Effect of Some Chemical Treatments on Fruiting of 'Leconte' Pears

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Abstract: This investigation was carried out to evaluate the effect of some chemical treatments to enhance fruit set and improve fruit characteristics of Le Conte pear trees. It was performed during seasons 2003 and 2004 at the experimental research station of Faculty of Agriculture, Cairo University, Giza Governorate. Different concentrations of boron, gibberellic acid (GA), benzyl adenine (BA) and sucrose were applied at full bloom and three weeks later. All the applied treatments significantly increased initial fruit set, final fruit set and yield compared to the control trees in both seasons of the study. However the highest significant initial fruit set was produced as a result of 5% sucrose at full bloom and it averaged 13.04 and 16.71% in the two successive seasons. Also, 20% sucrose spray at full bloom resulted in the highest significant final fruit set as it averaged 7.9 and 8.7% in both seasons. Similarly significant improvements were attained in fruit characteristics as a result of the applied treatments. Data are presented for the studied fruit characteristics which comprised of average weight, volume, length, diameter, shape index, specific gravity, firmness, total soluble solids (TSS), acidity and TSS/acid ratio as a result of the applied treatments during the two studied seasons. It can be recommended from the present study to apply the enhancement chemical treatments at full bloom as they gave better results than after three weeks from bloom, also sucrose applications either at 5 or 20% caused significant improvement in fruit set, yield and most of the studied fruit characteristics.

Key words: Pears, Boron, GA, BA, sucrose, fruit set, fruit characteristics

INTRODUCTION

Pear fruit is one of the favourite fruits of temperate zone and is considered the third of deciduous fruits and the fourth among all fruits in its global distribution. ‘Leconte’ is the main pear cultivar grown in Egypt, resulted as a hybrid between Pyrus communis X Pyrus serotina. The total cultivated area of pears fluctuated sharply during the last decades due to fire blight infection; however it reached 7557 feddans in 2003 with annual production of 35 441 tons. Productivity of pear orchards varies in Egypt from year to year and location to another. This might be attributed to limited ovules viability and stigma receptivity, poor pollen germinability, ovule abortion, excessive flower abscission and low fruit set. Since consumers prefer large pears, fruit size becomes a very important marketing parameter and the economic benefits of treatments capable of improving average fruit size are considered of high potential. In order to improve productivity of pears in terms of fruit set and fruit quality several investigations were carried out either by applying gibberellic acid GA or by applying sucrose. Boron -as an essential trace element required for optimal pollen germination and acceleration of pollen tube growth- was used extensively and was found to reduce percentage of flowers drop and increase percentage of fertile flowers resulting in successful fruit setting and thus increased yield of apples, almonds and olives.

Therefore the present investigation was carried out to investigate the influence of the most promising chemical treatments on improving fruit set, yield and fruit quality of Le Conte by applying different concentrations of GA, BA (Benzyl Adenine), boric acid and sucrose at full bloom and three weeks later.

MATERIALS AND METHODS

This study was carried out during two successive seasons 2003 and 2004 on seven years old Le Conte pear trees budded on Pyrus communis rootstock, planted at 5X5 m and grown in loamy soil in the Experimental Research Station of the Faculty of Agriculture Cairo University at Giza. Trees were of normal growth, uniform in vigour under furrow irrigation system and received normal fertilization and cultural practices as scheduled in
Yield: The produced fruit yield on each replicate tree resulting from the applied treatments was expressed as weight of fruits in kg/tree which was attained at harvest stage. This was determined 110 days after flowering in both seasons of the study.

Physical fruit characteristics: Samples of 10 fruits from each replicate tree i.e. 30 fruits for each of the applied treatments were picked randomly at harvest to determine:

1. Average fruit weight (g/fruit)
2. Average fruit volume (cm$^3$)
3. Specific gravity (g/cm$^3$)
4. Average fruit length and diameter (cm)
5. Fruit shape index (L/D ratio)
6. Fruit firmness as Lb/ inch$^3$ by the use of a magness taylor pressure tester

Chemical fruit characteristics:

1. Total soluble solids of fruit juice (TSS%) was measured by hand refractometer \[15\]
2. The percentage of total acidity was determined as in fruit juice was measured as malic acid according to (A.O.A.C 1985)\[15\]
3. Total soluble solids/ acid ratio was calculated for each replicate of the applied treatments

The effect of the previous treatments was studied by evaluating their influence on the following parameters:

FRUITION: On each replicate tree five shoots distributed on different sides were chosen randomly and tagged at the beginning of the growing season. All inflorescences on each shoot were counted and recorded. Random flower samples of 50 inflorescences were collected to estimate average number of flowers/inflorescence.

Initial Fruit Set: Three weeks after flowering initial fruit set percentage on replicate trees of the studied treatments was calculated from the following formula:

\[
\text{Initial fruit set} = \frac{\text{FR} \times 100}{\text{AVF} \times \text{NF}}
\]

FR= Number of fruits/ shoot
AVF= Average number of flowers/ inflorescence
NF= Number of inflorescences/ shoot

Final Fruit Set: Sixty days after flowering, final fruit set percentage was calculated in the same sequence mentioned above for the initial fruit set percentage.

RESULTS AND DISCUSSION

Fruit set and yield: Figure (1) shows that all spraying treatments significantly increased initial and final fruit set also yield/tree compared to the control trees which recorded the lowest significant values of these parameters in both seasons of the study.

The highest significant initial and final fruit set percentage was attained as a result of sucrose application at 5 and 20 ppm in seasons 2003 and 2004. At the first season, highest significant initial set percentage ranged between 11.90- 13.32% which resulted from the application of BA (200 ppm), boric acid (100 ppm), GA$_3$ (40 ppm), sucrose 5 and 20% at full bloom (Fig 1a). Meanwhile initial fruit set in the control trees which was the lowest significant percentage averaged 6.61%. Although higher percentages of fruit set were observed during the second season, sucrose 5 and 20% and other treatments such as
Figure 1: Effect of chemical treatments on fruiting of Le Conte pears
1- Control (sprayed with water only); 2- Boric acid 50 ppm; 3- Boric acid 100 ppm; 4- Boric acid 200 ppm; 5- GA, 10 ppm; 6- GA, 20 ppm; 7- GA, 40 ppm; 8- BA 100 ppm 9- BA 200 ppm; 10- BA 400 ppm; 11- Sucrose 5%; 12- Sucrose 10%; 13- Sucrose 20% 14- Sucrose 10%; 15- GA, 20 ppm; 16- BA 200 ppm; 17- Boric acid 100 ppm.
Figure 2: Effect of chemical treatments on fruit weight, volume and specific gravity of Le Conte pears

1-Control (sprayed with water only); 2- Boric acid 50 ppm; 3- Boric acid 100 ppm; 4- Boric acid 200 ppm; 5-GA, 10 ppm; 6- GA, 20 ppm; 7- GA, 40 ppm; 8- BA 100 ppm 9- BA 200 ppm; 10- BA 400 ppm; 11- Sucrose 5%; 12-Sucrose 10%; 13- Sucrose 20% 14- Sucrose 10%; 15- GA, 20 ppm; 16- BA 200 ppm; 17- Boric acid 100 ppm.
Figure 3: Effect of chemical treatments on fruit shape of Le Conte pears

1-Control (sprayed with water only); 2- Boric acid 50 ppm; 3- Boric acid 100 ppm; 4- Boric acid 200 ppm; 5- GA, 10 ppm; 6- GA, 20 ppm; 7- GA, 40 ppm; 8- BA 100 ppm 9-BA 200 ppm; 10- BA 400 ppm; 11- Sucrose 5%; 12-Sucrose 10%; 13- Sucrose 20% 14- Sucrose 10%; 15- GA, 20 ppm; 16- BA 200 ppm; 17- Boric acid 100 ppm.
Figure 4: Effect of chemical treatments on fruit Firmness of Le Conte pears
1-Control (sprayed with water only); 2- Boric acid 50 ppm; 3- Boric acid 100 ppm; 4- Boric acid 200 ppm; 5- GA, 10 ppm; 6- GA, 20 ppm; 7- GA, 40 ppm; 8- BA 100 ppm 9- BA 200 ppm; 10- BA 400 ppm; 11- Sucrose 5%; 12- Sucrose 10%; 13- Sucrose 20% 14- Sucrose 10%; 15- GA, 20 ppm; 16- BA 200 ppm; 17- Boric acid 100 ppm.

Fruit weight: During both seasons highest significant fruit weight ranged between 185.1- 199.5 g and resulted from spraying of GA, 10, 20 and 40 ppm and boric acid 50 ppm at full bloom. Meanwhile the lowest average fruit weight was produced on control trees as it reached only 144 and 146.3 g in both seasons (Fig 2a).

Fruit volume: Highest significant fruit volume reached 200 and 204.6 cm3 in seasons 2003 and 2004. The highest levels were observed as a result of boric acid 50 ppm, GA, 10, 20 and 40, BA 400 ppm and sucrose 5% in both seasons of the study (Fig 2b). Whereas the lowest significant fruit volume resulted on the control trees and reached 153.3 and 158.8 cm3 in both seasons.

Fruit specific gravity: In the first season highest significant fruit specific gravity was noticed as a result of BA 200 ppm, GA, 10 ppm and sucrose 10% applications, meanwhile the lowest level resulted from boric acid application at 200 ppm (Fig 2c). In both seasons, highest levels of specific gravity ranged between 0.94- 1.09 and the lowest levels ranged between 0.86- 0.89.

Fruit shape: Fruit shape involves fruit length, diameter and fruit shape index (L/D ratio) (Fig 3). Highest values of fruit length reached 8.63 and 8.36 cm in both seasons of the study, the highest significant levels were recorded as a result of GA, 20ppm, BA 200 ppm, sucrose 5 and 10%. Meanwhile fruit diameter was not significantly affected by the applied treatments. However the lowest significant fruit shape index resulted from boric acid 50 ppm application as it averaged 1.05 and 1.10 in the two seasons of the study.
Table 1: Effect of chemical treatments on TSS and acidity of Le Conte pears

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Fruit firmness: In both seasons of the study, highest significant fruit firmness ranged between 14.7-16 (LB) and resulted from applications of GA, 20 ppm, GA40 ppm and sucrose 20% at full bloom also from GA, 20 ppm application 3 WAFB (Fig 4). Whereas the lowest significant value of fruit firmness resulted from the control trees as it averaged 11.50 and 11.47 (LB) in seasons 2003 and 2004.

Fruit Chemical Characteristics: The effect of the applied treatments was investigated on the most reliable fruit chemical characteristics which involved TSS, acidity and consequently TSS/ acid ratio (Table 1). In both seasons of the study boric acid 100 ppm resulted in the highest significant TSS as it reached 14.00 and 14.23. However the lowest significant levels of TSS reached 11.4 and 11.77 as it resulted from boric acid 50 ppm and on the control trees in the two seasons of the study.

Meanwhile the lowest significant values of acidity reached 0.23 and 0.20 and were produced as a result of sucrose 5% and boric acid 100 ppm (3WAFB) applications in seasons 2003 and 2004. Consequently it can be noticed that TSS/ acid ratio was significantly affected by the applied treatments. Highest significant values of TSS/ acid ratio reached 60 and 58.86 as it resulted from boric acid 100 ppm (3WAFB) and sucrose 5% applications in the two seasons of the study. Whereas the lowest levels of TSS/ acid ratio were exhibited from BA 100 ppm and the control treatments during both studied seasons.

The general positive effects of sucrose and boric acid applications as a source of boron could be attributed to enhanced pollen germination and pollen tube growth which increases fruit set and yield. Similar findings were reported on apricot [17-19], olives [14] and annona [19]. Also it was reported that sucrose 10% application at full bloom increased yield, average fruit weight, volume, dimensions and TSS of Le Conte pear [8].

Similar positive effects of GA, on Le Conte pear fruit weight and volume were reported earlier [20], later it was concluded that 5 ppm GA, application at full bloom enhanced fruit set [9] and 10 ppm increased pear fruit weight and size [17] in addition that 50 ppm GA, at the same stage increased yield and improved fruit quality in terms of fruit weight, volume, dimensions and TSS [3]. Recently similar trend was observed on Canino apricot in response to 40 ppm GA, at full bloom [17].

It was found from the present study that BA increased fruit volume and shape which was previously performed on Spadona and Coscia pear cultivars as a result of BA application at 100 ppm [8]. Similar effect of BA was noticed on apples and was referred to stimulated cell division [21]. The main weakness of pear fruit is that it soon softens during ripening and develops physiological disorders such as watery and core breakdown [22]. Thus, treatments that led to high level of fruit firmness proved to be more promising to increase postharvest life and maintain pear fruit quality.

REFERENCES


