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IMPACT OF MOLYBDENUM AND BORON AS FOLIAR APPLICATION ON GROWTH, YIELD, SOME CHEMICAL COMPOSITION AND SEED QUALITY OF FABA BEAN (VICIA FABA L.)

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ABSTRACT: *Two fields experiments were conducted during two successive seasons in 2010/2011 and 2011/ 2012 at Kafr EL_Zayiat Center, Gharbia Governorate, to study the effect of foliar application of two micro-nutrients, molybdenum and boron on Faba bean variety Giza 2. Faba bean plants were sprayed two times with different levels of molybdenum (0.0, 10 and 20 mg/l), likewise different rates of boron (0.0, 100 and 200 mg/l) either singly or together. First spray was after 45 days from sowing and the second after 60 days from sowing. The obtained data showed the positive effect of high rates of such nutrients (20 and 200 mg/l), on fresh and dry weights of stems, leaves, roots and whole plants. Roots were the most organs affected by such nutrients after 90 days from sowing. Significant increases in faba bean yield and yield components was occurred. The percentage increases in seed yield were19.33 and 19.82%, respectively for the first season, beside, 20.26 and 20.75%, at a respective order for the second season. Corresponding significant increases in macronutrients (nitrogen, phosphorus and potassium), molybdenum and boron concentrations, also its uptake in seeds, and both of crude protein and protein yield and total carbohydrates in such organ for two seasons were observed. Such increases were a companied by corresponding significant decreases for such nutrients in straw for two growing seasons. In general significant increases in germination percent, shoots length, radical length, seedling fresh weights, seedling dry weights and EC for two seasons for Giza 2 variety were indicated. The obtained data declared that the superior interaction effect was recorded for plants received a combined treatment of 20 mg/l Mo+ 200 mg/l B for all studied characters for Giza 2 cultivar.*

Key words: *Faba bean, molybdenum (Mo) and boron (B) concentrations and uptake.*

INTRODUCTION

Broad bean (Vicia faba L.) is the world fourth most important crop after wheat, rice and maize. Broad bean is grown primarily for seeds and secondly for fodder and raw material for industrial processes. The seeds are used for both human and animal consumption. The vegetative parts of the plant are made into compost or a good source of organic manure. Broad bean is one of the most important foods in Egypt.

Molybdenum is an important element for growing faba bean as leguminous crop; it is important and suitable for using molybdenum, which plays an important role in nitrogen assimilation. It is a part of nitrate reductase, which is involved in reduction of NO_3 to NH_4 after its absorption by plants (EL-Mansi *et al.,* 2000). Also, it is a structural component of nitrogenase, which involved in nitrogen fixation in legumes (Bennet, 1994 and Vieira *et al*., 1998). Shehata (2001) reported that, Mo application at rate of 1 and 2 ppm increased significantly straw and roots dry weights after 45 days from sowing, yield and yield components, nitrogen, phosphorus, potassium and molybdenum concentrations and uptake in straw, roots and seeds as well as protein content in pea plants.

Similarly, boron plays a key role in pollination and seed set processes; so that its deficiency can cause decrease in seed formation and subsequent yield reduction (Ziaeyan and Rajaie, 2009). Vitosh *et al*. (1997) expressed that B involved in

carbohydrates metabolism and it is essentially for protein synthesis, pollen germination, seed and cell wall formation. Rehem *et al*. (1998) stated that B plays a key role in water and nutrients transportation from root to shoot. They believe those boron shortage barren stalks and small, twisted ears. Shaaban (2010) observed that boron concentration ranged in soil between 5-100 mg B kg^{-1}, while plant tissues contain 10-100 mg B kg^{-1}. Boron is taken up by the plant roots in the form of boric acid or borate. He added that the boron functions in the plant are its incorporation in: (1) Cell wall synthesis and structure, (2) Cell membrane, (3) Metabolism of nucleic acids and protein synthesis, (4) Carbohydrate metabolism and transport, (5) Metabolism of plant growth regulators and (6) Phenol metabolism. Shabaan *et al*. (2011) reported that boron foliar nutrition in the form of boric acid (17% B) after 45 and 60 days from sowing has significantly increased plant height, leaf area, total dry weights, also N, P, K, Fe, Zn, Mn, B, Cu contents of faba bean leaves after 75 days from sowing, also significant increases were found in number of pods, number of seeds per pod, seed yield, seed protein and carbohydrates content.

Padma *et al*. (1989) notice that a combined application of molybdenum at rate of 20 mg/l and boron at rate of 200mg/l over 20 or 40 days after bean sowing increases the plant height, number of leaves, flowers and pods, root length and assimilation area, which increases the green pods yield on average up to 4.7 t/ ha compared to 3.1t/ h obtained for control objects.

The evaluation of vigor tests for predicting seed planting value is important in providing better results for ranking the quality and for indicating planting value of seed lots than the standard germination test. Many vigor test methods have been proposed by different organization viz Anon (1993) and Anon (2002). Seeds quality has direct influences on success of crop and significantly contribution to productively levels (Bewley and Black, 1994).

So, the aim of this work is to study the effect of using molybdenum and boron by spraying method either separately or in combination on fresh and dry weights of faba bean organs i.e. stems, leaves, roots and whole plants, after 90 days from sowing, yield and yield attributes, macronutrients (nitrogen, phosphorus and potassium), molybdenum and boron concentrations and uptake, beside crude protein, protein yield and total carbohydrates in seeds and straw as well as germination percent, shoot length, radical length, seedling fresh and dry weights and EC of faba bean.

MATERIALS AND METHODS

Two fields experiments were conducted in dual successive seasons 2010/2011 and 2011/2012 at Kafr EL-Zayiat Center, Gharbia Governorate to study the effect of spraying faba bean plants variety Giza 2 with Mo and B at different levels (0.0, 10 and 20 mg/l Mo and 100 and 200 mg/l B) either singly or together on growth characters, yield and yield components, also chemical composition and seed quality for faba bean. The experiments soil was clayey in texture. Representive surface soil sample (1-30cm) was taken before performance of the experiments, where the mechanical and chemical characteristics were determined using the standard methods according to Black (1965) and Page *et al*., (1982). The obtained data were reported in Table (1).

The faba bean seeds were cultivated at 8 and 13 October in the first and second seasons, respectively. Two seeds were in hill and 20 cm spacing, after emergency plants were thinned to one plant per hill using the experimental design of randomized complete block with three replicates, where the area of each plot was (3x3.5) = 10.5m^2.

The studied treatments were as follow.

Control, 10 mg/l Mo, 20 mg/l Mo, control + 100mg/l B, 10mg/l Mo+ 100mg/l B, 20 mg/l Mo+ 100mg/l B, control+ 200mg/l B, 10mg/l Mo + 200 mg/l B and 20 mg/l Mo+ 200 mg/l..

Table (1): Mechanical and chemical properties of the studded soil

Soil properties	First season (2010/ 2011)	Second season (2011/2011)
Mechanical analysis		
Sand %	12.59	12.60
Silt %	34.11	34.04
Clay %	53.30	53.36
Textural class	Clayey	Clayey
Chemical analysis		
CaCO3	2.35	2.41
EC(dSm^{-1}) (1:5 soil : water extract)	0.41	0.46
pH (1:2.5 soil : water suspension)	7.49	7.51
Available N (mg/kg)	41.17	39.84
Available P (mg/kg)	12.59	12.64
Available K (mg/kg)	385.10	386.22
Available Zn (mg/kg)	0.80	0.81
Available Mn (mg/kg)	3.99	4.12
Available Fe (mg/kg)	4.52	4.65
Available Mo (mg/kg)	0.08	0.09
Available B (mg/kg)	0.43	0.51

All plots received phosphorus fertilizer as calcium superphosphate (15%) at a rate of 15 kg P_2O_5 /fed. before sowing. Potassium fertilizer as potassium sulphate (48% K_2O) was applied at rate of 24 kg K_2O /fed. as a recommended dose after 35 days from sowing. Basic application of nitrogen fertilizer at rate of 20 kg/fed. was added before the first irrigation (after thinning) directly in the form of ammonium nitrate (33.5% N) as an activating dose. Molybdenum as ammonium molybdate and boron as boric acid (17% B) were applied as foliar fertilization at two times. The first spray was at 45 days from sowing and the second spray was at 60 days from cultivation at a rate of 400 l /fed. The other different field practices were followed in the usual manner for faba bean cultivation. Plants were grown till maturity and sampled twice; the area of each sample was $1m^2$. The first sample was taken after 90 days from sowing; the second sample was at harvest. At the first sample, fresh and dry weights of stems, leaves, roots and whole plants (g/plant) were recorded. The harvest date was 5 and 7 May for the first and second seasons, respectively. At harvest, agronomic traits were determined i.e. plant heights (cm), number of branches/ plant, number of pods/plant, weight of pods (g/plant), weights of seeds (g/plant), 100-seed weights (g), seed yield (ardab/ fed.) and straw yield (ton/fed.).

At Seed Technology Research Department, Field Crops Research, Institute, Agricultural Research Center during 2010/2011 and 2011/2012, laboratory experiments were carried out to assess seed quality from the field experiments. Germination percentage was expressed by the percentage of normal seedlings at the end of testing period according to the International Seed Testing Association I.S.T.A (1985). Three replication of seeds were planted in boxes of (40x20x20 cm) dimension containing sterilized sandy soil. The boxes were watered and incubated at 20°c in germination chamber for (10 days). Normal seedlings were count and expressed as the germination percentage at the final count. Ten normal seedlings from each replicate were taken to measure shoot and radical length (cm). the seedling dry weight according Kirshnasamy and Seshu (1990).

For chemical determinations, plants were fine powdered and wet digested according to Chapman and Pratt (1961). Nitrogen percentage was determined in seeds and straw by using microkjeldhal methods and crude protein percentage was estimated in such organ by multiplying N% by 6.25 as described by A.O.A.C. (1990). Phosphorus, potassium percent and total carbohydrates in seeds and straw were determined by using the procedure described by A.O.A.C. (1990). Molybdenum concentration in prior

organs was estimated calorimetrically as described by Reisenauer (1965). Boron in seeds was determined according to John *et al*. (1975). Nutrients uptake were calculated from multiplying nutrients percent by dry materiel weights of seeds and straw. Protein yield was determined by multiplying crude protein by seeds and straw dry matter weights. Least significant differences test was used for comparing treatments means as described by Barabara and Brain (1994).
Note: ardab = 155 kg.

RESULTS AND DISCUSSIONS

Fresh and dry weights of stems, leaves, roots and whole plants.

Data presented in Table (2) indicated that, control treatment (no molybdenum or boron fertilizer) gave the lowest fresh and dry weights (g/plant) of stems, leaves, roots and whole plants for both seasons. Increasing molybdenum foliar nutrition from zero to 20 mg/l passing through 10 mg/l recorded a gradual favourable and even high significant effect on those parameters, since the increases in weight of stems either fresh or dry weights reached 212.72 and 45.08 (g), respectively for the first season, also data were 215.78 and 46.71 (g), at respective order for the second season. The positive effect of this nutrient might be due to that molybdenum application could increase the number of chloroplasts, enhance the stability of lipid bilayer of chloroplast, increase the density of chloroplast lamella and grana, enhance the stability of mesophyll cell wall and cell membrane and consequently enhance the fresh and dry weights (Wang *et al*., 2009). These results are in harmony with those obtained by Shehata (2001).

Results at the same Table (2) indicate that, foliar fertilizer with all rates of boron especially with 200 mg/l after 45 and 60 days from sowing resulted in further significant increases in leaves fresh weights by about 130.80 and 131.82 (g) for the first and second seasons, respectively, beside significant increases in leaves dry weights reached 27.39 for the first season and 28.32 (g) for the second season. Similar trends were found for the other growth characters for both growing seasons. In this connection, Dell and Huang (1997) concluded that boron deficiency inhibit root elongation through limiting of cell enlargement and cell division in the growing zone of root tips and that in severe boron deficiency cases, root growth is ceases leading to the death of root tips. They added that the early inhibition in root growth by boron deficiency cause the higher shoot/ root ratio. Carpena *et al*. (2000) found that reduction of both root and shoot dry weight of pea plant as results of boron deficiency. Jiao *et al*. (2005), found that the failure of deficient leaves to resume elongation, reduction in leaf expansion and the formation of intercellular airspaces as results of boron deficiency.

Pooled data in Table (2) showed that, more promotive effect on growth parameters were obtained when molybdenum together with boron at all rates as comparing with that of control for two growing seasons. The highest significant increases was induced for the combined treatment of 20 mg/l Mo+ 200 mg/l B, since the increases in fresh and dry weights of root amounted to 43.13 and 12.84 (g), in the order state for the first season. In case of second season, data were 45.52 and 13.99 (g), respectively. Corresponding highest significant increases in whole plant fresh and dry weights by about 471.15 and 112.78 (g), at a respective order for the first season as well as 476.18 and 117.15 (g), respectively for the second season.

Results also indicted that individual or combined treatments of molybdenum and boron at all levels showed more effect on fresh and dry weights of roots more than those belonged to stems and leaves throughout the two growing seasons. The obtained finding suggest that such combination treatments can achieve the balance between molybdenum and boron nutrients inside faba bean plants tissues that induced an augmentation in the studied growth parameters affected by such treatments. In this respect, Shaaban *et al*. (2004) reported that special nutrient balance between boron and other nutrients led to increase the shoot tissues.

Table (2): Effect of molybdenum and boron either individually or together on fresh nd dry weights of stems, leaves, roots and whole plant of faba bean after 90 days from sowing for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011							
B (mg/l)	Mo (mg/l)	Fresh weights (g/plant)				Dry weights (g/plant)			
		Stems	Leaves	Roots	Whole plant	Stems	Leaves	Roots	Whole plant
0.0	Control	190.87	116.90	26.28	334.05	40.20	21.69	5.43	67.32
	10	206.72	124.94	30.51	362.17	43.56	23.67	7.66	74.89
	20	212.72	129.24	32.14	374.10	45.08	24.61	8.16	77.85
100	Control	210.75	127.31	33.48	371.53	44.87	25.05	8.22	78.14
	10	246.03	147.82	39.51	433.36	52.88	30.51	10.22	93.61
	20	251.15	152.99	40.94	445.08	55.46	34.18	10.71	100.35
200	Control	218.70	130.80	36.40	385.90	48.01	27.39	9.14	84.54
	10	256.81	156.38	42.43	455.62	57.12	36.14	11.24	104.50
	20	264.50	163.52	43.13	471.15	60,69	39.25	12.84	112.78
L.S.D.	5%	13.22	7.81	3.66	17.48	2.81	1.25	1.32	5.02
	1%	19.52	11.53	5.40	25.81	4.15	1.85	1.95	7.41
C.V.		12.61	11.44	10.22	10.41	9.44	9.61	10.12	10.71
Treatments		2011-2012							
B (mg/l)	Mo (mg/l)	Fresh weights (g/plant)				Dry weights (g/plant)			
		Stems	Leaves	Roots	Whole plant	Stems	Leaves	Roots	Whole plant
0.0	Control	191.15	117.10	27.61	335.86	41.21	22.20	5.91	69.32
	10	207.3	125.29	32.61	365.20	44.92	24.41	8.42	77.75
	20	215.78	130.37	33.99	380.14	46.71	25.38	8.94	81.03
100	Control	213.33	138.04	36.58	387.95	45.99	25.81	9.08	80.88
	10	247.40	149.49	41.82	438.71	54.64	31.43	11.20	97.27
	20	252.80	153.89	43.14	449.83	57.10	35.18	11.75	104.03
200	Control	220.30	131.82	38.56	390.68	49.95	28.32	10.10	88.37
	10	258.24	157.10	44.98	460.32	59.20	37.28	12.24	108.72
	20	266.14	164.52	45.52	476.18	62.73	40.43	13.99	117.15
L.S.D. *	5%	14.91	8.10	4.12	18.64	3.21	1.43	1.63	5.63
	1%	22.01	11.96	6.08	27.52	4.74	2.11	2.41	8.31
C.V. **		12.71	11.61	11.41	11.51	10.22	11.44	11.31	11.71

***: Treatments. **: Coefficient of variations.**

Yield and yield components.

Comparing the efficiency of molybdenum when applied at different rates, using the foliar spray method after 45 and 60 days from sowing, it could be noted that those rates produced significant increases in yield of faba bean and its components as compared with the control treatment throughout the two growing seasons, with some exception. The high significant increases were obtained by using high dose 20mg/l molybdenum, since the increases in plant heights (cm), number of branches/ plant and number of pods/plant amounted to 116.55, 4 and 17, respectively for the first season, likewise 120.78, 5 and 19, at a respective order for the second season. Vieira *et al*. (1998) pointed that foliar

fertilization with Mo rates from 14 to 100 mg/l, increased of the seed yield, dry matter, nitrate reductase, nitrogenase activities and the number of root nodule EL-Saady *et al*. (2007) found that Mo has positive effect on broad bean dry matter yield of straw and seeds which may be due to increases in plant growth, tillering and yield components. These results are in agreement with those obtained by Rizk (2003).

Data in Table (3) also indicate that exogenous foliar application of boron at 200 mg/l significantly increased those parameters comparing with those obtained with the faba bean not sprayed with boron (control) for two growing seasons, since the increases in weight of pods/ plant (g), weights of seeds /plant (g) and 100-seeds weights (g) reached 91.50, 71.93 and 62.31, respectively for the first season as well as 96.95, 80.23 and 62.62, at respective order for the second season. Many investigators reported the main role and the main effects accompanied by B in grown plant media. Boron is essential for flower iniation and seed number by changing in phytohormones balances, by the regulation of sink-source relationship that is necessary to ensure proper completion of the reproductive phase even in condition of limited supply of mineral nutrients (Simojoki, 1972; Vaughan, 1977; Garg *et al*., 1979 and Marschner, 1986). Similar results were obtained by Ahmed *et al*. (2009), Mahler and Shafii (2009) and Kekec *et al*. (2010).

Table (3): Effect of molybdenum and boron either individually or together on yield and yield components of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011							
B (mg/l)	Mo (mg/l)	Plant height (cm)	No of branches /plant	No of pods /plant	Weights of pods /plant (g)	Weights of seeds /plant (g)	100-seeds Weights (g)	Seeds yield (ardab/fed.)	Straw yield (ton/fed.)
0.0	Control	107.51	3	12	55.63	44.74	56.71	10.14	1.87
	10	112.05	4	14	66.33	52.56	59.30	11.04	2.04
	20	116.55	4	17	81.45	62.88	61.18	12.10	2.21
100	Control	114.78	4	15	70.15	56.70	59.98	11.49	2.11
	10	123.18	5	20	96.88	76.36	62.48	12.62	2.37
	20	125.02	6	21	102.87	80.98	63.70	12.87	2.42
200	Control	118.77	5	19	91.50	71.93	62.31	12.15	2.25
	10	128.63	6	23	116.76	90.48	64.34	13.01	2.44
	20	131.31	7	24	123.55	92.76	65.52	13.34	2.49
L.S.D.	5%	4.13	0.55	1.13	6.74	5.28	8.01	0.80	0.16
	1%	6.10	0.81	1.67	9.95	7.80	11.82	1.18	0.23
C.V.		11.22	10.41	10.61	11.33	10.66	10.13	10.21	9.81
Treatments		2011-2012							
B (mg/l)	Mo (mg/l)	Plant heights (cm)	No of branches /plant	No of pods /plant	Weights of pods /plant (g)	Weights of seeds /plant (g)	100-seeds Weights (g)	Seed yield (ardab/fed.)	Straw yield (ton/fed.)
0.0	Control	108.22	3	13	61.31	49.80	56.81	10.17	1.90
	10	113.91	4	16	74.31	58.80	59.71	11.16	2.08
	20	120.78	5	19	87.10	66.51	61.35	12.23	2.23
100	Control	117.95	4	17	81.45	62.70	60.34	11.50	2.16
	10	125.12	6	21	102.99	81.10	62.99	12.84	2.42
	20	127.10	6	22	107.56	84.58	64.01	12.99	2.47
200	Control	122.85	5	20	96.95	77.12	62.62	12.28	2.30
	10	130.96	7	24	125.71	93.12	64.90	13.24	2.48
	20	133.16	7	25	129.80	95.43	65.85	13.66	2.54
L.S.D. *	5%	4.91	0.61	1.71	7.60	5.86	6.69	0.89	0.18
	1%	9.25	0.90	2.52	11.22	8.65	9.88	1.31	0.27
C.V. **		11.41	12.10	12.66	12.71	11.71	11.13	12.31	11.71

***: Treatments. **: Coefficient of variations.**

On using the mixture of Mo and B, similar trends existed for plants fresh and dry weights after 90 days from sowing (Table2), which can be used in predicating seed yield at harvest as correlation coefficient between them. Further significant increases in seeds and straw yield (Table3) could be noted with all combined treatments applications. Foliar nutrition mixture 20 mg/l Mo+ 200 mg/l B gave the highest significant increases in seed (ardab/fed.) and straw yield (ton/fed.) by 13.34 and 2.49, in the order state for the first season. Also, data were 13.66 and 2.54, respectively for the second season. The positive action of this treatment may be due to that applying boron improved the accumulation of seed dry matter in early stages of seed development and substance transport from pod wall to seed in later stages which result in high seed yield (Yang *et al*., 2009). These results are in full agreement with Ziolek (1983), he reported that after application of foliar nutrition with boron, manganese and molybdenum, the number of seeds from one plant increased by 12.3% on average and this was the most important components of the yield of faba bean. Ewa *et al*. (2004) found that a combined application of boron at rate of 0.3% and molybdenum at rate of 0.02% coincided with the highest bean plants and the number of pods with seeds and of seeds per plant compared to the control.

Macronutrients concentration.

Data in Table (4) clearly showed gradual significant increases in nitrogen concentration in seeds as the applied molybdenum levels increases as comparing with that of control. This for the two growing seasons. Its increases due to 20 mg/l molybdenum induced 4.20 and 4.40% for the first and second seasons, respectively. The same trends were noticed for phosphorus and potassium concentrations in such organ. According to Mender and Hansch (2002) molybdenum is essential in normal assimilation of N by plants. It is important to nitrate reductase enzymes which catalyses the key step in nitroganic nitrogen assimilation. In addition, many investigators reported that molybdenum enhance nitrogenase enzyme in roots nodule which fixes N_2 to NH_2 to be assimilated by the plant and hence increase vegetative growth and consequently increase P, K and other nutrients uptake (Khalil *et al*., 1990 and Wang *et al*., 2009). These results support those reported by EL-Mansi *et al*. (2000) and Mahdi and Omran (2005).

Also, Table (4) declared that plants sprayed with boron at all levels after 45 and 60 days from sowing increases macronutrient concentrations in faba bean seeds as comparing with the control treatment for both seasons. The highest rate (200 mg/l) was the most effective one in this respect, since the increases in phosphorus concentrations reached 0.490 and 0.500% for the first and second seasons, respectively. In this connection Cakmak *et al* (1995) suggested that the primary effect of boron deficiency would be in increase of membrane permeability that cause nutrient leakage from the cell and thus lowering their concentrations in the plant organs. Similar results were obtained by Marschner (1995), Shaaban *et al*. (2006) and Thomas *et al*. (2007).

Moreover, high significant increases in nutrient concentrations in such organ were recorded by combination between molybdenum and boron at all rates for two growing seasons. It is worthy to state that the combined treatment of 20 mg/l Mo+ 200 mg/l B achieved the maximum values, in nitrogen and potassium concentrations, it were 4.50 and 0.97% ,respectively for the first season, wherever 4,67 and 0.99%, at a respective order for the second season The superiority effect of molybdenum and boron together may be due to the suitable balance between those nutrients required to the best yield and the highest values of nutrients concentrations as found by Ziolek (1983).

Data in Table (4) also indicated that addition of molybdenum and boron either separately or in combination at all rates significantly decreases macronutrient concentrations in straw as comparing with that of control for two seasons. Such trend might emphasize the increase in seed yield occurred under the above mentioned treatments (Table 3).

Table (4): Effect of molybdenum and boron either individually or together on macronutrients concentrations in seeds and straw of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011					
B (mg/l)	Mo (mg/l)	Seeds			Straw		
		N%	P%	K%	N%	P%	K%
0.0	Control	3.71	0.43	0.75	0.93	0.081	1.33
	10	4.02	0.455	0.80	0.93	0.081	1.32
	20	4.20	0.488	0.85	0.92	0.080	1.32
100	Control	4.17	0.477	0.83	0.92	0.081	1.31
	10	4.41	0.510	0.90	0.90	0.079	1.29
	20	4.47	0.533	0.91	0.91	0.079	1.29
200	Control	4.29	0.490	0.88	0.91	0.080	1.30
	10	4.48	0.550	0.93	0.90	0.080	1.28
	20	4.50	0.515	0.97	0.89	0.078	1.29
L.S.D. *	5%	0.20	0.02	0.03	0.07	0.08	0.09
	1%	0.30	0.03	0.05	0.11	0.12	0.13
C.V. **		8.16	8.71	9.14	8.66	8.14	10.11
Treatments		2011-2012					
B (mg/l)	Mo (mg/L)	Seeds			Straw		
		N%	P%	K%	N%	P%	K%
0.0	Control	3.85	0.439	0.76	0.94	0.083	1.35
	10	4.19	0.469	0.81	0.93	0.082	1.32
	20	4.40	0.491	0.87	0.93	0.083	1.33
100	Control	4.35	0.487	0.84	0.92	0.080	1.32
	10	4.57	0.522	0.91	0.91	0.080	1.29
	20	4.60	0.544	0.93	0.91	0.080	1.30
200	Control	4.46	0.500	0.89	0.92	0.081	1.31
	10	4.65	0.562	0.95	0.91	0.081	1.29
	20	4.67	0.590	0.99	0.89	0.080	1.29
L.S.D. *	5%	0.22	0.03	0.04	0.08	0.10	0.11
	1%	0.32	0.04	0.06	0.12	0.15	0.28
C.V. **		9.14	9.55	10.23	9.54	8.71	10.71

*: Treatments. **: Coefficient of variations.

Macronutrients uptake.

Results in Table (5) showed that foliar nutrition with molybdenum at the applied rate of 20 mg/ l significantly increased macronutrients uptake in seeds as compared with the control treatment throughout the two growing seasons, where the increased in nitrogen uptake amounted to 78.77 and 83.41 kg/fed. for the first and second seasons, respectively. However, in general such nutrients showed no significant improvement for macronutrients uptake in straw with some exceptions. These results are in full agreement with EL-Saady *et al*. (2007).

The same data noted that more significant increases in NPK uptake in seeds were obtained by spraying boron at all levels with the superiority of 200 mg/l. This was observed for two seasons, since the increases of phosphorus uptake rose to 9.23 and 9.52 kg/fed. for the first and second seasons, respectively. Similar results were obtained by Fageria *et al*. (2007). Such increases were accompanied by corresponding nonsignificant increases in phosphorus uptake in straw for both seasons.

Table (5): Effect of molybdenum and boron either individually or together on macronutrients uptake in seeds and straw of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011					
B (mg/l)	Mo (mg/l)	Seeds			Straw		
		N (kg/fed.)	P (kg/fed.)	K (kg/fed.)	N (kg/fed.)	P (kg/fed.)	K (kg/fed.)
0.0	Control	58.31	6.76	11.79	17.39	1.51	24.87
	10	68.79	7.79	13.69	18.97	1.65	26.93
	20	78.77	9.15	15.94	20.33	1.77	29.17
100	Control	74.27	8.50	14.78	19.41	1.71	27.64
	10	86.26	9.98	17.60	21.33	1.87	30.57
	20	89.17	10.63	18.15	22.02	1.91	31.22
200	Control	80.79	9.23	16.57	20.48	1.80	29.25
	10	90.34	11.10	18.75	21.96	1.95	31.23
	20	93.05	11.89	20.06	22.16	1.94	32.12
L.S.D. *	5%	5.64	0.64	0.89	1.80	0.61	3.75
	1%	8.33	0.95	1.32	2.66	0.90	5.51
C.V. **		8.13	9.65	9.10	8.21	7.71	7.81
Treatments		2011-2012					
B (mg/l)	Mo (mg/l)	Seeds			Straw		
		N (kg/fed.)	P (kg/fed.)	K (kg/fed.)	N (kg/fed.)	P (kg/fed.)	K (kg/fed.)
0.0	Control	60.69	6.92	11.98	17.86	1.58	25.65
	10	72.48	8.11	14.01	19.34	1.71	27.46
	20	83.41	9.31	16.49	20.74	1.85	29.66
100	Control	77.54	8.68	14.97	19.87	1.73	28.51
	10	90.95	10.39	18.11	22.02	1.94	31.22
	20	92.62	10.95	18.73	22.48	1.98	32.11
200	Control	84.89	9.52	16.94	21.16	1.86	30.13
	10	95.43	11.53	19.50	22.57	2.01	31.99
	20	98.88	12.49	20.96	22.61	2.03	32.77
L.S.D. *	5%	5.97	0.66	1.06	1.97	0.67	3.92
	1%	8.81	0.97	1.57	2.91	0.99	5.79
C.V. **		9.33	9.75	9.72	8.63	8.16	8.33

*: Treatments. **: Coefficient of variation

Moreover, more positive effect on macronutrients uptake were observed by combined-use of molybdenum and boron at all levels of applications, responding significant macronutrients uptake in seeds and straw as comparing with the control treatment for both seasons. Foliar application of 20mg/l Mo+ 200 mg/l B gave the highest significant increases in potassium uptake reached 20.06 and 32.12 kg/fed. in the order state for the first as well as 20.96 and 32.77 kg/fed. for the second seasons.

Molybdenum and boron concentrations.

Results in Table (6) showed that molybdenum concentrations in faba bean seeds were significantly increased by addition of molybdenum at all rates. The high rate (20 mg/l) was the most effective in increasing Mo concentrations by 0.93 and 0.94 mg/kg for the first and second seasons, respectively. This investigation shows that it is possible to produce enriched seeds by foliar application of high Mo rates without seed yield reduction, that seeds may induce higher yield potential. Similar results were obtained by Shehata (2001) and Vieira *et al*. (2005).

Table (6): Effect of molybdenum and boron either individually or together on molybdenum and boron concentrations in seeds and straw of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011				2011-2012			
B (mg/l)	Mo (mg/l)	Seeds		Straw		Seeds		Straw	
		Mo (mg/kg)	B (mg/kg)	Mo (mg/kg)	B (mg/kg)	Mo (mg/kg)	B (mg/kg)	Mo (mg/kg)	B (mg/kg)
0.0	Control	0.78	72.16	0.26	21.56	0.79	72.74	0.27	22.31
	10	0.91	80.33	0.25	21.12	0.92	80.51	0.26	22.11
	20	0.93	83.30	0.25	20.95	0.94	84.14	0.25	22.12
100	Control	0.84	88.64	0.25	20.81	0.85	88.63	0.26	21.10
	10	0.95	89.44	0.22	18.98	0.96	90.27	0.23	19.01
	20	0.97	92.81	0.21	18.90	0.98	93.71	0.23	19.50
200	Control	0.88	90.73	0.23	20.11	0.89	92.06	0.24	20.86
	10	0.96	94.42	0.23	19.92	0.97	96.43	0.23	19.95
	20	0.98	96.89	0.22	18.91	0.99	97.97	0.23	19.81
L.S.D.	5%	0.09	3.12	0.61	2.61	0.10	3.71	0.73	2.86
	1%	0.13	4.61	0.90	3.85	0.15	5.48	1.08	4.22
C.V.		8.41	8.71	9.42	9.14	9.13	9.65	8.66	9.45

*: Treatments. **: Coefficient of variations.

Table (6) illustrate that the high level of boron (200 mg/l) induced a high significant increases in boron concentrations in seeds, by about 90.73 and 92.06 mg/kg for the first and second seasons, respectively followed by low level (100 mg/kg B). Oliveria *et al*. (2006) reported that B-deficient plant induces decrease in the number of vascular bundles and the xylem was disorganized. Phloem elements in the peduncle vascular cylinder did not show clear differentiation. The few xylem elements that were formed were also disorganized. Modification caused B-deficiency may have impaired B and photosynthates translocation into new plant growth. Similar results were confirmed by Allam *et al*. (2004).

Combination treatments as foliar spray occurred a pronouncing increases in seeds concentrations for two seasons. The smaller effect was recorded by applying 10 mg/l Mo+ 100 mg/l B, whereas the highest values were induce under 20 mg/l Mo+ 200 mg/l B in combination, where increases in molybdenum and boron concentrations rose to 0.98 and 96.89 mg/kg in the order state for the first season, beside 0.99 and 97.97 mg/kg at a respective order for the second season. Such increases were accompanied by corresponding decreases in straw concentrations for both seasons that may be as an indicator for more molybdenum and boron translocation to seeds. This means increases in seed yield occurred under the above mentioned treatments (Table 3). The above mentioned results may refer to that, foliar application of molybdenum and boron can greatly improve nutritional status of faba bean plant suffering from deficiency.

Molybdenum and boron uptake.

Data presented in Table (7) cleared that treatment of 20 mg/l Mo significantly affected molybdenum uptake in seeds of faba bean more than treatment of 10 mg/l Mo as comparing with the control treatment throughout the two growing seasons. Since the increases reached 1.74 and 1.78 g/fed. for the first and second seasons, at a respective order. Such increase in uptake of molybdenum was due in part to increase dry matter yield as well as molybdenum concentrations in plant tissues (Table 3). Various hypotheses have been put forward to explain that (i) increased translocation of Mo from the root cells into the upper parts ensuring its effective utilization on plant (Stout *et al*., 1951), (ii) stimulation of Mo-uptake because of the formation of complex phosphomolybdate anion in the soil which can be observed more readily for the plant

(Barshad, 1951) and (iii) precipitation of iron (Fe), aluminum (AL) and calcium (Ca) components which release Mo to bind with organic matter or to particle surfaces, that indicate to Mo solubility (Karimian and Cox, 1978).. Similar results were previously mentioned by Rizk (2003) and Hristozkova *et al*. (2007).

Table (7) indicated that a gradual significant increases in boron uptake in seeds as the applied boron levels increased as comparing with the control treatment for both seasons, where the increases due to 200 mg/l boron amounted to 170.87 and 175.23 g/fed. for the first season and second season, respectively. The same trend was observed by Allam *et al* (2004) and Liao *et al*. (2011).

Moreover, nutrients uptake were more affected by the combinations treatments of molybdenum and boron at all rates. The combined used of 20 mg/l Mo+ 200 mg/l B produced the highest significant increases in molybdenum nd boron uptake in seeds by about 2.03 and 200.34, g/fed. at a respective order for the first season, beside 2.10 and 207.43 g/fed., respectively for the second season. On the other hand, foliar addition of molybdenum and boron either separately or together at all rates increased molybdenum and boron uptake in straw but it was non significant for both seasons.

Crude protein percent, protein yield and total carbohydrates.

The results in Table (8) showed that there was a significant increase in crude protein percent in faba bean seeds by molybdenum addition. The great test effect was recorded with high dose (20 mg/l) as compared with low level (10 mg/l) and control treatment, since its increases rose to 26.25 and 27.50% for the first and second seasons, respectively. Similar trends were found for protein yield and total carbohydrates for two growing seasons. Similar results were obtained by Shehata (2001). He added that the increase in protein content of pea by Mo addition may be attributed to the role of Mo in normal assimilation of N by plants, because Mo is an essential component of nitrate reductase and nitrogenase which controls the reduction of nitrate and helps in fixing N_2 to NH_3 and increase N content of plants. Ewa *et al*. (2004) found that foliar fertilization with molybdenum increased the protein yield by 5.5% compared to the control.

Table (7): Effect of molybdenum and boron either individually or together on molybdenum and boron uptake (g/fed.) in seeds and straw of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011				2011-2012			
B (mg/l)	Mo (mg/l)	Seeds		Straw		Seeds		Straw	
		Mo (g/fed.)	B (g/fed.)	Mo (g/fed.)	B (g/fed.)	Mo (g/fed.)	B (g/fed.)	Mo (g/fed.)	B (g/fed.))
0.0	Control	1.23	113.41	0.49	40.32	1.25	114.66	0.51	42.39
	10	1.56	137.46	0.51	43.08	1.59	139.27	0.54	45.99
	20	1.74	156.23	0.55	46.30	1.78	159.50	0.56	49.33
100	Control	1.50	157.86	0.53	43.91	1.52	157.98	0.56	45.58
	10	1.86	174.95	0.52	44.98	1.91	179.66	0.56	46.00
	20	1.94	185.14	0.51	45.74	1.97	188.68	0.57	48.17
200	Control	1.66	170.87	0.52	45.25	1.69	175.23	0.55	47.98
	10	1.94	190.40	0.56	48.60	1.99	197.89	0.57	49.48
	20	2.03	200.34	0.55	47.09	2.10	207.43	0.58	50.32
L.S.D.	5%	0.21	9.33	0.30	8.29	0.25	9.75	0.34	8.38
	1%	0.31	13.77	0.44	12.24	0.37	14.39	0.50	12.37
C.V.		8.66	8.14	8.19	9.12	9.16	9.23	8.91	9.66

*: Treatments. **: Coefficient of variations.

Table (8): Effect of molybdenum and boron either individually or together on crude protein percent, protein yield (kg/fed.) and total carbohydrates (%) in seeds and straw of faba bean for 2010/2011 and 2011/2012.

Treatments		2010-2011					
B (mg/l)	Mo (mg/l)	Seeds			Straw		
		Crude Protein (%)	Protein yield (kg/fed.)	Total carbohydrates (%)	Crude Protein (%)	Protein yield (kg/fed.)	Total Carbohydrates (%)
0.0	Control	23.19	364.48	71.4	5.81	108.65	46.12
	10	25.13	430.02	72.70	5.81	118.52	45.23
	20	26.25	492.32	73.30	5.75	127.08	45.51
100	Control	26.06	464.12	73.40	5.75	108.65	45.11
	10	27.56	539.10	74.60	5.63	118.52	44.16
	20	27.94	557.36	75.60	5.69	127.08	44.33
200	Control	26.81	504.90	74.81	5.69	128.03	46.10
	10	28.00	564.63	77.50	5.63	137.37	43.12
	20	28.13	581.64	78.80	5.56	138.44	44.58
L.S.D. *	5%	1.19	22.11	0.61	15.81	15.81	0.53
	1%	1.75	32.64	0.90	23.34	23.34	0.78
C.V. **		9.11	8.16	4.16	8.27	8.66	5.23
Treatments		2011-2012					
B (mg/l)	Mo (mg/l)	Seeds			Straw		
		Crude Protein (%)	Protein yield (kg/fed	Total carbohydrates (%)	Crude Protein (%)	Protein yield (%)	Total Carbohydrates (%)
0.0	Control	24/06	379.27	71.45	5.88	111.72	46.98
	10	26.19	453.03	73.10	5.81	120.85	46.22
	20	27.50	521.30	74.95	5.81	129.56	45.34
100	Control	27.19	484.66	73.52	5.75	124.20	45.24
	10	28.56	568.40	74.71	5.69	137.70	45.33
	20	28.75	578.87	75.66	5.69	140.54	44.98
200	Control	27.88	530.67	74.88	5.75	132.25	46.43
	10	29.06	596.37	77.64	5.69	141.11	44.26
	20	29.19	618.04	78.85	5.56	141.22	44.96
L.S.D. *	5%	1.24	23.51	0.66	0.32	16.44	0.56
	1%	1.83	34.71	0.97	0.47	24.27	0.83
C.V. **		9.52	8.71	4.97	8.13	9.92	5.91

*: Treatments. **: Coefficient of variations

In addition, foliar spray with boron at all doses significantly increased those parameters, especially with 200 mg/l throughout the two growing seasons. Where the increases in protein yield in seeds and straw were 504.90 and 128.03 kg/fed., at a respective order for the first seasons, as well as 530.67 and 132.25 kg/fed., respectively for the second season. Loomis and Durst (1991 and 1992), declared that intracellular boron concentration in plant should keep optimal protein synthesis. Ziaeyan and Rajaia (2009) stated that B and Zn fertilizer significantly increased grains protein content. These results are in full agreement with those obtained by Seguin and Zheng (2006).

As for the effect of the interaction between molybdenum and boron at all levels, the data in Table (8) indicate that further greatest positive effect on such studied parameters for both growing seasons was occurred. The treatment of 20 mg/l Mo +200 mg/l B gave the highest

increases significantly in total carbohydrates percent in seeds by about 78. 80 and 78.85% for the first and second seasons, respectively. In this connection, Davies, (1980) found that boron-deficient plants are known unable to effect complete protein or carbohydrate synthesis, especially plant grown in soil rich in free calcium. In such case, more boron is required to prevent deficient. Shaaban *et al.* (2006) reported that the highest carbohydrates content was recorded when faba bean plants received nitrogen combined with boron. However, crude protein percent and total carbohydrates percent in straw decreased significantly as results foliar fertilizer with molybdenum and boron at all rates either individually or in combinations. This was true for two growing seasons.

Seedling Vigor Characters

Data in Table (9) generally revealed a significant effect of molybdenum and boron on germination percentage, shoot length, radical length, seedling fresh and dry weights and electrical conductivity of faba bean variety (Giza 2). When the cultivated bean plants are exposed to a deficiency of this microelements they do not grow beyond the seedling stage or are affected by necrosis after 55 days after emergence (Ambrosano, *et al*., 1990 and Morales *et al*., 1998). The highest values in germination percent (86 and 87% for the first and second seasons, respectively) was obtained by 100 mg/l boron when used compared to control (77and 87% for the first and second seasons, at a respective order). While the lowest value (82,82,82 and 83% for the first seasons and 83,83, 83 and 84% for the second season) when 10 mg/l, Mo, 10 mg/l Mo + 100 mg/l B, 10 mg/l + 200 mg/l B and 200 mg/l B, respectively were used compared to control and not significant different was observed between them. Brodrick *et al*. (1992) found that low level of molybdenum in seeds bean sown (< 1.41 mg kg^{-1}) producing seeds with 50% lower germination. The highest values in shoot length (18.40, 17.70 and 17.50 for the first season, likewise 18.73, 17.80 and 17. 63 for the second season) when 10 mg/l Mo, 100 mg/l B and 20 mg/l Mo + 200 mg/l B used respectively, compared to control (13.0 and 13 23). For radical length, the highest values (9.3, 9.2 and 9.0 for the first season and 9.36, 9.24 and 9.12 for the second seasons) obtained by 10 mg/l Mo +100 mg/l lB,10 mg/l Mo +200 mg/l B and 20 mg/l Mo + 100 mg/l B, respectively compared to control (6.7 and 6.72). Mixed between molybdenum and boron showed an obvious effect on root. The results showed that these mixtures increased root length compared to the individual application of Mo and B. Padma *et al*. (1989) notice that a combined application of molybdenum and boron over 20 or 40 days after sowing increases root length and assimilation area. In seedling fresh weight (gm). The highest values (26.0 and 26.10 for the first and second seasons, respectively) was obtained by 20 mg /l Mo + 100 mg/l B compared to control (13.0 and 13.30). While the lowest values (16.00 and 16.05) was obtained by 20 mg/l Mo + 200 mg/l B compared to control. In seedling dry weights (gm), the highest values (3.80, 3.70 and 3.40 for the first season, also 3.85, 3.77 and 3.45 for the second season) were attributed to the treatments 200 mg/kg B, 20 mg/kg Mo + 200 mg/l B and 10 mg/l Mo when used compared to control (2.30 and 2.37). The treatments 10 mg/l Mo + 100 mg/l B and 10 mg/l Mo +200 mg/l B decreased seedling dry weights. The values 2.40 and 2.60, respectively for the first season and 2.60 and 2.61, respectively for the second season. For electrical conductivity (Ec) the lowest values (29.8 and 29.86 for the first season as well as 29.10 and 29.19 for the second season) was obtained by 10 mg/l Mo + 200 mg/l B and 10 mg/l Mo + 100 mg/l B, respectively , compared to control (37.5 and 37.55). One of the main symptoms of B toxicity is rapid inhibition of root elongation (Choi et l., 2007). On the same hand plants exposed to B toxicity found to exhibit increase of malondialdehyde (HAD) and hydrogen peroxide (H_2O_2) content resulting in oxidative stress and membrane oxidation (Ardic *et al*., 2009).

Table (9): Effect of molybdenum and boron either individually or together on seedling vigor test of faba bean for 2010/2011 and 2011/2012 growing seasons.

Treatments		2010-2011					
B (mg/l)	Mo (mg/l)	Germination (%)	Shoot Length (cm)	Radical Length (cm)	Seedling fresh Weights (g)	Seedling Dry Weights (g)	EC dSm^{-1}
0.0	Control	77	13.0	6.70	13.00	2.30	37.50
	10	82	18.40	6.60	16.30	3.40	30.20
	20	84	13.70	7.50	16.10	2.70	33.70
100	Control	86	17.70	5.50	14.20	2.70	31.20
	10	82	17.10	9.30	22.20	2.40	29.10
	20	83	16.60	9.00	26.00	3.00	29.80
200	Control	83	14.30	5.20	20.50	3.80	35.2
	10	84	15.50	9.20	20.32	2.60	37.10
	20	85	17.50	8.20	16.00	3.70	33.00
L.S.D. *	5%	3.66	2.29	1.04	3.17	0.81	4.0
	1%	5.40	3.38	1.54	4.67	1.20	5.90
C.V. **		2.57	8.46	8.02	8.77	1.75	7.20
Treatments		2011-2012					
B (mg/l)	Mo (mg/l)	Germination (%)	Shoot Length (cm	Radical Length (cm)	Seedling fresh Weights (g)	Seedling Dry Weights (g)	EC dSm^{-1}
0.0	Control	78	13.23	6.72	13.30	2.37	37.55
	10	83	18.73	6.65	16.39	3.45	30.43
	20	85	13.79	7.58	16.15	2.74	33.81
100	Control	87	17.80	5.57	14.29	2.79	31.24
	10	83	17.19	9.36	22.25	2.60	29.15
	20	83	16.66	9.12	26.10	3.23	29.86
200	Control	84	14.34	5.24	20.52	3.85	35.26
	10	85	15.58	9.24	20.38	2.61	37.19
	20	86	17.63	8.27	16.05	3.77	33.09
L.S.D. *	5%	3.68	2.31	1.10	3.19	0.84	4.23
	1%	5.43	3.41	1.62	4.71	1.24	6.24
C.V. **		2.59	8.52	8.52	8.81	1.79	7.26

*: Treatments. **: Coefficient of variations

Conclusion

The essentiality of molybdenum and boron has been established in different metabolic pathways of higher plants (Marschner, 1995). These micronutrients even in small quantities are essential for plant growth. Micronutrients deficiency decreased growth, productivity, mineral concentrations, photosynthetic pigments and carbohydrates. In this respect, spraying faba bean plant with molybdenum especially at a high rate (20mg/kg) after 45 and 60 days from sowing proved to be the best treatment in alleviating this problem, resulting in increasing faba bean growth, yield and chemical constituents. In addition, many other attempts had made to overcome this disorder caused by deficiency including exogenous application of boron particularly at 200 mg/kg as a crop spray, which ultimately gave higher faba bean yield and production. The interactive between molybdenum and boron gave the further increases in nutrients concentrations and

uptake which reflected on the yield under the present soil conditions (Table 1).

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تأثير الرش بالموليبدنم والبورون علي النمو والمحصول والتركيب الكيماوي وجودة البذور لنبات الفول البلدي

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الملخص العربي

أقيمت تجربتان حقليتان في مركز كفر الزيات– محافظة الغربية خلال الموسم الشتوي ٢٠١٠/ ٢٠١١ و ٢٠١١/ ٢٠١٢ بهدف دراسة مدي تأثير رش الفول البلدي صنف جيزة ٢ لثلاث مستويات من الموليبدنم (صفر و ١٠ و٢٠ مليجرام / لتر) بالإضافة إلي ثلاث مستويات من البورون (صفر و ١٠٠و ٢٠٠ مليجرام / لتر). وتم استخدام هذين العنصرين في محاليل الرش في صورة منفردة أو متحدين. وقد اجري الرش علي مرتين الرشة الأولي بعد ٤٥ يوم من تاريخ الزراعة والرشة الثانية بعد٦٠ يوم من تاريخ الزراعة. أكدت النتائج المتحصل عليها فاعلية المعدل المرتفع لكل من هذين العنصرين (٢٠ و٢٠٠ مليجرام / لتر) في صورة منفردة هما الأفضل مقارنة بالمعدلات الأخرى في أحداث استجابة معنوية في الأوزان الخضرية والجافة للسيقان والأوراق والجذور وفي هذا المضمار كانت الجذور هي أكثر أعضاء نبات الفول البلدي تأثيرا وذلك بعد ٩٠ يوم من تاريخ الزراعة في كلا موسمي الزراعة. استجابة إحصائية لمحصول الفول البلدي ومفرداته حيث وصلت الزيادة النسبية لمحصول البذور١٩.٣٣و ١٩.٨٢ %علي التوالي في الموسم الأول بالإضافة إلي ٢٠.٢٦و ٢٠.٧٥% علي التوالي في الموسم الثاني. وجود زيادة معنوية لمحتوي الحبوب من العناصر الكبرى (نيتروجين– فوسفور– بوتاسيوم) بالإضافة إلي الموليبدنم والبورون. أيضا وزيادة معنوية للبروتين الخام والكربوهيدرات الكلية . هذه الزيادة صاحبتها نقص محتوي السيقان من هذه العناصر في كل من موسمي الزراعة. قد أدي إضافة الموليبدنم والبورون إلي زيادة معنوية في نسبة الإنبات و طول السيقان و طول الجذور والوزن الخضري والجاف للبادرة والتوصيل الكهربائي في كل من موسمي الزراعة في صنف جيزة ٢. سجلت النتائج المتحصل عليها أنه نتيجة إضافة معدلات الموليبدنم مع البورون أدي إلي زيادة عالية في الإنتاج كما ونوعا. في هذا المضمار إضافة الموليبدنم بمعدل ٢٠ مليجرام / لتر مع البورون بمعدل ٢٠٠ مليجرام / لتر كان له تأثيرا في إظهار النتائج المرجوة علي كل التقديرات السابقة التي أجريت في هذه الدراسة في كل من موسمي الزراعة لصنف جيزة ٢.