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Crop Productivity and Quality of Some Varieties of Lentils Under the Influence of Spraying Boron in The Newly Cultivated Land.

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ABSTRACT

Field experiments were conducted during winter seasons of 2013/2014 and 2014/2015, to study the effect of B on growth and yield of lentil grown in newly soil. The lentils variety (Giza- 29, Giza-9, Giza-51, Giza370 and Giza-4) were treated with application of B (0.0, 0.75 and 1.5 gm/l) as boric acid. The results showed that some growth character as plant height, number of branches/plant, number of pods/plant, seed yield, grain yield, 1000 grains, biological yield were increased with increasing concentration of boron. Also, content of grains from some nutrient as protein, nitrogen, phosphors, potassium, zinc and magnesium were increase with increase boron. This study indicated that growing of lentil in sandy soils needs to supplement by B which remunerate loss of yield.

Keywords: productivity and quality, varieties of lentil, spray of boron, newly land.

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INTRODUCTION

Lentil *(Lens culinaris* L.) was primary grown in southwest Asia about 7,000 B.C. It is best modified to the cooler temperate zones of the world, or the winter season in Mediterranean climates. Lentil is an important source of dietetic protein in the Mediterranean and especially in Egypt. Lentil, a constituent of the legume family, therefore, it can supply a significant part of its nitrogen requirement by fixing nitrogen from the air when inoculated with the appropriate rhizobial inoculants. Total world lentil production ranged from 4,393,150 million tons at 2014. Major lentil producing countries include Canada, Turkey, Syria, Australia, India, Nepal and the United States [1].

Several new high yielding varieties have been developed by Egyptian scientists in department of legumes followed to Agriculture Research Center, either by direct selection and/or through hybridization. The yield and quality of lentil varieties could be further improved. [2] Studied 9 quantitative traits in 48 genotypes of lentil and observed high extent of genetic variation for grain yield, 100 grain weight and number of pods per plant. They also found positive and significant association of grain yield with number of seeds per pod and number of pods per plant and negative association of 100 grain weight with primary branches per plant and pods per plant. [3] in their studies of 25 exotic lentil genotypes reported highly significant variation in morphological traits like, flowering, maturity, pods per plant, seeds per pod, biological yield and seed yield. They suggested early maturing, shorter varieties with more number of branches and seeds per pod be considered an index for selection in lentil germplasm. [4] Assessed fourteen lentil genotypes under different environments and observed considerable variations for all the traits including days to 50% flowering, days to maturity, plant height, number of branches, pods per plant, seeds per plant, 1000 seed weight, biological yield and grain yield. [5-6] released two high yielding varieties of lentil and showed highly significant variation in most of the morphological traits including days to 50% flowering, number of branches, number of pods, plant height, days to maturity, 1000 seed weight, grain yield and harvest index. [7] studied the genetic parameters, characters association and path coefficient analysis between yield and yield contributing characters in 25 lentil genotypes. The genotypes exhibited a wide range of variability for all the studied traits. High heritability accompanied by moderate to high GCV and genetic gain were observed for number of pods per plant, number of branches per plant, 100 seed weight, seed yield per plant and harvest index. Based on quantitative traits, [8] assessed the genetic diversity in lentil landraces collected from Jordan and reported significant differences in seed yield, biological yield, pods per plant, seeds per pod, seed weight, plant height and primary branches. [9] assessed correlation, path co-efficient and genetic diversity in 30 accessions of lentil and reported low differences between phenotypic coefficient of variability and genotypic co-efficient of variability in most of the morphological traits. High h2 was noted for number of pods, days to flowering, biological yield, 1000 seed weight and seed yield. High h2 coupled with high genetic advance for number of pods, days to flowering, biological yield, 1000 seed weight and seed yield signifies the influence of additive gene effect for these traits. The biological yield, number of pods and seeds per plant, harvest index are the most efficient yield components for improving grain yield in lentil. Seed yield was positively correlated with biological yield, pods, seeds per plant and harvest index, [10]. [11] showed highly significant variance for genotypes, seasons and locations for days to 50% flowering, maturity, pod number, 1000 grain weight and grain yield in lentil. They also noted highly significant positive correlations between seed yield with number of pods and number of seeds per plant while significantly negative correlations between seed yield and days to 50% flowering and days to maturity. They found number of seeds per plant and number of pods as principal yield components in lentil. [12] studied the morphological characters in lentil genotypes. Their study based on quantitative traits for assessment of genetic diversity in 110 lentil germplasm, including landraces, popular varieties, phenologically adapted exotic lines and advanced selected lines of diverse origin. High heritability estimates along with high genetic advance are more helpful in predicting gain under selection than heritability alone (13). The varieties different between them to responses to boron concentration and, may reduce the crop yield by boron nutritional of lentils plant. Variation for boron concentration in different crops had assessed at a specific growth stage rather than at different growth stages. This causes a difficulty in assessing the overall degree of boron of a crop, particularly because degree of boron varies with the developmental stage, [14-15-16-17-18].

MATERIALS AND METHODS

Two field experiment were carried out at agriculture research and production farm of Nobaria at Behara Government, that is followed to the National Research Centre during two successive winter seasons of 2013/2014 and 2014/2015. Amis of study is productivity and quality of some varieties of lentil (Giza 29, Giza 9, Giza 370, Giza 4 and Giza 51) under spray of boric acid concentration (00, 0.75 and 1.5 gm/l). The experiment was laid out in a randomized block design with three replications. The source of boron was borax (11per cent boron). Boron was applied as spray treatment along with the recommended dose of fertilizer nitrogen (20 kg per hectare), phosphorus (60 kg per hectare) and potash (40kg per hectare) as basal through urea, di-ammonium phosphate and nitrate of potash respectively. Lentil seeds were inoculated with Bradyrhizobium japonicum culture at 5g per kg seed after treating with bavistin at 2.5g per kg seed before sowing the plot area was 10.5m² (3 x 3.5m) and seeds of lentil cultivar was sowing on 12th November, 15th November 2013/2014 and 2014/2015 respectively in rows. All recommendation agriculture ministry operations were done as and when necessary. The crop was harvested on 10th and 18th May, 2014 and 2015 respectively.

Table (1): Mechanical and chemical analyses of experimental soil [average of the two seasons].

Item	Value		Element	Value	
Physical properties			Available macro element mg/100g		
Sand%	85.00		P	0.82	L
Silt%	10.00		K	9.94	L
Clay%	4.00		Mg	17.00	L
Texture	Sandy		Ca	94.21	L
			Na	52.17	H
Chemical properties			Available microelement ppm		
P^H	7.89	H	Fe	7.40	L
EcdS/m	1.60	H	Mn	6.50	L
CaCO3%	1.98	L	Zn	1.13	L
O.M%	0.56	VL	Cu	0.42	L

VL= very low, L=low, M = medium H= high, according to [19].

***Chemical analysis**:* Total Nitrogen content: Sample of 0.2 gm dry material were digested by sulphuric and perchloric acids using Micro-Kjeldahl method [20]. Distillation was carried out with 40% NaOH, and ammonia was received in 4% boric acid solution. Protein content was determined by the Kjeldahl method for the calculation of all proteins which equal nitrogen content multiplied by 6.25, [21].Potassium content: weight of 0.2 g dry matter from canola shoot was extracted for one hour in a boiling-tube of distilled water in a boiling water bath, the extract was filtered. Sodium and potassium content in the aqueous extracts were measured with Flame Photometer. Meanwhile, chloride was determined by titration by 0.001 N $AgNO_3$ and using potassium dichromate as indicator. Phosphorous content: Phosphorous was determined calorimetrically at wave length 725 nm using chlorostannous-reduced molybdo phosphoric blue color method, in hydrochloric described system as described by [21].

Statistical analysis:

The experiment was conducted as split plot design having varieties in main plot and intervals in sub plot. Data were subjected to statistical analysis of variance according to [22], and L.S.D value for comparison.

RESULTS AND DISCUSSION

Varieties

Data presented in table 1 showed that superiority variety of Giza 51 on all varieties including (Giza 29, Giza 9, Giza 370 and Giza 4) at control boron concentration at all growth and yield characters while, the great reduction in this parameters were observed with boron concentration (control) with Giza 9. The supplement in plant high, number of branches, numbers of pods/plant, seed yield/plant, seeds yield/ha, weight of 1000 seeds and biological yield due to variation between varieties. All parameters refer to variety Giza 51 that have high value compared with all varieties. The augment in plant high, number of branches, numbers of pods/plant, seed yield/plant, seeds yield/ha, weight of 1000 seeds and biological yield due to boron fertilization was as well reported by [23]. [24] also convincingly suggested that application of boron increased pods per plant in groundnut. [25] reported that flowering and fruit development were controlled by a shortage of boron.

Boron has a marked influence on yield attributing characters like number of branches per plant, pods per plant and 100 seed weight. The yield attributing characters were increased with the increase in boron levels up to 1.5 kg per hectare. It might be due to the role of boron in cell differentiation and development, translocation of photosynthates and growth regulators from source to sink.

This result shows that boron could stimulate yield by increasing pods on lateral branches, seed number, and overall seed yield of lentil. Maximum benefit was obtained by increasing the yield with the application of boron per hectare.

The effect of different levels of boron nutrition on seed and straw yield was found to be significant. The seed yield was significantly higher (1466 kg per hectare) when the crop received 1.5 kg boron per hectare and the lowest (1026 kg per hectare) from control. The lowest in control plot might be due to boron deficiency. Results are in accordance with that of [26], who documented that crop yields, in general, have been promoted by regular application of boron. [27] also reported that seed yield of cowpea increased significantly with the increase in boron application. Stover yields produced by the application of 1.5 kg per hectare and 2.0 kg per hectare were found to be at par but significantly higher over other levels. It might be due to increase in plant height and number of branches per plant as a result of cell wall strength, cell division and sugar transport which are plant functions related to boron. The similar trend was also observed on biological yield.

Boron regulates transport of sugars through membranes, cell division, cell development, and auxin metabolism. Without adequate levels of boron, plants may continue to grow and add new leaves but fail to produce fruits or seeds. A continuous supply of boron is important for adequate plant growth and optimum yields. The evidence generally shows that B is important in cell division and is apparently a necessary component of the cell wall.

B is required by plants to stabilize a positive electrostatic charge in the plasma membrane that is generated by the actions of phytochrome and gravity. There is a certain minimum requirement of B for a plant, below which a deficiency symptom will develop. As well, there is a certain maximum level of tolerance, above which toxicity symptoms appear.

Table1: Effect of boron on yield and its components of lentils plant.

Treatments		Plant height	number of branches/plant	Number of pods / plant	Seed yield / plant g	Seeds yield t/ha	1000 seeds /gm	Biological Yield t/ha
Giza- 29	Control	42.4	10	27.1	0.676	1.106	21.6	2.12
	0.75	42.6	14	27.6	0.981	1.226	23.4	2.44
	1.5	43.3	18	28.2	1.195	1.366	24.1	2.58
Giza-9	Control	41.4	9	27.2	1.419	1.826	21.3	2.04
	0.75	44.6	12	29.7	1.156	1.106	23.1	2.32
	1.5	45.5	15	30.2	0.914	1.236	23.7	2.45
Giza-51	Control	46.3	12	27.3	1.562	1.026	22.3	2.24
	0.75	47.1	15	30.3	0.992	1.356	23.9	2.57
	1.5	47.7	19	32.1	1.73	1.466	24.8	2.68
Giza370	Control	43.2	10	27.3	1.079	1.786	21.6	2.00
	0.75	43.8	13	28.4	1.379	1.136	23.7	2.35
	1.5	45.6	16	30.4	1.217	1.246	24.6	2.46
Giza-4	Control	45.4	11	27.0	1.045	1.166	22.1	2.18
	0.75	45.9	14	29.2	1.029	1.256	23.5	2.47
	1.5	46.1	18	31.1	1.546	1.346	24.4	2.56
LSD V		5.2	3.2	4.8	0.4	1.1	2.8	0.8
LSD T		2.9	2.1	2.5	0.1	0.4	1.3	0.3
LSD V x T		1.2	1.3	0.5	0.09	0.2	0.6	0.1

Effect of varieties

Results presented in Table (2) revealed that lentil cultivars were significantly differed in their grain macro and micronutrients contents. The most pronounced increases in protein, N, k, P, Mn, Cu, Fe and Zn content of grains were recorded by Giza 51cultivar, while the lowest values of grains content from all minerals that analysis obtained by Giza 9 cultivar in mean seasons. It is evident also from the results in the same table that varieties had significant effect on macro and micronutrients of grains.

Effect of Boron on Protein

The highest protein, N, k, P, Mn, Cu, Fe and Zn content was also found from 1.5 kg boron per hectare and the lowest from control as table 2. It is manifest from the results that protein, N, k, P, Mn, Cu, Fe and Zn content was influenced by boron fertilization. The increase in protein, N, k, P, Mn, Cu, Fe and Zn content might be due to the involvement of boron in the synthesis of protein. Similar findings were also reported by [28-29-30].

Applied broadcast or in bands foliar applications, besides resulting in higher B uptake, could be used to advantage if a farmer omitted the addition of B in the N-P-K bulk fertilizer or if B-deficiency is suspected. Foliar applications during early growth result in greater absorption of B than applications made at later growth stages.

There was a positive effect of B rates on B protein, N, k, P, Mn, Cu, Fe and Zn content in seeds plant; whereas Mn concentration decreased. [31] reported significant differences in B concentrations in leaf blades, petioles and fruits of cotton plant with 2.2 kg B ha-1 compared to untreated check. They further reported that among the four plant tissues (leaf blades, stems, petioles, and fruits), leaf blades had the highest and stems had the lowest B concentration with 2.2 kg B ha-1. [32] reported that B concentration for alfalfa was 78 and 122 mg kg-1 in lower leaves and 62 and 86 mg kg-1 in upper leaves; whereas 17 and 21 mg kg-1 in lower stems and 23 and 28 mg kg-1 in upper stems with control and 12.5 kg B ha-1 treatments, respectively. Further, they concluded that leaves contained more B than stems, while lower leaves maintained more B than that of upper ones.

Table 2: Effect of boron (g/l) on elements content in seeds of lentils plant.

Treatments		Protein %	Nitrogen g/kg	Potassium g/kg	Phosphor g/kg	Mn m/kg	Cu m/kg	Fe m/kg	Zn m/kg
Giza- 29	Control	23.95	3.833	4.9131	3.893	45.391	9.6339	46.289	42.095
	0.75	25.45	4.073	5.1431	4.273	46.491	10.353	48.659	45.305
	1.5	26.83	4.293	5.3231	4.513	48.181	10.623	50.199	47.875
Giza-9	Control	23.39	3.743	4.8531	3.823	45.291	9.5639	46.119	42.025
	0.75	24.76	3.963	5.0831	4.203	46.291	10.093	48.499	45.085
	1.5	26.08	4.173	5.2531	4.343	46.821	10.413	48.929	46.845
Giza-51	Control	22.95	3.673	4.7631	3.773	44.991	9.4939	46.059	41.775
	0.75	24.01	3.843	5.0431	4.133	46.091	9.9339	48.299	47.665
	1.5	26.70	4.273	5.4431	4.513	47.891	10.563	50.999	48.605
Giza370	Control	23.64	3.783	4.8931	3.873	45.291	9.6039	46.049	40.975
	0.75	25.26	4.043	5.1231	4.253	46.391	10.323	48.419	44.185
	1.5	28.08	4.493	5.4831	4.643	49.391	11.193	51.359	48.195
Giza-4	Control	23.08	3.693	4.8331	3.803	45.191	9.5339	45.889	40.905
	0.75	24.45	3.913	5.0631	4.183	46.191	10.063	48.259	43.965
	1.5	27.39	4.383	5.4131	4.573	48.591	10.763	50.889	47.595
LSD V		6.981	0.595	0.184	0.456	6.773	2.829	4.272	7.681
LSD D		6.121	0.905	0.074	0.556	2.623	2.939	7.372	9.081
LSD V x D		2.801	0.386	0.172	0.056	1.493	0.899	1.212	1.781

Under B deficient conditions, concentration of Cu decreased in tomato leaf [33]. [34] found positive correlation between B and Fe and Cu contents of sunflower. They suggested that B could indirectly affect catalase activity via Fe and Cu. However, [35] reported that concentration of Cu remained unaffected in blades of cotton at lower and higher levels of B.

Application of B at higher rates depressed the concentrations of Mn in most of crops [36]. [37] reported antagonistic relationship between B and Mn in rice. Data reported herein indicate an increase in Fe and Zn concentration accrued in leaves, stems, burs, seed and lint with increasing B rates. [38] reported that uptake of Fe was increased with B application in groundnut.

CONCLUSION

The present study revealed that Best varieties growing in the newly area cultivar Giza 29 because it gives higher productivity in the number of pods and weight of 1000 seeds and thus obtain the highest yield. Concentration of boron at 1.5 g/l increased the characteristics of the seed concentration of minerals and yield.

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