ENHANCING WATER USE EFFICIENCY OF "LE CONTE"PEAR TREES UNDER DESERT SOIL CONDITIONS

By

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B.Sc. Agric. Sci. (Horticulture), Fac. Agric., Fayoum Univ., 2006

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Title of Thesis: Enhancing Water Use Efficiency of "Le Conte" Pear Trees Under desert soil Conditions**.**

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ABSTRACT

This study carried out during three successive seasons 2015, 2016 and 2017 on "Le-Conte" pear trees grafted on *Pyrus comunis* and growing in loamy sand soil under drip irrigation system, to investigate the effects of water regime treatments (50%, 75% and 100% of crop water requirement (CWR) as well as anti-transpiration materials (Kaolin and Green Miracle) or black polyethylene mulch which used as additional treatment to enhance water use efficiency. The first season was considered to be as a preliminary season to eliminate the residual effects of the previously used irrigation treatment.

Results showed that although the highest irrigation rate gave the highest fruit set, yield and fruit weight, the additional treatments under 75 % of CWR produced the same significantly results in comparison with trees received 100 % of CWR without any additional treatments. While firmness and TSS increased with decreasing the irrigation rate. Furthermore add kaolin improved TSS and firmness. Also, using kaolin and mulching under 100 or 75% of CWR were increasing vegetative growth parameters. Applying 100% of CWR with kaolin was significantly induced the highest leaf N, Fe and Zn content. Applying 75% with kaolin induced significantly the highest K and Ca content. As well as using mulching under 75% of CWR induced significantly the highest P and Mg. The highest leaf total chlorophyll was attributed to the applying 100% of CWR and improved by add additional treatments. The highest leaf total carbohydrates were attributed to the applying 100% or 75% of CWR. Also, additional treatments improved leaf carbohydrates content. In general increment in promoting growth hormones IAA, GA3 in parallel with increasing the applied water and vice versa while the contrary result was occurs with ABA. Under any irrigation regime, applying anti-transpiration material or mulching induced significantly enhancement in IAA, GA3 and induced significantly lower ABA in comparison with un-additional treatment. On other hand a significant higher peroxidase was gave by applying 50% followed by applying 75%, compared to the lowest values occurs by applying 100% of CWR. Lowest irrigation regime caused the highest percentage of fruit sunburn, which achieved the lowest percentage with using kaolin. Application of 50% of CWR was the most effective in inducing the highest water use efficiency, which were also improved by adding additional treatments.

Key words: Le-Conte pear –water regimes –anti-transpiration –kaolin –green miracle – mulching - water use efficiency.

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INTRODUCTION

Pear is one of the most important deciduous fruits grown worldwide. "Le- Conte" is the main pear cultivar grown in Egypt which resulted as a hybrid between (*Pyrus communis*, L.) and (*Pyrus serotina*, Rehd). According to Ministry of Agricultural and Land Reclamation (2016), Egyptian cultivated area reached 13345 feddans that produced about 69752 tons with an average production of 6281 tons/ feddan.

Water is the most limiting factor for crop production, especially in areas where agriculture relies heavily on irrigation. The importance of water in living organisms results from its unique physical and chemical properties, which also determine its functions in plant physiology (Pretorius and Wand 2003). The main constraint to food production is water availability, which is influenced by climate change and increased consumption in different areas. Agriculture requires high amounts of water, exceeding 70% worldwide (FAO, 2011; Kohli *et al*., 2010). The most recent forecast for climate change suggests a significant increment in temperature and a major reduction in the annual precipitation during the 21st century leading to a 17% decline in the water resources available for agriculture world-wide (García-Tejero *et al*., 2010). Therefore, the current problems of shortage of water resources available for agriculture make it imperative to look for alternative methods of water deficit for our irrigation systems.

Deficit irrigation (DI), defined as the application of water below full crop-water requirements, is an important tool to achieve the goal of

reducing irrigation water use. The application of water below the evapotranspiration (ET) requirements is termed deficit irrigation. Irrigation supply under DI is reduced relative to that needed to meet maximum evapotranspiration (English, 1990). But some studies noticed that DI can cause a negative effect on growth and productivity of fruit trees (Daniells *et al*., 1987; Robinson and Alberts, 1986). The results on fruit trees showed that water deficits and the associated water stresses during developmental stages would not negatively affect fruit yield. Many researchers have reported effects of regulated water deficits on vegetative growth, flowering, fruit growth, and yield in different pear tree cultivars under different climatic conditions (Mitchell *et al.,* 1984, Caspari *et al.,* 1994; Marsal *et al.,* 2000). Some investigators found that RDI techniques used from the early stages of fruit growth up to the end of shoot growth affected vegetative growth by inhibiting shoot development, but did not affect the final fruit size, number of fruit produced or yield (Chalmers *et al.,* 1984; Li *et al.,* 1989). Goldhamer *et al.* (2006) reported variations in the effects of water stress treatments applied at different times on the yield and yield components of almonds. According to Le *et al.* (1989) and Girona *et al.* (1997), Timing of water deficits was found to have important effects on productivity of fruit trees. On the other hand, excessive water may have adverse effects on fruit quality, since it increases vegetative growth, promoting nutritional imbalance and decreasing fruit dry mass (Liao and Lin, 2001; Jackson and Colmer, 2005).

So merge a number of ways with some must be incorporated to saving water with the minimum negative effect. Antitranspirants are a

method of reducing the impact of drought, that are chemical compounds whose role is to train plants by gradually hardening them to stress (Khalil *et al.,* 2011). Reducing transpiration can play a useful role by preventing the excessive loss of water to the atmosphere via stomata (Khalil, 2006). That involved in increasing drought resistance by tending to cause xeromorphy and/or stabilizing cell structure (Ouda *et al*., 2007). There are different types of antitranspirants: film-forming which stops almost all transpiration; stomatic, which only affects the stomata; reflecting materials (Nasraui, 1993). Kaolin is a naturally occurring mineral, main constituent is kaolinite (Obaje *et al,* 2013). It is a non-toxic alumino silicate (Al_4 Si_4 O_{10} $(OH)_8$) clay mineral; kaolin spray decreased leaf temperature by increasing leaf reflectance and reduced transpiration rate more than photosynthesis in plants (Ibrahim and Selim, 2010). It can be expected that, the kaolin applications reduced leaf temperature, reduced the water require for trees under stressed- water apple trees (saving water irrigation), may be increased the yield and improve the quality of fruits and prolonged the shelf life of fruits after harvesting.

Green Miracle is a new-generation of anti-stress product. It is based on long chain fatty alcohol derived from non-edible vegetable oil. Green Miracle functions primarily on the principle of reflecting the sun's rays. Applied as a foliar spray, it forms a thin glassy film-coat, which reflects incident light more than it would occur under normal conditions. This prevents the thermic effect of light on plant tissues.

Mulching is generally used to improve the soil around plants, can reduce the amount of time spent on tasks such as watering and

weeding. Mulches help soil retain moisture in summer, prevent weeds from growing and protect the roots of plants in winter (Davis, 1975). Plastic mulches provide many positive advantages for the user, such as increased yields, earlier maturing crops, with higher quality, enhanced insect management, and weed control (Saeid *et al.*,1993). Also, mulching was improving vegetative growth and distribution of roots and their absorption of nutrients (Verma *et al.*, 2005).

The aim of this study is to enhancing water use efficiency of "Le-Conte" pear trees under desert soil conditions by using deficit irrigation (DI) with anti-transpiration materials and plastic mulches.

REVIEW OF LITERATURE

1. Effect of water regime, anti-transpiration and mulching treatments on fruit set (%)

Generally fruit set percentage decreased under deficit water regime (Nikbakht *et al.,* 2011 and Grijalva-Contreras, 2013). Water deficit and high fruit loads in the previous season significantly reduced the concentration of winter (RSC) so a combination of two factors reduced initial fruit set (Lopez *et al*., 2007). Also, fruit set percent of olive decreased as the water was reduced (Grijalva-Contreras, 2013).

However used of antitranspirants materiel reduced the negative effect of trees fruit set under deficit irrigation system. Whereas Masoud (2012) on Apricot reported that spraying the three antitranspirants material namely green miracle, Kaolin and vapor gard each at 1.0 to 4.0 % was significantly increased the yield expressed in number of fruits per tree and weight (kg.) comparing with the control**.** Also, Rehab (2014) found that using kaolin treatment under stress irrigation improved fruit set and decreased the percentage of fruit drop. Furthermore, Abdel Ghani *et al* (2013) on olive concluded that, kaolin foliar spray at 5% significantly increased yield as number of fruits per tree or weight (kg) of Aggezi and Picual olives compared to foliar spray with calcium carbonate (5%) and tap water. Also, yield as number of fruits per tree of Balady mandarin trees was significantly increased by all kaolin treatments comparing with control (Ali *et al*. 2017). In addition, mulch treatment effected on fruit set (Patra *et al*., 2003; Abouziena *et al.,* 2014). On Le-Conte pear, Fruit set percentage ranged in the two seasons, respectively, from 3.6% and 4.0% in the