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Effect of Calcium Nitrate and Boric Acid Sprays on Fruit Set, Yield and Fruit Quality of cv. Amhat Date Palm

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Abstract: The objective of the present study is to investigate the impact of spraying boric acid and/or calcium nitrate on fruit set, yield and fruit of cv. Amhat date palm. The present study was carried out during 2011/2012 growing seasons. Palms were sprayed with boric acid at 250 and 500 ppm and calcium nitrate at 1 and 2% as individual application or in a combination between boric acid and calcium nitrate concentrations treatments. In general, results indicated that spraying date palm inflorescence with both boric acid and/or calcium nitrate had a significant effect on fruit set, yield and fruit physical and chemical characteristics of Amhat date palm. The superior treatment concerning yield and fruit quality was spraying boric acid at 500 ppm combined with calcium nitrate at 2% in the two experimental seasons.

Key words: Date palm · Fruit set · Yield · Fruit quality · Boric acid · Calcium nitrate

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is concerned as one of the important crops in arid and semi-arid regions of the world. Date palm is one of the ancient domestic fruit trees in the Middle East countries and their fruits play an important role in the nutrition pattern of many people. It has always played an important role in the economic and social life of the people of these regions. The total production of date fruits in Egypt is about 1.3 million tons [1]. Spraying macro and micro nutrients had also important role in fruit set, fruit retention and development and cause efficient yield and quality improvement [2]. Impact of some macro and micro elements on date yields and fruit quality were reported by many investigators [3-5]. In addition, many investigators mentioned the effect of micro-nutrient in pollen grain germination and pollen tube growth in many plant species [6-8]. Boron has effect on many functions of the plant such as hormone movement, activate salt absorption, flowering and fruiting process and pollen germination specially its influences on the directionality of pollen tube growth [6]. Boron seems to play an important role in achieving satisfactory fruit set [7, 8, 9, 10]. Abd El-Fatah *et al.* [11] on "Costate" persimmon found an increment in fruit weight due to foliar sprays of boric acid. Boron is involved in processes such as protein synthesis, transport of sugars and carbohydrate metabolism [12]. Calcium is conceder as one of the most important minerals determining the quality of fruit since it is required for cell elongation and cell division [13]. Till now, a little attention have been paid towards nutrient elements in particular Ca^{+2} for palm nutrition, especially grown on sandy soil, except the addition of little manures at winter as a source of trace elements. Despite minor elements affect greatly the physiological processes and play an important role in fruit retention of many fruit trees, as well as, improving the yield and fruit quality [2, 14, 15]. In addition, calcium functions appeared as a cross-linkage of the middle lamella, which binds cells together. It is also needed in enzymatic reactions (such as in the reduction of No_3^-), provides the balance of anions and cations in the plant and plays an important role in the stabilization of cell membranes [16].

The objective of the present study is to evaluate the effect of spraying boric acid and/or Calcium nitrate on fruit set, yield and fruit quality of cv. Amhat date palm.

MATERIALS AND METHODS

This study was carried out during two successive seasons (2011and 2012) on 40 years old cv. Amhat date palm (*Phoenix dactylifera* L.) grown on clay soil at private

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orchard located in El-Badrashin, Giza Governorate, Egypt. The selected palms were uniform of nearly equal size and growth vigor. They were subjected to the normal cultural practices. Pollination was carried out using the same pollen grains source. The leaf bunch ratio was maintained at 8:1. Twenty seven palms were selected and divided into 9 treatments in three replicates (each is one palm) and arranged in a randomized complete block design. Palms were subjected for the following spraying treatments:

- Control (spraying palms with water only).
- Boric acid at 250 ppm.
- Boric acid at 500 ppm.
- Calcium nitrate at 1%.
- Calcium nitrate at 2%.
- Boric acid at 250 ppm mixed with calcium nitrate at 1%.
- Boric acid at 250 ppm mixed with calcium nitrate at 2%.
- Boric acid at 500 ppm mixed with calcium nitrate at 1%.
- Boric acid at 500 ppm mixed with calcium nitrate at 2%.

All treatments were replicated three times where each palm inflorescence per each treatment was sprayed at full-bloom with the solution till run off. The number of spathes per palm was adjusted eight bunches by removing earliest, latest and smallest inflorescence for each palm. Fruit sample were collected at ripening stage. The following determinations were carried out:

Fruit Set and Fruit Retention: Initial fruit set and fruit retention percentages were evaluated one month after pollination and at harvested time, respectively. Five female strands per bunch were randomly selected from each replicate. The number of fruit set was recorded and then fruit set percentage and fruit retention was calculated as the following equations:

$$\text{Fruit set (\%)} = \frac{\text{No. of fruits setting on the strand}}{\text{Total No. of flower per strand}}$$

$$\text{Fruit retention (\%)} = \frac{\text{No. of retained fruits}}{\text{No. of retained fruit+ No. of flower scars}}$$

Yield: yield was estimated as bunch weight for each treatment

Fruit Physical and Chemical Characteristics: Samples of 30 date fruits were randomly picked from each bunch of each treated palm for determining the physical and chemical properties as following:

Fruit Physical Characteristics: Fruits of each sample were weighed (g) and measured as length (cm) and diameter (cm) and then the flesh and seeds of the same sample were separately weighed (g). Also fruits of each sample were measured as volume (cm^3) and calculated its specific gravity (g/cm^3).

Fruit Chemical Characteristics: Total soluble solids % (TSS) in fruit juice was determined by hand refractometer. Acidity was determined as malic acid percentage [17]. TSS/acid ratio was calculated for each sample.

Fruit Sugars and Tannins Content: Total sugars were determined in the methanol extract using the phenol sulphoric acid method and the percentage was calculated on dry weight basis according to Dubois *et al.* [18]. Reducing sugars were determined in methanol extract according to A.O.A.C. [19], while Non-reducing sugars were calculated as the difference between total sugars and reducing sugars. On the other hand, tannins content was determined in fruits according to the official method described by Winton and Winton [20].

Statistical Analysis: The obtained data were tabulated and statistically tested for analysis of variance using MSTAT-C) [21] and the significant differences among the various treatments were compared using LSD values at probability of 0.05 according to Waller and Duncan [22].

RESULTS AND DISCUSSION

Fruit Set and Fruit Retention: Regarding the percentages of fruit set and fruit retention in response to Boric acid and/or Calcium nitrate spraying treatments, it is evident from the data presented in Fig. 1 that all studied treatments resulted in significant increase in fruit set percentage compared with the control in both experimental seasons. On the other hand, Boric acid at 500 ppm either alone or in combination with Calcium nitrate at different concentrations gave the highest value of fruit set % in both seasons. The best results concerning fruit set % were obtained by spraying boric acid at 500 ppm mixed with calcium nitrate at 2% (78 and 79% in the two seasons, respectively), followed by treatment of boric acid at 250 ppm mixed with calcium nitrate 2% (75 and 76% in the first and

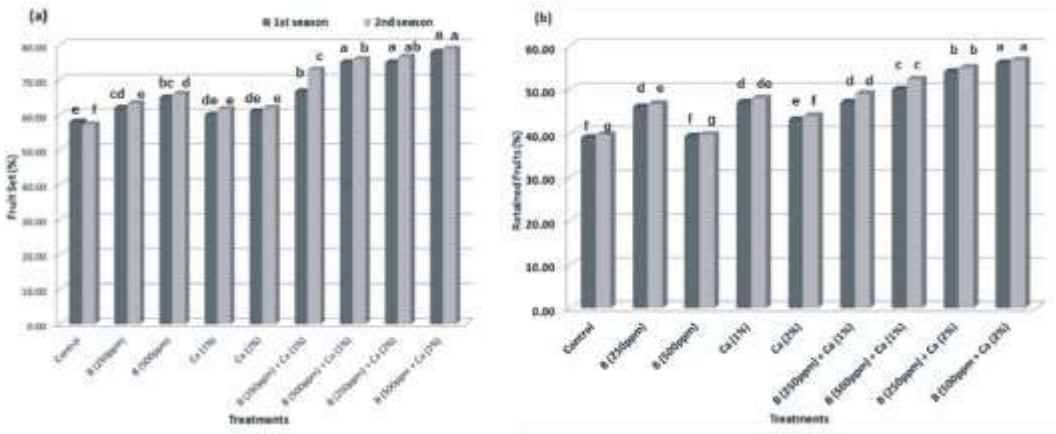

Fig. 1a-b: Effect of calcium nitrate and boric acid sprays on setting of cv. Amhat date palm, (a) Fruit set (%), (b) Fruit retention. Columns with different letters show significant differences at p= 0.05 using LSD.

second seasons, respectively) and boric acid at 500 ppm mixed with calcium nitrate at 1% which gave the same percentage. On the contrast, the lowest fruit set % recorded by control (58 and 57.3% in the both seasons).

Regarding fruit retention %, data indicated that spraying calcium nitrate at 1% or 2% increased fruit retention percentage as compared with control treatment in the two seasons. The highest fruit retention percentage was obtained by spraying boric acid at 500 ppm combined with calcium nitrate at 2% (56 and 56.67 in the two seasons, respectively), followed by spraying boric acid at 250 ppm combined with calcium nitrate at 2% (54 and 55% in both seasons). In the contrary, control treatment recorded the lowest fruit retention % (38.9 and 39.6 in the first and second seasons, respectively).

The obtained results go in line with the findings of Abdel-Hafeez *et al.* [23] on Kelsey plum and Chaplin *et al.* [24] on Italian prune. Taylor *et al.* [25] found that increasing fruit set due to boron may attribute to its role in maintaining high pollen viability and germination. As fruit retention results, it was agree with those obtained by Singh and Sant Ram [2], Babu *et al.* [14] and Khan *et al.* [15], Abd El-Mageed and Abd El-Fattah [26], Fawzia *et al.* [27] and Abd El-Messih *et al.* [28], where they found that fruit retention of many other fruit trees had been improved under similar applications with calcium. A tentative explanation for the increased fruit removal force, due to calcium sprays may be due to improving the formation of cellulose and lignin. These materials are required for building plant structure or preventing the abscission layer formation and consequently the reduction in pre-harvest fruit drop [29]. On the other hand, from the above results, it could be explain that the presence of boric acid and

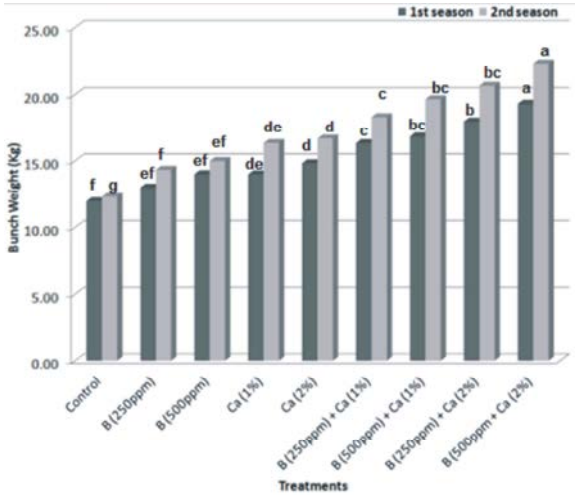

Fig. 2: Effect of calcium nitrate and boric acid sprays on yield as bunch weight of cv. Amhat date palm. Columns with different letters show significant differences at p= 0.05 using LSD.

calcium nitrate together in the same solution had a positive effect on increasing fruit set % and fruit retention %. This may be due to the improving effect of such treatments on nutritional status of the palms which reflected on increasing fruit set and fruit retention. In this respect, Qin [30] and Hassan [31] reported that the improving fruit set could be explained as a result increasing pollen grains germination and pollen tube elongation due to boron treatments.

Yield (Bunch Weight): Bunch weight as indication of yield of cv. Amhat date palm as affected by boron and/or calcium spray is illustrated in Fig. 2. The results show that

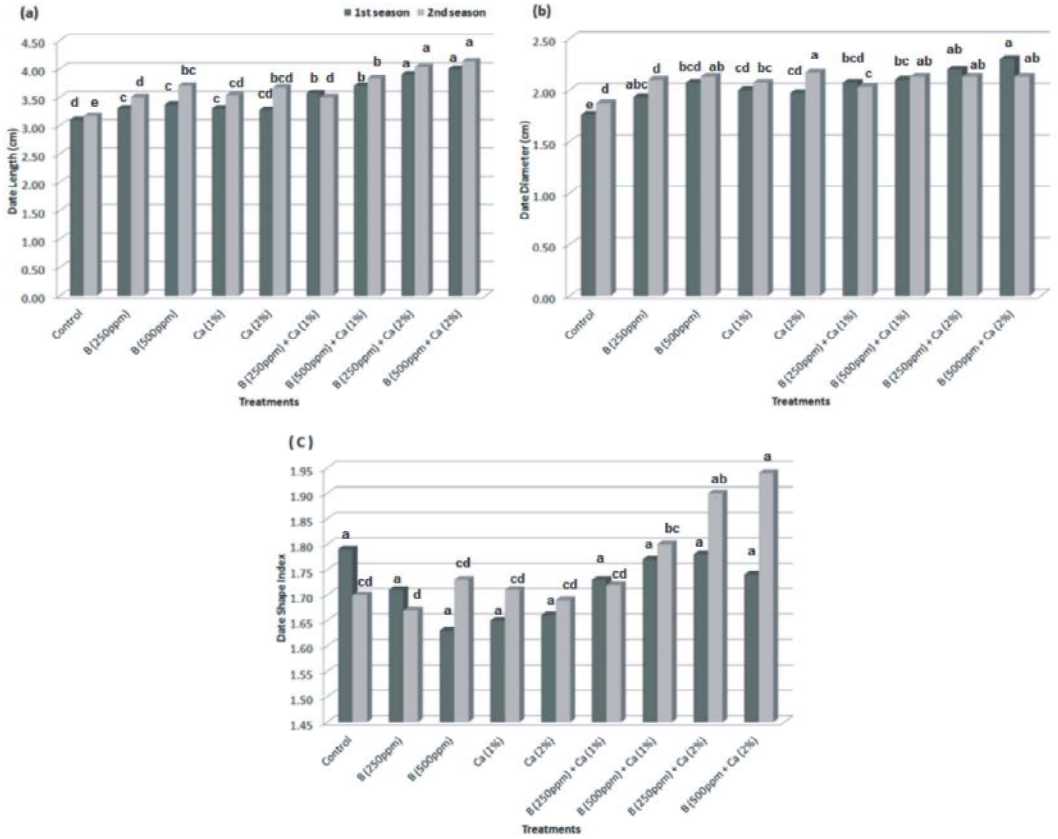

Fig. 3a-c: Effect of calcium nitrate and boric acid sprays on fruit dimension of cv. Amhat date palm. (a) Fruit length (cm) (b) Fruit diameter (cm), (c) Fruit shape index. Columns with different letters show significant differences at p= 0.05 using LSD.

spraying B and/or Ca increased bunch weight as compared with the control in both growing seasons. The highest bunch weight was recorded from spraying boric acid at 500 ppm combined with calcium nitrate at 2% (19.3 and 22.3Kg in the two seasons, respectively), followed by spraying boric acid at 250 ppm mixed with calcium nitrate at 2% (18 and 20.6Kg in the first and second seasons, respectively). The lowest bunch weight was obtained from control palms which recorded 12 and 12.3Kg in both experimental seasons, respectively.

Foliar sprays of boron at bloom stage for different fruit crops at the critical periods of pollen formation, germination and fertilization just prior to seed and fruit set. Foliar applied with boron is rapidly absorbed by the flowers, consequently help flower to have enough B to carry them through flowering and fruit set. Also, boron increases flower production and retention, pollen tube germination and elongation and fruit development [32]. Increasing fruit yield due to boron and/or calcium spray may be attributed to their effect an increasing fruit set. Also, it may attribute to the role of boron in enhancing many metabolic processes such as carbohydrate transport [33, 34]. The present data are in agreement with those obtained of Al-Hamoudi [35] on Barhee date palm. Etman *et al.* [3], Atalla *et al.* [4], Desouky *et al.* [36] and Harhash and Abdel-Nasser [37] reported that K and B fertilization increased yield of date palm. In this concern, boron has more effect than calcium in increasing fruit set and yield of date palm and both of Ca and B have a synergistic effect [38] considered to be essential for actively growing region of plants such as bud development.

Fruit Physical Characteristics: The effect of different foliar spray concentrations of boric acid and calcium nitrate either alone or combined together on fruit dimension (cm) and fruit shape index are presented in Fig. 3. As regard to fruit length, all treatments increased significantly fruit length in the two studied seasons as compared with control. The highest significant fruit length (4 and 4.1 cm) was obtained by spraying 500 ppm boric

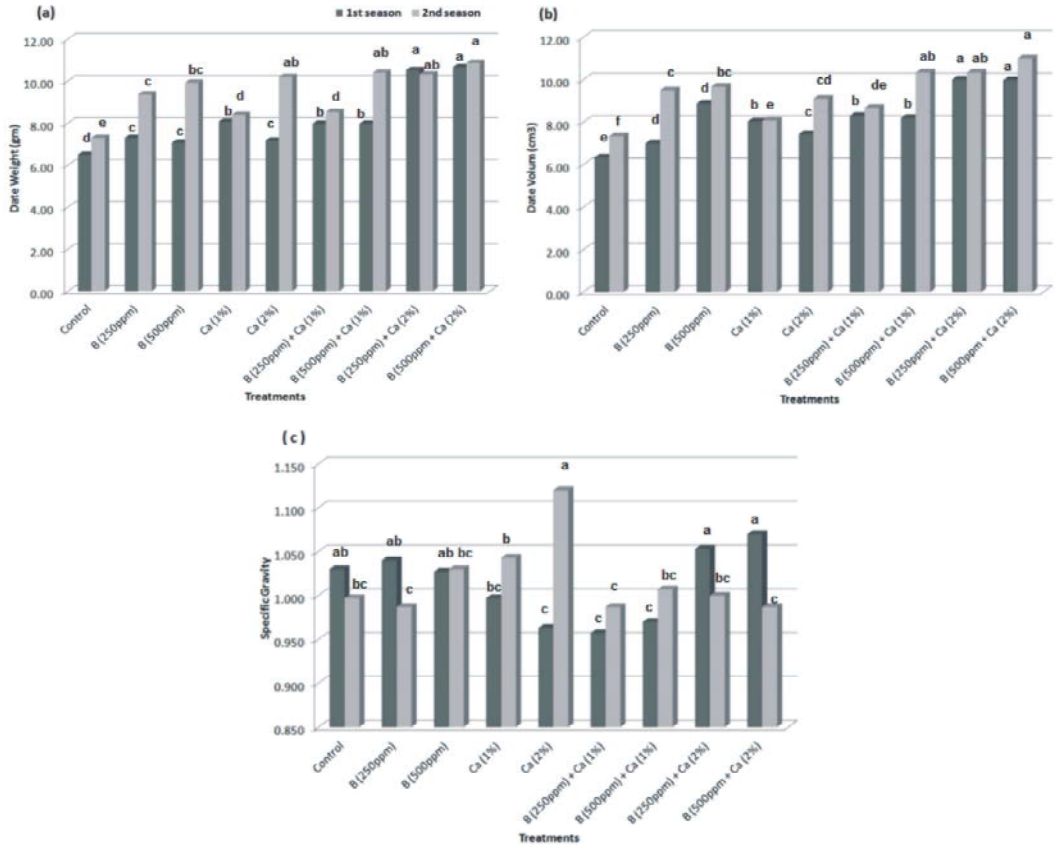

Fig. 4a-c: Effect of calcium nitrate and boric acid sprays on fruit heaviest of cv. Amhat date palm. (a) Fruit weight (gm), (b) Fruit volume (cm^3), (c) Fruit specific gravity. Columns with different letters show significant differences at p= 0.05 using LSD.

acid mixed with 2% calcium nitrate, followed by 250 ppm boric acid combined with 2% calcium nitrate which recorded 3.9 and 4.03 cm in the first and second seasons, respectively as compared with the lowest fruit length (3.1 and 3.17 cm) which obtained by control in the two growing seasons, respectively. As fruit diameter, the highest fruit diameter (2.3 in the first season and 2.1 in the second season) was obtained by spraying 500 ppm boric acid mixed with calcium nitrate at 2%. On the contrast the lowest fruit diameter was recorded by untreated dates which recorded 1.76 and 1.87 cm in both seasons, respectively. Regarding fruit shape index, treatments were not affected them significantly in the first seasons. Whereas in the second season, the highest fruit shape index (1.94) was cleared by spraying 500 ppm boric acid combined with 2% calcium nitrate.

Fruit weight (g), fruit volume (cm^3) and specific gravity are existed in Fig. 4. All treatments increased significantly fruit weight as compared with control in the two studied seasons. The highest significant fruit weight (10.67 and 10.87 g in the two seasons, respectively) was recorded by spraying 500 ppm boric acid mixed with 2% calcium nitrate, followed by 250 ppm boric acid mixed with 2% calcium nitrate (10.53 and 10.33 g in both growing seasons, respectively). In the contrary, the lowest fruit weight (6.5 and 7.3 g in the first and second seasons, respectively) was recorded by control treatment.

As consider to fruit volume, the highest value (10 cm^3) was evidenced in the first season by spraying boric acid at 250 ppm mixed with calcium nitrate at 2%. Whereas, in the second season, the highest fruit volume (11 cm^3) was recorded by spraying 500 ppm boric acid mixed with 2% calcium nitrate. On contrast, control treatment recorded the lowest fruit volume (6.3 and 7.3 cm^3) in the two studied seasons, respectively. Specific gravity was affected significantly by different treatments in the two experimental seasons. Specific gravity of dates ranged from 0.96 to 1.07 g/cm^3 in the first season and 0.98 to 1.12 g/cm^3 in the second season. Flesh weight percentage and seed weight percentage are showed in Fig. 5.

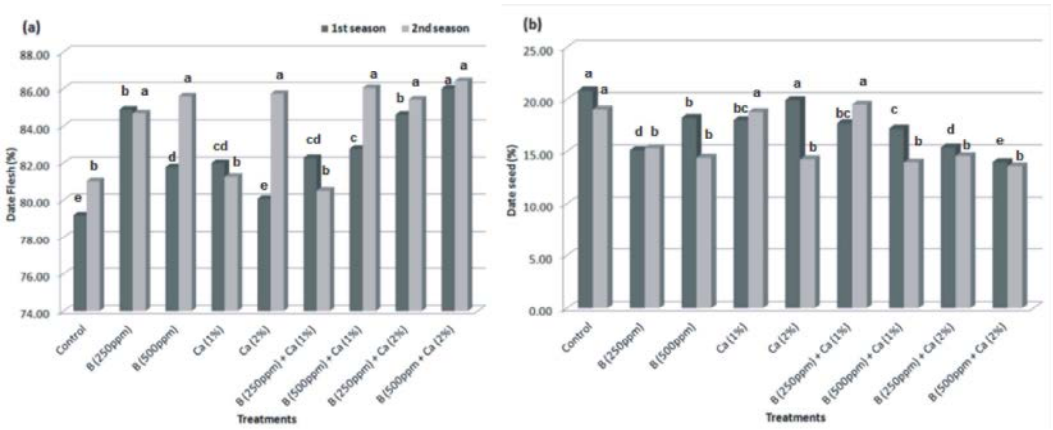

Fig. 5a-b: Effect of calcium nitrate and boric acid sprays on fruit component of cv. Amhat date palm. (a) Flesh weight (%), (b) Seed weight (%).Columns with different letters show significant differences at p= 0.05 using LSD.

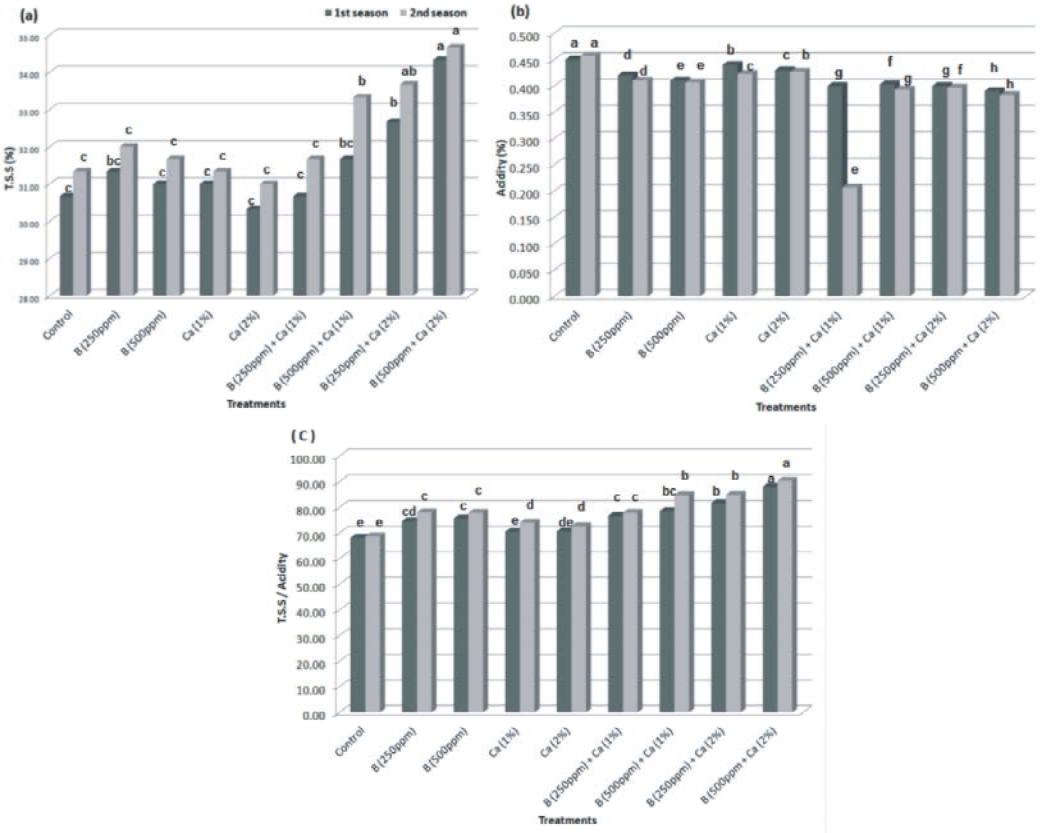

Fig. 6a-c: Effect of calcium nitrate and boric acid sprays on fruit chemical characteristics of cv. Amhat date palm. (a) TSS (%), (b) Acidity (%), (c) TSS/Acid ratio. Columns with different letters show significant differences at p= 0.05 using LSD.

The highest flesh weight % (86 and 86.4% in the two studied seasons, respectively)was obtained by spraying boric acid at 500 ppm combined with calcium nitrate at 2%, followed by spraying boric acid at 250 ppm combined with calcium nitrate at 2% (84.6 and 85.4% in the first and second seasons, respectively). On the other hand, the highest seed weight % was obtained by control treatment which recorded 20.8% in the first season and 19% in the second season. Whereas, the lowest seed weight % (14 and 13 % in the two seasons, respectively) was recorded

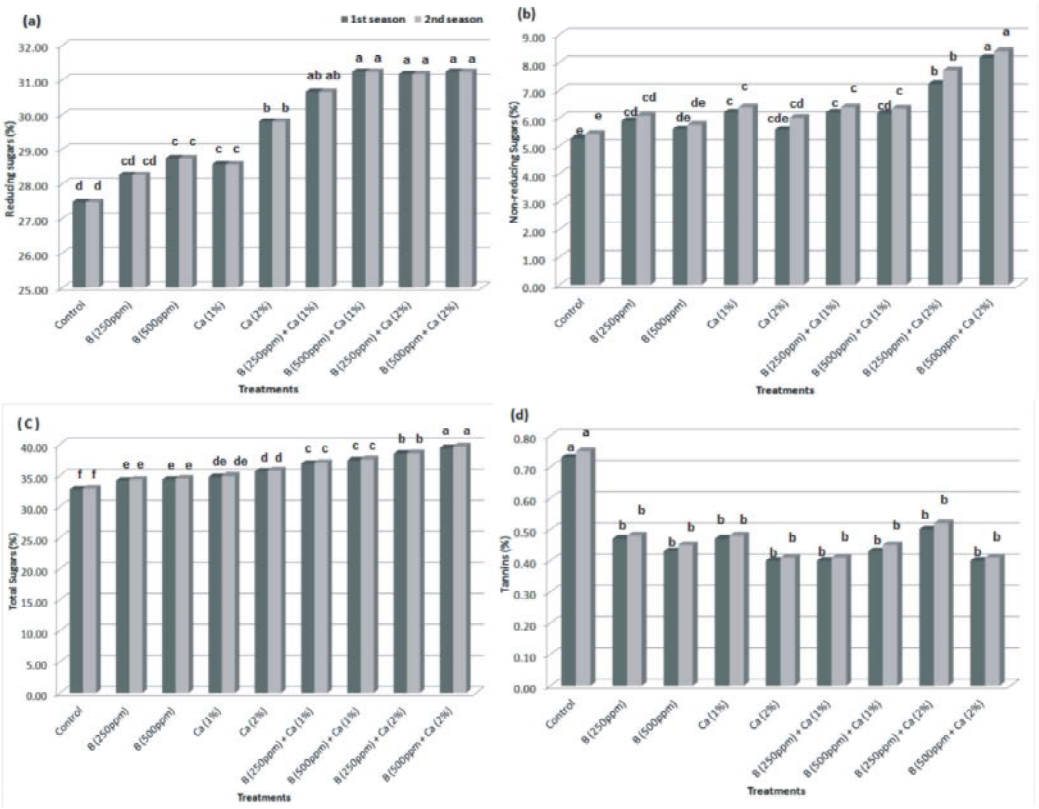

Fig. 7a-c: Effect of calcium nitrate and boric acid sprays on fruit chemical Contents of cv. Amhat date palm. (a) Reduced sugars (%), (b) Non-reduced sugars (%), (c) Total sugars (%), (d) Tannins (%).Columns with different letters show significant differences at p= 0.05 using LSD.

by spraying 500 ppm boric acid mixed with 2% calcium nitrate. Increasing fruit physical character may be attributed to the improvement of fruit growth and uptake of both Ca and/or B nutrients that accelerate metabolic processes. Similar finding were reported by Khayat *et al.* [10], Desouky *et al.* [36] Harhash and Abdel-Nasser [37] and Shahin [39].

Fruit Chemical Characteristics: Fig. 6 explained fruit chemical Characteristics as TSS (%), acidity (%) and TSS/acid ratio of Amhat date palm as affected by spraying both boric acid and calcium nitrate separately or combined together. Combination of both boric acid and calcium nitrate increased significantly T.S.S content except dates that treated with 250 ppm boric acid combined with 1% calcium nitrate as compared with control treatment in the two growing seasons. Dates sprayed with 500 ppm boric acid combined with 2% calcium nitrate gave the highest significant T.S.S content (34.3 and 34.7% in the first and second seasons, respectively). On contrast, the lowest T.S.S % was observed at control fruit which recorded 30.6 and 31.3 % in the first and second seasons, respectively. Regarding acidity, all treatments produced less acidic fruits than the control. The least fruits acidity (0.39 and 0.38% in the two studied seasons, respectively) was produced due to spraying 500 ppm boric acid combined with 2% calcium nitrate. Whereas, the highest value of fruits acidity (0.45% in the first season and 0.46% in the second season) was determined in the control palms. For T.S.S/acid ratio, spraying 500 ppm boric acid mixed with 2% calcium nitrate showed the highest ratio (88 and 90 in both seasons, respectively) compared with the control which recorded the lowest ratio (68.2 and 68.7 in the two studied seasons, respectively).Similar findings were reported by Harhash and Abdel-Nasser [37], Desouky *et al*. [36] and Shahin [39].

Sugars and Tannins Contents: Data presented in Fig. 7 indicated that reducing sugars, non-reducing sugars, total sugars and tannins were significantly affected by different treatments in the two experimental seasons. All combinations between boric acid and calcium nitrate

increased reducing and non-reducing sugars percentage in the two studied seasons compared to the control and treatments of spraying boric acid and calcium nitrate separately. Regarding reducing sugars, no significant differences were observed among all combination treatments of both boric acid and calcium nitrate. While, there was a significant differences between the combined treatments and the individual spraying with boric acid or calcium nitrate including the control. The highest value of reducing sugars in both studied seasons (31.24%) was recorded by spray boric acid at 500 ppm with calcium nitrate at both concentrations 1 and 2%.

Concerning the non-reducing sugars, the highest percentage (8.17 and 8.41 in the first and second seasons, respectively) was detected by spraying boric acid at 500 ppm combined with calcium nitrate at 2%. Whereas, the lowest percentage was observed at control palms since reached 5.27% in the first season and 5.43 % in the second one. As for total sugars content, results showed that fruit content from total sugars was significantly affected by different treatments. The highest total sugars content (39.5 and 39.6 % in the two seasons, respectively) was obtained by spraying 500 ppm boric acid combined with 2% calcium nitrate, followed by 250 ppm boric acid combined with 2% calcium nitrate (38.5 and 38.8 in the first and second seasons, respectively). On the contrary, the lowest total sugars content (32.74 and 32.90% in the two seasons, respectively) was obtained in control. Spraying boric acid and calcium separately or in combination had no effect on tannins content in dates of all treatments, but it significantly lower than control which gave the highest value (0.73 and 0.75 mg/100g in the two seasons, respectively). Hansch and Mendel [12] that boron has a main role in many processes specially transport of sugars and carbohydrate metabolism.

CONCLUSIONS

Calcium and boron play an important role in fruit set, fruit retention and development and cause efficient yield and quality improvement. Our results revealed that spraying Amhat date palm inflorescences with boric acid and calcium nitrate as individual or in combination had a positive effect on fruit set, yield and fruit quality. However, it could be concluded that the promising treatment is spraying boric acid at 500 ppm in combination with calcium nitrate at 2% since it gave the highest values concerning fruit set, fruit retention, bunch weight and fruit physical and chemical characteristics.

REFERENCES

1. FAO, 2010. Food and Agriculture Organization of the United Nations.
2. Singh, R.S. and Sant Ram, 1983. Studies on the use of plant growth substances for fruit retention in mango cv. Dashehair. Indian J. Hort., 40(3 and 4): 188-194.
3. Etman, A.A., A.M. Atalla, A.M. El-Kobbia and S.M. El-Nawam, 2007. Influence of flower boron sprays and soil application with some micro nutrients in calcareous soil on 1 Vegetative growth and leaf mineral content of date palm cv. Zaghloul in Egypt. The 4th symposium on date palm in Saudi Arabia (Challenges of Processing, Marketing and Pests control), Date Palm Research Center, King Faisal Univ., Al-Hassa, 5-8 May, 2007, Abstract book, pp: 72.
4. Atalla, A.M., A.A. Etman, A.M. El-Kobbia and S.M. El-Nawam, 2007. Influence of flower boron sprays and soil application with some micro nutrients in calcareous soil on 2 Yield, quality, mineral content Zaghloul dates in Egypt. The 4th symposium on date palm in Saudi Arabia (Challenges of Processing, Marketing and Pests control), Date Palm Research center, King Faisal Univ., Al-Hassa, 5-8 May, 2007, Abstract book, pp: 73.
5. Westover, F. and I. Kamas, 2009. Investigation of spray timing of boron and effects of micro-nutrient sprays on yields of Blanc du Bois wine grapes. Proceedings of the Texas Viticulture Enology Research Symposium, June, 2-3, 2009, Granbury, Texas.
6. Robbertse, P.J., J.J. Lock, E. Stoffberg and L.A. Coetzer, 1990. Effect of boron on directionality of pollen tube growth in Petunia and Agapanthus. African J. Bot., 56: 487-492.
7. Talaie, A., A.T. Badmahmoud and M.G. Malakout, 2001. The effect of foliar application of N, B and Zn on quantitative and qualitative characteristics of olive fruit. Iranian J. Agric. Sci., 32(4): 727-736.
8. Wojcik, P. and M. Wojcik, 2003. Effect of boron fertilization on Conference pear tree vigor, nutrition and fruit yield and storability. Plant and Soil, 256(2): 413-421.
9. Baldi, E., M. Toselli, D. Deudellar, M. Taglivini and B. Maringoni, 2004. Foliar feeding of stone fruit trees. Informatore-Agrorio, 60(21): 43-46.

10. Khayyat, M., E. Tafazoli, S. Eshghi and S. Rajaee, 2007. Effect of nitrogen, boron, potassium and zinc on yield and fruit quality of date palm. American-Eurasian J. Agric. And Environ. Sci., 2(3): 289-296.
11. Abdel-Fattah, D.M., S.A. Mohamed and O.M. Ismail, 2008. Effect of bio-stimulants, Etherl, boron and potassium nutrient on fruit quality of *Costata persimmon*. Aust. J. of Basic and Applied Sci., 2(4): 1432-1437.
12. Hansch, R. and R.R. Mendel, 2009. Physiological of mineral micro-nutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl). Current opinion in plant Biol., 12: 259-266.
13. Rizzi, E. and A. Abruzzese, 1990. Effects of calcium treatment on some biochemical indexes during the developing of apple fruit. Hort. Abst., 60(7): 4966- 4973.
14. Babu, R.S., C.B.S. Rajput and S. Rath, 1984. Effect of zinc, 2, 4, D and GA_3 in Kagzi lime *Citrus aurantifolia* Swingle, IV. Fruit quality. Haryana J. Hort. Sci., 11(1/2): 59-65.
15. Khan, M.N., A.B. Malik, M.I. Makbdoom and A. Hag, 1993. Investigations on the efficiency of exogenous synthetic growth regulators on fruit drop in mango *Mangifera indica* Linn. J. Hort., 20(1): 1-14.
16. Stebbins, R.L., D.H. Dewey and V.E. Shull, 1972. Calcium crystals in apple stem, petiole and fruit tissue. HortSci., 7: 492-493.
17. A.O.A.C., 1980. Official Methods of Analysis. 13th Ed. Association of Official Analytical Chemists, Washington D.C., USA.
18. Dubois, M., K.A. Gilles, J.K. Hamilton, P.A. Rebers and F. Smith, 1956. Colorimetric method for determination of sugars and related substances. Anal. Chem., 28: 350-256.
19. A.O.A.C., 1995. Official Methods of Analysis. 15th Ed. Published Association of Official Analytical Chemists, Washington D.C., USA.
20. Winton, A.L. and K.B. Winton, 1958. The Analysis of Foods. John Wiley and Sons, Inc., London, pp: 853-867.
21. MSTAT-C Package, 1998. Software program for the design and analysis agromatic research experiments, MSTAT-C, Version 7, Michigan State Univ., M.S., USA.
22. Waller, A. and D.B. Duncan, 1969. Multiple range and multiple tests, Biometrics, 11: 1-24.
23. Adel-Hafeez, A.A., Azza I. Mohamed, Neven M. Taha and S.M.A. Mehaisen, 2010. Effect of some sources of potassium and calcium as foliar sprays on fruit quality of storability of Kelsey plum. Egypt. J. Hort., 37(2): 65-73.
24. Chaplin, M.N., R.L. Stebbins and M.N. West Wood, 1977. Effect of hall applied boron sprays on fruit set and yield of Italian prune. HortSci., 12: 500-501.
25. Taylor, L.X., T. Vogt and M.P. Turcich, 1994. Flavones and functional pollen, pp: 62-77 in A.G. Stephenson and The-huikao (Pollen-Pistil interactions and pollen tube growth). Proceedings of ninth annual state symposium in plant physiology May, 19-21, Amer. Soc. Plant Physiol., Ogists series, pp: 12.
26. Abd El-Mageed, Nagwa, A. and S.M. Abd El-Fattah 2007. Effect of calcium and boron treatments on yield, fruit quality, leaf and fruit mineral contents of pear trees grown in calcareous soils. J. Adv. Agric. Res. (Fac. Agric., Saba Basha), 12(3): 459-477.
27. Fawzia, M. Eissa, Magda M. Naser and M.M. Yehia, 2008. Effect of boron and calcium treatments on yield and fruit quality of Le Conte pears. Minufiya J. Agric. Res., 33(2): 471-488.
28. Abd El Messeih, W.M., M.M. Yehia, Nagwa A. Abd El-Megeed and G.B. Mikheal, 2010. Effect of some treatments for improving vegetative growth, leaf mineral compositions, fruit set, yield, fruit quality and limitation of flowers and fruit abscission of Le Conte pear trees at El Nubaria region. J. Adv. Agric. Res. (Fac. Agric, Saba Basha), 15(1): 151-170.
29. Nijjar, G.S., 1985. Nutrition of Fruit, Published by Mrsusha Rajkumer for Kalyeni publishers, New Delhi, pp: 10-270.
30. Qin, X., 1996. Foliar spray of B, Zn and Mg and their effects on fruit production and quality of Jincheng orange *Citrus sinensis*. Journal of South West Agricultural Univ., 18(1): 40-45.
31. Hassan, H.S.A., 2000. Morphological and Physiological studies on flowering, pollination and fruiting of Picual olive trees. PhD Thesis, Fac. of Agric., Cairo Univ., Egypt, pp: 111.
32. Callan, N.W., M.M. Thompson and M.H. Chaplin, 1978. Fruit set off Italian prune following fall foliar and spring boron sprays. J. Amer. Soc. Hort. Sci., 103: 253-257.
33. Marschner, H., 1995. Mineral Nutrition of Higher Plants. Academic Press, London. ISBN: 0124735436.

34. Mengel, K. and E.A. Kirkby, 2001. Principles of Plant Nutrition. 5th Rev. Ed., Kluwer Academic Publisher (United States). ISBN-10: 1402000081.
35. Al-Hamoudi, A.H., 2006. Studies on fruit set of date palm. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.
36. Desouky, I.M., A. El-Hamady, A. Hassan and A. Abdel Hamid, 2007. Effect of spraying Barhee flowers with potassium sulphate and boric acid on fruit set, productivity and date properties. The 4th Symposium on Date Palm in Saudi Arabia (Challenges of Processing, Marketing and Pests control), Date Palm Research Center, King Faisal Univ., Al-Hassa, 5-8 May, 2007, Abstract book, pp: 76.
37. Harhash, M.M. and G. Abdl-Nasser, 2010. Improving of fruit set, yield and fruit quality of Khalas tissue culture derived date palm through bunches spraying with potassium and/or boron. Australian J. Basic and Applied Sci., 4(9): 4164-4172.
38. Ahmad, W., A. Niaz, S. Kanwal and A. Rahmatullah, 2009. Role of boron in plant growth. A review J. Agric. Res., 47(3): 329-338.
39. Shahin, M., 2007. Effect of potassium fertilization on growth, leaves nutrient content and yield of Khalas date palm in Al-Hassa Oasis (K.S.A). The 4th Symposium on Date Palm in Saudi Arabia (Challenges of Processing, Marketing and Pests control), Date Palm Research Center, King Faisal Univ., Al-Hassa, 5-8 May, 2007, Abstract book, pp: 77.