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Kalsiyum Nitrat ve Borik Asidin Yapraktan Uygulanışının Şalgamda (Brassıca rapa L.) Büyüme, Verim ve Besin Elementleri İçeriğine Etkisi

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Özet

Kalsiyum nitrat ve borik asidin yapraktan uygulanışının şalgamda (Brassıca rapa L.) büyüme, verim ve besin elementleri içeriğine etkisini incelemek amacıyla Mısır-Assiuot governor şartlarında killi topraklarda 2008 ve 2009 yıllarında Baladi ve Japanese isimli iki şalgam çeşidi ile iki tarla denemesi kurulmuştur. Borik asidin (H_3BO_3) 0'dan 4g/l'ye kadar değişen 4 dozu ve kalsiyumun, kalsiyum nitrat formunda ($CaNO_3$)5g/l olarak bir dozu kullanılmıştır. Sonuçlara göre uygulamalar ile kontrol arasında önemli farklılıklar görülmüştür. Ekimden 50 gün sonra Balady çeşidi en yüksek bitki boyu, yaprak taze ağırlığı ve kök/bitki oranı değerlerine sahip olmuştur. Japanese çeşidi, yapraklarda P, K, Ca ve kökte P yönünden en yüksek besin elementi içeriğine sahipken, Balady çeşidinin köklerinde N, K, Ca, B ve yapraklarında B içeriği yönünden en yüksek içeriğe sahip olduğu belirlenmiştir. Ancak, 5 g/l kalsiyum nitrat ile 1 g/l borik asit uygulaması baş çapı, yaprak taze ağırlığı, kökler ve toplam bitki taze ağırlığında azalmaya yol açmış ve yine yapraklardaki azot ile yaprak ve köklerdeki potasyum içeriğinin de düşmesine yol açmıştır. Her iki sezonda yapraktan uygulanan 2 g/l dozundaki borik asit yapraklardaki B ve kökteki Ca içeriğinde önemli seviyede artışa yol açarken, tek başına Ca uygulaması yapraktaki K ve B'nin azalmasına yol açmıştır. Yine her iki sezonda, kalsiyum nitrat (5g/l)ve borik asit (1g/l)uygulamalarının kombinasyonu kökteki azotu artırmış, borik asit (2g/l)uygulaması ile yapraktaki Ca miktarı artarken, yine kökteki P miktarı da borik asit (4g/l)uygulaması ile artış göstermiştir.

***Anahtar kelimeler**: Şalgam (brassica rapa L.), Çeşitler, Yapraktan uygulama, Kalsiyum, Bor, Verim.*

Effect of Foliar Application of Calcium Nitrate and Boric Acid on Growth, Yield and Nutrient Contents of Turnip Plant (Brassica rapa L.)

Abstract

Two field experiments were conducted to investigate the effect of foliar application of calcium and boron and their combinations, on growth, yield and nutrients concentration of turnip plant (Brassica rapa L.) which grown under clay soil condition in Assiuot governorat -, Egypt during two successive seasons of 2008 and 2009, including two varieties of turnip plants, which are called as Baladi and Japanese. Four concentrations of B, were applied as Boric acid (H_3BO_3) form which was ranging from 0 to 4 g/l,, and one concentration of Ca as calcium nitrate ($CaNO_3$) form was a dose of 5g/l. The results showed that there were significant differences between the treatments and the controls. After 50 days from sowing, the data shown that Balady variety showed the highest plant height, fresh weight of leaves and root/plant. Japanese variety had the highest nutrient concentrations of P, K, Ca in leaf and P in root, while Balady variety had the highest value in terms of N, K, Ca, B in root and B in leaves. However, sprays of calcium nitrate at concentration of 5g/l + Boric acid 1g/l significantly increased the head diameter, fresh weight of leaves, root and led to improving of fresh weight of total plant, as well as N in leaves and K nutrient content of leaves and root. In both seasons, Boric acid (2g/l) foliar application gave rise to significant increases in the concentrations of the B in the leaves and Ca in the root and on the opposite, foliar application of Ca alone, led to decrease of K and B in leaves as compared with the other applications. In both seasons, the combination between calcium nitrate (5g/l) and Boric acid (1g/l) increased N in root, and with Boric acid (2g/l) increased Ca in leaves while Boric acid (4g/l) increased P concentration in root.

***Keywords**: Turnip (brassica rapa L.), Varities, Foliar application, Calcium, Boron, Yield.*

Introduction

Turnip (*Brassica rapa* L.) is one of a source food in Egypt. The roots used for human consumption and the stems and leaves are used for livestock. Turnip plants grow in a cool and moderate temperatures and well adapted for the winter season of Egypt. In Egypt the loss of soil fertility by continual nutrient removal by crops without adequate replenishment, beside to imbalanced plant nutrition, which is reflected by inability of the crop to express its genetic yield potential, then a consequent causing lower yield than expected is produced. Some studies pointed out that there are a deficiency in calcium and boron in some plants in Egypt.

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Calcium and boron deficiency has become a common problem in most fields because of the increased use of fertilizers that are deficient in calcium and boron, beside the unavailability of calcium and boron in the soil and subsequent deficiency in the plant. Boron is an essential micronutrient for the normal growth of plants (Shelp 1993). Its deficiency is a widespread nutritional disorder in many countries (Gupta 1993). Turnip, are sensitive to calcium and boron deficiency. A common feature in B deficiency is the disturbance in the development of meristematic tissues, whether these are root tips, tips of upper plant parts or tissues of the cambium. Alkaline soils have reduced uptake of boron due to high pH. Boron deficiency in crops causes a breakdown of the growing tip tissue or a shortening of the terminal growth. This may appear as resetting. Internal tissues of turnips show breakdown and corky, dark discoloration.

Boron is a nutrient required by plants, but the difference between varieties must be considerable. Differential degrees of B deficiency have been reported for many plant species and cultivars, evidencing different plant abilities in tolerating low B concentrations or in translocation B to the growing tissues. (Gupta, 1993; Rerkasem & Jamjod, 1997; Brown & Shelp, 1997). Turnip growth was generally enhanced when foliar boron applied at appropriate levels at suitable time. Turnip productivity is often limited because of soil alkality problems. One problem for plants grown on alkality soils could be boron (B) deficiency. Boron primarily regulates the carbohydrate metabolism in plants. Calcium deficiency leads to death of growing points, abnormally dark green foliage, premature shedding of blossoms and buds.

Old cultivated soils in Egypt started to lose their ability to provide plants with their requirements of some nutrients such as calcium and boron due to many reasons such as high pH, low organic matter and compactness. The problem with this is that in the higher pH of soils; Ca and B are unavailable to the plants root. Under such conditions, ground applications of calcium and boron are ineffective. For this reason, foliar application is often more efficient than broadcast application to correct calcium and boron deficiency. During the recent years studies are showing foliar fertilization is more efficient than soil application in supplying plants with a useable form of calcium and boron. However, there is relatively little research into calcium and boron in Egypt compared to other nutrients. The purpose of this study was to determine effects of the foliar application of calcium and boron levels as single nutrient or in combinations on morphological characters, yield as well as tissue nutrients concentration of turnip (Brassica rapa L.).

Materials and Methods

Two field experiments were carried out at Agricultural Experimental Farm, Assiuot Governorate during the growing seasons of 2008 and 2009. The objective of the investigation was to study the effect of calcium and boron fertilizer in different levels on growth and yield of turnip plants in the varieties of Baladi and Japanese.

Before turnip planting, soil sample were taken to test physical and chemical properties of the experimental soil. Phosphorus was applied to soil before planting at the level of 30 P_2O_5/fed. Nitrogen was applied at the level of 90 Kg N /fed during the vegetative growth, while potassium was added as K_2O at rate of 24 Kg K_2O/fed during tubers forming. Foliar application of calcium nitrate ($CaNO_3$) and Boric acid (H_3BO_3), were used for two times (at30th and 45th days), as source for calcium and boron. The experiments included eight treatments, which were as follows: Control, Boric acid (1, 2 and 4g/l), calcium nitrate (5g/l), calcium nitrate (5g/l) + Boric acid (1, 2 and 4g/l). Treatments were arranged in a split plot design with three replicates. Varieties occupied the main plots and nutrient treatments were allocated at random in the sub plots.

Data records

The plants were harvested after 50 days from planting. At harvest, ten individual plants were used to data as fallowing; Number of leaves, Plant height (cm), Head diameter (cm/plant), and fresh weight for leaves and root (g/plant). Samples were collected from all treatments to investigate the amount of the N, P, K, Ca and B elements.

Chemical analysis

Soil testing

Soil samples were analyzed for texture with a hydrometer (Bouyoucos, 1954), for pH and electric conductivity (EC) using water extract (1:2.5) method, (Jackson, 1973), for total calcium carbonate ($CaCO_3$%): calcimeter method was used as described by Alison and Moodle (1965). The organic matter (O.M%) content was determined according to Walkley and Black (1934) by using potassium dichromate (Chapman and Pratt, 1978). Phosphorus was extracted by using sodium bicarbonate (Olsen et al., 1954). Potassium (K^+) was extracted by using ammonium acetate. Boron was determined with Azomethine-H according to Wolf (1971).

Beet seeds planted in silty clay soil in the Experimental Research Station of the Faculty of Agriculture Assiout University.

The plants were on normal growth, uniform in vigour under furrow and flooding irrigation system and normal fertilization was applied as scheduled in the station program . According to the tentative values of soil characteristics and available nutrient concentrations, soil testing revealed that the experimental soil was silty clay texture, alkalinity in reaction (pH 8.11). It had satisfactory content of total calcium carbonate (2.50%) and electric conductivity (0.40 dS/m), low in organic matter (1.90%), moderate in phosphorus, potassium and low in calcium (2.7, 30, and 102mg/100g), respectively, as well as B 0.80 mg/kg).

Plant analysis

The plant material was digested using an acid mixture consisting of nitric, perchloric and sulfuric acids in the ratio of 8:1:1 (v/v), respectively (Chapman and Pratt, 1978). Nitrogen (N) was determined in the dry plant material by using the boric acid modification described by Ma and Zuazage (1942), and distillation was done with using a Buechi 320-N2-distillation unit. Phosphorus was photometrically determined by using the molybdate vanadate method according to Jackson (1973). Potassium was determined using flame photometer (Eppendorf). Boron was determined with Azomethine-H according to Wolf (1971).

The soil data were evaluated with using the criteria which published by Ankerman and Large (1974) and Lindsay and Norvell (1978), whereas the leaf analysis data were evaluated according to the criteria reported by Jones et al. (1991) in Plant Analysis Handbook.

Statistical analysis

The data were statistically analyzed as split plot design according to Snedecor and Cochran (1980), where the means of different treatments were compared using the least significant difference (L.S.D) test at 5% level of probability.

Results and Discussion

(This sentence should be written again). One the common responsive crops to boron fertilizer is the turnip plants. Turnips are highly sensitive to calcium and boron deficiency and respond very well to applications of calcium and boron. Soil pH has a significant impact upon the availability of boron to plants. Adsorption of boron from soil particles increases the soil pH; thus, boron becomes increasingly unavailable to the plants as parallel with pH increases. The results of soil testing showed that the experimental soils had high pH and low organic matter content. Moreover, soil was low in their available content of calcium and boron which were measured by the critical levels according to Ankerman and Large (1974). Data presented in Table 1 exhibited that Balady variety was higher than Japanese variety in plant height, fresh weight of leaves and root/plant.

As for effect of two varieties on leaf and root nutrients, Table 2 show that Japanese variety had the highest value in nutrient concentrations of P, K ,Ca in leaf and P in root, while Balady variety was the highest in N, K, Ca, B in root and B in leaves. The increments of nutrients took-up by turnip plants differed from one variety to another. These tissue concentration differences between cultivars suggest that nutrient uptake into root is strongly genetically regulated. The results also showed that the two turnip varieties differ in their capacity to absorption of the nutrients, even when they are grown in the same soil and application of the same fertilizater. The wide variation of different genotypes in their ability to absorb, translocation and utilize nutrients from soil was mentioned by some authors (Brown, 1979; Zaharieva, 1982). However, the varieties varied in their efficiency to utilize nutrients of the soil might be due to the difference in their nutrient requirements (Mengel & Kirkby, 1987). Karlsson et al. (2006) found significant variability in tuber calcium concentration among cultivars which grown under same environment.

Table 1. Effect of varieties on yield and yield components of turnip

Variety	Number of leaves	Plant height (cm)	Head diameter (cm/plant)	Fresh weight (g/plant) Leaves	Root	Total plant
			First season			
Japanese	10.5	44	3.6	66	107	173
Baladi	10.2	65	3.8	146	143	289
LSD 5%	NS	6	NS	37	12	37
			Second season			
Japanese	11.0	45	4.0	90	125	215
Baladi	10.8	69	3.9	152	165	317
LSD 5%	NS	2	NS	25	10	22

Tables 3, 4 shows that the most spraying treatments were significantly increased their growth parameters and yield/plant compared to the control plant in the two varieties. The highest values of fresh weight of leaves and root resulted from foliar application of Ca (5g/l) + B (1g/l). It was led to increasing of total yield/plant.

The beneficial effect of Ca (5g/l) + B (1g/l) could be attributed to the physiological role of calcium and boron which prevents physiological disorders. Cell wall strength and thickness are increased by calcium addition. Calcium is a critical part of the cell wall that produces strong structural rigidity by forming cross-links within the pectin polysaccharide matrix and proteins, forming the cell wall-modulates and the transfer of extra cellular signals into intercellular space (Tuckey, 1983, Polevoiy, 1989 and Wu et al., 2002). Also, such a result might be attributed to some possible reasons including that this small quantities of boron led to increased activities of metabolic processes in plant. Adequate B nutrition is critical not only for high yields but also for high quality crops (Brown and Shelp, 1997). Some studies have shown that soil - or foliar-applied Ca and B increases plant yield and improve its quality (Matoh and Kobayashi 1998, Wojcik and Lewandowski, 2003).

Table 2. Effect of varieties on leaf and root nutrients of turnip

Variety	N	P	K	Ca	B	N	P	K	Ca	B
	%				ppm	%				ppm
	Leaves					Root				
	First season									
Japanese	3.04	0.51	5.81	3.72	32.3	2.27	0.63	3.63	0.57	23.8
Baladi	3.20	0.43	3.86	3.08	34.4	2.57	0.43	4.81	0.90	28.4
LSD 5%	NS	0.01	0.07	0.01	1.39	0.02	0.01	0.01	0.03	3.4
	Second season									
Japanese	3.33	0.49	4.71	3.62	35.06	2.25	0.56	3.53	0.48	27.4
Baladi	3.47	0.36	4.10	3.14	39.25	2.36	0.40	4.42	0.53	34.1
LSD 5%	NS	0.03	0.12	0.05	3.02	0.02	0.05	0.01	0.01	1.0

Table 3. Effect of boron and calcium on yield and yield components of turnip

Treatment	Number of leaves	Plant height (cm)	Head diameter (cm/pant)	Fresh weight (g/plant)		
				Leaves	Root	Total plant
	First season					
Control	08.5	43	2.8	80	113	193
B (1g/l)	09.7	50	2.8	85	102	187
B (2g/l)	10.9	58	4.9	98	132	230
B (4g/l)	11.3	58	3.3	140	118	258
Ca (5g/l)	10.9	58	3.8	99	118	217
Ca (5g/l) + B (1g/l)	10.8	59	4.8	146	167	313
Ca (5g/l) + B (2g/l)	10.6	60	4.3	110	147	257
Ca (5g/l) + B (4g/l)	10.2	52	3.1	89	104	193
LSD 5%	1.34	5	1.0	32	8	11
	Second season					
Control	10.50	50	3.7	96	123	219
B (1g/l)	10.92	55	3.5	101	144	245
B (2g/l)	10.67	60	4.1	116	149	265
B (4g/l)	11.83	64	4.8	133	161	294
Ca (5g/l)	11.83	56	3.6	115	145	260
Ca (5g/l) + B (1g/l)	11.92	61	4.7	164	180	344
Ca (5g/l) + B (2g/l)	10.08	59	3.8	127	144	271
Ca (5g/l) + B (4g/l)	9.5	53	3.7	119	123	242
LSD 5%	1.40	3	N.S	20	8	9

Results in Table 5 pointed out that at the two seasons, generally, the boron level of the leaves is higher than of the roots. These result agreement with Amberger, 1974 who mentioned that the boron level of the sugar beets leaves is much higher than that of the roots Also, show that foliar application of Boric acid (2g/l) resulted in the highest of B in leaves and that foliar application of Ca(5g/l)+B (1g/l) and Ca(5g/l)+B (2g/l), resulted in the highest concentration of Ca and N in the roots respectively. Ca increasing the ability of the plant for nitrate absorption and metabolism. Increase of N led to increase protein content of the roots. Tabrizi et al 2008 reported that root yields increased with increasing nitrogen rates. Also, calcium is important for Cell wall strength and thickness. On the other hand, Amberger, 1974 mentioned that Boron is essential for protein metabolism. Also, Ca (5g/l) increased P concentration in the root. It’s Known that Ca activating some of the phosphatises. On the other hand, P was decreased in the leaves as a result of Ca or B foliar application alone or in combination, while Ca foliar application alone, led to decrease of K and B concentrations in leaves in both seasons. This may be caused by antagonism between Ca and both of K and B. Concerning the interaction effect among the two varieties and treatments on leaf and root nutrients, data in Table 6 show that in Japanese variety, B concentrations in leaves were higher than Baladi variety with foliar application of Boric acid at 2g/l at both seasons. while at concentration of 4g/l, in Baladi variety N increased in roots and

K increased with the treatment of $CaNO_3$ (5g/l)+Boric acid (1g/l) concentration in both seasons. On the other hand, in both varieties boron was increased in roots resulted from foliar application of $CaNO_3$ (5g/l) + Boric acid (2g/l). The improvement in B content can be explained by the beneficial effect of Ca and boron on absorption, translocation and assimilation processes.

Table 4. Effect of interaction of the varieties and treatments on yield and yield components of turnip

Variety	Treatment	Number of leaves	Plant height (cm)	Head diameter (cm/pant)	Fresh weight (g/plant)		
					Leaves	Root	Total plant
	First season						
Japanese	**Control**	10.0	41	3.7	62	103	165
	B (1g/l)	10.0	42	2.5	52	73	125
	B (2g/l)	10.0	49	4.8	39	128	167
	B (4g/l)	10.0	41	2.3	85	86	171
	Ca (5g/l)	11.0	45	4.1	63	115	178
	Ca(5g/l)+B (1g/l)	12.0	50	4.9	107	151	258
	Ca (5g/l)+B (2g/l)	11.0	45	4.2	70	146	216
	Ca (5g/l)+B (4g/l)	11.0	40	2.7	48	87	135
Baladi	**Control**	7.0	45	1.9	98	123	221
	B (1g/l)	10.0	58	3.1	117	130	247
	B (2g/l)	12.0	68	4.9	156	170	326
	B (4g/l)	13.0	74	4.3	194	150	344
	Ca (5g/l)	11.0	71	3.5	135	121	256
	Ca(5g/l)+B (1g/l)	10.0	68	4.7	184	176	360
	Ca (5g/l)+B (2g/l)	11.0	75	4.4	151	148	299
	Ca (5g/l)+B (4g/l)	9.0	64	3.5	130	122	252
	LSD 5%	1.90	7.0	1.47	45	50	67
	Second season						
Japanese	**Control**	11.0	42	4.46	87	121	208
	B (1g/l)	11.0	43	3.37	77	114	191
	B (2g/l)	11.0	48	3.57	86	118	204
	B (4g/l)	11.0	49	4.10	75	92	167
	Ca (5g/l)	11.0	42	3.70	97	142	239
	Ca(5g/l)+B (1g/l)	11.0	51	4.69	120	141	261
	Ca (5g/l)+B (2g/l)	12.0	47	4.50	108	161	269
	Ca (5g/l)+B (4g/l)	11.0	41	3.80	73	110	183
Baladi	**Control**	10.0	50	2.93	104	124	228
	B (1g/l)	11.0	55	3.67	126	155	281
	B (2g/l)	11.0	60	4.69	147	180	327
	B (4g/l)	13.0	64	5.40	191	236	427
	Ca (5g/l)	13.0	56	3.49	132	149	281
	Ca(5g/l)+B (1g/l)	13.0	61	4.64	208	219	427
	Ca (5g/l)+B (2g/l)	9.0	59	3.07	147	126	273
	Ca (5g/l)+B (4g/l)	9.0	53	3.57	165	135	300
	LSD 5%	1.97	5	1.26	29	51	56

These results are agreement with Shorrocks (1997) who pointed out that a deficiency of boron which shown by a positive response to boron application. It has been reported in more than 80 countries and for 132 crops over the last 60 years. Accordingly, physiological performance of plants was improved as manifested by increased efficiency of roots in absorbing nutrients from the soil (Amberger, 1980; Balba, 1980). (Dell & Huang 1997) state that deficiency of B inhibits root elongation through limiting cell enlargement and cell division in the growing zone of root tips. Donald *et al.*, 1998 mentioned that boron facilitates transport of carbohydrates through cell membrane i.e starch and sugars. On the other hand, Carpena *et al.*, 2000 showed that high Ca supply in plants promoted B mobilization to the shoot. The present study revealed that an increase in yield was due to increase in N, P, K, Ca and B concentration of roots in response to foliar spray of calcium nitrate + Boric acid.

Conclusion

Foliar application of Boric acid (H_3BO_3) 1 g/l, with combination of calcium nitrate ($CaNO_3$) 5g/l. fertilizers are suggested in such conditions, it's the best treatment as it showed significant yield of turnip. The results showed that calcium and boron could be used for foliar application on turnip plants to prevent or correct it's deficiencies that may limit crop growth and yield. Disorders of the nutrient ratios in the turnip plants can be lead to unbalanced nutrition. For a better nutritional balance, it is necessary to include calcium and boron in a regular foliar application program.

Table 5. Effect of boron and calcium on leaf and root nutrients of turnip

Treatment	N	P	K	Ca	B	N	P	K	Ca	B
	%			ppm		%			ppm	
	Leaves					Root				
First season										
Control	2.05	0.505	4.04	3.27	22.0	2.35	0.625	3.30	0.565	15.0
B (1g/l)	3.23	0.495	5.18	3.04	32.5	1.82	0.445	3.68	0.690	18.5
B (2g/l)	3.94	0.465	5.47	3.88	41.3	2.09	0.470	4.20	0.850	23.3
B (4g/l)	2.71	0.460	5.66	3.69	38.8	2.36	0.415	4.44	0.820	30.8
Ca (5g/l)	2.48	0.470	3.35	3.21	22.8	2.78	0.785	4.77	0.670	25.5
Ca(5g/l)+B (1g/l)	3.71	0.460	5.77	2.95	35.3	2.77	0.545	5.44	1.040	28.0
Ca (5g/l)+B (2g/l)	3.59	0.385	4.94	3.50	35.8	2.84	0.495	4.47	0.690	35.5
Ca (5g/l)+B (4g/l)	3.23	0.520	4.25	3.67	37.8	2.35	0.460	3.48	0.580	32.5
LSD 5%	0.37	0.013	0.08	0.03	2.2	0.02	0.011	0.01	0.02	1.9
Second season										
Control	3.01	0.510	3.64	3.23	26.0	1.85	0.515	3.42	0.590	22.5
B (1g/l)	3.74	0.450	4.45	3.09	35.8	1.93	0.350	2.86	0.495	26.0
B (2g/l)	2.39	0.435	4.78	3.31	45.0	2.47	0.500	5.15	0.770	27.5
B (4g/l)	4.09	0.365	4.42	3.23	42.5	2.63	0.300	3.27	0.630	33.0
Ca (5g/l)	4.11	0.385	3.06	3.02	30.8	2.08	0.775	3.44	0.505	26.3
Ca(5g/l)+B (1g/l)	2.87	0.370	5.01	4.15	38.5	2.66	0.445	4.92	0.950	31.5
Ca (5g/l)+B (2g/l)	3.58	0.460	5.44	3.23	37.0	2.79	0.500	4.25	0.800	39.3
Ca (5g/l)+B (4g/l)	3.34	0.440	4.44	3.78	41.8	2.01	0.450	4.48	0.810	39.8
LSD 5%	0.15	0.014	0.058	0.08	1.58	0.04	0.02	0.07	0.03	1.69

Table 6. Effect of interaction of the varieties and treatments on leaf and root nutrients of turnip

Variety	Treatment	N	P	K	Ca	B	N	P	K	Ca	B
		%			ppm		%			ppm	
		leaves					Root				
	First season										
Japanese	**Control**	2.96	0.58	4.66	3.96	23.5	2.31	0.87	3.36	0.48	16.0
	B (1g/l)	3.55	0.59	7.13	2.98	31.5	2.05	0.73	3.31	0.65	19.0
	B (2g/l)	4.48	0.54	6.65	4.56	47.0	1.78	0.60	3.84	0.48	20.0
	B (4g/l)	2.31	0.51	8.08	4.42	39.5	1.55	0.37	4.13	1.01	29.0
	Ca (5g/l)	2.62	0.56	2.98	3.74	23.5	2.92	0.80	3.84	0.48	24.5
	Ca(5g/l)+B (1g/l)	2.91	0.41	7.22	2.98	28.0	2.87	0.50	4.22	0.53	19.5
	Ca (5g/l)+B (2g/l)	2.95	0.37	5.04	3.70	32.5	2.53	0.70	3.94	0.48	35.5
	Ca (5g/l)+B (4g/l)	2.52	0.50	4.70	4.03	32.5	2.14	0.48	2.40	0.48	27.0
Baladi	**Control**	1.14	0.43	3.41	3.17	22.0	2.39	0.38	3.23	0.65	14.0
	B (1g/l)	2.91	0.40	3.23	3.10	33.5	1.59	0.16	4.04	0.73	18.0
	B (2g/l)	3.40	0.39	4.28	3.20	35.5	2.40	0.34	4.56	1.21	26.5
	B (4g/l)	3.11	0.41	3.23	2.96	38.0	3.16	0.46	4.75	0.63	32.5
	Ca (5g/l)	2.34	0.38	3.71	2.67	22.0	2.63	0.77	5.70	0.85	26.5
	Ca(5g/l)+B (1g/l)	4.50	0.51	4.32	2.91	42.5	2.66	0.59	6.65	1.55	36.5
	Ca (5g/l)+B (2g/l)	4.22	0.40	4.84	3.30	39.0	3.15	0.29	4.99	0.90	35.5
	Ca (5g/l)+B (4g/l)	3.94	0.54	3.80	3.30	43.0	2.55	0.44	4.56	0.68	38.0
LSD 5%		0.56	0.03	0.18	0.04	03.9	0.03	0.02	0.02	0.02	2.70
	Second season										
Japanese	**Control**	3.95	0.74	3.86	3.55	26.0	2.22	0.78	3.98	0.48	19.5
	B (1g/l)	3.07	0.47	4.85	3.17	35.5	2.14	0.45	2.40	0.38	20.5
	B (2g/l)	2.54	0.52	4.90	3.22	51.5	2.66	0.50	3.36	0.50	22.0
	B (4g/l)	4.15	0.35	4.56	3.55	40.0	1.74	0.44	3.22	0.58	30.5
	Ca (5g/l)	3.80	0.52	2.70	2.98	29.5	1.76	0.79	3.65	0.48	22.0
	Ca(5g/l)+B (1g/l)	2.41	0.37	4.80	5.00	29.5	2.65	0.54	4.13	0.68	23.0
	Ca (5g/l)+B (2g/l)	3.79	0.51	7.22	3.26	33.5	2.78	0.52	3.74	0.48	42.0
	Ca (5g/l)+B (4g/l)	2.91	0.51	4.80	4.26	35.0	2.01	0.49	3.74	0.55	39.5
Baladi	**Control**	2.06	0.28	3.42	2.91	26.0	1.48	0.25	2.85	0.70	25.5
	B (1g/l)	4.41	0.43	4.04	3.01	36.0	1.72	0.25	3.32	0.61	31.5
	B (2g/l)	2.24	0.35	4.66	3.40	38.5	2.28	0.51	6.94	1.04	33.0
	B (4g/l)	4.02	0.38	4.28	2.91	45.0	3.51	0.16	3.32	0.68	35.5
	Ca (5g/l)	4.42	0.25	3.42	3.06	32.0	2.40	0.76	3.23	0.53	30.5
	Ca(5g/l)+B (1g/l)	3.33	0.37	5.22	3.30	47.5	2.67	0.35	5.70	1.29	40.0
	Ca (5g/l)+B (2g/l)	3.37	0.41	3.66	3.20	40.5	2.81	0.48	4.75	1.12	36.5
	Ca (5g/l)+B (4g/l)	3.77	0.37	4.08	3.30	48.5	2.00	0.41	5.22	1.07	40.0
LSD 5%		0.22	0.01	0.06	0.11	02.2	0.06	0.03	0.10	0.03	2.40

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