



EFFECTS OF ZINC, BORON AND ACTIVE DRY YEAST SPRAYS ON YIELD AND FRUIT QUALITY OF ZAGHLOUL DATE PALM

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ABSTRACT

The beneficial effects of boron, zinc and active dry yeast on yield and fruit quality of Zaghloul date palm grown at the Experimental Orchard, Faculty of Agriculture, Assiut University, Egypt was studied during 2011, 2012 and 2013 seasons.

The experiment was set up in a complete randomized block design with ten replicates each of one bunch. All treatments were sprayed two times after fruit set and one month later. The obtained results could be summarized as follow:

- Boron, zinc and active dry yeast sprays significantly increased the fruit retention percentage and bunch weight compared to the untreated ones. Yeast application was more effective compared with boron or zinc application.
- Spraying either yeast, boron or zinc at any studied concentration was accompanied with improving fruit quality in terms of significant increase in fruit weight, total soluble solids and sugar contents. No significant differences were detected between spraying with yeast at 250 or 500 ppm, 500 or 1000 ppm zinc, as well as, boron at 1000 or 2000 ppm. Moreover, active dry yeast spraying revealed the highest improvement in palm yield and fruit quality.

However, it can be concluded that spraying either boric acid, zinc sulphate or active dry yeast twice after fruit set and one month later increased the palm yield and improved the fruit quality of Zaghloul date palm. Meanwhile, using dry yeast as more effective than both boric acid and zinc sulphate.

INTRODUCTION

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 patterns of many people. Egypt is considered among the top ten date producers, **FAO (2012)**. Zaghloul cultivar is one of the most economically important of soft date palm grown in Egypt. One of the best tools for date palm reproductive is fertilization (**Khayyat et al 2007**). The efficient use of fertilizers to increase crop yield is an important goal in all agricultural systems. Increasing public concern, excessive nutrient loss from agricultural land encourage the researchers to find more efficient ways to apply fertilizers. Foliar fertilization has the advantage of low application rates, uniform distribution of fertilizer materials and quick responses to applied nutrients. Moreover, hidden hungers can easily be managed (**Umer et al 1999 and Mengel, 2002**).

Spraying micronutrients improves fruit set, fruit retention and development as well as yield and fruit quality (**Sarrwy et al 2012 and Omar et al 2014**). Boron is involved in processes such as protein synthesis, transport of sugars, and carbohydrate metabolism (**Hansch and Mendel, 2009**). The impact of some microelements, such as boron on dates yield and fruit quality seems to play an important role in achieving satisfactory fruit set and fruit quality (**Etman et al 2007 and Khayyat et al 2007**). Spraying date palm inflorescences with boric acid and/or calcium nitrate had a significant effect on fruit set, yield and fruit quality of date palm (**Sarrwy et al 2012 and Omar et al 2014**). Zinc is an essential micro-element for plant. It is involved in many enzymes reactions and is necessary for growth and development, as well as protein and carbohydrate metabolism. Foliar applica-

tion of zinc sulfate is more effective on yield and fruit quality (Harhash and Abdel-Nasser, 2010; Sarrwy et al 2012 and Omar et al 2014). Moreover, use of bio-fertilization is recommended as a safe fertilization method to increase productivity and quality of many fruit species. Applications of bio-fertilizers are now available commercially, specific strains are used as biological fertilizers, for nitrogen, phosphorus and silicate dissolving such as N-fixing bacteria and yeasts. The various positive effects and benefits of applying active dry yeast as bio-fertilizer were attributed to its own different nutrients, greater amounts of vitamins and cytokinin as natural plant hormone and stimulating photosynthesis (Subba Rao, 1984).

The objective of this study is to evaluate the effect of bunches spray with boron, zinc and yeast on yield and fruit quality of Zaghloul date cultivar.

MATERIALS AND METHODS

The present study was carried out during three successive seasons of 2011, 2012 and 2013 on 10 uniform Zaghloul date palms (*Phoenix dactylifera* L.). The palms grown in the Experimental Orchard of the Faculty of Agriculture, Assiut University, Egypt, where the soil has a clay texture. Palms were selected randomly and at similar age (20 years-old), uniform in growth and subjected to the same management and cultural practices except the studied spray treatments. The leaf/bunch ratio was adjusted at the end of the blooming season to meet their value of 7:1. Bunches were thinned to 10 per palm and the artificial pollination was uniformly performed in respect of source, date and method.

This investigation included the following seven spray treatments.

- 1- Control (distilled water).
- 2- Zn SO₄ (500 ppm & 1000 ppm).
- 3- ZnSO₄ at 1000 ppm.
- 4- H₃BO₃ at 1000 ppm.
- 5- H₃BO₃ at 2000 ppm.
- 6- Active dry yeast at 250 ppm.
- 7- Active dry yeast at 500 ppm.

These treatments were applied on the same palm. The experiment was set up in a complete randomized block design with ten replicates each of one bunch. The dry pure yeast powder was activated by using sources of carbon and nitrogen with the ratio 6:1 according to Barnett et al (1990).

All treatments were applied two times just at after fruit set and one month later. Bunches were sprayed using a small hand sprayer until run-off.

Bunches were separated from each side with plastic sheets to avoid any contamination between other treatments.

Bunches were harvested at the first of September when fruits reached Khalal stage and their weights were recorded. Twenty five fruits from each bunch were picked at random to determine the physical fruit characteristics, i.e. fruit weight, fruit dimensions, percentage of fruit flesh. The chemical constituents i.e. TSS% using handy refractometer, total and reducing sugars, as well as, total acidity % (as a citric acid/100 g pulp) were also, determined according to A.O.A.C. (1985).

Statistical analysis was done according to Mead et al (1993) using L.S.D. at 5% to compare between different treatment means.

RESULTS

Yield

The fruit retention percentage and bunch weight are considered as index for the palm yield. Data presented in Table (1) show the effect of boron, zinc and active dry yeast sprays on fruit retention percentage and bunch weight of Zaghloul date palm during 2011, 2012 and 2013 seasons. It is obvious from the data that the results took similar trend during the three studied seasons. In a general view, all treatments significantly increased the fruit retention percentage, and bunch weight compared to the untreated one (control). Application of 500 ppm active dry yeast showed the greatest percentage of fruit retention (47.18, 45.70 & 48.10%) and the heaviest bunch weight (17.40, 18.90 & 17.80 kg) during the three studied seasons, respectively.

No significant differences were recorded between spraying with yeast at 250 or 500 ppm, as well as boron at 1000 or 2000 ppm. The increment percentage of bunch weight was (29.85, 30.34 & 30.88%) due to spray yeast at 500 ppm compared to the control in 2011, 2012 and 2013 seasons, respectively.

Fruit quality

Physical properties

Data in Tables (1 & 2) indicated that spraying Zaghloul date bunches with either boron, zinc or active dry yeast significantly increased the fruit weight, flesh percentage and fruit dimensions as compared with the control. Spraying active dry

Table 1. Effect of zinc, boron and active dry yeast sprays on fruit retention %, bunch weight and fruit weight of Zaghloul date palm during 2011, 2012 and 2014 seasons.

No.	Property Treat.	Fruit retention (%)			Bunch weight (kg)			Fruit weight (g)		
		2011	2012	2013	2011	2012	2013	2011	2012	2013
1	Control	41.82	41.30	43.40	13.40	14.50	13.60	19.32	19.96	20.37
2	ZnSO ₄ 500 ppm	43.95	43.48	45.88	15.60	16.80	15.80	21.36	21.80	22.40
3	ZnSO ₄ 1000 ppm	44.50	43.82	46.28	16.90	17.30	16.30	21.68	22.46	23.00
4	H ₃ BO ₃ 1000 ppm	46.15	44.10	47.11	16.50	17.90	16.60	22.63	23.17	23.44
5	H ₃ BO ₃ 2000 ppm	46.30	44.60	47.38	16.90	18.30	17.10	23.15	23.75	24.10
6	Yeast 250 ppm	46.80	45.40	47.68	17.00	18.40	17.30	23.18	23.84	24.30
7	Yeast 500 ppm	47.18	45.70	48.10	17.40	18.90	17.80	23.33	24.16	24.60
LSD 5%		2.11	2.01	2.38	1.08	1.42	1.29	1.18	1.37	1.66

Table 2. Effect of zinc, boron and active dry yeast sprays on flesh percentage and fruit dimensions of Zaghloul date palm during 2011, 2012 and 2014 seasons.

No.	Property Treat.	Flesh (%)			Fruit length (cm)			Fruit diameter (cm)		
		2011	2012	2013	2011	2012	2013	2011	2012	2013
1	Control	89.49	90.18	89.26	5.32	5.41	5.56	2.55	2.68	2.71
2	ZnSO ₄ 500 ppm	91.15	92.06	90.68	5.78	5.86	5.93	2.68	2.81	2.85
3	ZnSO ₄ 1000 ppm	91.28	92.25	90.80	5.82	5.92	6.02	2.72	2.83	2.87
4	H ₃ BO ₃ 1000 ppm	91.45	92.36	91.16	5.98	6.08	6.12	2.72	2.84	2.89
5	H ₃ BO ₃ 2000 ppm	91.64	90.47	91.10	6.14	6.23	6.31	2.75	2.89	2.91
6	Yeast 250 ppm	91.92	92.60	91.38	6.21	6.32	6.38	2.76	2.71	2.93
7	Yeast 500 ppm	92.18	92.74	91.55	6.29	6.39	6.48	2.76	2.90	2.94
LSD 5%		1.48	1.51	1.13	0.39	0.33	0.38	0.11	0.10	0.18

yeast at 500 ppm gave the highest fruit weight, flesh percentage and dimensions compared to control. The higher values were significantly obtained in a descending order with 500 ppm yeast, 250 ppm yeast, 2000 ppm boron, 1000 ppm boron, followed by either 1000 ppm or 500 ppm zinc treatment. Meanwhile, the heaviest fruit weight (23.33, 24.16 & 24.60 g) was recorded on bunches that treated by 500 ppm active dry yeast spray during the three studied seasons, respectively. The corresponding increment due 500 ppm active dry yeast spray was attained (20.76, 21.10 & 20.65%) compared to the unsprayed ones, respectively.

Generally, the above results disclosed that the 500 ppm active dry yeast greatly improved all fruit physical properties under study. Such treatment are very important target than total yield due to the improve in physical fruit traits induce an increase in packable yield.

Chemical properties

Data in **Table (3)** indicated that spraying bunches with either Zn, B or yeast, at any concentration was accompanied with improving the chemical fruit properties in terms of significant increase in the total soluble solids and sugars contents and significant decrease in the total acidity percentage as compared to the control. No significant differences between spraying with yeast 250 or 500 ppm, zinc 500 or 1000 ppm as well as boron at 1000, or 2000 ppm. The highest values of total soluble solids and sugars content and the lowest one of total acidity percentage were significantly obtained in a descending order with yeast followed by either zinc or boron treatments. The highest TSS values (36.20, 36.80 & 36.90%) were obtained due to spray with 500 ppm active dry yeast during the three studied seasons, respectively.

Table 3. Effect of zinc, boron and active dry yeast sprays on some chemical constituents of Zaghloul date palm during 2011, 2012 and 2014 seasons.

No.	Property Treat.	TSS (%)			Total sugars (%)		
		2011	2012	2013	2011	2012	2013
1	Control	31.60	32.60	32.50	24.36	26.46	25.84
2	ZnSO ₄ 500 ppm	35.30	35.90	36.20	27.85	29.80	29.38
3	ZnSO ₄ 1000 ppm	35.70	36.40	36.60	28.18	30.24	29.85
4	H ₃ BO ₃ 1000 ppm	34.90	35.50	35.80	27.64	29.60	29.18
5	H ₃ BO ₃ 2000 ppm	35.10	35.70	36.10	27.80	29.94	29.45
6	Yeast 250 ppm	35.90	36.50	36.90	28.26	30.39	29.80
7	Yeast 500 ppm	36.20	36.80	36.90	28.48	30.51	30.04
LSD 5%		1.68	1.56	1.37	1.58	1.87	1.18
No	Property Treat.	Reducing sugars (%)			Titratable acidity (%)		
		2011	2012	2013	2011	2012	2013
1	Control	18.29	18.76	17.98	0.241	0.228	0.225
2	ZnSO ₄ 500 ppm	20.95	21.14	20.64	0.219	0.209	0.203
3	ZnSO ₄ 1000 ppm	21.18	21.50	20.96	0.218	0.206	0.201
4	H ₃ BO ₃ 1000 ppm	20.82	21.16	20.50	0.204	0.196	0.192
5	H ₃ BO ₃ 2000 ppm	20.90	21.24	20.68	0.201	0.193	0.190
6	Yeast 250 ppm	21.28	21.65	20.94	0.196	0.189	0.185
7	Yeast 500 ppm	21.44	21.72	21.30	0.198	0.190	0.184
LSD 5%		0.89	0.96	0.79	0.020	0.016	0.019

On other hand, the lowest ones (31.60, 32.60 & 32.50%) were recorded on the untreated bunches during the three studied seasons, respectively. Generally, the above results disclosed that the active yeast spray revealed the highest improvement of the considered chemical fruit properties.

DISCUSSION

Foliar fertilization has the advantage of low application rates, uniform distribution of fertilizer materials and quick responses to applied nutrients (Umer et al 1999). Fruit retention % and bunch weight as well as yield of date palm cultivars had been improved with boron and zinc application (Omer et al 2014). A tentative explanation is that boron and zinc increase fruit removal force due to its involvement in many enzymatic reactions that regulate protein and carbohydrate metabolism necessary for growth and development (Swietlik, 1999 and Sarrway et al 2012). Using bio-fertilizers are considered a promising alternative for chemical fertilizers. It is very safe for human, animals and environment (Verna, 1990). The main sources of bio-fertilizers are bacteria, fungi and cyano-

bacteria. Recently, using active dry yeast on fruit trees has received apparent interest. The positive effects of applying active yeast were attributed to its content of different nutrients, higher percentage of proteins, large amount of vitamin B and natural plant growth hormones (Moor, 1979).

The obtained results are nearly in the same line with these obtained by Khayyat et al (2007); El-Salhy et al (2007); Desouky et al (2007); Harhash & Abdel-Nasser (2010); Soliman & Obeed (2011); Osman et al (2011); Elkhaat & Elnoam (2013) and Omar et al (2014).

Fruit quality of date palm cultivars had been improved with boron, zinc and bio-fertilization application. Boron and zinc had a main role in many processes, especially transport of sugars and carbohydrate and proteins metabolism, that increased cell division and cell enlargement leading to increase the fruit weight and dimensions, as well as, hasten the maturation of fruits. In addition yeast has higher percentage of proteins and large amount of natural plant growth hormones, i.e. auxin and cytokinins which enhance cell division and enlargement induce an increase the fruit weight and size as well as hastened the fruit maturation.

In addition, such results are in harmony with those of **Osman (2003)**; **Ashour et al (2004)**; **El-Salhy et al (2007)**; **Attalla et al (2007)**; **Khayyat et al (2007)**; **Harhash & Abdel-Nasser (2010)**; **Soliman & Obeed (2011)**; **Osman et al (2011)**; **Sarrwy et al (2012)**; **Elkhayat & Elnoam (2013)** & **Omar et al (2014)** on different date palm cvs.

Conclusion

Generally, it is concluded that spraying bunches of Zaghloul date palm with either boric acid (1000 ppm) or zinc sulphate (500 ppm) as well as active dry yeast (250 ppm) just after fruit set and one month later has a positive effect on fruiting of Zaghloul date palm. However, active dry yeast spray was more effective than both boric acid and zinc sulphate sprays.

REFERENCES

- A.O.A.C. 1985.** Association of Official Agricultural Chemists. Official Methods of Analysis 14th Ed. pp. 490-500, Benjamin Franklin Station, Washington, D.C., U.S.A.
- Ashour, N.E., Hassan, H.S.A. and Mostafa, E.A.M. 2004.** Yield and fruit quality of Zaghloul and Samani date palm (*Phoenix dactylifera* L.) as affected by pollination methods. **Annals Agric. Sci. Ain Shams Univ., Cairo, 49(2): 631-642.**
- Attalla, A.M., Etman, A.A., El-Kobbia, A.M. and El-Nawam, S.M. 2007.** Influence of flower boron spray and soil application with some micronutrients in calcareous soil on: II- Yield, quality and mineral content of Zaghloul dates in Egypt. The 4th symposium on date palm in Saudi Arabia, Date Palm. Research Center, King Faisal Univ., 73 p.
- Barnett, J.A., Payne, E. and Yarrow, D. 1990.** Yeast characteristics and identification. 2nd Ed Cambridge Univ. Press.
- Desouky, I.M., El-Hamady, A. and Abdel-Hamid, N.A. 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, Date Palm. Research Center, King Faisal Univ., 76 p.
- Elkhayat, H.M. and El-Noam, S.M. 2013.** The use of bio-fertilizer to enhance fruit quality and productivity Zaghloul and Samani date palms. **Alex. J. Agric. Res., 58(2): 131-140.**
- El-Salhy, A.M., Marzouk, H.M., Abdel-Galil, H.A. and Mahmoud, A.M. 2007.** Effect of some pollination treatments on yield and fruit quality of some date palm cultivars. The 4th Symposium on Date Palm in Saudi Arabia, Date Palm. Research Center, King Faisal Univ., 98 p.
- Etman, A.A., Attalla, A.M., El-Kobbia, A.M. and El-Nawam, S.M. 2007.** Influence of flower boron spray and soil application with some micronutrients in calcareous soil on: I- Vegetative growth and leaf mineral content of date palms cv. Zaghloul in Egypt. The 4th symposium on date palm in Saudi Arabia, Date Palm. Research Center, King Faisal Univ., 72 p.
- FAO, 2012.** "Statistics" Food and Agriculture Organization of United Nations, Rome, Italy.
- Hansch, R. and Mendel, R.R. 2009.** Physiologically mineral, micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B & Cl. **Curr Opin, Plant Biol., 12(3): 259-266.**
- Harhash and Abdel-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. of Basic and Applied Sciences, 4(9): 4164-4172.**
- Khayyat, M., Tafazoli, E., Eshghi, S. and Rajaei, S. 2007.** Effect of nitrogen, boron, potassium and zinc on yield and fruit quality of date palm Am-Euras. **J. Agric. Environ. Sci., 2 (3): 289-296.**
- Mead, R., Gurnow, R.N. and Harted, A.M. 1993.** Statistical Methods in Agriculture and Experimental Biology (2nd ed) Chapman and Hall, London, pp. 10-44.
- Mengel, K. 2002.** Alternative or complementary role of foliar supply in mineral nutrition. **Acta Hortic. 594: 33-47.**
- Moor, T.C. 1979.** Biochemistry and physiology of plant hormones pub. By Springer-Verlag, New York, U.S.A.
- Omar, A.K., Ahmed, M.A. and Al-Obeed, R.S. 2014.** Improving fruit set, yield and fruit quality of date palm (*Phoenix dactylifera* L. cv. mnifi) through bunch spray with boron and zinc. **J. of Testing and Evaluation, 43(4): 1-6.**
- Osman, S.M. 2003.** Effect of bio-fertilizer on physical and chemical properties of Zaghloul date palm. **Annals Agric. Sci., Ain Shams Univ., Cairo, 48(1): 297-305.**
- Osman, S.O.A., Moustafa, F.M.A., Abdel-Galil, H.A. and Ahmed, A.Y.M. 2011.** Effect of yeast and effective microorganisms (EM₁) application on the yield and fruit characteristics of Bar-

- tamuda date palm under Aswan conditions. **Assiut J. of Agric. Sci. 42 (Special Issue) 5th Conf. of Young Scientists Fac. of Agric., Assiut Univ., pp. 332-349.**
- Sarrwy, S.M.A., Gadalla, E.G. and Mostafa, E.A. 2012.** Effect of calcium nitrate and boric acid on fruit set and fruit quality of cv. **Amhat date palm. World Agric. Sci., 8(5): 506-515.**
- Soliman, S.S. and Al-Obeed, R.S. 2011.** Effect of boron and sugar spray on fruit retention and quality of date palm. **American-Eurasian J. Agric. & Environ. Sci., 10(3): 404-409.**
- Subba Rao, N.S. 1984.** Bio-fertilizer in Agriculture Oxford IBH Company, New Delhi, India.
- Swietlik, D. 1999.** Zinc nutrition in horticultural crops. **Horticultural Review, 23: 109-180.**
- Umer, S., Bansal, S.K., Imas, P. and Magen, H. 1999.** Effect of foliar fertilization of potassium on yield, quality and nutrient uptake of groundnut. **J. Plant Nutr., 22: 1785-1795.**
- Verna, L.N. 1990.** Role of biotechnology in supplying plant nutrients in the vine ties, **Fertilizer News 35: 87-97.**