ENHANCING THE PRODUCTIVITY AND FRUIT QUALITY OF "LE CONTE" PEAR TREES VIA GROWTH REGULATORS, NUTRIENTS AND AMINO ACIDS

BY

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B.Sc. Agric. Sci. (Horticulture), Fac. Agric., El-Azhar Univ., Egypt, 2005

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APPROVAL SHEET

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CONTENTS

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Title of Thesis: Enhancing the Productivity and Fruit Quality of Le Conte Pear trees via Growth Regulators, Nutrients and Amino Acids
Supervisors: Dr. Remzi Gorge Stino
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ABSTRACT

This study was carried out during two successive seasons 2008 and 2009 on mature "Le Conte" pear trees. Selected trees were sprayed Stimulate at 0.5%, Stimulate at 0.5 + X-Cyte at 1%, Stimulate at 0.5%. + Sett at 1.5%, Antistress at 0.3%, Potassium Phosphite at 2.5%, Pepton at 1000ppm, Berelex 15ppm a.i. and control. Treatments were sprayed with the specified solutions till run off at full bloom stage (70% of flower buds reached the stage of full open) except for Berelex which was applied three times at 30%, 60% and 100% open flower stages at 15ppm every time. Then selected trees were sprayed Pepton at 1000 ppm, Antistress at 0.3%, Potassium Phosphite at 2.5%, and Nitrite balancer. Treatments were sprayed with the specified solutions till run off at three times after fruit set stage (mid May, mid June and mid July) on pear trees. The basic productivity, fruit quality, vegetative growth parameters were assessed. All the applied treatments significantly increased initial fruit set, decreased fruit abscission, increased yield and enhanced fruit quality compared with the control trees. Immunity isozymes showed clear enhancements in activity due to treatments and this might be the indirect reason for the better productivity in addition to the direct effect of treatments. Highest significant effects were due to Stimulate + X-Cyte treatment which in a way led to better fruit quality in terms of both TSS% and firmness. This treatment also induced highest P and Ca leaf contents. Reasons for this effect might be directly due to the effects of these growth regulators in increasing the parthenocarpic setting, cell division and elongation or indirectly as a result of the increased calcium and phosphorus in the leaves which have positive effects on productivity and quality. Potassium Phosphite followed in its' effect might be attributed directly to its' nutritive effect in increasing the potassium content or in directly due to enhancing trees immunity towards bacterial and fungal diseases that destroy, abscise or abort the blossoms. Antistress treatment was sprayed at three times after fruit set stage (mid May, mid June and mid July) on pear trees Induced significantly the highest average fruit weight, volume, length and diameter.

Key words: "Le Conte" pear, Stimulate, X-cyte, Sett, Antistress, Potassium Phosphite, Pepton, Berelex, Productivity, Fruit quality

INTRODUCTION

Pear is one of the most important fruits grown worldwide. It ranks the sixth concerning the cultivated area. "Le Conte" is the main pear cultivar in Egypt. It resulted as a hybrid between (*Pyrus communis* L.) and (*Pyrus serotina Rehd*). The cultivated area reached 10514 feddans produced about 44713 tons with an average production of 4.25 tons/Fadden (Ministry of Agriculture, 2009) while the world an average production of 7.94 tons/Fadden (FAO stat, 2009).

This average production is rather low and in general inconsistent. The reason for this might be attributed to low fruit set due to partial self incompatibility (Hegedûs, 2006; Mariana, 2007) and the majority of fruit set is parthenocarpic (Moriya *et al.*, 2005) or with a few number of seeds (El-Bassel, 2010). This in return leads to high abscission and thereby low and inconsistent yield. In addition to its inferior fruit quality with abundant stone cells (Jing *et al.*, 2008).

Other problems of pear production include insufficient winter chilling that results late and irregular flowering in a period with unfavorable weather conditions that leads to low fruit set and high abscission percentages of fruit set abscission (Ashour *et al.*, 2005). Late flowering also results in infection with fire blight and blossom blight that are active in the prevailing weather conditions and causes blossoms and fruit set damage and thus reduce the productivity (Shoeib *et al.*, 1985; Abo-El-Dahab *et al.*, 1990).

The scope of the present investigation is to illustrate the effect of some growth regulators i.e gibberellins, auxins and cytokinins and their mixtures, amino acids and nutritional compounds on enhancing the productivity and fruit quality of "Le Conte" pears. The effects of these compounds on the vegetative growth, leaf nutritional status and enzymatic activity related to immunity system were also assessed. Additional effects of fire and blossom blights were also monitored.

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DEDICATION

I dedicate this work to whom my heart felt thanks; to my mother and my father for their patience and help, as well as to my brother and my sister.

REVIEW OF LITERATURE

Available review related to the present investigation is cited under the following headings

1. Fruit set percentage

Effect of growth regulators

Clear enhancements in fruit set percentages in some fruits were dedicated to foliar applications of auxins (Vivian-Smith and Koltunow, 1999; Gemüse-und, 2006)**,** cytokinins (Gillaspy *et al.,* 1993; Calzoni and Speranza, 1996; Vivian-Smith and Koltunow, 1999)**,** gibbrellins (Herrero, 1984; Talon *et al*., 1992; Manabu *et al*., 2008) and growth regulators combinations (Bangerth and Schröder, 1994**;** Negi and Sharma, 2005; Manabu *et al.,* 2008**).** Their effects were dedicated to increasing the parthenocarpic set as a result of increasing the sensitivity of the ovaries.

Effect of GA_3

With regards to the effect of GA_3 on fruit set percentage, Kabeel *et al.* (1999) recorded that the highest values of fruit set percentage was induced by GA_3 at 40ppm sprayed at full bloom on "Le Conte" pear trees (14.63 – 15.29% in both seasons respectively) compared with control (9.87 – 10.64% in both seasons respectively). In addition, El Seginy and Khalil (2000) noticed that foliar sprayed application of 20ppm GA_3 at 70% full bloom on "Le Conte" pear trees induced significant increase in fruit set percentage in both seasons of the investigation (5.20 – 4.94%) compared with control (4.17 – 3.31%). Singh *et al.* (2003) showed that 5ppm GA_3 sprayed at mid bloom on "Le Conte" pear

trees induced the highest significant final fruit set (63.3%) compared with control (24.3%). In addition, Kabeel *et al.* (2003) found that 15ppm GA_3 sprayed at mid bloom on "Le Conte" pear trees tended to show significant increase in the final fruit set percentage (11.29–12.12%) compared with control (9.14–10.11%) in both seasons respectively. Moreover, Singh and Sharma (2005) found that the highest significant fruit set percentage (7.88%) was recorded with 20ppm GA_3 applied at the full-bloom stage on soft pear "Punjab Beauty", while the control fruit set was only 3.64%. Also, Yehia and Hassan (2005) indicated that foliar application of GA_3 at 40ppm at full bloom on "Le Conte" pear trees induced the highest significant initial fruit set compared to the control. Negi and Sharma (2005) showed that foliar spray of GA_3 at 30ppm at full bloom stage on "Flemish Beauty" pear trees induced increased significantly the percentage of fruit set in both season (33.29–15.90%) compared with control (30.18 – 12.60%).

Manabu *et al.* (2008) on "Ohrin" apple trees reported that foliar application of 500ppm GA_3 immediately after removal of the floral parts increased the fruit set percentage (60.0%) significantly when compared with the control (24.1%).

Effect of auxins

Bonghi *et al.* (2002) sprayed NAA 5 days after full bloom (DAFB) at 5ppm on 'Rosada' pear trees. This treatment acted as a setting agent where higher concentrations thinned the blossoms with various degrees. Moreover, Singh *et al.* (2003) illustrated that NAA 5ppm at mid bloom on "Le Conte" pear trees tended to show

the highest significant final fruit set percentage (46.1%) compared with control (24.3%).While NAA at 10ppm at mid bloom on "Le Conte" pear trees resulted in 27.5% only. More Recent, Abd-El-Messeih *et at.* (2010) noticed that foliar spray of Amecton (NAA at 1mg/l) at 70% full bloom on "Le Conte" pear trees induced the highest significant fruit set percentage (11.65%) compared with control (6.18%).

On "Ohrin" apple trees Manabu *et al.* (2008) reported that foliar application of 4.5ppm Dichlorprop (2.4-DP) immediately after removal of the flower parts increased the fruit set percentage (31.0%) significantly compared with control (24.1%).

As far as effect of auxin on fruit set of stone fruits, Bolat and Pirlak (1999) high lighted the fact that IAA stimulated pollen germination and pollen tube growth in "Hasanby" apricot, the best results was obtained at 0.05ppm, but the higher doses decreased it.

Effect of cytokinins

Guirguis *et al.* (2003) showed that the percentages of initial fruit set and fruiting of "Le Conte" pear, were significantly increased by CPPU ((N- (-2-chloro-1-pyridinyl)-N-phenylurea)) treatments as compared with the control. The best results were attributed to 40ppm of the first season, whereas, in the second one the low and medium concentrations i.e. resulted in significant increases both initial fruit set and fruiting. Manabu *et al.* (2008) reported that foliar application of 5ppm Forchlorfenuron (CPPU) immediately after removal of the flower parts on "Ohrin" apple

trees increased fruit set percentage (64.3%) while control was fruit set (24.1%).

Yehia and Hassan (2005) that foliar application of 200ppm BA at full bloom on "Le Conte" pear trees resulted the highest significant increased initial fruit set. Foliar application of 5ppm BA at full bloom on "Flemish Beauty" pear trees increased significantly the percentage of fruit set (32.94%) compared with control (30.18 %) (Negi and Sharma, 2005).

As far as effect of cytokinins on the fruit set of stone fruit it was reported by Bolat and Pirlak (1999) that pollen germination and pollen tube growth increased by kinetin applications on "Hasanby" apricot, the best results were due 0.05 - 5ppm, Whereas the higher doses decreased it.

Effect of growth regulators combination

Numerous researchers postulated that application of several growth regulators was more effective than each alone.

On "Flemish Beauty" pear trees Negi and Sharma (2005) showed that foliar combined application of GA_3 (20ppm) + BA (10ppm) at full bloom induced the highest significant increased the percentage of fruit set (36.18 – 18.52 %) compared with control (30.18 – 12.60%).

Foliar application of GA_3 (10ppm) + BA (5ppm) + NAA (5ppm) on "Delicious" apple at the pre-bloom stage resulted in the maximum increment in fruit set up to (62.84%) over control (Sharma and Ananda, 2004). Moreover, Yehia and Hassan (2005) reported that foliar spray of GA_3 (40ppm) + BA (200 ppm) at full

bloom on "Le Conte" pear trees showed the highest significant percentage of fruit set (6.7 and 7.9%) in both season. In this respect, Manabu Watanabe *et al.* (2008) reported that foliar application immediately after removal of the flower parts of GA_3 at 500ppm + Dichlorprop (2.4-DP) at 4.5ppm + (CPPU) 5ppm on "Ohrin" apple trees increased significant fruit set percentage (89.3%) compared with control (24.1%).

Effect of amino acids

With regards to the effect of amino acids on fruit set percentage, Crisosto *et al.* (1992) recorded that the influence of polyamines in increasing fruit set has been observed in apple and pear particularly "Comice" pear. Putrescine enhanced pollen tube ovule penetration and delayed ovule senescence without affecting flower ethylene production. More recent, Franco-Mora (2005) reported that fruit set in late pollinated flowers of "Housui" (S_3S_5) Japanese pear that present gametophytic self-incompatibility increased significantly compared with control with pre-pollination putrescine applications. Concentrations of 1.0mM had a better effect than 0.01mM. In vitro pollination tests revealed that higher pollen germination was present in the stigmas of flowers sprayed with 1.0mM of putrescine compared to the controls. In addition, Yehia *et al.* (2009) illustrated that spraying Antistress (polypeptide enzymes 15%) at 0.66% at bud swelling, full bloom, and two weeks after petal fall and the first of July on "Le Conte" pear trees induced the highest significant fruit set compared with control. Fayek *et al.* (2011) referred to that amino acids foliar

spray applied twice during bud burst and full bloom stages at one g/l on "Le Conte" pear trees induced the highest significant initial and final fruit set percentages.

As far as effect of amino acids on the fruit set fruit set of stone fruits, it was reported by Alburquerque *et al.* (2006) that the exogenous application of 10mM putrescine on "Bergeron" apricot increased the percentage of functional ovules from 17.1% (control) to 33.3%. They added that these results prove the effects of polyamines on ovary development and indicate the possible improvement of apricot ovule development by their exogenous application.

Effect of different minerals nutrient

Effect of potassium

Attala (1997) referred that potassium application increased the fruit set of "Anna" apple trees significantly. Moreover, on "Le Conte" pears El Seginy and Khalil (2000) noticed that foliar application of KO_2 at 3ml/l at bud swelling and 70% full bloom on "Le Conte" pear trees induced increase significantly fruit set percentage in both season (4.63 – 4.13%) compared with control (4.17 – 3.31%).

El-Sherif *et al.* (2008) on "Japanese" plum trees reported that foliar sprays Coda-PK (16.1% K_2O_2 & 8.5% P_2O_5) at full bloom gave a pronounced effect on fruit set percentage (12.83 &15.38) compared with untreated trees (5.7 & 6.22) in both seasons respectively.