected on vegetative growth of orange trees this may be attributed to the role of organic fertilizer in increasing the level of available minerals from the organic matter (Barakat *et al.*, 2012).

e. Leaves dry matter