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EFFECT OF FOLIAR SPRAY WITH BORON AND COPPER ON DRY WEIGHT , YIELD AND STORABILITY OF ONION UNDER SANDY SOIL CONDITIONS

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ABSTRACT: Two field experiments were carried out during two winter seasons of 2000/2001 and 2001/2002 at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of foliar spray with boron, copper and their interaction on dry weight, yield and storability of onion under sandy soil conditions.

Spraying onion plants with boron at 70 ppm increased chlorophyll a,b, total (a+b) in leaf tissues, K(%) in roots and leaves, P (%) in bulb , but decreased weight loss and sprouting percentage of bulbs during storage period.

Foliar spray with copper at 100 ppm increased dry weight of bulb and total dry weight/ plant, chlorophyll a, b, total (a+b) and caroteindes in leaf tissues. Maintime, copper at 50 or 100 ppm increased K (%) in roots, P (%) in bulbs, P(%) and K (%) in leaves, average bulb weight, and total and marketable yield / fed. Whereas spraying with copper at 50 ppm recorded minimum weight loss and sprouting percentage of bulbs during storage period.

The interaction between boron and copper at different concentrations recorded maximum total dry weight / plant, average bulb weight, total and marketable yield/*fed*, but recorded minimum sprouting percentage of bulbs during storage period compared with control. The interaction between boron at 35 ppm and copper at 100 ppm or between boron at 70 ppm and copper at 50 ppm recorded minimum weight loss percentage of bulbs during storage period.

Key words: boron, copper, dry weight, yield, sprouting and weight loss percentage.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable crops in Egypt as well as in other countries. In Egypt, the cultivated area for dry crop (single cropped) was 68,070 feddan with an average of 11.209 ton /*fed* in 2000*

Recently, a great attention has been focused on growing onion plants under new reclaimed sandy soil conditions using drip irrigation system, for increasing its productivity to meet the increment in human population as well as exportation. Also, it is well known that sandy soil is infertile and has very small amounts of micro-elements.

Foliar spray with boron increased dry matter in bulbs of onion (Agwah,1990),dry weight of lea-ves, bulb and total dry weight of garlic plant (El-Ghamriny, 1991), N,P and K% in bulbs of onion (Sliman *et al.*,1999)and total yield of onion (Agwah,1990; Sliman *et al.*,1999) compared with the control, whereas foliar spray of onion plants with B decreased weight loss and sprouting percentage of bulbs during storage period compared with the control (Alphonse, 1997).

Spraying plants with Cu enhanced dry weight of leaves, bulbs and total dry weight of garlic (El-Sawah, 1990), chlorophyll a and b in leaf tissues (Eid *et al.*, 1991 with garlic; Abou-Grab *etal.*, 1993 with onion) and total and marketable yield of onion (Hindi *et al.*, 1983; El-Kafoury *et al.*, 1991) compared with the control.

Therefore, the objetive of this investigation was to study the effect of foliar spray with B and Cu single or conjunction on dry weight, yield and storability of onion under sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were carried out under the conditions of sandy soils at El-Khattara Experimental Farm ,Fac. Agric., Zagazig University during 2000/ 2001- 2001/2002 seasons, to study the effect of boron (as boric- acid) and copper (as copper sulphate) and their interaction on dry weight,plant chemical composition, yield and storability of onion under sandy soil conditions.

The physical and chemical properties of the experimental soil are presented in Table 1.

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Table 1: physical and chemical properties of experimental soil

property	2000/2001 season	2001/2002 season
1. Physical properties		
Sand %	94.36	92.80
Silt %	3.76	5.30
Clay %	1.88	1.90
2. Chemical properties		
Organic matter %	0.04	0.06
Available N (ppm)	4.21	3.87
Available P (ppm)	3.34	4.17
Available K (ppm)	10.73	10.39
AvailableZn(ppm)(extracted by EDTPA	0.35	0.38
AvailableB(ppm)(extracted by EDTPA)	0.30	0.34
AvailableCu(ppm)(extracted by EDTPA)	0.29	0.31
E.c.(mmohs/cm)	2.24	2.31
pH	8.09	8.01

This experiment included nine treatments which were the combinations between three concentrations of boron i.e., (0, 35 and 70 ppm) three concentrations of copper i.e. (0,50 and 100 ppm) .

These treatments were arranged in a split plot design with three replications. Boron concentration were randomly arranged in the main plots, and copper concentration were randomly distributed in the sub plots. Experimental unit area was 10.8m.^{2} It contains three dripper lines with 6 m long and 60 cm between each two drippers. Two lines were used for yield determination and other one line was used for sample to measure vegetative growth. One row was left between each two experimental units as a guard row to avoid the overlapping of spraying solutions.

Plants were sprayed with micronutrients solution three times at 30, 45, and 65 days after transplanting.

Each experimental unit received 2 liter solution of boron or copper using spreading agent

(super film) in all treatments. The untreated plants (check) were sprayed with tap water and spreading agent (super film).

The local cultivar of onion Giza 20 was used in this study. Onion seeds were obtained from Onion Research Section, Field Crop Research Institute, Agriculture Research Center. Seeds were sown on October 6th., while transplanting of seedlings took place on January 1st in both seasons of study.

All plots received equal amounts of FYM at rate of 30 m^3/*fed* and 400 kg/*fed* calcium superphosphate (15.5% P_2O_5) during soil preparation., ammonium sulphate (20.5%N) at the rate of 500 kg/*fed* and 200 kg potassium sulphate (48-52% K_2O). One third of ammonium sulphate and potassium sulphate were added at soil preparation and the rest two thirds were divided into eight equal portions and added weekly through water irrigation (fertigation).

The other normal agricultural treatments for growing onion plants were practiced.

Data Recorded

A random sample of five plants from each experimental unit was randomly taken at 105 days after transplanting and the following data were recorded:

1. Dry Weight

The different parts of onion plants; i.e., roots, bulbs and leaves were oven dried at 70°C till constant weight , then dry weight of roots, bulbs, leaves as well as total dry weight/plant were recorded.

2. Leaf Pigments

Disks sample from the fourth inner leaf was obtained from every experimental unit at 105 days after transplanting to determine chlorophyll a,b and carotenoides according to Wettestein(1957).

3. Nitrogen, Phosphorus and Potassium

They were determined in the roots, bulb and leaves on the basis of dry weight according to the method described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

4. Yield and its Components

After 150 days from transplanting, bulbs were harvested then the following data were recorded:

1. Average bulb weight (gm) :
Bulbs taken from every

experim-ental unit were counted and weighed then average bulb weight was calculated,

2. Total yield of bulb (ton/*fed*): it was calculated from the yield/ plot,
3. Marketable yield (ton/ *fed*) or marketable yield (%): Bulbs with diameter more than 3.5 cm, and
4. Pickles bulbs yield (ton / *fed*) or pickles bulbs (%): Bulbs with diameter less than 3.5 cm.

5. Storability

At harvest time the yield of every experimental unit was cured for two weeks in the field, then the tops and roots were removed. Samples of cured bulbs (4 kg from every experimental unit)were put in palm crates and stored under normal room conditions (28 ± 5 °C and 60-65% R.H.). In both seasons the storage zero time was June1st and the end was April 30th, and the following data were recorded monthly in both seasons of study:

1. Weight loss (%): Bulbs of each experimental unit were weighed at 30 days intervals then the cumulative weight loss percentage was calculated.
2. Sprouting percentage (%): It was estimated and expressed as percentage of number of visually sprouted bulbs.

Statistical analysis: All the data were subjected to statistical analysis of variance according to Snedecor and Cochran (1980). Means separation was done by LSD at 0.05 level of probability.

RESULTS AND DISCUSSION

I. Dry Weight

a. Effect of boron

Data in Table 2 show that spraying onion plants with boron at different concentrations had no significant effect on dry weight of roots, bulb leaves and total dry weight / plant in both seasons. These results contradicted with those reported by Agwah (1990) on onion and El-Ghamriny (1991) on garlic.

b. Effect of copper

Results in Table 2 indicate that spraying onion plants with copper had significant effect on dry weight of roots, bulb, leaves and total dry weight / plant, except dry weight of roots and leaves in the second season. Dry weight of bulb and total dry weight/ plant in both seasons and dry weight of roots and leaves in the first season were increased with increasing concentrations of copper up to 100ppm with no significant

differences between 50 and 100 ppm in most cases. These results agree with those reported by El-Sawah (1990) on garlic.

c. Effect of the interaction between boron and copper

Data in Table 3 indicate that the interaction between boron and copper had no significant effect on dry weight of roots, bulb, leaves and total dry weight / plant, except total dry weight/plant in both seasons and dry weight of bulbs in the second season. The interaction between boron x copper at different rates recorded maximum total dry weight/plant compared with the control.

II. Leaf Pigments

a. Effect of boron

Data in Table 4 illustrate that foliar spray with boron at different concentrations had significant effect on chlorophyll a, b, and total (a+b), in the first season, and had no significant effect on chlorophyll a,b, and total (a+b), in the second season, and carotenoides in both seasons. Chlorophyll a, b, and total (a+b), in leaf tissues were increased with increasing concentrations of boron up to 70 ppm with no significant differences between 35 and 70 ppm with respect tochlorophyll(b) in the first season only.

b. Effect of copper

Results in Table 4 indicate that spraying onion plants with copper had significant effect on chlorophyll a, b, total (a+b) and carotenoides in the first season and had no significant differences on chlorophyll(a), total (a+b) and carotenoides in the second season and chlorophyll(b) in the first season. Chlorophyll a, total (a+b) and carotenoides in leaf tissues were increased with increasing concentration of copper up to 100 ppm in the first season only.

Copper involved in cell wall formation, electron transport and oxidation reactions (Bennett, 1994) and this in turn increased chlorophyll content. These results agree with those reported by Eid *et al.* (1991) on garlic and Abuo-Grab *et al.* (1993) on onion.

c. Effect of the interaction between boron and copper

Data in Table 5 indicate that the interaction between boron and copper had no significant effect on chlorophyll a, b, total (a+b) and carotenoides in leaf tissues in both seasons, except chlorophyll (a) in the first season. The interaction

between boron at 70 ppm and copper at 100 ppm of each gave the highest value of chlorophyll (a) in leaf tissues in the first season only.

III. Plant Chemical Composition

a. Effect of boron

Data in Table 6 illustrate that foliar spray with boron at different concentrations had significant effect on K (%) in roots and leaves in both seasons and N % in roots in the first season and P (%) in bulbs in the second season, but had no significant effect on N, P and K (%) in bulbs and leaves, P content in roots in both seasons and N (%) in roots in the second season. K (%) in roots and leaves and P (%) in bulbs were increased with increasing concentration of boron up to 70 ppm in both seasons. These results agree with those reported by Sliman *et al.* (1999) on onion with respect to P (%) in bulbs.

b. Effect of copper

Data in Table 6 indicate that spraying with copper had significant effect on N,P and K (%) in roots, bulbs and leaves, except N (%) in roots, N and K (%) in bulbs in both seasons, N % in leaves in the first season, N and P (%) in roots and N and K(%) in bulbs in the second season. Spraying with copper at 50 or 100 ppm gave the highest values of K (%) in roots, P (%) in bulbs and P (%) and K % in leaves with no significant differences between 50 or 100 ppm and the control in most cases.

c. Effect of interaction between boron and copper

It is clear from data in Table 7 that the interaction between boron and copper had significant effect on K (%) in roots, P (%) in leaves in both seasons, P (%) in roots, N, P and K (%) in bulbs, N and K (%) in leaves in the first season and N and P (%) in roots, P and K(%) in bulbs in the second season. In general, the interaction between boron at 70 ppm and copper at 50 or 100 ppm gave the highest values of K(%) in roots and P (%) in bulbs with no significant differences between them in both seasons.

IV. Yield and its Components

a. Effect of boron

Data in Table 8 show that spraying with boron had no significant effect on average bulb weight, total and marketable yield/*fed*, but had significant effect

on pickles yield/*fed* in both seasons.Untreated plants gave the highest pickles yield with no significant differences between untreated plants and sprayed one with boron at 35 ppm in the first season and untreated and sprayed with boron at 70 ppm in the second season. These results may be due to that B had no significant effect on dry weight of roots, leaves and bulbs and total dry weight/ plant (Table 2). These results contradicted with those reported by Agwah (1990) and Sliman *et al.*, (1999) on onion.

b. Effect of copper

Presented data in Table 8 indicate that spraying with copper at different concentrations had no significant effect on average bulb weight, total and marketable yield and pickles yield, except average bulb weight, total and marketable yield in the second season. Spraying with copper at 50 or 100 ppm recorded maximum average bulb weight, total and marketable yield compared with control in the second season only. The stimulative effect of copper on yield may be due to that copper increased dry weight of bulb and total dry weight/ plant (Table 2). These results agree with those reported by Hindi *et al.* (1983) and El-Kafoury *et al.*, (1991) on onion.

c. Effect of interaction between boron and copper

Presented data in Table 9 show that the interaction between boron and copper had significant effect on average bulb weight and total and marketable yield/*fed*, but had no significant effect on pickles yield in both seasons. The interaction between boron and copper at different rates recorded maximum average bulb weight, total and marketable yield/ *fed* compared with the control (untreated).

V. Storability

V.1 Weight loss percentage

a. Effect of boron

Presented data in Table 10 show that spraying onion plants with boron had no significant effect on weight loss percentage of onion bulbs during storage period, except at 90 days in the first season and at 180, 210 ,240 and 270 days from the beginning of storage in the second season. Weight loss percentage of onion bulbs during storage period increased with increasing storage period. Spraying onion plants with 70 ppm boron recorded minimum weight loss percentage of onion bulbs during storage period. These results may be due to that boron

may play a role in decreasing respiration and transpiration rates. Storage temperature had an effect on weight loss occurring in onions during storage. Since respiration increase with temperature, greater weight losses would be expected at a higher temperature due either to respiration or water loss (Warid, 1976).

Alphonse (1997) found that boron (5%) decreased significantly the weight loss percentage of onion bulbs by about 10-14 %, whereas borax (5%) decreased losses by about 10-17 % lower than the control.

b. Effect of copper

Data in Table 10 indicate that spraying onion plants with copper at different concentrations had significant effect on weight loss percentage of onion bulbs during storage period at 240 ,270 and 300 days in the first season and 180, 210, 240, 270, and 300 days from the beginning of storage in the second season. Weight loss percentage of onion bulbs during storage period increased with increasing storage period and decreased with foliar spray with copper at 50 or 100 ppm. Spraying onion plants with copper at 50 ppm recorded minimum weight loss percentage of onion bulbs during storage period.

Copper affects the formation and chemical composition of cell wall which in turn affects lignification (Marschner,1995) and this may decrease weight loss percentage of onion bulbs.

c. Effect of the interaction between boron and copper

Data in Table 11 indicate that the interaction between boron and copper had significant effect on weight loss percentage of onion bulbs during storage at 270 and 300 days in the first season and 210, 240, 270 and 300 days from the beginning of storage in the second season. The interaction between boron and copper at different concentrations gave the lowest weight loss percentage of onion bulbs during storage compared with the control (untreated). The interaction between boron at 70 ppm and copper at 100 ppm or between boron at 70 ppm and copper at 50 ppm recorded minimum weight loss percentage of onion bulbs during storage.

V.2. Sprouting percentage

a. Effect of boron

Data in Table 12 indicate that boron had significant effect on sprouting percentage of onion

bulbs during storage at 270 and 300 days from the beginning of storage in the first season, but had no significant effect on sprouting percentage in the second season. Sprouting percentage of onion bulbs initiated at 210 days from the beginning of storage (end of dormancy). The sprouting percentage in bulbs during storage period, increased with prolonging storage period. Spraying onion plants with boron at 35 ppm recorded minimum sprouting percentage of onion bulbs during storage. The role of boron to decrease sprouting percentage might be due to that boron decreases the respiration rate and thus, lowered the breakdown of the carbohydrates which caused the deterioration of bulbs with very poor and non marketable quality.

Alphonse (1997) found that the highest percentage values of sprouted bulbs was noticed in the control bulbs, while the lowest percentage values were in bulbs treated with borax (5%).

b. Effect of copper

Presented data in Table 12 illustrate that copper had significant effect on sprouting percentage of onion bulbs during storage at 240 and 270 days from the beginning of storage in the first season, but had no significant effect on sprouting percentage in the second season. Spraying onion plants with copper at 50 ppm recorded minimum sprouting percentage of onion bulbs during storage.

c. Effect of the interaction between boron and copper

Data in Table 13 indicate that the interaction between boron and copper had significant effect on sprouting percentage at 300 days from the beginning of storage period in the first season. Sprouting percentage of onion bulbs initiated at 210 days from the beginning of storage and increased with increasing storage period .The interaction between boron and copper at different concentrations recorded minimum sprouting percentage at 300 days from the beginning of storage period compared with the control.

REFERENCES

Abou-Grab, O.S., E.A.Y. El-Kabbany, and S.H.H. Kandeel. 1993. Effect of some micro-nutrients on growth, seed yield, photosynthetic pigments and mineral contents of onion. Egypt. J. Appl. Sci. 8 (12): 89-105.

Agwah, E.M.R. 1990. Effect of boron on growth, yield and accumulation of sugar and carbohydrates in bulbs of onion (*Allium cepa* L.). Ann. Agric. Sci., Moshtohor, 28 (2): 1267-1278.

Alphonse, M. 1997. Response of stored onions to different boron treatments. Alex.J.Agric. Res., 42 (1):171-183.

Bennett, W.F. 1994. Nutreint deficiencies and toxicities in crop plants. The Am. Phytopathol. Soc.St.Paul, Minnesota, pp.202.

Bremner, J.M. and C.S. Mulvaney 1982. Total nitrogen. In: Page, A.L., R. H. Miller, and D. R. Keeney (Eds.) Methods of Soil Analysis, Part. 2 Am. Soc. Agron. Madison WI. USA pp. 595 - 624.

Eid, S.M., Nadia S. Shafshak, and F.A. Abo-Sedera.1991.Effect of potassium fertilization and foliar application of certain micro-nutrients combinations on growth, yield and chemical composition of garlic plants. Ann. Agric. Sci. Moshtohor 29 (2) : 981-992.

El-Ghamriny, E.A.1991. Influence of foliar applied B and / or Zn on growth and yield of garlic. Zagazig J. Agric. Res. 18 (6): 1999 - 2007.

El-Kafoury, A.K., Nadia S. Shafshak, M.A. Ibrahim and F. A.Abo-Sedera.1991. Response of onion (*Allium cepa* L.) grown sets to some fertilizer treatments. Egypt. J. Appl. Sci.6(10): 234-243.

El-Sawah, M.H. 1990. Influence of foliar applied Cu and / or Mn on growth and yield of garlic. Zagazig J. Agric. Res. 17 (2) :411-416.

Hindi, M.H., A.H. Firgany and S.A. Moursi.1983. Effect of different application methods of some micronutrients on onion plants. Proc. of the First Conf. Agron. 829-838.

Jackson, M.L. 1970. Soil Chemical Analysis. Prentice Hall, Englewood Cliffs, New Jersy.

Marschner, H. 1995. Mineral Nutrition of Higher Plants. 2nd (ed.), Academic Press, Harcount Brace and Company, Published London San Diego, New York, Boston, Sydney, Tokyo, Toronto, pp.864.

Olsen, S.R. and L.E. Sommers. 1982. Phosphorus. In: Page, A.. L., R. H. Miller, and D. R. Keeney (Eds). Methods of Soil

Analysis. Part 2, Am. Soc. Agron. Madison. W I. USA,. pp. 403-430.

Sliman, Z.T., M.A. Abd El-Hakim and A.A. Omran.1999. response of onion to foliar application of some micro-nutrients Egypt. J. Agric. Res.77 (3) : 983-993.

Snedecor, G.W. and W.G. Cochran 1980. Statistical Methods. 7th ed. Iowa Stat University Press, Am., Iowa, USA.

Warid, C.M. 1976. The influence of temperature on weight loss from stored onion bulbs due to desiccation, respiration and sprouting. Ann. Appl. Biol. 83 (1): 149-155 (C.F. Hort. Abstr. 46: 11224, 1976).

Wettestein, D.1957. Chlorophyll. Lethale und der Submikrosk-opische Formwechsel der Plastiden. Exptl. Cell Reso. 12: 427 - 506.

Table 2: Effect of foliar spray with boron and copper on dry weight of onion plants under sandy soil conditions

Characters / Treatments	Dry weight (gm/organs)							
	Roots	Bulb	Leaves	Total	Roots	Bulb	Leaves	Total
Effect of B	2000/2001 season				2001/2002 season			
00 ppm	0.387	4.907	2.596	7.890	0.370	7.452	3.951	11.883
35 ppm	0.396	5.198	3.080	8.574	0.326	7.301	4.529	12.156
70 ppm	0.351	5.640	3.161	9.152	0.348	7.129	4.000	11.477
LSD at 0.05 level	NS	NS	NS	NS	NS	NS	NS	NS
Effect of Cu								
00 ppm	0.333	4.502	2.471	7.306	0.327	6.683	3.973	10.983
50 ppm	0.400	5.244	3.128	8.772	0.367	7.550	4.129	12.106
100 ppm	0.400	5.998	3.238	9.636	0.350	7.649	4.378	12.377
LSD at 0.05 level	0.052	0.373	0.592	0.479	NS	0.562	NS	0.887

Table 3: Effect of the interaction between foliar spray with boron and copper on dry weight of onion plants under sandy soil conditions

Treatments / Characters		Dry weight (gm/organs)							
		Roots	Bulb	Leaves	Total	Roots	Bulb	Leaves	Total
B	X Cu	2000/2001 season				2001/2002 season			
00 ppm	00 ppm	0.320	4.160	2.093	6.573	0.323	5.963	3.640	9.926
	50 ppm	0.440	5.013	2.653	8.106	0.407	8.213	3.787	12.587
	100 ppm	0.400	5.547	3.040	8.987	0.380	8.180	4.427	12.987
35 ppm	00 ppm	0.360	4.613	2.720	7.693	0.333	7.203	4.347	11.883
	50 ppm	0.400	5.293	3.427	9.120	0.327	7.220	4.307	11.854
	100 ppm	0.427	5.687	3.093	9.207	0.317	7.480	4.933	12.730
70 ppm	00 ppm	0.320	4.733	2.600	7.653	0.323	6.883	3.933	11.140
	50 ppm	0.360	5.427	3.303	9.090	0.367	7.217	4.293	11.877
	100 ppm	0.373	6.760	3.580	10.713	0.353	7.287	3.773	11.413
LSD at 0.05 level		NS	NS	NS	0.830	NS	0.974	NS	1.190

Table 4: Effect of foliar spray with boron and copper on leaf pigments of onion plants under sandy soil conditions

Characters / Treatments	Chlorophyll (mg/gm DW)			Carotenoides (mg/gm DW)	Chlorophyll (mg/gm DW)			Carotenoides (mg/gm DW)
	a	b	(a+b)		a	b	(a+b)	
Effect of B	**2000/2001 season**				**2001/2002 season**			
00 ppm	2.41	1.64	4.05	1.28	3.03	2.47	5.50	1.76
35 ppm	2.53	1.84	4.37	1.41	3.16	2.46	5.62	1.78
70 ppm	2.65	1.95	4.63	1.47	3.24	2.57	5.81	1.82
LSD at 0.05 level	0.08	0.22	0.20	NS	NS	NS	NS	NS
Effect of Cu								
00 ppm	2.46	1.82	4.28	1.36	3.08	2.43	5.51	1.80
50 ppm	2.42	1.65	4.07	1.28	3.18	2.61	5.79	1.81
100 ppm	2.74	1.97	4.71	1.48	3.17	2.46	5.63	1.75
LSD at 0.05 level	0.15	NS	0.40	0.09	NS	NS	NS	NS

Table 5: Effect of the interaction between foliar spray with boron and copper on leaf pigments of onion plants under sandy soil conditions

Characters / Treatments		Chlorophyll (mg/gm DW)			Carotenoides (mg/gm DW)	Chlorophyll(mg/gm DW)			Carotenoides (mg/gm DW)
		a	b	(a+b)		a	b	(a+b)	
B	X Cu	2000/2001 season				2001/2002 season			
00 ppm	00 ppm	2.50	1.59	4.09	1.92	2.83	2.13	4.96	1.65
	50 ppm	2.30	1.57	3.87	1.25	2.97	2.68	5.65	1.76
	100 ppm	2.44	1.77	4.21	1.30	3.30	2.16	5.46	1.89
35 ppm	00 ppm	2.46	1.92	4.38	1.44	3.14	2.53	5.67	1.86
	50 ppm	2.32	1.60	3.92	1.25	3.25	2.57	5.82	1.82
	100 ppm	2.18	2.01	4.19	1.55	3.08	2.28	5.36	1.67
70 ppm	00 ppm	2.43	1.95	4.38	1.34	3.27	2.65	5.92	1.90
	50 ppm	2.66	1.79	4.45	1.36	3.32	2.58	5.90	1.85
	100 ppm	2.97	2.12	5.09	1.60	3.14	2.49	5.63	1.71
LSD at 0.05 level		0.26	NS	NS	NS	NS	NS	NS	NS

Table 6: Effect of foliar spray with boron and copper on N,P and K contents of onion plants under sandy soil conditions

Characters / Treatments	Minerals contents (%)								
	Roots			Bulbs			Leaves		
	N	P	K	N	P	K	N	P	K
Effect of B				**2000/2001 season**					
00 ppm	1.44	0.351	0.88	1.40	0.440	2.98	1.29	0.243	3.89
35ppm	1.34	0.322	0.95	1.44	0.415	2.85	1.08	0.231	3.79
70 ppm	1.20	0.356	1.17	1.61	0.436	3.05	1.04	0.247	4.38
LSD at 0.05 level	0.14	NS	0.15	NS	NS	NS	NS	NS	0.25
Effect of Cu									
00 ppm	1.42	0.326	1.03	1.48	0.382	2.78	1.23	0.252	4.24
50 ppm	1.24	0.374	1.05	1.60	0.447	3.03	1.19	0.258	4.25
100 ppm	1.31	0.329	0.93	1.37	0.461	3.07	0.99	0.210	3.57
LSD at 0.05 level	NS	0.033	0.08	0.17	0.043	NS	NS	0.030	0.37
Effect of B				**2001/2002 season**					
00 ppm	1.28	0.277	1.75	0.93	0.390	2.22	1.86	0.182	3.16
35 ppm	1.29	0.361	1.93	0.86	0.477	2.29	1.80	0.198	3.29
70 ppm	1.20	0.362	1.97	0.88	0.443	2.31	1.70	0.195	3.72
LSD at 0.05 level	NS	NS	0.06	NS	0.037	NS	NS	NS	0.21
Effect of Cu									
00 ppm	1.31	0.322	1.90	0.97	0.457	2.26	1.66	0.204	3.49
50 ppm	1.15	0.356	1.74	0.84	0.407	2.20	1.75	0.170	3.27
100 ppm	1.31	0.322	2.01	0.85	0.446	2.35	1.96	0.202	3.42
LSD at 0.05 level	NS	NS	0.14	NS	0.036	NS	0.10	0.016	0.16

Table 7: Effect of the interaction between boron and copper on N, P and K contents of onion plants under sandy soil conditions

Characters / Treatments		Minerals contents (%)								
		Roots			Bulbs			Leaves		
		N	P	K	N	P	K	N	P	K
B X	Cu	2000/2001 season								
00ppm	00ppm	1.60	0.295	0.86	1.32	0.377	2.92	1.53	0.255	4.14
	50ppm	1.30	0.429	1.06	1.54	0.475	2.97	1.30	0.243	4.11
	100ppm	1.41	0.329	0.74	1.35	0.466	3.06	1.03	0.230	3.41
35ppm	00ppm	1.32	0.329	0.97	1.50	0.405	2.73	1.12	0.243	3.62
	50ppm	1.32	0.287	0.90	1.47	0.405	2.79	1.26	0.298	4.14
	100ppm	1.37	0.349	0.97	1.36	0.433	3.03	0.87	0.153	3.63
70ppm	00ppm	1.35	0.354	1.25	1.63	0.363	2.70	1.03	0.259	4.95
	50 ppm	1.09	0.405	1.18	1.80	0.461	3.33	1.01	0.235	4.51
	100 ppm	1.16	0.309	1.08	1.39	0.485	3.12	1.07	0.247	3.67
LSD at 0.05 level		NS	0.058	0.15	NS	NS	NS	NS	0.052	NS
B	X Cu	2001/2002 season								
00 ppm	00 ppm	1.32	0.308	1.92	1.03	0.410	2.18	1.87	0.213	3.74
	50 ppm	1.20	0.251	1.66	0.68	0.368	2.10	1.71	0.154	3.00
	100 ppm	1.32	0.272	1.66	1.07	0.391	2.39	2.02	0.180	2.73
35 ppm	00 ppm	1.34	0.284	1.90	0.87	0.527	2.31	1.48	0.197	3.27
	50 ppm	1.20	0.458	1.76	0.89	0.438	2.18	1.70	0.168	2.98
	100 ppm	1.24	0.340	2.14	0.82	0.466	2.37	2.22	0.230	3.62
70 ppm	00 ppm	1.17	0.373	1.87	1.01	0.433	2.31	1.64	0.201	3.46
	50 ppm	1.05	0.359	1.81	0.95	0.415	2.33	1.84	0.188	3.82
	100 ppm	1.39	0.354	2.22	0.67	0.480	2.29	1.63	0.197	3.90
LSD at 0.05 level		NS	NS	0.25	0.29	NS	NS	0.17	0.029	0.28

Table 8: Effect of foliar spray with boron and copper on yield and its components of onion plants under sandy soil conditions

Characters / Treatments	Yield and its components					
	Average bulb weight (gm)	Total yield (ton/*fed*)	Marketable yield (ton/*fed*)	Marketable yield (%)	Pickles yield (ton/*fed*)	Pickles yield (%)
Effect of B			**2000/2001 season**			
00 ppm	87.778	8.553	8.374	97.919	0.179	2.081
35ppm	91.122	8.723	8.540	97.902	0.183	2.098
70 ppm	92.519	8.820	8.690	98.530	0.130	1.463
LSD at 0.05 level	NS	NS	NS	0.453	0.032	0.447
Effect of Cu						
00 ppm	88.072	8.488	8.311	97.914	0.177	2.086
50 ppm	90.728	8.767	8.598	98.072	0.169	1.928
100 ppm	91.619	8.842	8.698	98.371	0.144	1.629
LSD at 0.05 level	NS	NS	NS	NS	NS	NS
Effect of B			**2001/2002 season**			
00 ppm	96.743	9.341	9.152	97.042	0.279	2.958
50 ppm	104.098	9.971	9.781	98.094	0.190	1.906
100 ppm	94.504	8.957	8.687	96.997	0.270	3.003
LSD at 0.05 level	NS	NS	NS	NS	0.065	NS
Effect of Cu						
00 ppm	94.084	9.046	8.823	97.535	0.223	2.465
50 ppm	98.999	9.529	9.241	96.978	0.288	3.022
100 ppm	102.262	9.785	9.557	97.670	0.228	2.330
LSD at 0.05 level	3.640	0.395	0.446	NS	NS	NS

Table 9: Effect of the interaction between foliar spray with boron and copper on yield and its components of onion plants under sandy soil conditions

Treatments	Characters	Yield and its components					
		Average bulb weight (gm)	Total yield (ton/*fed*)	Marketable yield		Pickles yield	
				(ton/*fed*)	(%)	(ton/*fed*)	(%)
B	X Cu			2000/2001 season			
00 ppm	00 ppm	77.600	7.571	7.328	96.790	0.243	3.210
	50 ppm	92.400	8.944	8.804	98.435	0.140	1.565
	100 ppm	93.333	9.122	8.992	98.338	0.152	1.662
35 ppm	00 ppm	90.270	8.681	8.533	98.295	0.148	1.705
	50 ppm	90.657	8.801	8.600	97.716	0.201	2.284
	100 ppm	89.440	8.688	8.488	97.698	0.200	2.302
70 ppm	00 ppm	96.347	9.211	9.070	98.469	0.104	1.531
	50 ppm	89.127	8.556	8.389	98.060	0.167	1.940
	100 ppm	92.083	8.694	8.613	99.068	0.081	0.932
LSD at 0.05 level		6.029	0.615	0.678	1.117	NS	1.123
B	X Cu			2001/20021 season			
00 ppm	00 ppm	83.453	8.190	7.949	97.057	0.241	2.943
	50 ppm	99.500	9.633	9.246	95.983	0.387	4.017
	100 ppm	107.277	10.470	10.260	97.994	0.210	2.006
50 ppm	00 ppm	101.860	9.679	9.469	97.830	0.210	2.170
	50 ppm	108.047	10.346	10.168	98.280	0.178	1.720
	100 ppm	102.387	9.888	9.705	98.139	0.183	1.861
100 ppm	00 ppm	89.940	9.269	9.050	97.637	0.219	2.363
	50 ppm	89.450	8.607	8.309	96.538	0.298	3.462
	100 ppm	97.123	8.996	8.705	96.765	0.291	3.235
LSD at 0.05 level		6.304	0.684	0.733	NS	NS	NS

Table 10: Effect of foliar spray with boron and copper on weight loss percentage of onion bulbs during storage period

Characters / Treatments	Weight loss (%) Storage period (days)									
	30	60	90	120	150	180	210	240	270	300
Effect of B	**2000/2001 season**									
00 ppm	3.29	4.14	5.56	7.65	9.98	13.66	17.38	20.25	24.79	34.79
35 ppm	3.52	4.94	6.01	7.58	9.83	13.12	17.11	19.52	23.94	34.12
70 ppm	3.32	3.59	4.73	6.88	9.82	13.32	16.78	19.51	24.42	33.94
LSD at 0.05 level	NS	NS	0.91	NS	NS	NS	NS	NS	NS	NS
Effect of Cu										
00 ppm	3.86	4.75	5.59	7.56	10.18	13.50	17.69	20.60	24.98	36.01
50 ppm	2.87	3.89	5.31	7.01	9.58	13.57	17.06	19.71	24.78	33.94
100 ppm	3.39	4.04	5.40	7.53	9.87	13.04	16.53	18.99	23.39	32.90
LSD at 0.05 level	NS	NS	NS	NS	NS	NS	NS	0.88	0.69	0.68
Effect of B	**2001/2002 season**									
00 ppm	2.44	4.93	7.54	9.69	12.29	14.84	18.30	21.94	29.98	39.79
35ppm	2.51	4.51	6.69	9.02	11.37	14.18	18.00	22.39	30.22	39.40
70 ppm	2.51	4.70	6.87	9.13	11.29	13.66	16.63	19.54	28.59	37.43
LSD at 0.05 level	NS	NS	NS	NS	NS	0.86	1.12	1.19	0.46	NS
Effect of Cu										
00 ppm	2.76	4.65	7.37	9.47	12.07	14.91	18.50	21.80	30.86	40.13
50 ppm	2.59	4.87	6.97	9.19	11.18	13.58	16.73	19.93	28.09	36.83
100 ppm	2.19	4.62	6.76	9.19	11.70	14.19	17.69	22.14	29.84	39.65
LSD at 0.05 level	NS	NS	NS	NS	NS	0.53	0.79	1.01	0.81	1.33

Table 11: Effect of the interaction between foliar spray with boron and copper on weight loss percentage of onion bulbs during storage

Treatments	Characters	Weight loss (%)									
		Storage period (days)									
		30	60	90	120	150	180	210	240	270	300
B	X Cu	2000/2001 season									
00 ppm	00 ppm	4.21	5.08	5.91	7.87	10.79	14.17	18.02	21.23	26.46	37.62
	50 ppm	2.46	3.67	4.99	6.87	9.08	13.66	17.41	20.04	26.04	34.08
	100 ppm	3.16	3.67	5.79	8.20	10.08	13.17	16.72	19.50	23.33	32.66
35 ppm	00 ppm	4.00	5.50	6.58	8.04	10.37	13.21	17.77	20.92	24.75	35.50
	50 ppm	2.96	4.58	5.54	7.12	9.29	13.12	16.92	19.29	24.54	33.66
	100 ppm	3.62	4.75	5.91	7.58	9.88	13.04	16.65	18.36	22.54	33.20
70 ppm	00 ppm	3.38	3.66	4.28	6.78	9.37	13.12	17.29	19.65	23.75	34.91
	50 ppm	3.21	3.41	5.41	7.04	10.37	13.91	16.85	19.79	25.21	34.08
	100 ppm	3.38	3.71	4.50	6.83	9.71	12.91	16.21	19.10	24.29	32.83
LSD at 0.05 level		NS	NS	NS	NS	NS	NS	NS	NS	1.20	1.18
B	X Cu	2001/2002 season									
00 ppm	00 ppm	2.29	5.08	7.87	10.00	12.91	16.00	20.41	23.50	32.58	42.71
	50 ppm	2.42	4.83	7.75	9.83	11.83	14.08	17.00	20.62	28.00	37.08
	100 ppm	2.00	4.87	7.00	9.25	12.12	14.46	17.48	21.71	29.37	39.58
35 ppm	00 ppm	3.83	3.96	7.00	9.25	11.83	14.83	18.93	23.33	31.16	39.66
	50 ppm	2.58	4.91	6.41	8.75	10.96	13.54	17.62	21.79	29.33	38.41
	100 ppm	2.37	4.67	6.66	9.08	11.33	14.16	17.44	22.04	30.16	40.12
70 ppm	00 ppm	2.54	4.91	7.25	9.16	11.46	13.91	16.16	18.58	28.83	38.04
	50 ppm	2.77	4.87	6.75	9.00	10.75	13.12	15.58	17.37	26.96	35.00
	100 ppm	2.21	4.31	6.62	9.25	11.66	13.96	18.16	22.67	30.00	39.25
LSD at 0.05 level		NS	NS	NS	NS	NS	NS	1.37	1.75	1.41	2.31

Table 12: Effect of foliar spray with boron and copper on sprouting percentage of onion bulb during storage period

Characters / Treatments	Sprouting (%)							
	Storage period (days)							
	210	240	270	300	210	240	270	300
Effect of B	2000/2001 season				2001/2002 season			
00 ppm	0.94	15.53	35.31	48.68	2.80	8.56	18.17	31.49
35 ppm	0.17	13.29	31.36	42.52	2.69	9.26	18.72	31.91
70 ppm	1.56	17.30	37.09	47.36	2.88	8.17	18.53	26.83
LSD at 0.05 level	NS	NS	4.07	3.07	NS	NS	NS	NS
Effect of Cu								
00 ppm	1.71	17.97	38.40	47.36	2.44	9.02	17.80	30.44
50 ppm	0.70	15.77	33.45	33.45	2.81	7.45	18.26	29.11
100 ppm	0.25	12.37	31.91	45.51	3.13	9.52	19.35	30.68
LSD at 0.05 level	0.77	3.13	4.43	NS	NS	NS	NS	NS

Table 13: Effect of the interaction between foliar spray with boron and copper on sprouting percentage of onion bulb during storage period

Treatments	Characters	Sprouting (%)							
		Storage period (days)							
		210	240	270	300	210	240	270	300
B	X Cu	2000/2001 season				2001/2002 season			
00 ppm	00 ppm	2.83	20.08	40.80	54.75	2.50	8.92	17.66	33.81
	50 ppm	0.00	14.44	32.77	47.76	2.92	7.30	20.87	30.94
	100 ppm	0.00	12.06	32.36	43.53	3.00	9.46	15.98	29.71
35 ppm	00 ppm	0.53	14.96	31.53	40.77	1.66	8.50	16.50	29.50
	50 ppm	0.00	16.33	34.77	43.10	2.49	8.96	18.15	31.16
	100 ppm	0.00	8.58	27.80	43.71	3.92	10.33	21.52	35.09
70 ppm	00 ppm	1.82	18.88	42.87	46.56	3.17	9.64	19.25	28.01
	50 ppm	2.11	16.55	32.82	46.23	3.01	6.10	15.77	25.24
	100 ppm	0.75	16.47	35.58	49.29	2.46	8.78	20.56	27.25
LSD at 0.05 level		1.34	NS	NS	6.24	NS	NS	NS	NS

تأثير الرش الورقي بالبورون والنحاس على الوزن الجاف ،المحصول والقدرة التخزينية للبصل تحت ظروف الأراضي الرملية

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أجريت تجربتان حقليتان خلال موسمين شتويين متتالين لعامي ٢٠٠٠ /٢٠٠١ ، ٢٠٠١ / ٢٠٠٢ في مزرعة التجارب الزراعية بالخطارة التابعة لكلية الزراعة ، جامعة الزقازيق لدراسة تأثير الرش الورقي بالبور ون و النحاس وتفاعلهما على الوزن الجاف والمحصول والقدرة التخزينية للبصل تحت ظروف الأراضي الرملية.

أدى الرش بمحلول البورون بتركيز ٧٠ جزء في المليون إلى زيادة كلوروفيل أ ، ب ، الكلى (أ+ب) في أنسجة الورقة ،ومحتوى الجذور و الأوراق من البوتاسيوم، ومحتوى الأبصال من الفوسفور ، بينما قللت النسبة المئوية للفقد في الوزن والتزريع للأبصال أثناء التخزين .

أدى الرش بمحلول النحاس بتركيز ١٠٠ جزء في المليون إلى زيادة كل من الوزن الجاف للأبصال، والوزن الجاف الكلى ، وكلوروفيل أ ، ب والكلى (أ+ب)، والكاروتينويدات فى أنسجة الورقة ، بينما أدى الرش بتركيز ٥٠ أو ١٠٠ جزء في المليون إلى زيادة نسبة البوتاسيوم في الجذور ، و نسبة الفوسفور في الأبصال، ونسبة الفوسفور والبوتاسيوم في الأوراق ، ومتوسط وزن البصلة، والمحصول الكلى والقابل للتسويق للفدان ، كما أدى الرش بالنحاس بتركيز ٥٠ جزء في المليون إلى نقص النسبة المئوية لكل من الفقد في الوزن والتزريع في الأبصال أثناء التخزين .

سجلت معاملات التفاعل بين البورون والنحاس بالتركيزات المختلفة أعلى القيم لكل من الوزن الجاف للنبات و متوسط وزن البصلة، والمحصول الكلى والقابل للتسويق للفدان، لكنها سجلت أقل القيم لنسبة التزريع للأبصال أثناء التخزين مقارنة بالكنترول، وسجلت معاملات التفاعل بين البورون بتركيز ٣٥ جزء في المليون مع النحاس بتركيز ١٠٠ جزء في المليون أو البورون بتركيز ٧٠ جزء في المليون مع النحاس بتركيز ٥٠ جزء في المليون أقل القيم بالنسبة للفقد في الوزن للأبصال أثناء التخزين .