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RESPONSE OF BROAD BEAN TO ZINC AND MANGANESE UNDER MARYOUT AND NOBARIA CONDITIONS

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ABSTRACT

Zinc and manganese sulphate were applied to broad bean at Maryout and Nobaria locations, as foliar spray in concentration 0, 1, 2 and 3 g/l. and as soil addition at rates of 0, 5, 10 and 15 kg./fed. In Maryout, growth parameters, yield and its components and chemical composition were enhanced with foliar spray application method than soil addition. While, method of application had no effect on number of tillers/plant and net weight percentage. In Nobaria, growth and yield of broad bean surpassed with soil addition application method than foliar spray, while method of application had no effect on net weight (%) , dry matter (%) and protein content of seeds.

Zinc sulphate application at 2 g/l. as foliar spray or 10 kg./fed. as soil addition increased growth , yield and manganese content of broad bean significantly than other zinc treatments. While the highest values of protein and zinc content in seeds obtained with 3 g./L or 15 kg/fed. Zinc sulphate application. These results obtained in Maryout and Nobaria locations. As regard manganese sulphate application at 1 g/l. as foliar spray or 5 kg./fed. as soil addition increased growth , weight of 100 seed , net weight , dry matter percentage. Also, protein and zinc content in seeds increased significantly with treatment 2g./L or 15 kg/fed. $MnSO_4$ than control treatment , but manganese sulphate application at conc. 3 g./L or 15 kg/fed. gave the highest yield of pods/plant , yield/fed. and manganese content in seeds under Maryout conditions. In Nobaria, application of manganese sulphate at 1 g./L as foliar spray or 5 kg/fed. as soil addition increased all characters of broad bean under study significantly than other manganese treatments, except manganese content in seeds surpassed with high rate of manganese application (3 g./L or 15 kg/fed.).

INTRODUCTON

Zinc and manganese nutrients are most important factors affecting legume plants productivity. In calcareous Maryout soil, a lack of zinc and manganese causes disturbance in plant growth because of most of nutrients are nonexchangable and unavailable to plants. On the other hand, in Nobaria soil, a lack of nutrients results from deficiency of elements in sandy soils. Hassan (1982) reported that Zn application treatments on various legume crops enhanced growth of all vegetative parts of plants. Accordingly, Abdrabou and Hamada (1991) found that seed yield of faba bean was highest with 0.8% Zn. Also, Gomaa (1991) added 0, 4 or 8 kg./fed. $ZnSO_4$ as soil addition or 0.2 kg. as foliar spray to faba bean and found that the yield was increased by Zn treatments and highest with foliar application. Abdrabou (1992) sprayed faba bean with Zn , the highest seed yield, pod no./plant, seed no./pod and 100 seed weight were obtained with 0.6% Zn. In the same year, Kucharaski and Niklewska used 0 - 1000 ppm. Zn as $ZnSO_4$ on faba bean, the best results obtained with 100 ppm. Zn application. In clay soil, Majumdar *et al.* (1994) applied 0 - 20 kg. Zn/ha. as zinc chloride , seed yield and zinc content increased with increasing levels of Zn fertilizers. Sakr *et al.*(1996) found that the highest seed yield of *V. faba* obtained with 1000 ppm. Zn foliar spray. In field trial Zn

application as foliar spray at 200 ppm. increased dry weight of plant, seed yield and protein content (Salam , 1998).

Many workers investigated the effect of manganese on legumes. El-Assiouty (1983) found that application of micronutrients increase the chemical components of bean plants. Mn application had a favorable effect on pod no., seed yield and content of protein in seeds (Kotecki, 1990). Also, Abdel-Reheem *et al.* (1992) concluded that pod no., seed yield and total nitrogen uptake increased in seeds of faba bean with 200 g. Mn/fed. application as foliar spray. Seeds and protein yield of faba bean increased significantly with addition of Mn at rate of 0.12 g./kg seeds (Azer *et al.*, 1992).

In the same line, Hegazy *et al.* (1993) sprayed *Vicia faba* with 0.1% Zn or Mn in vegetative and reproductive stage, seed yield was higher with Mn foliar application. In sandy soil, Mn or Zn in sulphate form were added to the soil , the optimum yield corresponds for faba bean seeds and shoots to 20 kg. Fe, Mn and Zn/fed. (Dahdoh, 1997).

This study aimed to determine the suitable application method of Zn and Mn to broad bean in Maryout and Nobaria region. Also to study the effect of Zn or Mn treatments on growth, yield and chemical composition of broad bean.

MATERIALS AND METHODS

This work was carried out during the two successive seasons of 1996-1997 and 1997-1998 at Maryout Experimental Station (highly calcareous soil) of Desert Research Center, and at Nobaria sector (sandy soil), El-Behera Governorate. Broad bean (Vicia faba), Kobrosy cultivar was used. Seeds were sown on october 25th and 28th in the first and second seasons respectively. The seeds were treated with *Rhizobium leguminosarum* before sowing. The experiment included 14 treatments with four replicates in a split plot design, according to Thomas and Hills (1975). The plot area was 1/400 feddan and consists of 5 rows, each of 3.5m. long and 60cm wide. The distance between hills was 30cm. The treatments were applied in the two locations under study as follows:

1- Plants were sprayed 30 and 50 days after sowing with 0,1,2 and 3g./l. zinc or manganese sulphate.
2- Zinc or manganese sulphate were added to the soil at rate of 0,5,10 and 15kg./fed. Each quantity was divided to two equal parts and added at 30 and 50 days after sowing respectively.

The Application methods were randomly arranged in the main plots, whereas zinc and manganese concentrations were distributed in sub-plots.

Data recorded were as follows:

A- Growth characters were studied 90 days after planting date in representative samples of 10 plants from each plot.
   1- Plant height (cm.).
   2- Plant weight (g.).
   3- No. of tillers per plant.

B- Yield and its components, four months after seeds planting.
   4- Yield of pods per plant.

5- No. of pods per plant.
6- Weight of 100 seed (g.)
7- Yield of pods (ton/fed.).

8- Net weight ($\frac{\text{average weight of seeds/pod}}{\text{average weight of pod}}$) × 100

9- Dry matter of seeds (%).

C- Chemical composition.

10- Protein content (%) of dry seeds samples was estimated by multiplied total N x 6.25. Total N was determined using micro-kjeldahl method described by Ranganna (1978).

11- Micro elements (Zn and Mn) were assayed according to the method described by Chapman and Pratt (1961).

Table (A) and (B) show mechanical and chemical analysis of Maryout and Nobaria soil, respectively.

Table (A)

Mechanical analysis (%)		Chemical analysis pH and soluble cations		Soluble anions (meq/l.)	
Sand	38.50	pH	8	HCO_3^-	04.00
Silt	33.00	Ca^{++}	18.10 meq/l.	CO_3^{--}	Nil
Clay	28.50	Mg^{++}	09.00 meq/l.	Cl^-	31.80
Texture class	Clay loam	Na^+	29.32 meq/l.	SO_4^-	21.82
		K^+	01.20 meq/l.		
		Mo^{+++}	00.30 meq/l.		

Table (B)

Sand	94.0	pH	7.3	HCO_3^-	2.4
Silt	02.5	Ca^{++}	5.8 mg/100g.	CO_3^{--}	5.8
Clay	03.0	Mg^{++}	4.6 mg/100g.	Cl^-	6.6
Texture class	Sandy	Na^+	2.7 mg/100g.	SO_4^-	Nil
O.M	00.4	K^+	1.7 mg/100g.		
		EC	1.7 ms/cm.		

Mechanical analysis of soil was carried out according to Piper (1950). While chemical analysis was performed as described by Jackson (1958).

RESULTS AND DISCUSSION

A-Growth characters:

Data in Table(1) show that plant height and plant weight of broad bean increased significantly with foliar spray application method than soil addition under Maryout conditions, while methods of application did not affect significantly no. of tillers per plant. The highest values of growth characters obtained with application of zinc sulphate at 2g./L. as foliar spray or 10 kg/fed. as soil addition, the increment was significantly in both growing seasons. The same trend of results observed with application manganese sulphate at 1g./L. as foliar spray or 5 Kg/fed as soil addition .

Table (1) Effect of Zn and Mn application methods and concentrations on plant height, weight and No. of tillers/plant of broad bean under Maryout conditions.

Charct.	Plant height (cm.)						Plant fresh weight (g.)						No. of tillers / plant					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Conc. Meth	Spr.	S.add.	χ^{-}	Spr.	S.add.	χ^{-}	Spr.	S.add.	χ^{-}	Spr.	S.add.	χ^{-}	Spr.	S.add.	χ^{-}	Spr.	S.add.	χ^{-}
Cont.	70.0	66.0	68.0	84.0	80.4	82.2	249.0	242.3	245.7	227.8	218.0	222.9	5.8	6.0	5.9	5.5	5.4	5.5
Zn_1	76.0	68.2	72.1	92.3	81.6	87.0	249.7	243.2	246.5	229.5	217.8	223.7	6.0	6.1	6.1	6.0	5.6	5.8
Zn_2	86.5	74.6	80.6	104.0	91.5	97.8	354.2	253.0	303.6	302.2	225.0	263.6	7.2	7.0	7.1	6.5	6.5	6.5
Zn_3	70.2	72.3	71.3	85.4	88.8	87.1	349.8	245.4	297.6	284.1	224.5	254.3	6.7	6.3	6.5	5.9	5.8	5.9
Mn_1	82.6	69.8	76.2	100.4	83.3	91.9	302.7	339.7	321.2	265.3	301.6	283.5	8.3	8.0	8.2	7.8	7.7	7.8
Mn_2	76.0	69.0	72.5	94.2	82.3	88.3	248.8	262.9	255.9	226.4	232.0	229.2	7.3	6.6	7.0	7.0	6.0	6.5
Mn_3	68.5	67.5	68.0	82.8	80.2	81.5	250.6	244.0	247.3	229.5	217.7	223.6	5.8	6.0	5.9	5.4	5.5	5.5
Mean	75.7	69.6		91.9	84.01		286.4	261.5		252.1	233.8		6.7	6.6		6.3	6.1	
L. S. D. at 0.05 for:																		
Meth.			1.634		4.013			9.350			20.985				N.S		N.S	
Conc.			2.794		4.182			10.159			17.651				0.622		0.363	
M. X. C.			5.499		12.319			72.681			310.164				0.272		0.10	

Spr And S.add. refer to foliar spray and soil addition method, respectively.
Also. Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g./L. as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

Interaction between foliar spray method and zinc sulphate application at 2g./L. or manganese sulphate concentration at 1g./L. gave the highest growth parameters results of broad bean than other treatments. The beneficial effect ofZn application as foliar spray on growth of Vicia faba agree with Salam (1998). Also manganese application as foliar spray on faba bean had a favorable effect on plant growth (Kotecki, 1990).

In Nobaria region, data in Table (2) indicate that plant height and plant weight increased significantly with soil addition than foliar spray method in both growing seasons, while No. of tillers/plant increased significantly with soil addition method in second season only.

Zinc sulphate application at 2g./L. as foliar spray or 10 kg/fed. as soil addition gave the highest results of broad bean growth than other treatments of zinc. Also the highest values of growth characters observed with manganese sulphate application at 1g./L as foliar spray or 5 kg/fed. as soil addition. The increment of growth parameters was significantly in both growing seasons under study. The interaction between soil addition method and zinc sulphate application at 10 kg./fed. or manganese sulphate application at 5 kg./fed. increased growth characters significantly than other treatments in both growing seasons except No. of tillers/plant, interaction had no significant effect in first season.

These results are in the same line with Majumdar *et al.* (1994) and Dahdoh (1997) who added Zn and Mn in sulphate form to faba bean in sandy soil as soil addition and found significant increase in plant growth.

The obtained results show that increasing rate of Mn application decrease plant growth, and these results agree with Azer *et al.*(1992).

The favorable effect of zinc on plant growth may be due to increase in IAA content, Devlin and Witham (1979). As regard Zn has a role in the promotion of enzymes activity and the internal growth regulators, which may be connected with plant growth (Hassan, 1982).

The importance of Mn application to plant growth may be due to manganese is localyzed to a very extent between 50 and 80% in the chloroplasts, metachondria and other cell organella (Mucknhirn 1936). Also manganese has an important role in respiration and nitrogen metabolism (Devlin and Witham 1979).

B- Yield and its components:

Data in Table (3 and 4) indicate that, in Maryout location, yield and number of pods per plant, weight of 100 seeds and yield/fed. and dry matter of seeds (%) increased significantly with foliar spray application method than soil addition. On the other hand, method of application had no effect on net weight(%) of seeds.

Zinc sulphate concentration at 2g./L. as foliar spray or 10 kg/fed. as soil addition, gave the highest yield components of broad bean significantly than other treatments of zinc. As regard manganese sulphate concentration at 1g./L. as foliar spray or 5 kg/fed.

Table (2) Effect of Zn and Mn application methods and concentrations on plant height, weight and No. of tillers/plant of broad bean under Nobaria conditions.

Charct	Plant height (cm.)						Plant fresh weight (g.)						No. of tillers / plant					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Conc. Meth	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont.	62.4	70.0	66.2	68.6	77.2	72.9	144	157	150.5	166	176	171.0	3.3	3.3	3.30	3.6	3.7	3.65
Zn_1	63.6	73.3	68.5	69.9	84.4	77.2	170	286	228.0	186	313	249.5	4.2	5.6	4.90	5.0	6.7	5.85
Zn_2	69.5	81.8	75.7	77.2	95.0	86.1	203	308	255.5	225	358	291.5	5.6	6 5	6.05	6.6	7.7	7.15
Zn_3	65.1	72.3	68.7	71.5	81.9	76.7	147	233	190.0	176	263	219.5	4.8	5.5	5.15	5.6	6.6	6.10
Mn_1	76.0	74.4	75.2	83.4	82.5	82.95	265	293	279.0	291	300	295.5	8.4	8.9	8.65	9.7	9.9	9.80
Mn_2	73.2	72.6	72.9	80.4	78.7	79.55	250	261	255.5	291	208	249.5	5.6	5.1	5.35	6.4	6.2	6.30
Mn_3	63 0	71.7	67.4	69.2	79.2	74.2	170	160	165.0	195	180	187.5	4.7	6.5	5.60	5.4	7.8	6.60
Mean	67.54	73.73		74.31	82.7		192.7	242.6		218.6	256.9		5.2	5.9		6.0	6.9	

L. S. D. at 0.05 for:

Meth.	3.673	1.511	012.703	010.863	N. S.	0.350
Conc.	3.219	3.513	014.495	014.090	1.087	0.456
M. X. C.	7.297	8.694	147.976	139.825	N. S.	0.146

Spr. And S add. refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g./L. as foliar spray or 5, 10 and 15 kg/Fed as soil addition of zinc sulphate or manganese sulphate.

Table (3) Effect of Zn and Mn application methods and concentrations on yield of pods/plant, No. of pods/plant and weight of 100 seed of broad bean under Maryout conditions.

Charct	yield of pods (g./plant)						No. of pods/plant						weight of 100 seed (g.)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Conc. Meth	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add	$\bar{\chi}$	Spr.	S.add	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont	115.3	110.6	113.0	092.2	085.6	088.9	11.1	10.5	10.8	09.5	09.0	09.3	102.2	100.0	101.1	095.3	092.5	093.9
Zn_1	185.9	179.5	182.7	140.6	135.3	138.0	13.5	13.8	13.7	11.1	11.7	11.4	124.9	102.2	113.6	119.7	099.8	109.8
Zn_2	368.9	238.3	303.6	296.8	175.2	236.0	20.5	17.5	19.0	18.1	14.1	16.1	171.2	144.0	157.6	164.8	137.0	150.9
Zn_3	249.3	188.7	219.0	187.9	138.7	163.3	16.7	14.4	15.6	14.4	11.3	12.9	128.4	128.7	128.6	098.9	121.5	110.2
Mn_1	171.1	195.9	183.5	134.1	156.1	145.1	11.6	11.2	11.4	09.9	09.8	09.9	153.4	167.1	160.3	144.2	139.0	141.6
Mn_2	152.7	171.3	162.0	120.9	126.0	123.5	11.2	11.6	11.4	09.5	09.4	09.5	125.7	140.9	133.3	115.0	122.2	118.6
Mn_3	219.2	278.3	248.8	170.3	219.7	195.0	16.2	17.6	16.9	13.7	15.6	14.7	122.0	123.8	122.9	103.7	110.9	107.3
Mean	208.9	194.7		163.3	148.1		14.4	13.8		12.3	11.6		132.5	129.5		120.3	117.6	
L. S. D. at 0.05 for																		
Meth.	5.13		9.44			N. S		0.61			N.S		3.34					
Conc.	3.38		4.27			0.74		0.69			4.01		7.42					
M. X C.	8.04		12.82			0.36		0.33			5.67		11.06					

Spr And S.add. refer to foliar spray and soil addition method, respectively.
Also. Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g /L. as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

Table (4) Effect of Zn and Mn application methods and concentrations on pod yield/fed., net weight (%) and dry matter of seeds (%) of broad bean under Maryout conditions.

Charct.	Yield (ton/fed.)						Net weight (%)						dry matter of seeds (%)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Conc. Meth	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont.	3.0	3.1	3.05	2.6	2.7	2.65	34.5	37.3	35.9	32.8	35.0	33.9	16.0	15.0	15.50	14.6	13.2	13.9
Zn_1	4.3	3.6	3.95	3.6	3.2	3.40	41.1	38.7	39.9	37.7	33.9	35.8	17.4	16.3	16.85	15.9	14.4	15.2
Zn_2	6.9	4.7	5.80	6.5	4.2	5.35	46.1	44.0	45.5	42.0	40.3	41.2	21.6	19.8	20.70	20.4	17.8	19.1
Zn_3	4.8	3.4	4.10	4.3	3.1	3.70	38.9	42.9	40.9	35.7	39.3	37.5	24.2	17.3	20.75	22.7	15.1	18.9
Mn_1	3.9	3.6	3.75	3.6	3.2	3.40	40.4	49.8	45.1	36.9	45.7	41.3	19.7	25.3	22.5	18.0	23.9	20.9
Mn_2	3.9	3.8	3.85	3.8	3.6	3.70	38.2	42.9	40.6	35.1	39.3	37.2	18.1	16.8	17.5	16.1	14.9	15.5
Mn_3	4.3	5.0	4.65	4.4	4.1	4.25	36.2	37.6	36.9	34.4	34.5	34.5	18.4	15.8	17.10	16.7	13.7	15.2
Mean	4.4	3.9		4.1	3.4		39.3	41.9		36.4	38.3		19.3	18.0		17.8	16.1	
L. S. D. at 0.05 for:																		
Meth.		0.45			0.67			N. S.			N. S.			1.07			0.83	
Conc.		0.34			0.58			2.45			2.69			1.89			0.55	
M. X. C.		0.48			0.81			4.23			5.10			2.50			0.21	

Spr. And S.add. refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g./L. as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

As soil addition increased weight of 100 seed, net weight (%) and dry matter of seeds (%), while yield and number of pods per plant and yield of pods/fed. gave the highest values significantly with application 3g./L. manganese sulphate as foliar spray or 15 kg/fed. as soil addition than other manganese treatments.

The interaction between foliar spray method and zinc concentration at 2g./L. gave the highest yield and number of pods per plant, weight of 100 seed and yield /fed. of broad bean. While soil addition method with 5 kg/fed. manganese sulphate gave the highest percentage of net weight and dry matter of seeds.

These results in the same line with Gomaa (1991) and Abd rabou (1992), they obtained a good result of bean yield with adding zinc to plants as foliar spray. Also Abdel-Reheem *et al.* (1992) obtained a favorable effect of yield when sprayed plants of faba bean with manganese.

Table (5 and 6) show that, under Nobaria conditions, broad bean yield and number of pods per plant, weight of 100 seed and yield of pods/fed. increased significantly with soil addition method than foliar spray. On the other hand, method of application had no effect significantly on net weight (%) and dry matter of seed percentage.

Zinc sulphate concentration at 2 g./L as foliar spray or 10 kg/fed. as soil addition, surpassed than other treatments of zinc and gave the highest results of yield and its components. Also manganese sulphate concentration at 1g./L as foliar spray or 5 kg/fed. as soil addition gave the highest yield of broad bean than other treatments of manganese. The interaction between soil addition method and zinc at 10 kg/fed. or manganese at 5 kg/fed. gave the highest values of yield and its components in both growing seasons. These results in the same line with Gomaa (1991), Hegazy *et al.* (1993) and Majumdar *et al.* (1994), they obtained a best yield of faba bean with applying zinc as soil addition to plants. Also Azer *et al.* (1992) and Dahdoh (1997) obtained the optimum yield with application manganese to faba bean plants as soil addition.

The favorable effect of Zn on yield of broad bean may be due to zinc activate in the enzyme tryptophan synthetase, therefore, zinc participates in the metabolism of plants as an activator of several enzymes. Kucharski and Niklewska (1992) mentioned that, high rates of Zn decreased dehydrogenase and phosphatase activities in Rhizobium leguminosa, this explain that second rate of Zn gave the highest results of growth and yield while growth and yield decrease with increasing rate of Zn application.

The good effect of manganese on yield of plant may be due to manganese application increased nodulation which improve yield of faba bean (Hegazy *et al.*,1993). The site of manganese activity is in the oxygen-producing step in photosynthesis. Manganese is involved in electron transfer from water to chlorophyll during the high reaction of photosynthesis (Devlin and Witham, 1979).

Azer *et al.* (1992) indicate that the high rate of Mn application decrease yield of faba bean.

Table (5) Effect of Zn and Mn application methods and concentrations on yield of pods/plant, No. of pods/plant and weight of 100 seed of broad bean under Nobaria conditions.

Charct.	yield of pods (g./plant)						No. of pods/plant						weight of 100 seed (g.)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Conc. Meth	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr	S.add.	$\bar{\chi}$	Spr.	S add.	$\bar{\chi}$
Cont.	067.2	068.1	067.7	074.8	076.4	075.6	09.3	09.8	09.55	09.8	10.2	10.00	100.0	100.6	100.3	105.0	103.8	104.40
Zn_1	108.2	140.5	124.4	155.0	239.6	197.3	10.1	16.1	13.10	13.4	21.0	17.20	107.2	110.0	108 6	118.3	121.4	119.95
Zn_2	171.0	180.4	175.7	215.2	271.9	243.6	14.8	21.2	18.00	19.8	24.5	22.15	113.0	140.3	126.7	124.0	154.3	139.15
Zn_3	149.0	119.7	134.4	204.2	166.8	185.5	12.7	12.6	12.65	17.4	16.3	16.85	107.0	112.0	109.5	114.9	112.8	113.85
Mn_1	155.6	178.5	167.1	244.7	324.3	284.5	14.1	18.0	16.05	20.4	21.7	21.05	119.9	123.4	121.7	126.8	135.5	131.15
Mn_2	129.2	146.1	137.7	134.7	160.0	147.4	13.0	16.2	14.60	17.9	19.8	18.85	112.3	114.7	113.5	115.5	123.0	119.25
Mn_3	108.1	108.3	108.2	191.3	233.0	212.2	11.5	11.9	11.70	14.2	16.7	15.45	108.5	106.0	107.3	111.7	111.0	111.35
Mean	126.9	134.5		174.3	210.3		12.2	15.1		16.1	18.6		109.7	115.3		116.6	123.1	
L. S. D. at 0.05 for:																		
Meth.	07.19			23.58			0.49			0.84			5.59			3 16		
Conc.	03.81			18.26			1.12			1.40			3.42			3.19		
M. X. C.	10.23			34.78			0 88			1.39			4 84			4.51		

Spr. And S.add refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1.2 and 3 g./L as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

Table (6) Effect of Zn and Mn application methods and concentrations on yields of pods/fed., net weight (%) and dry matter of seeds (%) of broad bean under Nobaria conditions.

Charct	Yield (ton/fed.)						Net weight (%)						dry matter of seeds (%)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Meth. / Conc.	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont.	3.30	3.34	3.32	3.40	3.37	3.39	31.1	29.4	30.25	34.8	33.0	33.9	17.8	17.4	17.6	19.1	18.6	18.9
Zn_1	3.80	5.80	4.80	3.97	6.00	4.99	40.3	38.0	39.15	43.3	43.7	43.5	20.3	19.1	19.7	22.1	20.8	21.5
Zn_2	4.72	6.41	5.57	5.97	6.67	6.32	47.9	46.8	47.35	50.6	44.2	47.4	21.4	20.5	21.0	23.5	23.1	23.3
Zn_3	4.66	3.97	4.32	5.50	5.00	5.25	31.2	34.7	32.95	37.4	39.4	38.4	20.7	19.8	20.3	22.7	21.6	22.2
Mn_1	4.50	6.83	5.67	5.67	7.40	6.54	38.5	37.9	38.20	42.0	42.0	42.0	21.2	24.2	22.7	23.0	26.5	24.8
Mn_2	4.31	5.20	4.76	4.87	6.30	5.59	37.0	34.5	34.75	38.9	38.3	38.6	20.3	19.0	19.7	22.2	23.0	22.6
Mn_3	3.73	4.50	4.12	3.83	4.67	4.25	35.9	34.3	35.10	38.3	36.3	37.3	20.1	17.9	19.0	22.2	20.0	21.1
	4.15	5.15		4.74	5.63		37.4	36.5		40.7	39.6		20.25	19.7		22.1	21.9	
L. S. D. at 0.05 for:																		
Meth.	0.33		0.57				N.S			N.S			N. S.			N. S.		
Conc	0.17		0.26.				1.01			1.85			1.37			1.55		
M. X. C.	0.25		0.36				1.42			2.02			1.33			1.69		

Spr. And S.add. refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g./L. as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

C- Chemical composition:

Table (7) show that protein, zinc and manganese content in broad bean seeds increased significantly with foliar spray application method than soil addition method in both growing seasons under Maryout conditions. Zinc sulphate application at rate 3 g./L as foliar spray or 15 kg/fed. as soil addition, gave the highest protein and zinc content in seeds significantly , while manganese content surpassed with 2 g./L zinc sulphate application as foliar spray or 10 kg/fed. as soil addition than other treatments of zinc.

As regard manganese application at concentration 2 g./L as foliar spray or 10 kg/fed. as soil addition gave the highest values of protein and zinc content in broad bean seeds than other treatments of manganese , while manganese content of broad bean seeds increased significantly with manganese sulphate application at 3 g./L as foliar spray or 15 kg/fed. as soil addition than other treatments of manganese.

The interaction between foliar spray method and zinc sulphate application at 3 g./L gave the highest protein and zinc content of broad bean seed, while foliar spray method with 3 g./L manganese sulphate gave the highest manganese content of broad bean seeds than other treatments under study.

The favorable effect of zinc and manganese application as foliar spray on chemical composition of broad bean agree with El-Baz *et al.* (1990) and Sakr *et al.* (1996).

The favorable effect of applying zinc and manganese as foliar spray on broad bean under calcareous soil conditions due to micronutrient uptake by plant decrease by increasing soil pH from 5.6 – 7.7 (McEwen *et al.*, 1990)

Under Nobaria conditions, Table (8) show that method of application had no effect significantly on protein content of seeds, while foliar spray application method increased zinc and manganese content significantly than soil addition method.

Zinc sulphate application at concentration 3 g./L as foliar spray or at rate 15 kg/fed. as soil addition increased significantly protein and zinc content of broad bean seeds than other treatments of zinc, while zinc sulphate application at 2g./L as foliar spray or 10 kg/fed. as soil addition gave highest manganese content than other trof zinc. On the other hand, manganese application at 1g./L as foliar spray or 5kg/fed. as soil addition gave the highest content of protein and zinc in broad bean seeds than other manganese treatments, while the highest values of manganese content obtained with 3g./L manganese application as foliar spray or 15 kg/fed. manganese application as soil addition.

The results indicate that low rate of manganese application increase protein and zinc content in broad bean seeds than high rates of manganese, these results agree with Azer *et al.* (1992).

The increasing content of protein, zinc and manganese in broad bean seeds as a result of zinc and manganese application agree with Fawzi *et al.* (1989) , El-Baz *et al.* (1990) and Kotecki (1990).

The importance of zinc application to plants in increasing protein content maybe due to zinc must play an important role in protein synthesis (Devlin and Witham 1979).

Table (7) Effect of Zn and Mn application methods and concentrations on protein, zinc and manganese content in broad bean seeds under Maryout conditions.

Charct.	protein (%)						Zn (mg./100g.)						Mn (mg./100g.)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Meth. / Conc.	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{X}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont.	12.00	12.02	12.0	12.21	11.00	11.6	074	083	078.5	075	076	075.5	123	124	123.5	115	96	105.5
Zn_1	15.30	14.32	14.8	14.80	13.21	14.0	105	103	104.0	136	102	119.0	139	124	131.5	132	112	122.0
Zn_2	15.38	15.52	15.5	13.24	12.80	13.0	168	107	137.5	161	104	132.5	147	139	143.0	147	142	144.5
Zn_3	17.10	16.48	16.8	16.11	17.50	16.8	173	114	143.5	174	124	149.0	146	136	141.0	143	141	142.0
Mn_1	16.62	15.13	15.9	14.90	14.7	14.8	095	086	090.5	092	081	86.5	168	156	162.0	166	150	158.0
Mn_2	17.08	17.03	17.1	15.30	15.11	15.2	098	096	097.0	094	088	91.0	172	165	168.5	176	162	169.0
Mn_3	15.07	14.33	14.7	15.25	14.50	14.9	096	093	094.5	090	084	87.0	183	167	175.0	204	165	184.5
Mean	15.51	14.98		14.54	14.12		115.6	97.4		117	94		154	144.4		154.7	138.3	
L. S. D. at 0.05 for:																		
Meth.			0.47		0.33			1.08		4.80			2.56		3.51			
Conc.			0.31		0.21			4.08		3.34			3.64		4.89			
M. X. C.			0.43		0.30			5.77		4.72			5.14		6.91			

Spr. And S.add. refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g./L. as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

Table (8) Effect of Zn and Mn application methods and concentrations on protein, zinc and manganese concentration in broad bean seeds under Nobaria conditions.

Charct.	protein (%)						Zn (mg./100g.)						Mn (mg./100g.)					
Season	1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998			1996 - 1997			1997 - 1998		
Meth. / Conc.	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$	Spr.	S.add	$\bar{\chi}$	Spr.	S.add.	$\bar{\chi}$
Cont	11.43	11.60	11.5	12.20	10.82	11.5	072	067	069.5	075	072	073.5	090	095	092.5	090	096	093 0
Zn_1	14.14	16.47	15.3	12.41	14.97	13.7	109	136	122.5	105	113	109.0	097	128	112.5	138	138	138.0
Zn_2	14.91	15.38	15.2	13.54	14.92	14.2	128	143	135.5	116	138	127.0	131	146	138.5	146	145	145.5
Zn_3	19.80	17.25	18.5	17.92	15.68	16.8	136	157	146.5	120	160	140.0	116	133	124.5	141	141	141.0
Mn_1	20.00	15.38	17.7	18.60	16.66	17.6	112	115	113.5	101	116	108.5	153	170	161.5	175	175	175.0
Mn_2	16.52	13.25	14.9	14.95	13.98	14.5	095	110	102.5	080	105	092.5	160	190	175 0	182	182	182.0
Mn_3	15.20	12.88	14.0	13.80	13.30	13.6	081	89	085.0	070	096	083.0	168	193	180.5	178	189	183.5
Mean	16.00	14.60		14.77	14.33		104.7	116.7		95.3	114.3		131	151		150	152	
L. S. D. at 0.05 for:																		
Meth.		N.S		N.S			4.43			3.39			5.17			3.15		
Conc.		1.03		0.79			3.70			4.29			3.61			3.69		
M. X. C.		N.S		N.S			5.23			6.08			5.11			5.22		

Spr. And S.add. refer to foliar spray and soil addition method, respectively.
Also, Zn_1, Zn_2 and Zn_3 or Mn_1, Mn_2 and Mn_3 = 1,2 and 3 g /L as foliar spray or 5, 10 and 15 kg/Fed. as soil addition of zinc sulphate or manganese sulphate.

In the same line, there was positive correlation between the amount of micronutrients added and the content of these minerals by the different plant organs. These findings are in agreement with those of Muckenhirn (1936) and Ricks (1958).

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استجابة الفول الرومى للزنك والمنجنيز تحت ظروف مريوط والنوبارية

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تم إضافة كبريتات الزنك والمنجنيز للفول الرومى بمنطقتى مريوط، النوبارية ، إما رشـًا على النباتات بتركيز صفر،١ ،٢، ٣ جم/لتر أو إضافـة أرضيـة بمعـدل صفـر، ٥ ،١٠ ،١٥ كجم/الفدان وكانت النتائج المتحصل عليها:

أ- بالنسبة لطريقة الإضافة:

فى منطقة مريوط زادت صفات النمو، المحصول ومكوناته والمحتوى الكيماوى معنويـًا باستخدام طريقة الرش عن الإضافة الأرضية، بينما لم يكن هناك تأثير معنوى على عدد الفـروع للنبات ونسبة التصافى فى القرون. وعلى النقيض فى منطقة النوبارية فقـد زادت صفـات النمـو والمحصول معنويـًا بطريقة الإضافة الأرضية عن الرش بينما لم يكن هناك تأثير معنـوى علـى نسبة التصافى، نسبة المادة الجافة ومحتوى البروتين فى البذور.

ب- بالنسبة لتأثير العناصر:

أدى الرش بكبريتات الزنك بتركيز ٢جم/لتر أو إضافة أرضية بمعدل ١٠ كجم/فدان إلـى زيادة النمو والمحصول ومحتوى المنجنيز فى البذور معنويـًا عن باقى معاملات الزنـك ، بينمـا تفوق محتوى البذور من البروتين والزنك برش النباتات بكبريتات الزنك بتركيز ٣ جم/لـتر أو ١٥ كجم إضافة أرضية للفدان وذلك بمنطقتى مريوط والنوبارية.

أدى رش نباتات الفول الرومى بكبريتات المنجنيز بتركيز ١ جم/لتر أو إضافة أرضية بمعـدل ٥ كجم/فدان تحت ظروف مريوط إلى زيادة صفات النمو معنويـًا عن معاملات المقارنة. كمـا أدت نفس المعاملة إلى زيادة وزن المائة بذرة ، نسبة التصافى ونسبة المادة الجافة فى البذور معنويـًا. وقد زادت نسبة البروتين والزنك بالبذور باستخدام المعدل الثانى من المنجنيز (٢ جم/لـتر أو ١٠ كجم/فدان). أما الرش بكبريتات المنجنيز بمعدل ٣ جم/لتر أو ١٥ كجم/فدان إضافة أرضيـة أدى إلى تفوق محصول النبات ومحصول الفدان من القرون ، وأيضـًا زيادة محتوى المنجنيز بـالبذور معنويـًا عن باقى معاملات المنجنيز. أما فى منطقة النوبارية فقد تفوقت المعاملة بسلفات المنجنـيز بتركيز ١ جم/لتر رشـًا على النباتات أو ٥ كجم/فدان إضافة أرضية عن باقى معاملات المنجنـيز فى جميع الصفات ما عدا محتوى المنجنيز فى البذور الذى زاد مع المعدل المرتفع من المنجنـيز ٣ جم/لتر أو ١٥ كجم/فدان إضافة أرضية.