ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 43 (4): 2003-2014, (2005).

RESPONSE OF PEANUT CROP TO FOLIAR APPLICATION OF SOME MICRONUTRIENTS UNDER SANDY SOIL CONDITIONS

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ABSTRACT

Two field experiments were carried out at Ismailia Agriculture Research Station, Agriculture Research Center (ARC) during the two successive summer seasons, 2004 and 2005.

The main target of these experiments is evaluating the effect of foliar application of boron, zinc, manganese or iron on seed and pod yields, some yield components as well as nutrient status, oil and protein contents of peanut seeds. Boron was added at rates of 75, 150 and 300 mg B/L as boric acid. Zinc, manganese or iron was applied at rates of 150, 300 and 600 mg nutrient/L in the EDTA form.

Data obtained could be summarized as follows:

1. Peanut seed yield and most of the investigated yield components in both seasons as well as pod yield in the first season were significantly increased with B, Zn, Mn or Fe foliar nutrition. The highest values were attained by the foliar spraying with 600 mg/L Fe or Zn, 300 mg/L Mn and 150 mg/L B, in a descending order.
2. Foliar nutrition of B and Mn, up to 150 and 300 mg/L, respectively significantly enhanced seed N, P and K uptake in both seasons then the uptake declined by increasing B and Mn levels. Raising the concentration of spray solution of Zn and Fe up to 600 mg/L increased the values of all nutrients uptake except P-uptake which was not in line with increasing Zn and Fe rates .

3- B-foliar application increased seed B and Mn uptake and decreased Zn, Fe and Cu uptake. Zn-foliar spraying significantly enhanced Zn, B, Mn and Fe in seeds, however Cu uptake took an opposite trend. Spraying the plants with Mn and Fe increased uptake of the other micronutrients but antagonistic relationships were observed between Mn or Fe spraying and uptake of Zn and Cu.

4- Foliar feeding with the micronutrients under investigation significantly increased oil and protein contents in seeds. The treatment of 300 mg B/L gave the highest value of oil in seeds and the treatment of 600 mg Fe/L gave the highest value of protein in seeds.

Thus, under sandy soils conditions, spraying with concentrations of 600 mg Fe, 600 mg Zn, 300 mg Mn and 150 mg B/L at 30 and 45 days old of peanut plants gave the highest yields of peanut pods and seed and achieved a balance between macro- and micronutrients in plants and the best seed nutritive, oil and protein contents.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is the world fourth source of edible oil and the third important source of vegetable protein. Yet, it is one of the most important legume and oil crops cultivated in newly reclaimed sandy soils.

Increasing the fertility potential of sandy soils for high productivity of peanut requires a proper fertilization policy particularly with regard to micronutrients, where their deficiencies under these conditions are widespread and considered yield-limiting factors. In this concern, foliar application of micronutrients was successfully used for correcting their deficiency in crops. El-Fouly *et al.* (1995) stated that application of micronutrients foliarly can increase the yield of crops by an average of 22%. Concerning peanut crop, Saad *et al.* (1989) showed that addition of 0.1% aqueous zinc sulphate foliarly significantly increased the number of pods as well as weight of pods and seeds/ plant. Sudarsan and Ramaswami (1993) reported that spraying peanut plants with $ZnSO_4$ and borax increased seed yield and nutrients contents in seeds. Awad *et al.* (1994) found that pod yield of peanut was increased due to seed coating with Zn, Mn, Fe, Cu, B and Mo. Jiang *et al.* (1995) stated that average increases of peanut yield due to applying $ZnSO_4$, Fe-EDTA and B were 13.9, 12 and 8%, respectively. Singh (2001) observed that losses in groundnut yield caused by Fe, Zn and B deficiencies were 15, 16 and 19%, respectively.

Therefore, the current investigation was designed to evaluate the effect of foliar spray with different levels of Fe, Zn, Mn and B on pods and seed yields and yield components as well as contents of seed nutrients and oil and protein of peanut plants grown in a newly reclaimed sandy soil, under sprinkler irrigation system.

MATERIALS AND METHODS

Two field experiments were carried out in two successive summer seasons, 2004 and 2005, at Ismailia Agriculture Research Station, Agriculture Research Center. These trials were designed to study the effect of three levels of Fe, Zn, Mn or B on pod and seed yields and yield attributes as well as oil, protein and nutrient contents of the seeds of peanut plants (*Arachis hypogaea* L.) Cv. Giza 5. Fe, Zn or Mn was added at rates of 150, 300 and 600 mg of element in the EDTA form/L of spray solution. Boron was applied at rates of 75, 150 and 300 mg B/L in the form of boric acid. A non-fertilized treatment (Control), sprayed with water was also carried out. Therefore, there were 13 treatments (4 elements x 3 levels + control treatment).

Representative soil samples (0-30 cm) were taken from the experimental field before the cultivation for the two seasons to determine some soil properties (Table, 1), as described by Black (1965). Soil available macronutrients were determined by methods cited by Chapman and Pratt (1961); and soil available Fe, Mn and Zn were determined by the DTPA method of Lindsay and Norvell (1978). Soil available B was extracted by hot water and determined calorimetrically (Wolf, 1971).

Table (1): Characteristics and available nutrients of soil of the experimental sites in 2004 and 2005 summer seasons.*

I- Soil characteristics:

Season	Particle size distribution				
	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture class
2004	76.86	17.40	3.22	2.52	Sand
2005	75.20	16.29	4.58	3.93	Sand

Season	Chemical analysis											
	pH (1: 2.5 soil suspension)	$CaCO_3$ (%)	O.M. (%)	EC (dSm^{-1})	Soluble cations (me/L)				Soluble anions (me/L)			
					Ca^{2+}	Mg^{2+}	Na^+	K^+	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}
2004	7.73	1.35	0.21	1.03	4.56	2.51	3.04	0.23	–	4.43	2.84	3.07
2005	8.11	1.58	0.26	1.23	6.13	2.64	3.18	0.37	--	4.12	3.52	4.68

II. Available nutrients (mg/kg):

Season	Macronutrients			Micronutrients				
	N	P	K	Zn	Mn	Fe	B	Cu
2004	23.0	4.9	49.0	0.6	1.0	3.0	0.37	0.35
2005	28.7	5.7	54.5	0.9	1.2	4.1	0.29	0.51

*EC and soluble ions in saturation extract; extractants of available nutrients are: KCL (for N), sodium bicarbonate (for P), ammonium acetate (for K), DTPA (for micronutrients).

The experimental design was a randomized complete blocks with four replications having a plot area of 10.5 m^2 which contained five ridges each of 3.5 m in length and 0.6 m apart. Peanut seeds were sown on the 15th and 20th of April in the 1st and 2nd seasons, respectively in hills so as to have plants after thinning spaced at 10-cm apart. P-fertilizer was applied before planting at a rate of 30 kg P_2O_5/fed as calcium superphosphate (15.5% P_2O_5). N was applied at a rate of 30 kg N/fed as ammonium sulphate (20.6% N) however, K was added at a rate of 100 kg K_2O/fed as potassium sulphate (48% K_2O). Both N- and K-fertilizers were applied in two equal doses, at planting and one month later.

A sprinkler irrigation system was used to irrigate the crop. The usual agronomic practices of growing peanut plants were done. Spraying was performed twice, at the vegetative stage (30 days after sowing) and at beginning of flowering (50 days after sowing) at a rate of 300 L/fed in each spray. At harvesting (130 days after sowing), a representative sample of 5 plants was taken from each plot to determine: pods number/ plant, pods and seed weight /plant and seed index. Yield of pods and seeds /fed was calculated on the basis of the yield of the three middle rows. Concentrations of macronutrients and micronutrients in seeds were determined according to methods cited by Chapman and Pratt (1961) and Wolf (1971). Concentration of oil in seeds was done according to A.O.A.C. (1970). Seed protein percentage was estimated by multiplying the corresponding values of N% by 6.25.

Data were statistically analyzed according to Snedecor and Cochran (1982). Means of treatments were compared using the L.S.D. test at 5% probability.

RESULTS AND DISCUSSION

1- Effect on yields of pods and seeds and their components:

Pods and seed yields and their components (number of pods/ plant, pods and seed weight/ plant and seed index) as affected by foliar application of the micronutrients under investigation are presented in Table (2). Data show that spraying the peanut plants with any of B, Zn, Mn or Fe significantly increased seed yield in the two growing seasons. The effect concerning pod yield was positively significant, particularly in the first season. Shelling percentage and pods components, (except seed index) showed positive significant response in both seasons. In this concern, spraying the plants with the medium level of either B or Mn, and the highest level of either Zn or Fe attained the highest values caused by either element. Comparing the effect of nutrients, iron foliar spray recorded the highest positive impacts followed by Zn, Mn and B in a descending order. The superiority of Fe-treatments compared with the other reflects its importance. It mainly occurs in chloroplasts and heme and nonheme proteins; and is involved in the mechanism of photosynthetic electron transfer as well as in nitrate and sulfate reduction. The ions of Fe^{2+} and Fe^{3+} have catalytic and structural roles. Therefore, Fe promotes the growth of green parts and consequently produces high yields of pods and seeds (Marschner, 1998 and Nassar *et al.* 2002). On the other hand, the positive response of peanut plants to B application reflects the low content of available B in the soil (Table, 1). Boron has essential roles in plant metabolism, synthesis of nucleic acids, tissue development and sugar translocation facility (Marschner, 1998). The increases in peanut pods and seed yields due to Zn foliar application reflects its positive effect on leaf chlorophyll content, photosynthesis and reproduction (El-Sayed and Abo El-Nour, 1998). Zn also has an important role in the synthesis and level of tryptophan (precursor of the indol acetic acid, IAA) and activation of enzymes involed in the synthesis of IAA (Salisbury and Ross, 1992 and Nassar *et al.*, 2002). In addition, the positive effect of Mn reflects its importance in acting as a bridge between adenosen triphosphate "ATP" and enzyme complexes and in activating a number of enzymes in the tricarboxylic acid cycle (Clarkson and Hanson, 1980 and Nassar *et al.*, 2002) .

The current results of the positive effect of foliar spray with Fe, Zn, Mn and B on the yields of peanut pods and seeds and their attributes are in a good agreement with those reported by Sudarsan and Ramaswami (1993); Sarkar *et al.* (1998); Singh (2001) and Rifaat *et al.* (2004).

Table (2): Effect of micronutrients spray treatments in different concentrations on yields of pods and seeds as well as their components during the two studied seasons.*

Treatment		Pods No./plant		Pods weight (g/plant)		Seed weight (g/plant)		Seed index (g)		Pods weight (kg/fed)		Seed weight (kg/fed)		Husk weight (kg/fed)		Shelling (%)	
Element	Conc. mg/L)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control		22.06	28.58	32.47	41.84	19.98	30.09	95.0	99.3	1096	1340	675	964	421	376	61.59	71.94
B	75	23.80	30.68	35.92	42.85	23.09	33.28	97.6	99.7	1172	1327	754	1030	419	297	64.33	77.62
	150	26.47	33.13	37.00	45.89	25.56	37.04	98.4	101.0	1201	1342	830	1083	372	259	69.11	80.70
	300	22.93	28.82	33.76	43.35	21.18	31.44	96.0	99.5	1138	1387	714	1006	424	381	62.74	72.53
Mean		24.40	30.88	35.56	44.03	23.28	33.92	97.3	100.1	1170	1352	766	1040	405	312	65.47	76.95
Zn	150	25.07	31.91	36.83	43.74	24.20	34.39	98.2	100.0	1200	1352	789	1063	411	289	65.75	78.62
	300	26.77	34.79	38.18	45.97	26.49	37.52	98.9	101.5	1239	1344	860	1097	379	247	69.41	81.62
	600	27.77	37.39	40.73	47.77	28.64	39.42	99.0	102.0	1310	1377	921	1136	389	241	70.31	82.50
Mean		26.54	34.70	38.58	45.83	26.44	37.11	98.7	101.2	1250	1358	857	1099	393	259	68.56	80.91
Mn	150	24.60	31.70	35.99	43.54	23.28	34.07	98.1	99.8	1174	1347	759	1054	415	293	64.65	78.25
	300	26.71	34.23	37.41	45.62	25.96	37.12	98.8	101.0	1214	1334	842	1086	372	249	69.36	81.41
	600	23.65	28.91	34.77	43.44	22.21	31.91	97.0	99.5	1170	1389	747	1020	423	369	63.85	73.43
Mean		24.99	31.61	36.06	44.20	23.82	34.37	98.0	100.1	1186	1357	783	1053	403	303	66.02	77.70
Fe	150	25.54	32.97	37.18	44.80	24.56	35.67	98.3	100.0	1211	1347	800	1072	411	275	66.06	79.58
	300	27.53	36.18	38.89	47.41	27.17	39.01	99.0	102.0	1253	1367	875	1125	378	242	69.83	82.30
	600	27.84	37.57	41.47	50.31	29.54	43.25	99.1	102.1	1332	1450	949	1246	383	204	71.25	85.93
Mean		26.97	35.57	39.18	47.51	27.09	39.31	98.8	101.4	1265	1388	875	1148	391	240	69.17	82.60
L.S.D. at 5%		1.32	1.71	2.32	2.93	1.25	2.24	N.S	N.S	621	N.S	39.2	67.3	N.S	11.9	3.45	3.47

* Spray at 300 L/fed for each of two sprays (30 and 45 days after sowing)

2-Effect on seed macronutrients contents:

As shown in Table (3), foliar spray of B up to 150 mg/L and Mn up to 300 mg/L significantly increased seed N, P and K contents in both seasons. However, contents of these nutrients declined by raising the rates of B up to 300 mg/L and Mn to 600 mg/L although the contents remained higher than the control treatment. These results showed that B and Mn foliar spray enhanced NPK assimilation and translocation from the source (leaves) to the sink (seeds). These results agreed with the findings of Hassan (1996) on Mn and El-Shazly *et al.* (2003) on B.

Data in Table (3) also clearly show significant increases of both N and K concentrations and uptake by raising the rates of either Zn or Fe up to 600 mg/L for both seasons. In this concern, Fe foliar application recorded the highest increments, at all rates, compared with the other treatments. On the other hand, P-concentration and uptake progressively descended by raising the rates of Zn or Fe from 150 to 600 mg/L except P-content in the 1[st] season where it insignificantly increases by increasing Zn and Fe rates. In this accord, Dahdoh and Moussa (2000) reported that Zn and Fe foliar additions increased the concentration of K and decreased that of P in peanut plants. Mehasen and El-Ghozoli (2003) also reported a decrease in P-concentration of soybean plants by applying iron.

Table (3): Effect of micronutrients spray treatments in different concentrations on concentration and uptake of macronutrients seeds during the two studied seasons.*

Treatment		N				P				K			
Element	Conc. mg/L	1st season		2nd season		1st season		2nd season		1st season		2nd season	
		Conc (%)	uptake Kg/fed	Conc (%)	uptake Kg/fed	Conc (%)	uptake Kg/fed	Conc (%)	uptake Kg/fed	Conc (%)	uptake Kg/fed	Conc (%)	uptake Kg/fed
Control		2.78	18.8	2.47	23.8	0.37	2.50	0.21	2.02	0.96	6.48	0.82	7.90
B	75	2.79	21.0	2.58	26.6	0.37	2.9	0.23	2.37	0.98	7.38	0.85	8.76
	150	2.84	23.6	2.67	28.9	0.40	3.32	0.26	2.82	1.16	9.62	0.87	9.42
	300	2.91	20.8	2.72	27.4	0.40	2.86	0.33	3.32	1.22	8.71	0.91	9.15
Mean			21.8		27.6		2.99		2.84		8.57		9.11
Zn	150	2.84	22.4	2.61	27.7	0.42	3.31	0.37	3.93	1.00	7.89	0.86	9.14
	300	2.86	24.6	2.70	29.6	0.40	3.44	0.26	2.85	1.19	10.23	0.88	9.65
	600	2.95	27.2	2.74	31.1	0.37	3.41	0.23	2.61	1.32	12.16	0.94	10.68
Mean			24.7		29.5		3.39		3.13		10.09		9.82
Mn	150	2.82	21.4	2.59	27.3	0.40	3.04	0.33	3.48	0.99	7.52	0.85	8.96
	300	2.93	24.7	2.73	29.6	0.40	3.37	0.26	2.82	1.32	11.12	0.93	10.10
	600	2.85	21.3	2.70	27.6	0.37	2.76	0.23	2.35	1.18	8.82	0.88	8.98
Mean			22.5		28.2		3.06		2.88		9.15		9.35
Fe	150	2.84	22.7	2.65	28.4	0.40	3.20	0.33	3.54	1.02	8.16	0.87	9.33
	300	2.89	25.3	2.72	30.6	0.40	3.50	0.26	2.92	1.20	10.50	0.90	10.12
	600	2.97	28.2	2.78	34.6	0.37	3.51	0.23	2.87	1.34	12.70	0.96	11.97
Mean			25.4		31.2		3.40		3.11		10.45		10.47
L.S.D. at 5%			1.15		1.68		0.18		0.12		0.37		0.35

* Spray at 300 L/fed for each of two sprays (30 and 45 days after sowing)

3-Effect on seed micronutrients contents:

Data presented in Table (4) show that B foliar addition positively increased both B and Mn concentrations in peanut seeds. However, uptake of B in both seasons and Mn in the first season were significantly increased by spraying B up to 150 mg/L then they were declined although all values stayed higher than the control. These results are mainly related to the positive effect of B on seed yield of peanut (Table, 2). Regarding the uptake of Fe, Zn and Cu, foliar spray of B caused a positive effect, but increasing the rate of B was associated with slight decreases in their uptake. El-Shazly *et al.* (2003) on cotton and Rifaat *et al.* (2004) on peanut found that B foliar application caused increases in the uptake of B and Mn and decreases in the uptake of Fe, Zn and Cu.

Data in Table (4) also reveal that spraying the peanut plants with Zn enhanced the concentration as well as the uptake of Zn, Mn, Fe and B in seeds. However, the concentration of Cu and its uptake showed an opposite trend, where they were significantly decreased with raising the rate of applied Zn. Dahdoh and Moussa (2000) on broad bean and peanut and Rifaat *et al.* (2004) on peanut reported that foliar addition of Zn increased Zn, Mn and Fe uptake while decreased Cu uptake.

Results obtained in Table (4) also reveal that both B and Fe concentrations and uptake significantly increased in both seasons by Mn foliar addition up to 600 mg/L. Mn-concentration in both seasons also took the same trend however, its uptake progressively increased by Mn application up to 300 mg Mn/L but at 600 mg Mn/L the uptake was lower than at 300 mg Mn/L (but remained greater than the control). Seed yield at 600 mg Mn/L was lower than at 300 mg Mn/L (Table 2) and this is the main cause for the similar trend obtained in the uptake of Mn. On the contrary, the uptake of both Zn and Cu were progressively diminished by raising the rate of Mn up to 600 mg Mn/L.

Results shown in Table (4) also indicate that seed Fe, Mn and B concentrations and uptake were significantly increased in both seasons when spraying the peanut plants with Fe. However, seed Cu and Zn concentrations and uptakes were significantly decreased with increasing the rate of Fe, with few exceptions for Zn content in the first season. These findings are similar to those reported by Romero (1988) and Anderson and Parkpian (1988) for Fe & Zn and Fe & Cu antagonisms, respectively.

4-Effect on oil and protein percentage of peanut seeds:

Data in Table (5) clearly show that spraying the peanut plants with B, Zn, Mn or Fe at the different levels has positive effects on both seed oil and protein percentage in both growing seasons. There were no significant differences between different treatments for oil percentage but they were significantly affected on protein percentage. In this accord, the highest values of oil % were recorded with foliar addition of 300 mg B/L however, the foliar spray with 600 mg Fe/L gave the highest values of seed protein content. These results support those of Dahdoh and Moussa (2000), Mehasen and El-Ghozoli (2003) and Rifaat *et al.* (2004).

Table (4): Effect of micronutrients spray treatments in different concentrations on concentration and uptake of micronutrients seeds during the two studied seasons.*

Treatments		B				Zn				Mn				Fe				Cu			
		1st season		2nd season		1st season		2nd season		1st season		2nd season		1st season		2nd season		1st season		2nd season	
Element	Conc. (mg/L)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)	Conc. (ppm)	uptake (g/fed)
Control		26.7	18.0	14.7	14.2	79.6	53.7	42.8	41.2	37.8	25.5	23.4	22.5	313.4	211.4	235.0	226.4	7.7	5.19	5.0	4.82
B	75	31.3	23.6	25.3	26.1	94.9	71.5	65.2	67.2	39.0	29.4	29.1	30.0	351.9	265.2	264.0	272.0	9.0	6.78	5.0	5.15
	150	40.0	33.2	25.5	27.6	86.6	71.8	52.9	57.3	41.2	34.2	31.1	33.7	332.6	275.9	240.2	260.2	7.9	6.55	5.0	5.42
	300	42.0	30.6	26.3	26.5	80.5	57.5	48.0	48.3	45.1	32.2	34.0	34.2	309.9	221.3	223.6	224.9	6.3	4.50	4.3	4.33
Mean			28.9		26.7		66.9		57.6		31.9		32.6		254.1		252.4		5.94		4.97
Zn	150	27.5	21.7	16.7	17.8	101.0	79.6	73.4	78.0	40.9	32.3	30.1	32.0	341.4	269.2	261.9	278.4	10.0	7.89	5.0	5.32
	300	28.3	24.3	19.3	21.2	105.0	90.3	74.4	81.6	42.4	36.5	32.1	35.2	373.0	320.7	274.3	300.9	8.7	7.48	5.0	5.49
	600	29.8	27.5	23.4	26.6	105.6	97.3	77.4	87.9	45.4	41.8	34.0	38.6	380.2	350.3	292.2	332.0	7.0	6.45	4.7	5.34
Mean			24.5		21.9		89.1		82.5		36.9		35.3		313.4		303.8		7.27		5.38
Mn	150	27.5	20.9	15.7	16.5	95.5	72.5	69.8	73.6	49.4	37.5	35.2	37.1	337.9	256.5	259.5	273.5	9.3	7.06	5.0	5.27
	300	28.3	23.8	18.7	20.3	93.9	79.1	52.9	57.4	49.4	41.6	36.3	39.4	355.6	299.6	265.8	288.5	8.0	6.74	5.0	5.43
	600	29.7	22.2	23.3	23.8	84.5	63.1	49.9	50.9	50.5	37.7	37.8	38.6	374.9	280.1	289.1	295.0	7.0	5.23	4.7	4.80
Mean			22.3		20.2		71.6		60.6		38.9		38.4		278.7		285.7		6.34		5.17
Fe	150	27.7	22.2	18.0	19.3	96.7	77.3	69.5	74.5	40.9	32.7	30.1	32.3	385.4	308.2	300.2	321.9	10.3	8.24	6.0	6.43
	300	29.7	26.0	22.0	24.7	94.6	82.8	65.2	73.3	44.4	38.9	32.1	36.1	420.6	368.2	303.6	341.5	8.7	7.62	5.0	5.62
	600	30.0	28.5	24.7	30.8	85.4	81.0	51.4	64.1	47.0	44.6	34.7	43.3	425.0	403.2	305.7	381.0	7.7	7.30	4.8	5.98
Mean			25.6		24.9		80.4		70.6		38.7		37.2		359.9		348.1		7.72		6.01
L.S.D. at 5%			1.4		1.5		3.7		4.1		1.9		2.1		15.9		17.8		0.28		0.27

* Spray at 300 L/fed for each of two sprays (30 and 45 days after sowing)

Therefore, spraying the peanut plants with the solutions of Fe, Zn, Mn and B at rates of 600, 600, 300 and 150 mg/L, respectively give the highest pods and seed yields and is considered the best formula for achieving the most balance between macro-and micronutrients inside the plant as well as the highest nutrients, oil and protein contents in peanut seeds.

Table (5): Effect of micronutrients spray treatments in different concentrations on oil and protein percentage of peanut seeds during the two studied seasons.*

Treatment		Oil (%)		Protein (%)	
Element	Conc. (mg/L)	1st season	2nd season	1st season	2nd season
Control		46.1	47.5	22.0	24.9
B	75	46.6	47.9	22.2	25.0
	150	47.1	48.1	23.7	25.9
	300	47.6	49.6	24.6	27.3
Mean		47.1	48.5	23.5	26.1
Zn	150	46.3	47.9	22.7	25.2
	300	47.1	48.0	23.9	26.8
	600	47.3	48.7	24.7	27.6
Mean		46.9	48.2	23.8	26.5
Mn	150	46.2	47.9	22.5	25.1
	300	47.1	48.0	23.8	26.1
	600	47.2	48.7	24.6	27.5
Mean		46.8	48.2	23.6	26.2
Fe	150	46.4	47.9	23.1	25.5
	300	47.1	48.1	23.9	27.1
	600	47.5	48.7	24.8	27.9
Mean		47.0	48.2	23.9	26.8
L.S.D. at 5%		N.S	N.S	1.1	1.4

* Spray at 300 L/fed for each of two sprays (30 and 45 days after sowing)

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استجابة محصول الفول السودانى للرش الورقى ببعض العناصر الصغرى تحت ظروف الأراضى الرملية

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قسم بحوث تغذية النبات وخصوبة الأراضى ــ معهد بحوث الأراضى والمياه والبيئة ــ مركز البحوث الزراعية ــ الجيزة ــ مصر .

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالإسماعيلية ــ كمثالا للأراضى الرملية ــ خلال موسمى الزراعة الصيفيين ٢٠٠٤ ، ٢٠٠٥ بهدف دراسة تأثير الرش الورقى بثلاث مستويات من كل من البورون ، الزنك ، المنجنيز ، الحديد على محصولى البذور والقرون وبعض الصفات المحصولية لنباتات الفول السودانى وكذلك المحتوى الغذائى للبذور (محتواها من العناصر الكبرى والصغرى) ومحتواها من الزيت والبروتين .. وقد أضيف البورون بتركيزات ٧٥ ، ١٥٠ ، ٣٠٠ ملليجرام/لتر فى صورة حامض البوريك بينما أضيفت عناصر الزنك والمنجنيز والحديد بتركيزات ١٥٠ ، ٣٠٠ ، ٦٠٠ ملليجرام عنصر/ لتر فى صور مخلبية . ويمكن تلخيص أهم النتائج المتحصل عليها كالآتى:

١-أدى الرش الورقى لنباتات الفول السودانى بمحاليل العناصر الصغرى موضوع الدراسة (البورون ، المنجنيز ، الزنك ، الحديد) الى الزيادة المعنوية لمحصول البذور ومعظم الصفات المحصولية المدروسة فى كلا موسمى النمو وأيضا محصول القرون فى الموسم الأول ــ مقارنة بمعاملة الكونترول ــ وقد سجلت أعلى القيم لجميع الصفات السابقة عند رش النباتات بالحديد أو الزنك بمستوى ٦٠٠ ملليجرام عنصر/ لتر تلاها الرش الورقى بالمنجنيز بمعدل ٣٠٠ ملليجرام /لتر ثم الرش بالبورون بتركيز ١٥٠ ملليجرام/لتر .

٢-استجاب محتوى البذور من العناصر الكبرى (النيتروجين ، الفوسفور ، البوتاسيوم) معنوياً للرش الورقى بالبورون ، المنجنيز حتى تركيز ١٥٠ ، ٣٠٠ ملليجرام/لتر على التوالى كما أدى الرش الورقى بالزنك أو الحديد حتى تركيز ٦٠٠ ملليجرام/لتر الى الزيادة المعنوية لمحتوى البذور من النيتروجين والبوتاسيوم بينما سجلت علاقات تضاد عند زيادة تركيز الزنك أو الحديد فى محلول الرش ومحتوى البذور من الفوسفور .

٣-كان للرش الورقي لنباتات الفول السوداني بالبورون تأثير معنوي على محتوى البذور من البورون والمنجنيز كما شجع رش النباتات بعنصر الزنك أو المنجنيز أو الحديد من الزيادة المعنوية لإمتصاص العنصر وكذا محتوى البذور من العناصر الأخرى ٠٠ ومن ناحية أخرى لوحظت علاقات تضاد عند زيادة تركيز البورون في محلول الرش وامتصاص النباتات لكل من الزنك والحديد وأيضا بين المنجنيز ومحتوى البذور من الحديد ٠٠ فضلاً عن ظهور علاقات تضاد عند زيادة تركيز أي من العناصر الصغرى المدروسة في محلول الرش وامتصاص النباتات للنحاس ومحتوى البذور منه .

٤- التغذية الورقية لنباتات الفول السوداني بالعناصر الصغرى المختبرة أدت الى الزيادة المعنوية لمحتوى البذور من الزيت والبروتين في كلا موسمي النمو مقارنة بالنباتات الغير معاملة ٠٠ وقد سجلت أعلى القيم لمحتوى البذور من الزيت والبروتين عند رش النباتات بمحلول ٣٠٠ ملليجرام بورون/ لتر ، ٦٠٠ ملليجرام حديد/ لتر على التوالي .

ومن ثم يمكن القول أن رش نباتات الفول السوداني ــ تحت ظروف الأراضي الرملية ــ بمحاليل الحديد ، الزنك ، المنجنيز ، البورون بتركيزات ٦٠٠ ، ٦٠٠ ، ٣٠٠ ، ١٥٠ ملليجرام/ لتر على التوالي عند أعمار ٣٠ ، ٤٥ يوم يضمن الحصول على أعلى إنتاجية لمحصولي قرون وبذور الفول السوداني ويحقق الإتزان بين العناصر الصغرى والكبرى داخل النباتات وأفضل محتوى غذائي للبذور من العناصر الكبرى والصغرى وأعلى محتوى من الزيت والبروتين مقارنة بباقي معدلات نفس العنصر.