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Effect of Nitrogen, Boron, Potassium and Zinc Sprays on Yield and Fruit Quality of Date Palm

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Abstract: The present research was accomplished on *Phoenix dactylifera L.* cv. Shahany to investigate the effect of macro and micronutrients on fruit quality and quantity. Treatments were urea (0.5, 1%), boric acid (1500, 2500 ppm), potassium sulfate (1, 2%) and zinc sulfate (300, 600 ppm). Higher and lower yield were obtained from H_3BO_3 (1500 ppm) and control, respectively. The greater part of pulp weight, pulp/seed ratio, fruit length and diameter were resulted from H_3BO_3 (1500 ppm). Total soluble solids were the most in control; however, there were significant differences among treatments. The results of this study showed that mineral nutrients especially boron, increased yield and quality of fruits in 'Shahany' date palm.

Key words: Urea · boron · potassium · zinc · date palm · yield · fruit quality

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 nutritious pattern of many people. In Iran, many cultivars are grown in different regions according to the diversity of their climatic necessity, particularly average temperature and relative humidity that effect fruit growth and development. In each zone, soil conditions are different and generally undesirable, which possibly lead to lower nutrient flowing in inflorescences and fruits and consequently cultivar reproductive potentials don't become evident. One of the best tools for date palm reproductive potential studies is direct application of nutrient elements on inflorescences and fruits.

Nourish effects of some macro elements upon date palm yields and fruit qualities were reported by other [1-7]. In addition to macro elements, micro elements had also important role in fruit set, retention, development and cause efficient yield and quality improvement [8-10]. The efficient use of fertilizers to increase crop yield is an important goal in all agricultural systems [11]. However, matching nutrient application to crop requirements is not easy. It has been and will continue to be an ambitious pursuit for researchers and growers to maximize nutrient uptake by crops on the other hand, minimizing fertilizer application and leaching loss [11]. Plants usually absorb water and nutrients by their roots, therefore fertilizers are traditionally applied into the soil [12]. While soil application can supply enough nutrients to improve plant production, it also causes world-wild anxiety about environmental contamination for nutrients leaching into ground water [13]. Increasing public concern, excessive nutrient loss from agricultural land encourage the researchers to find more efficient ways to apply fertilizers [11]. The power of plant leaves to absorb nutrients has resulted in the fact that the foliar application of nutrients becomes a recurrent method for supplying nutrients to plants [14]. 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 [15]. Many workers have shown that fruit trees receiving foliar nitrogen applications, use fertilizers N more efficiently than trees that receive soil N applications [16, 17]. Faust [18] reported that plant growth stage and timing of fertilizer application affect nutrient uptake [18]. Using isotopically labeled N, it has been possible to demonstrate that developing inflorescences and fruits are a strong N sink [19]. Abou Aziz *et al*. [20] reported that urea application on avocado trees gave a highly significant increase in the tree yields [20]. However, soil and foliar urea applications on avocado cause increasing yield [21]. Yogaratnam *et al*. [22] reported that foliar applied urea, zinc and boron alone or in combination had no effect on fruit size in apple trees, but urea application causes increasing yield, moreover boric acid was inconsistent in

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effect [23, 24]. Potassium application increased yield and fruit quality in lemons and oranges [25]. Foliar sprays with $ZnSO_4$ failed to increase yields of 'Eureka' lemon trees [26]. Agaev [27] reported significant increases in yield of potato plants in response to soil and foliar Zn applications in the Caucasus region of the former Soviet Union. Yield increases were caused by both elevated numbers of tubers and their sizes [27]. The main aim of this study was to investigate the effects of some nutrient elements on fruit yields and quality of date palm trees.

MATERIALS AND METHODS

Plant selection and treatments: The experiment was conducted at a commercial plantation suburban Jahrom of Iran on date palm cultivar 'Shahany' in 2006 growing seasons. Nine uniform trees were selected based on height (350±50 cm), diameter (45±5 cm) and inflorescence's number (4 inflo.). The selected trees at on-year were treated according to the usual farm management, for example, artificial pollination, pruning, irrigation, fertilization and manuring. Spray treatments were:

- Control (Distilled water+wetter)
- Urea (0.5, 1%+wetter)
- H_3BO_3 (1500, 2500 ppm+wetter)
- K_2SO_4 (1, 2%+wetter)
- $ZnSO_4$ (300, 600 ppm+wetter)

All treatments were applied separately at *Khalal* stage of fruit growth and development. Sprays were applied by watering-can until 'run-off 'stage. Wettering agent was tween-20.

Yield: The value for the yield is means of 10 mature fruits in each of replications and 4 replications in each treatment. Means are given in grams per treatment.

Pulp characters: Pulp characters were calculated based on length (cm), weight (g), pulp/seed ratio (g) and diameter (cm).

Seed characters: Seed characters were calculated based on length (cm), weight (g) and diameter (cm).

Fruit quality: Water-soluble dry matter (%) in fruit was measured using a hand refractometer.

Statistical analysis: Each of inflorescences and trees were selected as one replication and a block in experiment, respectively. The experiment was arranged in completely randomized block design (CRBD) with 9 treatments and 4 replications. Means were compared with using Duncan's multiple range tests at 5% level. SPSS (11.5) was use for determine correlation among treats.

RESULTS AND DISCUSSION

Yield: Higher and lower yield were obtained from boric acid (1500 ppm) and control, (15.55 and 10.82 g) respectively (Fig. 2). Data (Table 1) indicated that fruit and seed development independent. Were shown that the rate of dry matter accumulation is accelerating by the live ovule at the fruit development period [28]. In seeded fruit the rapid increase in fruit growth starts at the beginning of the *Khalal* stage, simultaneously the seed entirely ceases growing [28]. Yogaratnam and Greenham [23] has shown that urea spray on apple trees did not increase yield, but, at our experiment urea spray caused higher fruit yield compared to control and there were no significant differences between H_3BO_3 (1500 ppm) and urea treatments.

Pulp characters: The fruit length was shown in Fig. 1 and 11-18. Lower fruit length (Fig. 1 and 11) was resulted from control (Fig. 3). Larger fruits resulted from urea spray

Table 1: Correlations between fruit and seed characters

	Fruit length (cm)	Seed length (cm)	Seed weight (g)	Pulp. weight (g)	Pulp/ seed ratio	Fruit weight (g)	Seed diameter (cm)	Fruit diameter (cm)
Fruit length (cm)	1			**	**	**		
Seed length (cm)	0.092	1	*				*	
Seed weight (g)	-0.535	0.688*	1		**		**	
Pulp. weight (g)	0.778**	0.393	-0.1441	1	*	**		
Pulp/seed ratio	0.875**	-0.275	-0.774**	0.727*	1	*	*	
Fruit weight (g)	0.776**	0.460	-0.101	0.996**	0.989*	1		
Seed diameter (cm)	-0.558	0.733*	0.853**	-0.071	-0.676*	-0.020	1	*
Fruit diameter (cm)	-0.341	0.295	0.308	0.177	-0.148	0.181	0.666*	1

[** correlation is significant at the 0.01 level], [* correlation is significant at the 0.05 level]

Fig. 1: Effects of nutrient elements on fruit length [up to down: zinc (600,300 ppm), urea (1, 0.5%), boron (1500, 2500 ppm), potassium (1, 2%) and control]

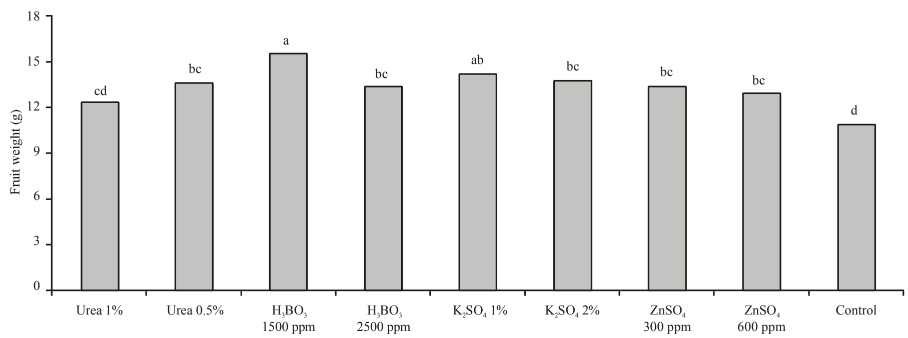

Fig. 2: Effect of urea, boron, potassium and zinc on fruit weight (g). Bars with the same letters are not significantly different according to DMRT at 5% level

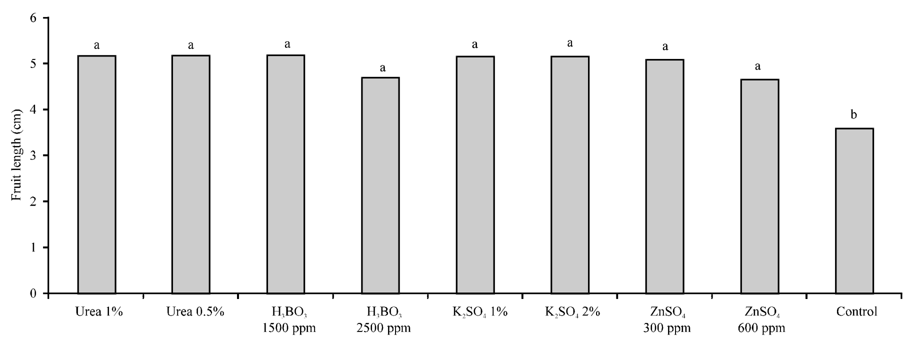

Fig. 3: Effect of urea, boron, potassium and zinc on fruit length (cm). Bars with the same letters are not significantly different according to DMRT at 5% level

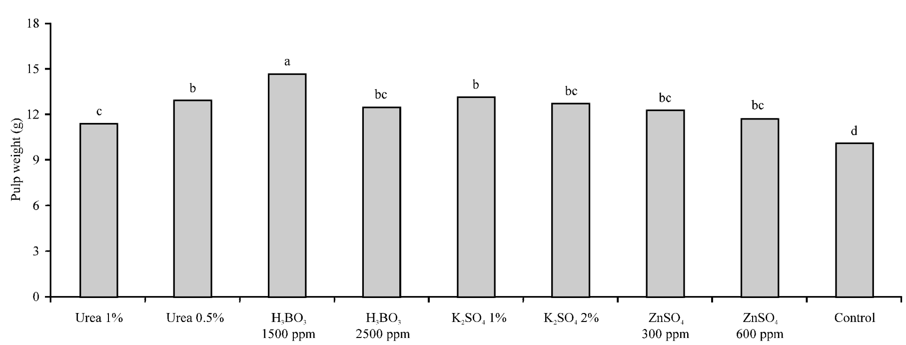

Fig. 4: Effect of urea, boron, potassium and zinc on pulp weight (g). Bars with the same letters are not significantly different according to DMRT at 5% level

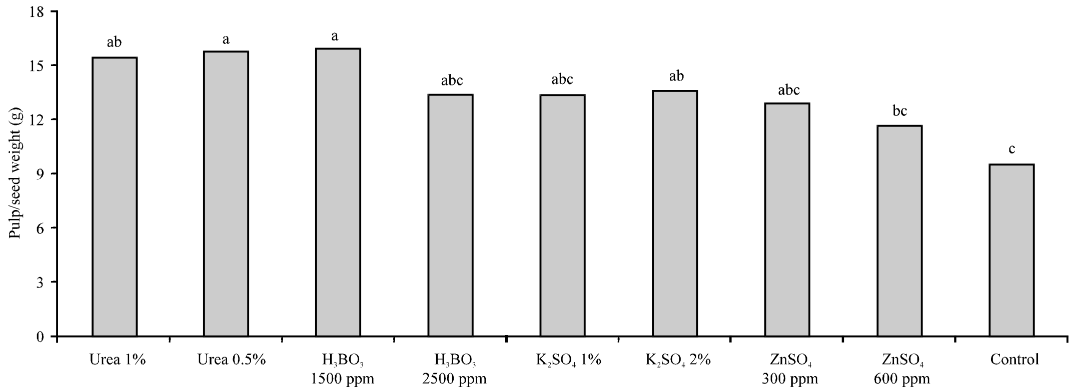

Fig. 5: Effect of urea, boron, potassium and zinc on pulp/seed weight (g). Bars with the same letters are not significantly different according to DMRT at 5% level

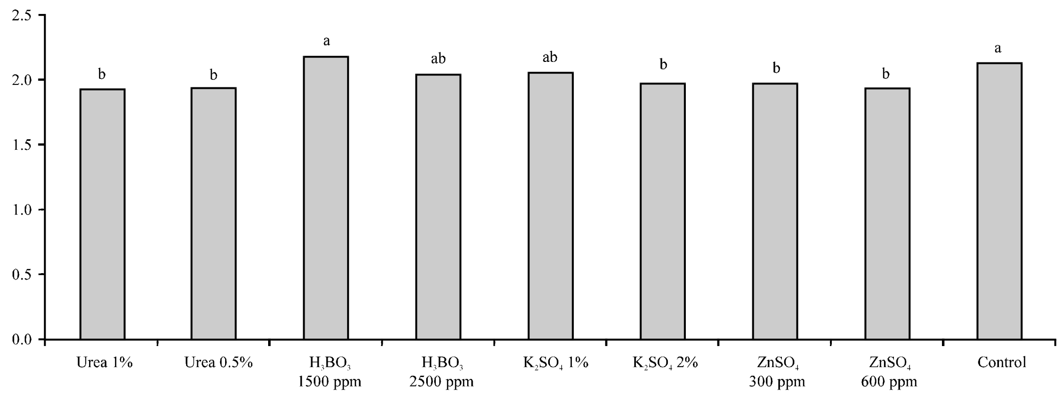

Fig. 6: Effect of urea, boron, potassium and zinc on fruit diameter (cm). Bars with the same letters are not significantly different according to DMRT at 5% level

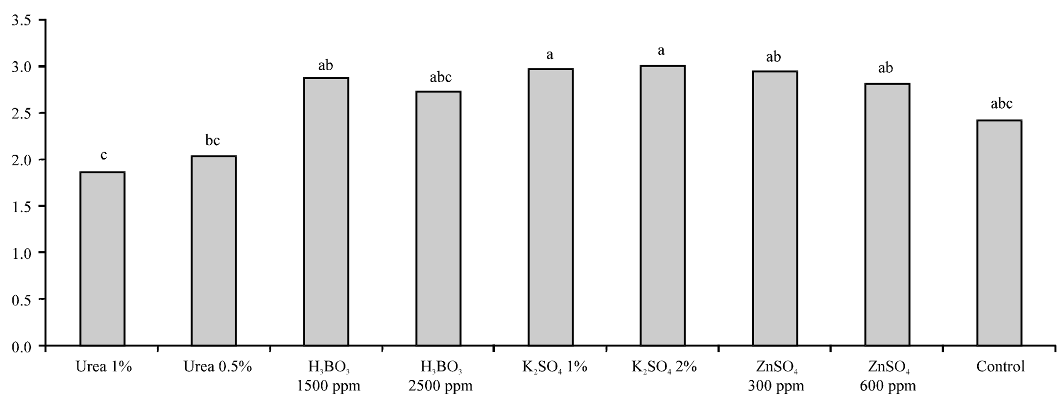

Fig. 7: Effect of urea, boron, potassium and zinc on seed length (cm). Bars with the same letters are not significantly differen according to DMRT at 5% level

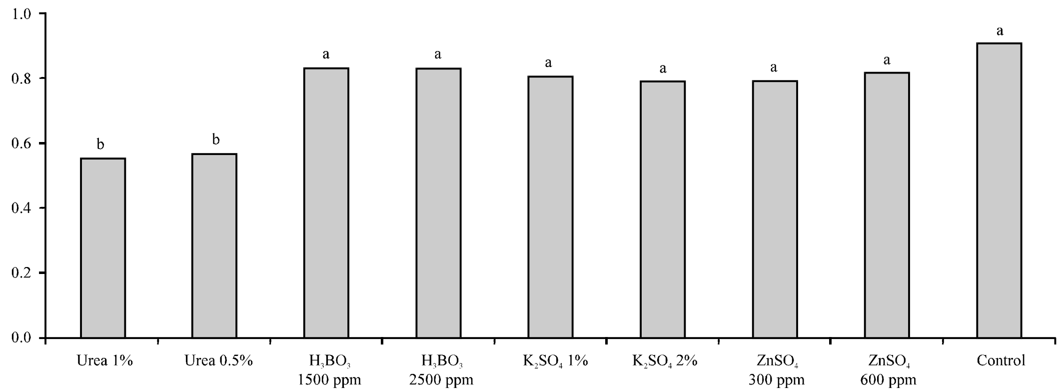

Fig. 8: Effect of urea, boron, potassium and zinc on seed diameter (cm). Bars with the same letters are not significantly different according to DMRT at 5% level

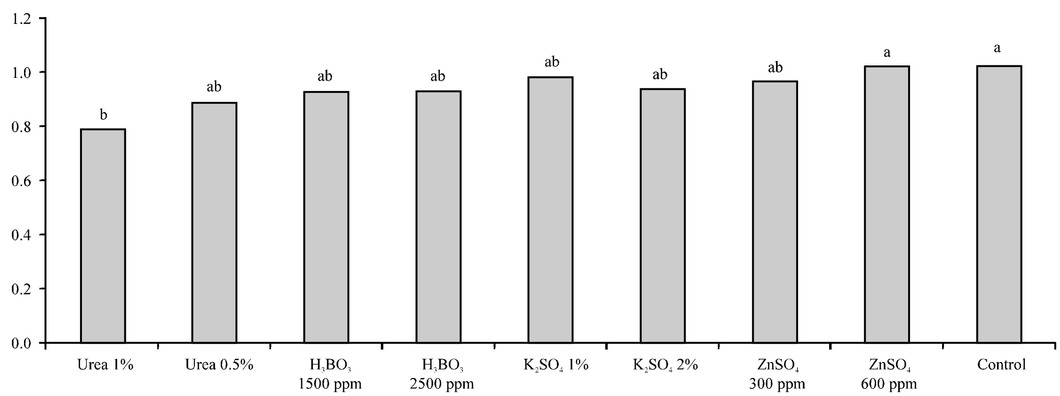

Fig. 9: Effect of urea, boron, potassium and zinc on seed weight (g). Bars with the same letters are not significantly different according to DMRT at 5% level

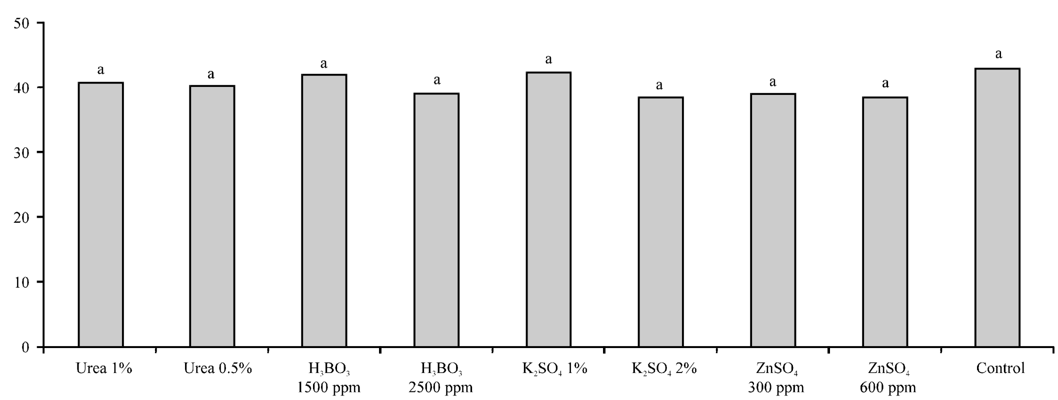

Fig. 10: Effect of urea, boron, potassium and zinc on total soluble solids (%).Bars with the same letters are not significantly different according to DMRT at 5% level

Fig. 11: Control [up], boron1500 ppm [down]

Fig. 12: Boron 2500 ppm [up], 1500 ppm [down]

Fig. 13: Zinc 300 ppm [up], boron 1500 ppm [down]

Fig. 14: Zinc 600 ppm [up], boron 1500 ppm [down]

Fig. 15: Urea 1% [up], boron 1500 ppm [down]

Fig. 16: Urea 0.5% [up], boron 1500 ppm [down]

Fig. 17: Boron 1500 ppm [up], potassium 1% [down]

Fig. 18: Potassium 2% [up], boron 1500 ppm [down]

compared to control (Fig. 1) that was in agreement with De La Rocha and Flores [29] in young avocado, strawberries and oranges; Nevin [21] and Abou Aziz *et al*. [20] in avocado tree results. There were no significant correlations between seed length, pulp weight, fruit weight, fruit diameter and fruit length (Table 1). There were positive correlations between fruit length with pulp weight, fruit weight and pulp/seed ratio (Table 1). There were significant differences among treatments on pulp weight and higher pulp weight showed at boric acid (1500 ppm) treatment (Fig. 4). By increasing pulp weight, seed weight decreased (Table 1). Pulp weight increment could be due to improving cell size or cell number by nutrient elements. Higher and lower pulp/seed ratio (Fig. 5) were resulted from H_3BO_3 (1500 ppm) and control, respectively. Moreover, pulp/seed ratio was close to H_3BO_3 (1500 ppm) results in urea treatments. Positive and negative correlations were shown between pulp/seed ratio with fruit length and seed weight, respectively (Table 1). Fruit diameter (Fig. 6) was higher on H_3BO_3 (1500 ppm) and significantly differs with other treatments, except by control. Positive correlations were obtained between fruit and seed diameter at the 0.01 level (Table 1). Acid boric sprays in our study caused improving in fruit size that in contrast with Yogaratnam and Johnson [30] results on apple trees. Potassium Sulfate sprays caused fruit improvement, in agreement with Umer *et al*. [15] on groundnut; Jones and Embleton [25] on lemons and oranges; Dialami and Pejman [31] on date palm trees results. Zinc Sulfate sprays in our studies increased fruit size and pulp/seed ratio compared to control. Fruit improvement from this treatment was in agreement with Eliyeva [32] results on apple trees. Acid boric causes cell division or nucleic acid synthesis within fruit growth and development period and consequently fruit growth improves [33]. Potassium is essential for fruit enlargement [34]. Moreover, potassium in some plants cause cell turgidity supplementally by reducing carbohydrates [35].

Seed characters: With increase potassium level (from 1 to 2%), seed length increased (Fig. 7). Higher seed diameter (Fig. 8) was resulted from control. Positive correlation was shown among seed diameter and weight (Table 1). Lower seed weight (Fig. 9) was resulted from urea 1% treatment. There were positive and negative correlations between seed weight with seed diameter and pulp/seed ratio, respectively (Table 1).

Fruit quality: Higher total soluble solids (Fig. 10) were obtained from control; however, no significant differences were resulted among treatments.

CONCLUSIONS

The improvement occurred in the fruit yield and quality could be attributed to effects of nutrients on carbohydrate influx or plant growth regulators synthesis in growing fruits. Our results have revealed that nutrient spray applications can also cause yield and fruit size improving, without thinning agent's requirements.

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