J. Agric. Sci. Mansoura Univ., 28 (9): 6911 – 6926, 2003

EFFECT OF FOLIAR SPRAYS OF ZINC AND BORON ON LEAF MINERAL COMPOSITION, YIELD AND FRUIT STORABILITY OF BALADY MANDARIN TREES

El-Baz, El. El. T.
Pomology Department, Faculty of Agriculture, Mansoura University

ABSTRACT

The results revealed that foliar sprays of both zinc and boron, alone or in combination increased significantly the concentration of N, K, Mn, Zn and boron in the mandarin leaves of spring flush compared with control. Significant increase in the yield of applied trees was obtained. The highest yield was achieved in response to zinc or boron alone, especially in the second season. Moreover, foliar sprays of such elements appeared to balance the biennial bearing of mandarin trees. The values of fruit size, fruit weight, juice, peel and pulp percentages per fruit showed a significant increase. Similar trends were observed with the chemical parameters values of mandarin fruit juice at the maturation stage.

The physical characters of fruits treated with zinc and boron either alone or in combination decreased significantly with increasing storage period. On the other hand, TSS, total acidity and vitamin C content declined gradually after the cold storage period. Similar results were also detected for the changes in TSS / acid ratio of fruit juice.

Thus, storability of fruits treated with zinc and boron in cold storage either alone or in combination was found to be better, as it minimized the magnitude of fruit weight loss, decayed fruit, juice, TSS percentages and vitamin C content and extended the storage life of mandarin fruits. Generally, foliar application of Zn or B on mandarin trees not only increased their yield but also appeared to improve the quality and storability of their fruits.

Keywords: Balady mandarin, boron, cold storage, foliar application, leaf mineral composition, yield, fruit quality and storability of fruits.

INTRODUCTION

Balady mandarin is considered as one of the most popular fruits among the citrus fruit group; its acreage tends annually to increase due to the high demand for both local and foreign markets;88000 feddans produced about 450000 tons of fruits (Ministry of Agriculture, 1998) were recorded. Mandarin fruit production represents about 25% of the total production of citrus fruits in Egypt.

Although many workers early investigated the effect of micronutrient elements as a foliar application on citrus fruit trees productivity and fruit quality, yet the role of these elements still occupy a considerable attention (Chapman 1968, El-Gazzar *et al.*, 1979,Taha *et al.*,1979, El-Shazly,1981,Abou-Rawash *et al.*, 1983,Barakat *et al.*, 1989 and more recently Josan *et al.*, 1995,Salem *et al.*, 1995, Sourour,2000,El-Hammady *et al.*, 2000,and Nyomora *et al.* 2000).

A vital role of zinc in plant metabolism was reported by many workers, thus Kolesnik and Tserevitinov (1966), Chvapil (1973) and El-sherif *et al.* (1990) pointed out that zinc may increase the stability of membranes ,which accumulate more Ca^{++} in fruit tissues .It is also interesting to indicate that slight increase in zinc of the fruit tissues ,may be favouruable for fruit quality. Thus, Chvapil (1973) stated that foliar spray of zinc may lead to releasing bound calcium from chelating and complexing agents (lignin,organic acid ,and proteins) for the transport to the fruits .

The role of boron in plant metabolism includes many physiological aspects, such as nucleic acid metabolism, protein, hormone, and carbohydrate biosynthesis as well as translocation, photosynthesis, cell division, cell wall synthesis membrane function (Ibrahim and Dana 1974, Gupta 1979, Pilbeam and Kirkby 1983, Gupta *et al.*1985 and Blevins and Lakaszueski 1998).

In addition to that boron is known to play a key role in the extension of plant cell walls through its association with cell-wall pectins and specifically in the formation of rhamnogalacturonan-B dimers, (Hu and Brown 1994, Kaneko *et al.*, 1997 and Banik and sen 1997), boron is also required for retention of fruitlets ,possibly by influencing sink strength of the developing embryo through auxin-mediated events , (Nyomora *et al.*, 2000). Recently, Xuan *et al.* (2001) indicated that fruits of "conference" pear treated with boron did not exhibit any browning disorders after 4 months of storage .

The effect of both zinc and boron as a foliar spray on the resultant fruits during the handling and storage period has not received adequate attention , especially when trees were under incipient deficiency. Because of its high quality and good flavor, this study was made in an attempt to put Egyptian mandarins on the list of citrus fruit export. The approach made was to study the effect of both zinc and boron sprays *via* leaves during growth and development on the chemical composition of fruits, their quality and storability for long periods.

MATERIALS AND METHODS

This study was carried out during two successive seasons (1999 & 2000). Uniform fifteen years old trees of Balady mandarin (*Citrus reticulata*, Blanco) buded on sour orange rootstock, grown at the orchard of the experimental station of faculty of Agriculture Mansoura university in clay loam soil, (pH 8.1) at four meters apart, under basin irrigation system and received similar agricultural practices, were selected to study the effect of Zn and B nutrient as a foliar spray on leaf mineral composition, yield, fruit quality and on fruit storability under cold storage 4°c±1 and relative humidity (R.H.) 85 % conditions.

Treatments tried were :

1. Control trees sprayed with water only.
2. Zn sulphate solution at 250 ppm Zn.
3. Zn sulphate solution at 500 ppm Zn.
4. Boric acid solution at 40 ppm B.
5. Boric acid solution at 80 ppm B.
6. Zn at 250 ppm +B 40 ppm.
7. Zn at 500 ppm +B 80 ppm.

Treatments were applied by using a portable high pressure sprayer. Trees were sprayed until solution run-off, applications were carried out two times on April 15th and June 15th every year in the presence of a suitable wetting agent.

Treatments were replicated three times taking a single tree as a unit. The trail was laid out in a completely randomized block design .Yield of trees, at commercial harvesting time; was recorded by using both average fruit weight and number of fruit per tree. A representative sample of twenty fruits from each replicate was carefully harvested at maturation stage; TSS / acid ratio were 9-10/1; and the data of the various physico-chemical characters were determined according to A.O.A.C. (1985). Another sample of 200 fruits from each treatment were also harvested; washed, , and dipped in aqueous solution of potassium permanganate ($KMnO_4$) 0.1% for two minuets, then air dried by an electric fan before packing into cartoon box. Mandarin fruits were stored under cold storage until 50% of the fruits deteriorated .

Some physical and chemical parameters were recorded after 15 days, 35 and 49 days from the beginning of storage. Also, fruits were periodically inspected for decay disorders, and the weight loss of stored fruits was also determined after the termination of each storage period.

For mineral determination, the leaves of non-fruiting terminals of spring flushes were collected at the age of 6 months, (Jones and Embleton, 1960), carefully washed with tap water, then rinsed two times with distilled water, oven dried at 65-70°C and exposed to wet ashing to determine N using the method of (A.O.A.C.,1985) and dry ashing. Ash was dissolved in dilute hydrochloric acid, filtered on an ashless filter paper into a marked 100 ml flask according to Rawe (1973). Mn and Zn were determined by atomic absorption spectrophotometer, K by flame photometry, and P by colorimetery, according to Jackson (1958) by using Spectronic 20 D+. Boron was determined using inductively coupled plasma (ICP) atomic emission spectrometry (Model ultima, 2JY) as described by Isaac and Johnson, Jr. (1990).

The statistical analysis of the obtained results was carried out according to Snedecor and Cochran, (1980) using the least significant difference (L.S.D.) values.

RESULTS AND DISCUSSION

1- Leaf element content:

The results presented in table (1) showed that the different applied zinc and boron sprays increased, especially in the second season of the study, leaf nitrogen, potassium, manganese, zinc, and boron contents above the incipient deficiency level to the optimum level compared with the unsprayed trees. These results are in accordance of those reported by Mohamed and Aly (1983), who reported that spraying zinc resulted in an obvious increase in the level of Zn, Mn, Fe, Ca, Mg, P, and K in the leaves of Washington Navel orange and Baladi mandarin. Also, Samra (1985) mentioned that the levels of nitrogen and zinc were increased as affected by zinc and GA_3 application to

Baladi mandarin trees. Sourour (2000) showed significant increment in leaf nitrogen and magnesium content in the second and both seasons respectively as affected by $ZnSO_4$ foliar application.

In addition to that, Taha *et al.* (1979) proved that June application was the most effective time for applying zinc,which caused a significant increase in zinc content of the mandarin leaves,also El-Shazly (1981) reported significant increases in N and K in the applied Valencia orange trees sprayed with zinc at low concentrations.

Table (1) : Effect of zinc and boron sprays on the element composition of Balady mandarin leaves. (On dry weight basis, seasons 1999 and 2000).

Treatments	N %	P %	K %	Mn (ppm)	Zn (ppm)	Boron (ppm)
Season 1999						
T_c	1.36	0.146	0.92	15.8	19.0	72.6
T_1	1.50	0.148	1.24	17.4	35.0	84.2
T_2	1.78	0.260	1.44	17.8	72.3	80.6
T_3	1.80	0.225	1.36	18.6	16.3	86.2
T_4	1.94	0.232	1.20	16.0	13.6	82.4
T_5	1.84	0.185	1.34	16.1	47.3	88.6
T_6	2.30	0.232	1.52	16.3	95.7	98.8
L.S.D. 5%	0.217	N.S.	0.132	2.26	10.57	N.S.
Season 2000						
T_c	1.48	0.185	0.84	17.3	26.2	78.0
T_1	1.38	0.187	1.15	18.7	30.1	80.4
T_2	1.42	0.220	1.16	14.6	62.8	87.6
T_3	1.68	0.211	1.44	17.0	25.6	95.4
T_4	2.42	0.266	1.0	11.2	24.0	91.0
T_5	2.20	0.230	1.14	12.4	37.4	898
T_6	2.18	0.222	1.60	13.4	67.7	98.5
L.S.D. 5%	0.247	N.S.	0.142	1.77	4.077	4.114

T_c = control trees sprayed with water only. T_1 = Zn sulphate solution at 250 ppm Zn.
T_2 = Zn sulphate solution at 500 ppm Zn. T_3 = Boric acid solution at 40 ppm B.
T_4 = Boric acid solution at 80 ppm B. T_5 = Zn at 250 ppm +B 40 ppm.
T_6 = Zn at 500 ppm +B 80 ppm.

2- Yield :

As evident from the obtained data in table (2), sprays of both Zn and B ethier alone or in combination significantly improved the yield of mandarins trees. The highest yields were obtained by treatments of boron alone (40 ppm), boron alone (80 ppm), Zn alone (250 ppm); 63.46, 62.86, and 59.15 Kg/tree as an average of both seasons of the study respectively. The increase occurred in both fruit number per trees and their fruit weight. The increments were apparent in the second season, whereas slight differences were recorded at the first one. Similar findings have been also reported by other workers in different fruits, El-Shazly (1981) on different citrus fruits, Hanson (1991) on sour Cherry, Josan *et al.* (1995) on lemon ,Banik and Sen (1997) on mango, Nyomora *et al.* (1999) on almond, Gobara (1998) on pear, and Sourour (2000) on Valencia orange. El-Sherif *et al.* (1990) reported that foliar application of zinc is considered as an emergency treatment to be applied as soon as zinc deficiency is detected for a growing crop. Also, numerous investigations have indicated that boron deficiency in plants results in abnormality of carbohydrate metabolism and its translocation (Dugger *et al.* 1957, Ibrahim and Dana 1974, Shorrocks and Nicholson 1980, Dugger 1983 and Hanson 1991). Also, Maksoud and Haggag (1996) pointed that boron sprays resulted in pertinent increment in the yield of apple trees, when sprayed between harvest and leaf fall.

Table (2) : Effect of foliar applications of Boron and Zinc on yield as a number per trees and kg per trees of mandarin. (Seasons, 1999 and 2000)

Treatments		No. of fruits/trees			Yield (Kg/ tree)		
		1999	2000	Av.	1999	2000	Av.
T_c		517	449	483	47.6	42.4	45
T_1		652	580	616	56.9	60.0	58.4
T_2		612	560	586	58.0	59.7	58.8
T_3		612	585	599	55.4	62.8	59.1
T_4		720	529	625	56.7	70.1	63.4
T_5		601	488	544	59.0	48.9	54.0
T_6		664	438	551	58.1	45.6	51.9
LSD	5%	82.5	86.8	75.8	10.6	11.22	5.26
	1%	112.4	120.8	105.4	12.8	15.42	7.18

***T_c = control trees sprayed with water only. T_1 = Zn sulphate solution at 250 ppm Zn.**
T_2 = Zn sulphate solution at 500 ppm Zn. T_3 = Boric acid solution at 40 ppm B.
T_4 = Boric acid solution at 80 ppm B. T_5 = Zn at 250 ppm +B 40 ppm.
T_6 = Zn at 500 ppm +B 80 ppm.

3 - Fruit quality:

Zn and B applications either alone or combined significantly increased weight and size of mandarin fruits as compared with untreated trees. Also, pulp percentage of treated fruits exhibited the same trend in fruit weight and size, whereas, peel percentage values tend to be decrease as affected by Zn and Boron applications. Fruit juice percentage increased, especially in the second season of the study, where a significant increase was obtained (tables 3&4). Similar results were reported by Barakat *et al.* (1989), Salem *et al.* (1995) on Balady mandarin sprayed with boron and Zinc, Josan *et al.* (1995) on lemon and Sourour (2000) on Valencia orange.

On the other hand, Samra (1985) claimed that fruit juice volume of mandarin trees was not affected by Zn and GA_3 treatments. El-Shazly, (1981) Suggested that zinc represents a prime importance in increasing yield per tree and fruit quality, where, Wallace *et al.* (1975) reported that intensive investigation of many leaf samples of citrus trees selected in Egypt showed low zinc concentration; zinc critical level being 20 ppm on dry weight basis.

Table (3): Effect of foliar sprays of boron and zinc on physical characters of Balady mandarin fruits. (Seasons 1999 and 2000)

Treatments		Fruit weight (g)			Fruit size (cm^3)			Juice (%)			Peel (%)			Pulp (%)		
		1999	2000	Av.	1999	2000	Av.	1999	2000	Av.	2000	1999	Av.	1999	2000	Av.
$^*T_c$		92.1	94.3	93.2	104.9	118.5	111.7	39.6	40.9	40.2	27.9	31	29.4	72.1	69.0	70.6
T_1		87.2	103.4	95.3	101.8	125.6	113.7	40.6	44.1	42.4	28.0	32.2	30.1	72.0	67.8	69.9
T_2		95.1	106.4	100.7	112.7	128.2	120.5	40.3	42.6	41.5	27.1	27.4	27.2	72.9	72.6	72.8
T_3		90.4	107.3	98.8	105.9	125.3	115.6	40.0	43.2	41.6	30.0	26.4	28.2	70.0	73.4	71.8
T_4		97.4	107.3	102.4	112.9	124.5	118.7	41.1	46.6	43.8	26.8	26.8	26.8	73.2	73.2	73.2
T_5		98.3	100.6	99.4	117.2	123.2	120.2	40.8	45.5	43.2	28.9	30.3	29.6	71.1	69.7	70.4
T_6		87.5	104.1	95.8	99.1	123.7	111.4	40.6	46.0	43.3	27.1	27.3	27.2	72.9	72.7	72.8
NLSD	5%	N.S.	8.7	7.09	7.4	5.6	5.2	N.S.	2.8	N.S.	3.4	2.5	2.6	3.4	2.4	2.6
	1%	N.S.	11.4	N.S.	10.1	8.0	7.1	N.S.	4.0	N.S.	N.S.	3.3	3.6	N.S.	3.3	3.6

$^*T_c$ = control trees sprayed with water only. T_1 = Zn sulphate solution at 250 ppm Zn. T_2 = Zn sulphate solution at 500 ppm Zn.
T_3 = Boric acid solution at 40 ppm B. T_4 = Boric acid solution at 80 ppm B. T_5 = Zn at 250 ppm +B 40 ppm.
T_6 = Zn at 500 ppm +B 80 ppm

Table (4): Effect of foliar sprays of boron and zinc on chemical characters of Balady mandarin fruits. (Seasons 1999 and 2000)

Treatments		TSS%			Acidity%			TSS /acid ratio			Ascorbic acid (mg/100 ml juice)		
		1999	2000	Av.	1999	2000	Av.	1999	2000	Av.	2000	1999	Av.
T_c		10.0	11.0	10.5	1.44	1.14	1.29	6.94	9.64	8.13	33.4	37.0	35.2
T_1		10.4	11.4	10.9	10.37	1.09	1.23	7.59	9.54	8.86	33.7	37.6	35.6
T_2		10.9	11.6	11.25	1.24	1.15	1.19	8.8	10.1	9.45	33.2	38.5	35.8
T_3		10.8	11.7	11.25	1.34	1.08	1.21	8.06	10.83	9.29	36.1	36.1	36.1
T_4		10.9	11.9	11.40	1.26	1.01	1.13	8.65	11.78	10.21	36.9	37.6	37.2
T_5		10.8	11.2	11.0	1.39	0.9	1.14	7.76	12.44	9.87	36.2	36.8	36.5
T_6		10.9	11.6	11.25	1.37	1.12	1.24	7.95	10.35	9.07	35.1	37.1	36.1
NLSD	5%	0.78	0.63	0.39	0.09	0.134	0.046	0.663	0.932	0.381	2.64	N.S.	1.63
	1%	1.09	N.S.	0.55	0.134	N.S.	0.062	0.903	1.321	0.518	N.S.	N.S.	N.S.

T_c = control trees sprayed with water only. T_1 = Zn sulphate solution at 250 ppm Zn. T_2 = Zn sulphate solution at 500 ppm Zn.
T_3 = Boric acid solution at 40 ppm B. T_4 = Boric acid solution at 80 ppm B. T_5 = Zn at 250 ppm +B 40 ppm.
T_6 = Zn at 500 ppm +B 80 ppm

They also noticed that zinc application enhanced uptake and concentration of K, Ca, Fe and Zinc, El-Sherif *et al.* (1990) and Josan *et al.* (1995) stated an increase in both size and weight of fruits on account of boron. Sourour (2000) reported the superiority of Zn in increasing both the number and weight of fruit per tree.

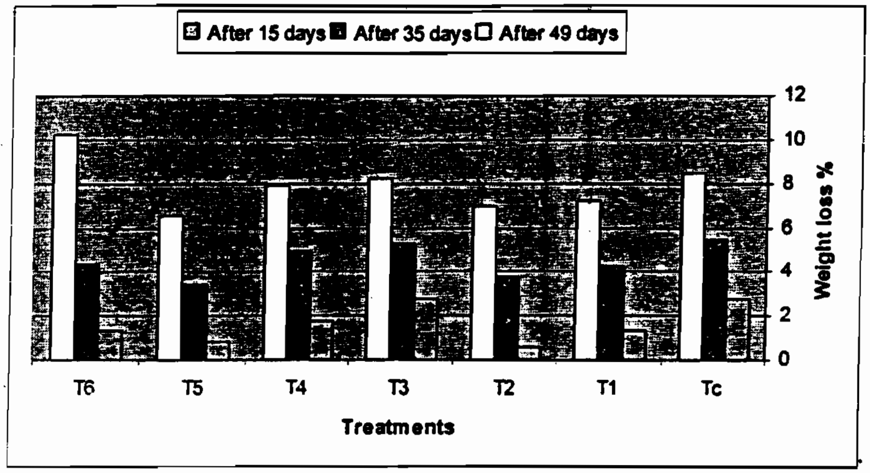
Effect of both zinc and boron application could be attributed to their involvement in the cell division and cell elongation. Generally, the increase in the available nutrients for mandarin trees after spraying both Zn and B or their combinations leads to improve the formation of cell wall components such as cellulose, lignin and preventing formation of abscission layer, consequently, reduction of pre -harvest abscission layer formation, consequently, reduction of preharvest fruit dropping (Nijjar, 1985).

The data presented in table 4 revealed that TSS% of mandarin juice tend to be higher in both seasons of the study under the effect of both zinc and boron applications, total titratable acidity showed an opposite trend, where the application induced somewhat earlier maturation of their fruits than control, therefore TSS/acid ratio tend to be higher than the control one. Vitamin C content showed significant variation as an average of both seasons the study. Similar findings have also been reported by other workers in different fruits, (Josan *et al.*, 1995 and Sourour 2000).

4-Storability of mandarin fruits:

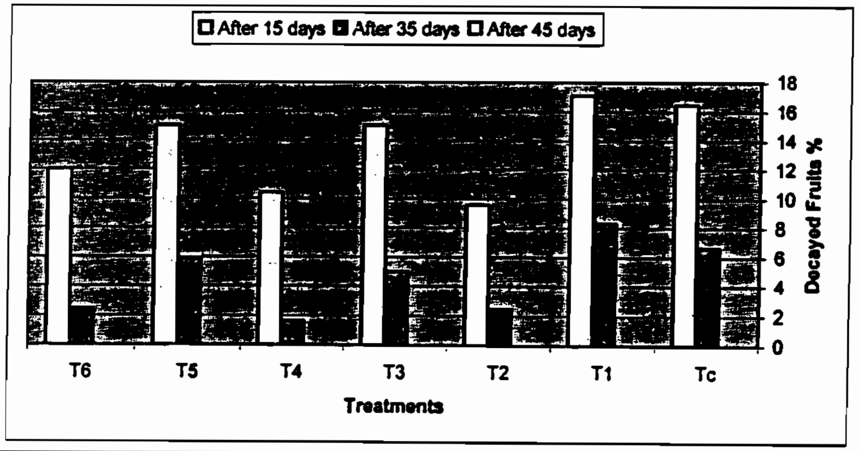
Careful examination of figures 1,2 and 3 indicates that the average values of weight losses, decayed fruits, and total loss percentage of fruits under cold storage conditions tend to be lower, as affected by zinc and boron applications; than the control ones. In general, there is tendency to increase by advancing the period of storage after 7 weeks. The more effective application, which reduced the losses, were Zn, 500 ppm , boron 80 ppm alone and the combined treatment of Zn at 250 ppm + boron at 40 ppm. These results are confirmed by various workers. Thus, Yagi (1980) in Sudan reported that Balady mandarin fruits Kept at 4°C lost 7.55% in 66 days as fruit weight losses, where room temperature storage shortened storage life of their fruits. Also, Chvapil (1973) stated that foliar sprays of zinc may be releasing bound calcium from chelating and complexing agents (lignin , organic acids, and proteins) to transport to the fruits , this may have a possible role in prolonging the storage life of fruits .Faust and Shear (1968) suggested that boron applications can improve the mobility of calcium to the fruit. In this connection, Xuan *et al.*(2001) indicated that Pear fruits sprayed with boron did not exhibit any browning disorders after 4 month of storage .In general, adequate boron nutrition is critical not only for high yield but also for high quality of fruits, a structural role of both zinc and boron in cell wall and in membrane function may well be involved in the future work.

Fig.1 Effect of foliar sprays of zinc and boron on fruit storage parameters under cold storage (Average of two Seasons, 1999 and 2000)



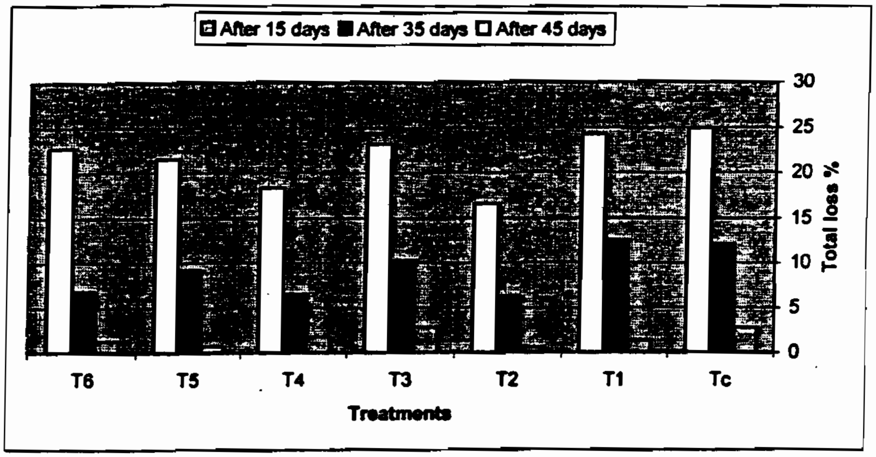
Storage parameters		Weight loss%		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	0.663	1.23	1.107
	1%	0.90	1.746	1.504

Fig.(1-a)



Storage parameters		Decayed Fruits %		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	N.S.	0.77	1.63
	1%	N.S.	1.07	2.29

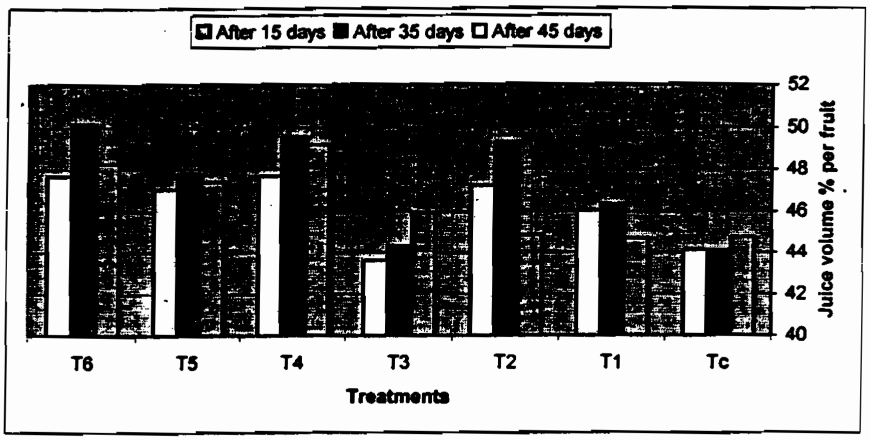
Fig.(1-b)



Storage parameters		Total Loss %		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	0.66	1.17	2.03
	1%	0.89	1.58	2.78

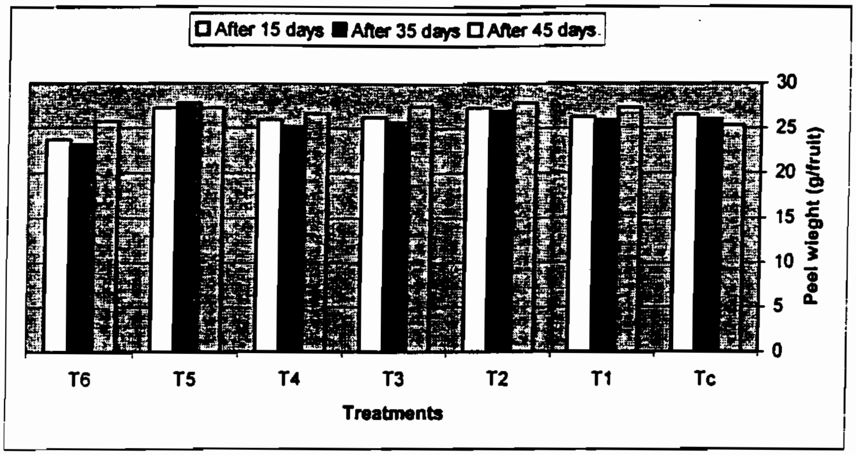
Fig.(1-c)

Fig.2 Effect of foliar sprays of zinc and boron on some physical parameters of mandarin fruits under cold storage (Average of two Seasons, 1999 and 2000)



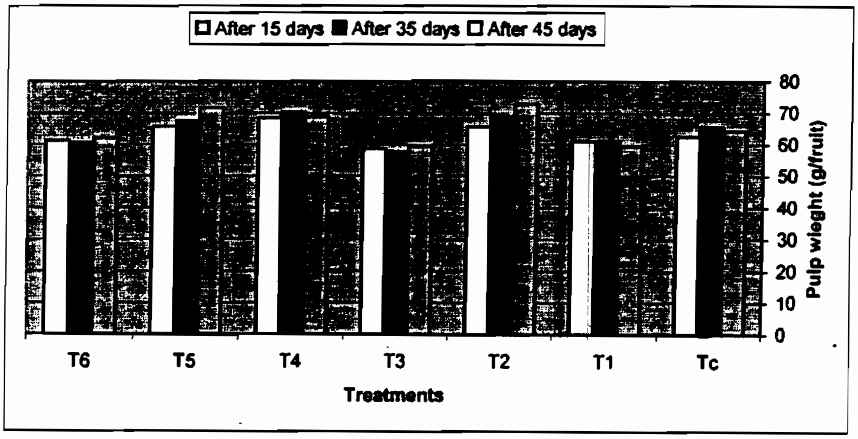
Storage parameters		Juice volume % per fruit		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	N.S.	3.26	N.S.
	1%	N.S.	4.57	N.S.

Fig.(2-a)



Storage parameters		Peel weight (g/fruit)		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	2.01	3.11	3.20
	1%	3.22	N.S.	N.S.

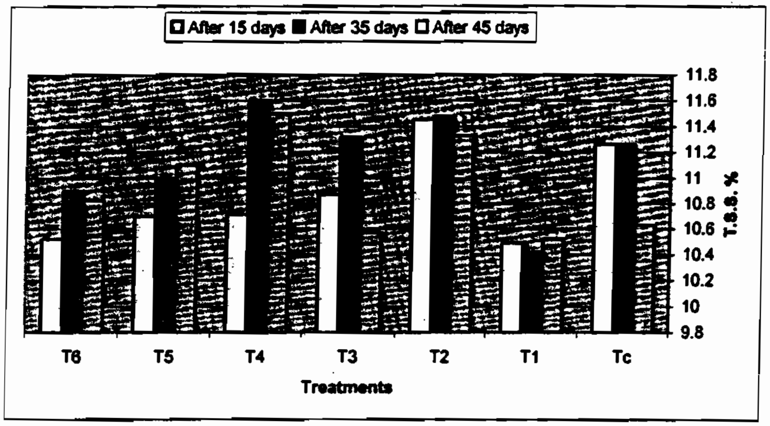
Fig.(2-b)



Storage parameters		Pulp weight (g/fruit)		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	5.19	4.33	4.88
	1%	7.18	5.9	6.88

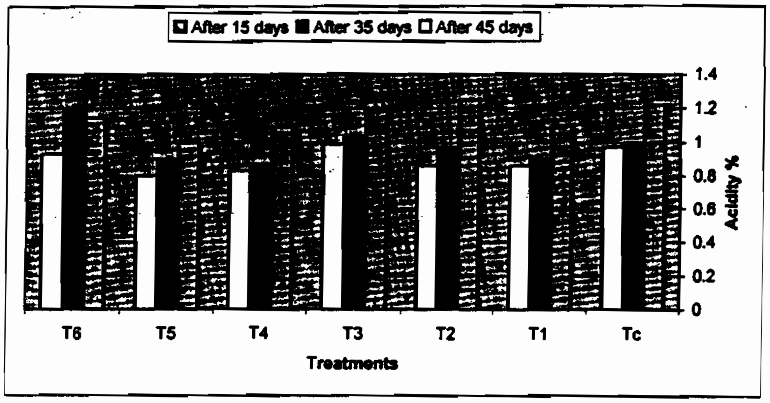
Fig.(2-c)

Fig.3 Effect of foliar sprays of zinc and boron on some chemical parameters of mandarin fruits under cold storage (Average of two Seasons, 1999 and 2000)



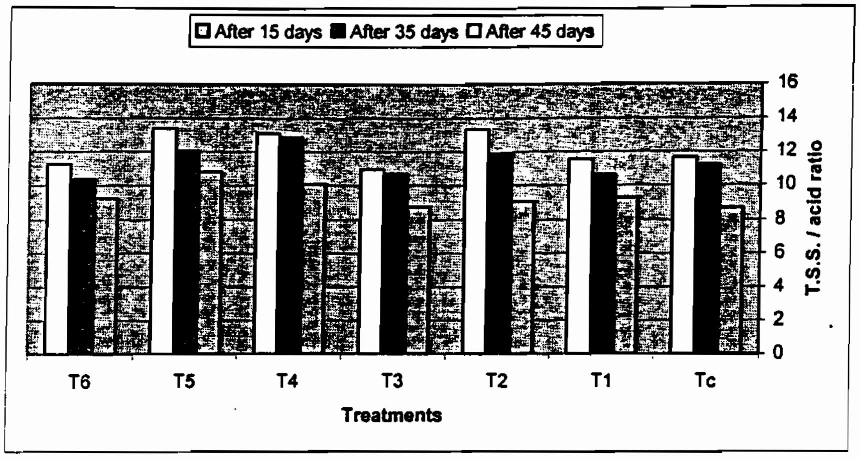
Storage parameters		T.S.S. %		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	0.33	0.43	0.33
	1%	0.45	0.60	0.44

Fig.(3-a)



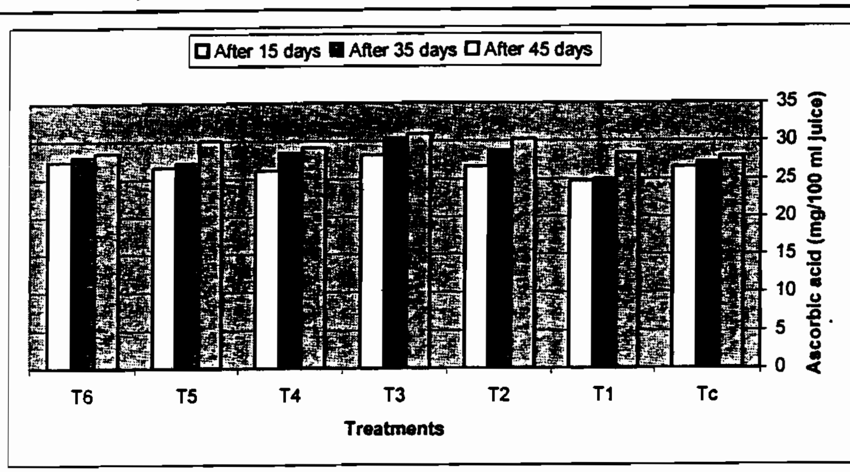
Storage parameters		Acidity %		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	0.097	0.104	0.082
	1%	0.134	0.154	0.115

Fig.(3-b)



Storage parameters		T.S.S./acid ratio		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	0.699	1.417	1.257
	1%	0.955	2.01	1.759

Fig.(3-c)



Storage parameters		Ascorbic acid (mg/100ml juice)		
		After 15 days	After 35 days	After 49 days
L.S.D.	5%	2.02	0.98	1.238
	1%	2.85	1.45	1.719

Fig.(3-d)

REFERECES

Abou-Rawash, M.; A.Z. Bondok and S. El-Shazly (1983). leaf mineral content of lime trees as affected by foliar application of chelated zinc and manganese. Annals Agric. Sci, Ain- Shams Univ. Cairo, Egypt, 28(2) : 1021-1031.

A.O.A.C. (1985). Official Methods of Analysis (A.O.A.C.) 12th Ed pp : 494-510. Benjamin Franklin station, Washington, D.C. U.S.A.

Banik, B.C. and S.K. Sen (1997). Effect of three levels of zinc, iron, boron and their interactions on growth, flowering and yield of mango Cv. Fazli. Hort., J. 10(1): 23-29.

Barakat, M.R.; A.M.Sweidan and M.E. Morsi (1989). Vegetative growth, flowering and fruiting efficiency of mandarin trees as affected by foliar application of boron, molybdenum and ascorbic acid. Bull.Fac. Agric. Cairo Univ., 35(2) : 1103-1106.

Blevins, D.G. and K.M. Lukaszweski (1998). Boron in plant structure and function. Annu. Rev. Plant Physiol. Plant Mol. Biol., 49 :481.

Chapman, H.D. (1968). The mineral nutrition of citrus. (In, The citrus Industry .volume II) pp 86-122. (Revised Edition by Reuther,W.,L.D. Batchelor and H.J Webber) Univ.California, Berkeley California ,U.S.A.

Chvapil, M. (1973). New aspects in the biological role of zinc : a stabilizer of macromoleculs and biological membranes. Life Sci., 13: 1041-1049.

El-Gazzar, A.M.; S.M. El-Azab and M. El-Safty (1979). Response of Washington Navel orange to foliar Application of chelated iron, zinc and manganese. Alex J. Agric. Res., 27 (1): 19-26.

El-Hammady, A.M.; N. Abdel-Hamid; M. Salah and A. Salah (2000). Effect of GA and calcium chloride treatments on delaying maturity, quality and storability of "Balady" mandarin fruits. Arab Universities Journal of Agricultural Sciences, 8(3):755-766.

El-Shazly, S.A.M. (1981). Mineral element analysis of some citrus plants as affected by some foliar application. Ph D Fac. of Agriculture, Ain Shams Univ.

El-Sherif, A.F.; S.M. Shata and R.A. Youssef (1990). Effect of rate and methods of zinc application on growth and nutrients uptake of tomato plants. Egypt. J. Hort. Sci., 12(2) : 123-129.

Faust, M. and C.B. Shear (1968). Corking disorders of apples: a physiological and biochemical review. Bot. Rev., 34:441- 469.

Gobara, A.A. (1998). Response of Le-Conte pear trees to foliar application of some nutrients. Egypt. J. Hort., 25(1) : 55-70.

Gupta, U.C. (1979). Boron nutrition of crops. Advances in Agronomy, 31: 273-307.

Gupta, U.C.; Y.W. Jame; C.A. Compbell; A.J. Leyshon and V. Nicholaichuk (1985). Boron toxicity and deficiency : A review. Canadian Journal of Soil Science, 65: 381-409.

Hanson, E.J. (1991). Sour cherry trees respond to foliar boron application. Hort.Sci., 26: 1142- 1143 .

Hu, H. and P. H. Brown (1994). localization of boron in cell walls of squash and tobacco and association with pectin : Evidence for a structural role of boron in the cell wall. Plant Physiol., 105: 681-689.

Ibrahim, I.M. and M.N. Dana (1974). Effects of Boron supply on carbohydrate metabolism in apple on three rootstocks. Egypt. J. Hort. Sci., 1(1): 44-56.

Isaac, R.A. and W.C. JohnsonJr (1990). Handbook of Reference Mothods for plant analysis (Yash P. Kalra, Ed.pp.165. CRC press, Boca Ranton, London, New York, Washington,D.C. .

Jackson, M.L. (1958)."Soil chemical analysis" Contable, Co. LTD, London,England.

Jones, W.W. and T.W. Embelton (1960). Leaf analysis – nitrogen control program for Oranges. Calif. Citrogr., 45:394-353.

Josan, J.S.; A.S. Sandhu; R. Singh and P.K. Monga (1995). Effect of various nutrient sprays on the fruit quality of Lemon. Indian J. Hort., 52(4): 288-290.

Kaneko, S.; T.Ishii and T. Matsungu (1997). A boronrhamnogalacturonan II complex from bamboo shot cell walls. Phytochemitry, 49:243-248.

Kolesnik, A.A. and D.G. Tserevitinov (1966). Effect of Zinc on accumulation of Ca, Mg, P, Fe and water in Apples. Fiziol. Rastenii, 13: 913-916.

Yagi, M.I. (1980). storage behavior of Baladi Mandarins in Sudan. Hort.Sci., 15(3):300-301.

Maksoud, M.A. and L.F. Haggag (1996). Effects of boron sprays on yield of apples. Egypt. J. Hort., 23 (2):191-195.

Ministry of Agriculture, Bull. (1998). Economic affairs sector, the central of Agricultural economy table, 81 p 227.

Mohamed,N.,El. and M.M. Aly (1983). Effectivseness of soil vs. foliar applied Zn on growth and mineral content of Washington Navel orange and Baladi mandarin seedling. J. Agric. Res. Tanta Univ., 9(2):393-406.

Nijjar,G.S.(1985). "Nutrition of fruits". Published by Mrs. Usha Rajkuman for Kalyani publishers, New Delhi India pp 52-137.

Nyomora, A.M.S.; P.H. Brown and B. Krueger (1999) Rate and time of Boron application increase almond productivity and tissue boron concentration. Hort. Sci., 34 : 242-245.

Nyomora, A.M.S.; P.H. Brown; K. Pinney and V.S. Polito (2000). Foliar application of Boron to Almond trees affects pollen quality. J.Amer. Soc. Hort. Sci., 125(2): 265-270.

Pilbeam, D.J. and E.A. Kirkby (1983). The physiological role of boron in plants. Journal Plant Nutrition, 6: 563-82.

Rawe,G.J. (1973). "Food analysis by atomic absorption spectroscopy" Vatian, Techtron, Australia. USA, Switzerland, pp 89 .

Salem, S.E.; T.A. Ibrahiem; L.F. Guindy and M.A. Myhob (1995). Response of Balady mandarin trees to foliar application of iron, zinc, manganese and urea under sandy soil conditions. Bull. Fac. Agric. Cairo Univ., 46(2): 277-288.

Samra ,N.R.(1985). Yield and fruit quality of Baladi mandarin as affected by Zn and GA_3 application .J.Agric.sci ,Mansoura Univ.,10(4):1427-1432.

Shorrocks, V.M. and Nicholson, D.D. (1980). The influence of boron deficiency on fruit quality. " In mineral nutrition of fruit trees, Ed, by Atkinson D., Jackson J.E. and Sharples R.O." pp. 103-108. Butterworth, London, Boston.

Snedecor, G.W. and G.W. Cochran (1980). Statistical Methods. 7th Ed. Iowa State Univ. Press, USA.

Sourour, M.M. (2000). Effect of foliar application of some micronutrient forms on growth, yield, fruit quality and leaf mineral composition of Valencia orange trees grown in North – Sinai. Alex J. Agric. Res., 45(1) : 269-285.

Taha, M.W.; A.M. El-Gazzar and A.Nawar (1979). Timing of foliar application of iron, zinc and manganese on responses of Orange and Mandarin trees. Alex. J. Agric. Res, 11: 11-18.

Wallace, A.; A.M. El-Gazzar; E.M. Romney and G.V. Alexander (1975). Emission Spectrographic Analysis of spot samples of citrus from different location in Egypt. J. Hort. Sci., 2(2) : 233-241.

Xuan, H.; J. Streif; H. Pfeffer; F. Dannel; U. R Mheld and F. Bangerth (2001). Effect of pre-harvest boron application on the incidence of CA-storage related disorders in 'Conference' pears. Jour. Hort. Sci. and Biotech., 76(2): 133-137.

تأثير الرش الورقى بعنصري الزنك و البورون علي التركيب المعدني للأوراق، المحصول، جودة الثمار، و قدرتها التخزينية لليوسفي البلدي

السيد البدوى طه الباز

قسم الفاكهة – كلية الزراعة – جامعة المنصورة

تم في هذا البحث دراسة تأثير كل من الزنك و البورون بمفرده أو في مخاليط منهما على التركيب المعدني لأوراق اليوسفي البلدي و جودة الثمار الناتجة، و قدرتها التخزينية و ذلك لليوسفي البلدي النامي في المزرعة التجريبية بكلية الزراعة بالمنصورة خلال عامي ١٩٩٩،٢٠٠٠ م.

أوضحت النتائج للمعاملات الخاصة برش كل من الزنك و البورون زيادة معنوية في تركيزات كل من النيتروجين و البوتاسيوم و المنجنيز و الزنك و البورون في أوراق دورة نمو الربيع و التي عمرها ستة اشهر المعاملة بالرش بالمحاليل خلال شهري ابريل و يونيو.

تم التوصل إلي زيادة مؤكدة في المحصول و خاصة في الموسم الثاني للدراسة حيث حققت قيم كل من حجم الثمار و وزنها وكذلك النسبة المئوية لكل من العصير و اللب زيادة مؤكدة و قد أوضحت النتائج اتجاها مماثلا بالنسبة للخواص الكيميائية للثمار.

و قد زادت كل من قيم الفقد الكلي المكونة من الفقد في الوزن و وزن الثمار التالفة مع تقدم فترة التخزين تحت ظروف التخزين المبرد حتى ٤٩ يوم تحت درجة حرارة ٤±١ ° س و رطوبة نسبية ٨٥% و يبدو أن مستوى هذا الفقد كان أقل بصورة معنوية في الثمار المعاملة و خاصة بـ ٥٠٠ جزء في المليون زنك، و ٨٠ جزء في المليون بورون بمفرديهما أو في مخاليط منهما و هذا يؤكد الحصول علي ثمار ذات جودة أعلي و قدرة تخزينية من تلك المستخدمة في المقارنة و هذا يتيح مجالا واسعا لتصدير اليوسفي المصري إلي الأسواق الخارجية بصورة ناجحة.