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Effect of Seed Coating with Some Micronutrients on Faba Bean (*Vicia faba* L.)

II-Effect on Yield, Yield Attributes and Mineral Composition

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TWO field experiments were conducted on the Experimental Farm of El-Gemmeiza Agric. Res. Station, Agric. Res. Center for two seasons; 1998/99 and 1999 /2000. The aim of these experiments was to evaluate the impact of coating Faba bean seed (Giza 2 variety) with certain micronutrients on the production and mineral composition of both Faba bean seeds and straw. Zn, Mn and Fe were applied by a seed coating method individually or in all possible combinations in EDTA- form at a rate of 0.3g for either Zn or Fe and 0.15 g for Mn/kg seeds. The mean results of the two growing seasons could be summarized as follows:

1- Yield components (number of branches and pods/ m^2; plant height in cm; weight of seeds in g/ plant and 100 seed weight in g) as well as seed, straw and biological yields in kg/feddan were positively affected by the application of Zn, Mn and Fe, either individually or in mixtures. In this respect, the maximum responses were observed with the triple treatment, followed by the double and single treatments, in a descending order.

2- Among the dual treatments, the mixtures of(Zn+Fe) and (Zn+Mn) gave the highest increments for the above-mentioned parameters whilst, Zn and Fe gave values higher than those of Mn.

3- Nitrogen, phosphorus and potassium contents in both seeds and straw were significantly increased by seed coating with various micronutrient treatments, especially with the triple one.

4- Application of the investigated micronutrients alone or in combinations caused significant increases in their content in both seeds and straw and also promoted the contents in other micronutrients. In the meanwhile, triple and dual treatments had superior effects.

5- Seed and straw yields were significantly correlated with its content of Zn, Mn and Fe as the following multiple regression equations:

$$Y_1 = 429.4 + 2.9X_1^{**} + 3.3X_2 + 0.47X_3 \quad (r^2 = 0.98)$$
$$Y_2 = 472.6 + 1.8X_1^{**} + 1.0X_2 + 0.52X_3 \quad (r^2 = 0.93)$$

Where;
Y_1 and Y_2 indicate the mean values of seed and straw yields, respectively in (kg/fed.).
X_1, X_2 and X_3 indicate the mean values of Zn, Mn and Fe content, respectively in (g/fed).
** significant at 0.01 level.

Keywords : Faba bean, Seed coating, Zn-Mn-Fe.

As Faba bean takes the first place among the most important legumes raised in Egypt, back- up research has been focussed on this particular crop to maximize its production through efficient fertilization.

In general, micronutrients are not applied regularly to plants with common fertilizers and fertilizing with macronutrients only is likely to promote imbalance between macro-and micronutrients, as well as between individual nutrients. Furthermore, Egyptian soils have a high pH and $CaCO_3$ - content and low content of organic matter. Under such conditions, availability of most micronutrients to plant is reduced (Mengel and Kirkby, 1982 and Amin *et al.*, 1988).

The essential roles of micronutrients in plant metabolism, as activators or co-factors in all vital processes of a plant, can not be ignored. This leads undoubtedly to an increase in the crop production, which is considered as the main goal in this respect (El-Kabbany *et al.*,1996). In this connection, the increase in Faba bean yield as affected by micronutrients has been reported by many workers such as Amin *et al.* (1988), Osman *et al.* (1991) and Azer *et al.* (1992) They showed that application of micronutrients significantly increased all yield components, as well as seed and straw yields. Amin *et al.* (1988) also found that seed and straw yields, 100-seed weight, grain nitrogen and mineral contents increased due to the application of Zn, Mn, Fe and Cu simultaneously. Crawford *et al.* (1989) indicated that with both Mn-deficiency and toxicity, accumulation rates of fresh weight, dry weight, N,P and K in cucumber plants, were lower than with Mn-sufficiency.

There is no doubt that nutritional interaction between iron and zinc exists in plants. Lindsay and Norvell (1969) indicated that the explanation for this interaction is not completely understood. Waly (1996) on pea, found that there is a competition-effect for Zn- application on Fe-content. However, Hassan (1996) and Nassar (1997) on wheat hinted to the positive effect of Zn on Fe-uptake. Mn-Fe interactions are also reported by many investigators. Some of them (Azer *et al.*,1992 and Waly, 1996) noticed that there is an antagonism relation between Mn and Fe, whilst others (Ibrahim and Shalaby, 1994 and Nassar, 1997) reported that Mn-application increases Fe-uptake .

Applications of micronutrients to soil and foliage have historically been made. Recently, an additional method of application has beep developed, including seed coating with such micronutrients. Osman *et al.* (1991), Shams El-Din (1993) and Nassar (1997) attributed the efficiency of seed coating methods with micronutrients to its effect on the proliferation of roots through the soil. This leads the plant roots to absorb more nutrients and to correct the suitable requirements of Zn, Mn and Fe for plants, consequently producing a high quantity and quality yield.

Therefore, the aim of this work was to throw some light on the effect of addition of Zn, Mn and/or Fe by seed coating on the quantity and quality of Faba bean grown in alluvial soil.

Material and Methods

Two field experiments were conducted at the El-Gemmeiza Agric. Res. Station, Agric.Res. Center, during two successive seasons (1998/99 and 1999 /2000) to compare the effect of some micronutrients, *i.e.* Zn, Mn and Fe applied individually or in combinations as seed coating on Faba bean production.

Soil samples were taken before sowing and prepared for determining physical and chemical properties as shown in Table (1).

TABLE 1. Physical and chemical analysis of investigated soil samples.

Season		1998/99	1999/2000
1- Physical analysis:			
Coarse sand	(%)	3.14	2.26
Find sand	(%)	20.28	14.58
Silt	(%)	24.95	28.75
Clay	(%)	51.63	54.41
Soil texture		clayey	clayey
Total $CaCO_3$	(%)	3.33	4.12
Organic matter	(%)	1.65	1.80
II- Chemical analysis :			
pH (1 soil: 2.5 water suspension)		7.90	8.10
EC (dS/m, 1 soil : 5 water extract)		1.25	1.58
Soluble ions (m.eq. /100 g soil, 1 soil : 5 water extract)			
1- Cations :			
Ca^{++}		1.10	1.50
Mg^{++}		0.90	1.30
Na^{+}		4.10	4.70
K^{+}		0.20	0.40
2- Anions :			
CO_3^{--}		--	--
HCO_3^{-}		1.40	1.70
Cl^{-}		4.00	5.00
SO_4^{--}		0.90	1.20
Available nutrients (ppm):			
1- Macronutrients:			
N (1 % Potassium sulphate extract)		21.20	25.00
P (1 M sodium bicarbonate extract)		8.00	9.60
K (1 M ammonium acetate extract)		440.00	498.00
2- Micronutrients (DTPA extract)			
Zn		1.00	1.30
Mn		7.50	8.90
Fe		8.70	11.00

Faba bean, Giza 2 cultivar, was planted in rows on November 22 and 26 in the 1^{st} and 2^{nd} season, respectively. The treatments were arranged in complete randomized blocks with four replications. The plot area was $10.5m^2$ (3 x 3.5m).

Fertilizers consisted of 15kg N/fed. as ammonium sulphate (20.6%N) and 30kg P_2O_5 /fed. as superphosphate (15%P_2O_5). N-fertilizer was added 25 days after planting, whereas P-fertilization was added before planting.

Coating treatments were carried out before planting. Seeds were coated with Zn, Mn and Fe at rates of 0.3,0.15 and 0.3 g/kg seeds, respectively. Seeds were first damped with a solution of a sticker substance (Triton B) and mixed with the chelated substance of tested micronutrients. Then, the coated seeds were air dried just before sowing.

At maturity(26 and 29 April for the 1^{st} and 2^{nd} season, respectively), Faba bean plants were harvested and the following characters were recorded :

1- Plant height (cm) 2-Number of branches and pods/m^2

3- Number of seeds/plant. 4-Seed weight (g/plant).

5- 100-seed weight (g). 6-Seed, straw and biological yields(kg/fed.)

From each plot, samples of both seeds and straw were dried, ground and wet digested using a H_2SO_4-$HClO_4$ acid mixture. In the digested product, nitrogen was determined with a micro-kjeldahl apparatus (Chapman and Pratt, 1961). Phosphorus was determined colorimetrically, according to Watanabe and Olsen (1965). Potassium was determined using a flame photometer (Richards, 1954). Zinc, manganese and iron were determined using an atomic absorption spectroscope (Chapman and Pratt, 1961).

All collected data were statistically analyzed according to Gomez and Gomez (1984).

Results and Discussion

1-Effect on yield and yield attributes

Yield attributes

Data in Table (2) indicated that, in both growing seasons, the number of branches and pods/m^2 of Faba bean plants significantly increased with application of different treatments of micronutrients. However, there were no significant differences between in plant height (cm), seed weight (g)/plant and 100-seed weight (g). The maximum values of all above-mentioned parameters were attained with the application of Zn, Mn and Fe simultaneously, whilst the least increments were recorded when micronutrients were applied individually. Double mixtures gave intermediate values.

The enhancing effect of the investigated elements on the number of branches and pods may be attributed to changes induced by these nutrients in the endogenous hormone ratios (Szirtes *et al.*, 1986 and Ibrahim and Shalaby, 1994) . The increases of both the seed index (100-seed weight) and the seed weight /plant may be due to these elements enablling the plants to grow well and to improve the transfer of the photosynthetic substances from leaves to seeds during the synthesis processes because of their effects on the enzymatic group. Consequently, the weight of seeds increases, according to Waly (1996) and Nassar (1997)on wheat. The superior effect of Fe- treatments, compared to the other individual treatments, is in agreement with that obtained by many investigators such as El-Gayar *et al.* (1988) on Faba bean plants.

Seed and straw yields

Concerning the effect of the micronutrients under investigation on seed, straw and biological yield of Faba bean, data presented in Table (3) indicated that all aforementioned parameters were positively affected by the different treatments, but there were no significant differences between the various treatments. Triple treatment (Zn+Mn+Fe) was superior in this respect. The mean values for the two seasons revealed that the increase of seed yield, compared to the control treatment, was 58.2% for triple mixture treatment 22.2 to 38.5% in case of dual mixtures and 9.9 to 17.4% in case of individual treatments. For straw yield, the corresponding increases were 61.5%, between 37.3 to 52.8% and between 30.1 to 39.1% respectively.

The positive effects of the micronutrients under investigation on both seed and straw yields can be explained as follows:

1- Seed yield is a function of the number of pods/m^2, seed yield/plant and 100-seed weight. These parameters are positively affected by micronutrients

TABLE 2. Effect of investigated micronutrient treatments on the content of photosynthetic pigments (mg/plant) in Faba bean leaves at 70 days age.

Treatments	No. of branches /m²			No. of pods/m²			Plant height(cm)			No. of seeds/plant			Seed weight(g/plant)			100-seed weight		
	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	25.0	21.1	23.1	87.3	93.2	90.3	103.9	123.6	113.8	29.1	32.0	30.6	16.4	18.4	17.4	56.02	57.44	56.73
Zn	26.9	23.8	25.4	102.0	123.7	112.9	106.8	126.5	116.7	31.8	36.7	34.3	18.7	22.0	20.4	58.22	59.76	58.99
Mn	25.0	22.9	24.0	96.5	107.5	102.0	105.5	126.4	116.0	29.9	36.0	33.0	17.4	20.8	19.1	27.13	57.67	57.40
Fe	25.0	24.1	24.6	107.0	111.0	109.0	104.7	124.0	114.4	31.7	37.2	34.5	18.5	22.2	20.4	58.16	59.25	58.71
Zn+Mn	31.3	26.9	29.1	112.0	130.4	121.2	110.3	132.3	121.3	34.5	40.0	37.3	20.7	24.3	22.5	60.09	61.10	60.60
Zn+Fe	34.4	28.2	31.3	112.9	147.2	130.1	109.5	131.7	120.6	36.1	40.5	38.3	22.2	25.7	24.0	60.49	63.45	61.97
Mn+Fe	29.7	25.4	27.6	111.0	128.7	119.9	107.0	129.7	118.4	32.6	37.6	35.1	19.4	22.9	21.2	59.00	60.68	59.84
Zn+Mn+Fe	36.2	33.0	34.6	118.0	168.3	143.2	116.9	134.8	125.9	40.2	44.9	42.6	25.5	29.2	27.4	63.72	63.72	63.67
L.S.D. at 5%	6.6	5.9	6.2	12.7	35.0	19.4	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

TABLE 3. Effect of some micronutrients on seed, straw and biological yield (kg/fed.) on Faba bean.

Treatments	Seed yield (kg/fed.)			Straw yield (kg/fed.)			Biological yield (kg/fed.)			Seed/Straw Ratio		
	1st season	2nd season	Mean	1st season	2nd season	mean	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	573	643	608	632	678	655	1205	1321	1263	0.91	0.95	0.93
Zn	656	772	714	877	944	911	1533	1716	1625	0.75	0.82	0.79
Mn	608	728	668	808	895	852	1416	1623	1520	0.75	0.81	0.78
Fe	648	778	713	855	943	899	1503	1721	1612	0.76	0.83	0.79
Zn+Mn	727	853	790	902	976	939	1629	1829	1729	0.81	0.87	0.84
Zn+Fe	780	903	842	983	1019	1001	1763	1922	1843	0.79	0.89	0.84
Mn+Fe	681	804	742	874	923	899	1555	1727	1641	0.78	0.87	0.83
Zn+Mn+Fe	896	1027	962	1019	1097	1058	1915	2124	2020	0.88	0.94	0.91
L.S.D.at 5%	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S			

addition (Table 2). Hence, yield is also increased. Likewise, straw yield is a product of plant height and number of branches/m^2. So, straw yield increased with increase of these measurements (Table 2)

2- Zn, Mn and Fe are involved directly or indirectly in formation of starch, protein and other biological components in Faba bean seeds through their role in the respiratory and photosynthesis mechanisms, as well as their roles in the activity of various enzymes (Monged *et al.*, 1993).

3-These micronutrients play important roles in stimulating the vegetative growth through increasing cell size and leaf area. Thus, the rate of photosynthesis increases (Mahmoud *et al.*, 1987).

4- The aforementioned trace elements delay the senescence of plants through raising the level of IAA, chlorophyll content and native assimilation ratio (NAR) in leaves. Thus, total dry matter accumulation and yield components increase (Kumar *et al.*, 1988).

The biological yield is the summation of seed and straw yields. Hence, it can be concluded that it increases as a result of increasing the above mentioned two fractions (Table 3).

The highest values of seed, straw and biological yields recorded with the triple treatment (Zn+Mn+Fe) may be due to the suitable balance among them. This enables the plants to grow well. As a result, yield components increase.

When the seed to straw ratio in both seasons was considered, the differences between the treatments were pronounced as shown in Table (3). This can be explained on the basis of the role of micronutrients under study in both the vegetative and reproductive stages. In this connection, Badr *et al* . (1996) reported that the role of specific micronutrients in prolonging the vegetative stage was accompanied by a competition between vegetative and reproductive growth.

2- Effect on macronutrients content

Data presented in Table (4) show that for the two seasons, N, protein, P and K contents in both Faba bean seeds and straw significantly increased with the addition of Zn, Mn and Fe, individually or in double and triple combinations.

The synergistic effects of these elements on the macronutrients content can be attributed to the following reasons:

1- Increasing the corresponding values of seed and straw yields, (Table 3).

2- These elements play important roles in assimilation processes *e.g.* proteins and nucleic acids synthesis, (Delvin and Withman, 1983) . They are considered essential components of various enzymes necessary for metabolic mechanisms (Vallee and Wacker, l973) .

3- Trace elements under investigation play a role in assimilation processes of organic and inorganic phosphorus compounds (phospholipids, phosphoproteins and phosphocarbohydrates).

Among the individual treatments, Fe and Zn surpassed Mn, whereas, in case of dual additions, the treatment of (Zn+Fe) gave the greatest value, followed by the treatments of (Zn+Mn) and (Mn+Fe), respectively.

The statistical analysis indicates that in most cases no significant differences exist between the individual treatments compared with each of the other ones or between the dual treatments. However, significant differences between the dual and individual treatments and between the triple treatment and the oher ones were registered. In this respect, Waly (1996) on pea and Nassar (1997) on wheat found that the addition of micronutrients simultaneously gives an additional enhancing effect in NPK contents, compared with the individual applications. Moreover, the superior effect of the triple treatment may be due to the suitable balance between the aforementioned micronutrients, which enable the plants to grow well and to absorb more quantities of NPK.

TABLE 4. Effect of some investigated micronutrients treatments on macronutrients content (kg/fed.) in Faba bean seeds and straw.

Treatments	N						Protein in seeds			P						K					
	Seeds			Straw						Seeds			Straw			Seeds			Straw		
	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	15.1	19.7	17.4	3.2	3.1	3.15	94	123	109	2.02	2.75	2.39	0.28	0.44	0.36	5.70	6.00	5.85	7.70	8.40	8.10
Zn	22.7	26.8	24.8	5.1	5.3	5.2	142	168	155	2.94	3.55	3.25	0.47	0.76	0.62	6.70	7.42	7.06	12.40	11.90	12.20
Mn	18.0	24.5	21.3	4.4	4.4	4.4	113	153	133	2.38	3.33	2.86	0.41	0.68	0.55	6.22	6.93	6.58	10.90	11.00	11.00
Fe	24.0	27.1	25.6	5.1	5.4	5.3	150	169	160	2.71	3.65	3.18	0.49	0.90	0.70	6.81	7.64	7.22	12.60	11.90	12.30
Zn+Mn	28.5	31.4	30.0	6.0	6.7	6.4	178	196	187	3.26	4.04	3.65	0.65	1.03	0.84	7.87	8.70	8.29	14.10	13.20	13.70
Zn+Fe	31.0	33.8	32.4	7.0	7.3	7.2	194	211	203	3.56	4.40	3.98	0.79	1.35	1.07	8.50	9.49	9.00	15.80	14.60	15.20
Mn+Fe	26.1	29.0	27.6	5.5	5.9	5.7	163	181	172	2.87	3.77	3.32	0.57	0.91	0.74	7.30	8.21	7.76	13.00	12.40	12.70
Zn+Mn+Fe	37.0	40.2	38.6	7.8	8.4	8.1	231	251	241	4.17	5.30	4.74	0.96	1.91	1.44	10.80	11.00	10.90	18.60	17.20	17.90
L.S.D. at 5%	6.6	10.6	5.47	0.7	0.7	0.6	34.9	66	34.2	0.65	1.40	0.70	0.08	0.10	0.07	1.54	2.89	1.49	2.89	1.56	1.21

3- Effect on micronutrients content

Data in Table (5) revealed that, for the two seasons, all investigated micronutrient treatments increased the contents of Zn, Mn and Fe in both Faba bean seed and straw, compared with the control treatment.

Mean values of the two seasons showed that the highest increments in Zn, Mn and Fe contents in seed and straw were attained when seed coating was done with the triple mixture of the aforementioned micronutrients, *i.e.* (Zn+Mn+Fe). In addition, application of any element individually significantly increased its content in Faba bean seeds and straw and also enhanced the content of other micronutrients in both the aforementioned two fractions. There were also significant differences between the dual treatments including the element and the other individual ones.

It is evident from Table (5) that the effect of treatments under investigation on micronutrients content was more pronounced in straw than in seeds.

The above-mentioned results can be explained on the basis of raising the corresponding values of both seed and straw yields. Faba bean seed coating with Zn, Mn and Fe promotes the proliferation of roots and leads the plants to grow well. Consequently, plant roots absorb more nutrients and correct the suitable requirements of Zn, Mn and Fe. These results are in harmony with those obtained by Osman *et al* . (1991) on Faba bean and Hassan (1996) and Nassar (1997) on wheat. In addition, Osman *et al.* (1991) indicated that more than 95% of Zn required by Faba beans is supplied by diffusion. They also reported that the role of iron in plants is affected by supply of Zn.

Finally, it is worthy to notice that Faba bean seed and straw yields are significantly correlated with the values of Zn, Mn and Fe contents in both the above two fractions, under different treatments of micronutrients (Fig. 1). The correlation coefficients between seed yield and Zn, Mn and Fe contents were 0.99, 0.94 and .098, respectively. For straw yield, the corresponding correlation coefficients were 0.92, 0.88 and 0.96. The simple regression equations were as follows:

$$Y_1 = -73 + 0.17X_1 \quad Y_2 = -60 + 0.11X_1$$
$$= -13 + 0.04X_2 \quad = -35 + 0.08X_2$$
$$= -341 + 0.73X_3 \quad = -517 + 1.25X_3$$

TABLE 5. Effect of investigated micronutrients treatments on micronutrients content (g/fed.) in Faba bean seeds and straw.

Treatments	Zn						Mn						Fe					
	Seeds			Straw			Seeds			Straw			Seeds			Straw		
	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	32.6	38.1	35.4	16.8	24.0	20.4	11.5	14.0	12.8	18.5	26.2	22.4	89	130	110	288	392	340
Zn	41.4	62.5	52.0	32.5	48.7	40.6	14.7	18.2	16.5	33.7	38.9	36.3	146	197	172	445	680	563
Mn	35.3	45.9	40.6	23.1	33.8	28.5	15.5	18.7	17.1	35.3	39.0	37.2	105	158	132	383	620	502
Fe	37.7	58.6	48.2	28.4	41.0	34.7	13.7	18.2	16.0	32.1	38.3	35.2	160	234	197	480	782	631
Zn+Mn	47.4	74.2	60.8	36.6	57.6	47.1	21.0	23.1	22.1	44.1	53.8	49.0	167	243	205	462	765	614
Zn+Fe	55.9	79.5	67.7	48.1	62.5	55.3	18.6	22.0	20.3	40.4	43.2	41.8	254	280	267	593	893	743
Mn+Fe	40.4	62.5	51.5	29.8	42.3	36.1	19.3	21.8	20.6	42.2	44.6	43.4	188	250	219	502	781	642
Zn+Mn+Fe	90.7	102.7	96.7	56.2	73.6	64.9	28.8	29.5	29.2	52.4	70.8	61.6	308	433	371	718	1005	862
L.S.D. at 5%	9.87	26.8	14.9	4.34	5.31	3.32	3.48	7.70	3.88	5.16	5.67	4.16	81	42.2	44.5	59.5	95.6	54.8

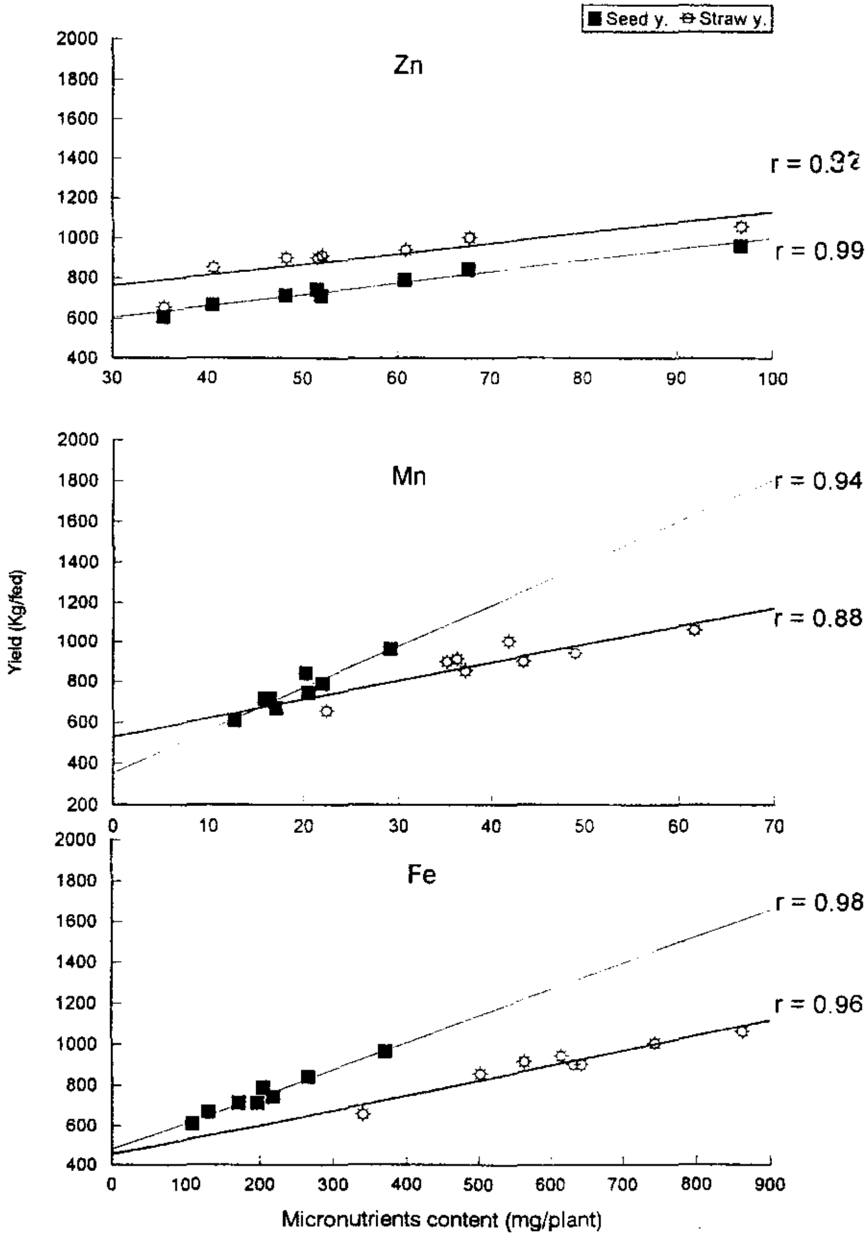

Fig. 1. Seed and straw yields of Faba bean (kg/fed.) as affected by micronutrients content under different treatments of micronutrients (mean values of two seasons).

Where, Y_1 and Y_2 indicate the mean values of seed and straw yields, respectively in (kg/fed.).

X_1, X_2 and X_3 indicate the mean values of Zn, Mn and Fe content, respectively in (mg/fed.).

The multiple regression equations were as follows:

$$Y_1=429.4+2.9X_1^{**} + 3.3X_2 + 0.47X_3 \quad (r^2 =0.98)$$
$$Y_2= 472.6 + 1.8X_1^{**} + 1.0X_2 + 0.52X_3 \quad (r^2 = 0.93)$$

From the foregoing results it can be concluded that seed coating with micronutrients has a positive effect on the quantity and quality of Faba bean yield. In this connection, triple application (Zn +Mn +Fe) attained the highest values of Faba bean yield and yield components as well as and macro-and micronutrient contents followed by dual and individual treatments, respectively. This reveals that application of micronutrients under investigation simultaneously gives additional pnositive effects on all above- mentioned parameters. The greatest response of Faba - bean plants to the triple treatment means that the amounts of Zn, Mn and Fe in the soil under study are not sufficient to face the requirements of Faba bean plants for these nutrients.

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تأثير تغليف البذور ببعض العناصر الصغرى على الفول البلدى
٢- التأثير على المحصول ومكوناته ومحتواه من العناصر الغذائية .

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معهد بحوث *الأراضى والمياه والبيئة- مركز البحوث الزراعية* - جيزة - مصر

أقيمت تجربتان حقليتان فى محطة البحوث الزراعية بالجميزة خلال موسمى الزراعة ١٩٩٨ /١٩٩٩ ، ١٩٩٩ /٢٠٠٠ بغرض دراسة تأثير تغليف بذور الفول البلدى بالزنك والمنجنيز والحديد على محصولى الحبوب والقش ومحتواهما من العناصر الغذائية الكبرى والصغرى وكذلك محتوى البذور من البروتين .

غلفت بذور الفول البلدى (صنف جيزة ٢) قبل الزراعة بعناصر الزنك والمنجنيز والحديد فى صورتها المخلبية (بمعدل ٣, . جم عنصر / كجم بذره فى حالتى فى الزنك والحديد وبمعدل ١٥, . جم /كجم بذور فى حالة المنجنيز) . وقد أضيفت هذه العناصر فى صور منفردة أو فى صورة مخاليط ثنائية أو ثلاثية .

وقد أشارت النتائج المتوسطة احصائيا لكلا موسمى النمو

والمتحصل عليها إلى النقاط الآتية :

١- أدت إضافة العناصر الصغرى موضوع الدراسة-منفردة أو فى صورة مخاليط -إلى زيادة مكونات محصول الفول البلدى (عدد الفروع والقرون /م٢ - ارتفاع النبات - عدد ووزن البذور / نبات - وزن المائة بذره) وكذلك زيادة محصول البذور والقش والمحصول البيولوجى /فدان . وقد تحققت أقصى الاستجابات لجميع المقاييس السابقة مع المعاملة الثلاثية للعناصر الصغرى (زنك +المنجنيز+الحديد) تلتها المعاملات الثنائية ثم المعاملات الفردية.

٢- بمقارنة معاملات العناصر الصغرى ببعضها فقد لوحظ تفوق معاملتى (الزنك + الحديد) ، (الزنك + المنجنيز) على معاملة (المنجنيز+ الحديد) وذلك فى حالة مخاليط العناصر الصغرى الثنائية بينما لوحظ ارتفاع القيم المتحصل عليها لجميع المقاييس المحصولية السابقة عند إضافة الحديد والزنك عنه عند إضافة المنجنيز (عند مقارنة المعاملات المنفردة للعناصر الصغرى ببعضها)

٣- أدى تغليف بذور الفول البلدى بمعاملات العناصر الصغرى إلى الزيادة المعنوية فى محتوى البذور والقش من النتروجين والفوسفور والبوتاسيوم وكذلك محتوى البذور من البروتين وقد سجلت أعلى القيم عند تغليف البذور بالعناصر الثلاث مجتمعة تلاها تغليف البذور بمخاليط العناصر الثنائية ثم بالعناصر منفردة.

٤- حققت إضافة العناصر الصغرى المدروسة زيادة معنوية فى محتواها فى كل من البذور والقش كما شجعت إضافتها من امتصاص غيرها من العناصر الصغرى وزيادة محتواها فى كلا المكونين السابقين وفى هذا الصدد تفوقت معاملات العناصر الصغرى الثلاثية والثنائية على التوالى على غيرها من المعاملات الفردية.

٥- ارتبط محصول البذور والقش معنويا بمحتواهما من الزنك والمنجنيز والحديد . وقد بينت ذلك معادلات الانحدار المركبة الآتية :-

محصول البذور = ٤ر٤٢٩+٩ر٢ زنك** + ٣,٣ منجنيز + ٤٧ . . حديد (معامل الارتباط = ٩٨ . ٠)

محصول القش = ٦ر٤٧٢ + ٨ . ١ زنك** + . . ١ منجنيز + ٥٢ . . حديد (معامل الارتباط = ٩٣ . ٠)