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Zn Increased Flowering and Pod Setting in Faba Beans and its Interaction with Fe in Relation to Their Contents in Different Plant Parts

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Abstract: A pot experiment was conducted under controlled conditions to study the effect of spraying Zn, Fe and their interactions on pod setting in faba beans. Fe and Zn concentrations were determined in leaves, stems and pods. Faba bean var. Giza 3 was used. Zn treatment increased the number of flowers and pods and percentage of pod setting. Fe showed adverse effects. Zn concentration in all organs was increased by spraying Zn, while it was not affected by spraying Fe. Fe spraying led to increases the Fe content in leaves and stems, while Fe content in pods was decreased. Spraying Zn caused Fe decreases in leaves and pods. Treatments which increased flowering and pod setting showed lower Fe/Zn ratios than the control and *vice versa*.

Key words: Flower setting, pod setting, faba bean, Giza 3, Fe, Zn

Introduction

Deficiency of micronutrients, especially Zn, Fe and Mn are widespread in most crops in Egypt either due to low available concentration in the soil, high demand of crops, nutrient imbalance or unfavorable agronomic practices (El-Fouly, 1983; El-Fouly *et al.*, 1984; Wallace, 1980; Amberger, 1980; Fawzi *et al.*, 1987). Spraying of micronutrients under field conditions in Egypt was found to increase the yield (Gomma *et al.*, 1986; Eweida *et al.*, 1980; El- Sheikh, 1981; Fawzi *et al.*, 1983; Hadi *et al.*, 1985; Fouly and Rezk, 1986). These studies were carried out using single elements or combinations of different elements. A previous field study to compare the effect of Fe, Zn and their combination on the yield of faba beans showed that each Zn and Fe alone as foliar spray caused increases in yield. The increase was higher in case of Zn application (El-Fouly *et al.*, 1996). Zn concentration in leaves was increased, while Fe concentration did not show considerable changes. Pod setting is influenced by different factors (El-Fouly, 1982). The present pot experiment was carried out to study the effect of Zn, Fe and their combination on pod setting in relation to their contents in different plant parts.

Materials and Methods

A pot experiment was conducted in a controlled greenhouse under 13hr light period with day temperature set at 20°C and night temperature at 15°C in the institute of Plant Nutrition, Technical University Munich. The pots were filled with 12 kg of air dried sandy clay loam soil with a pH of 7.6 and 12.4 % $CaCO_3$ and 0.9 ppm, 4.5 ppm, 170 mg/100 gm, 1.5 mg/100g and 25 mg/100 gm of Zn, Fe, N, P and K, respectively. Demineralized water was applied to bring the soil to its field capacity, which was initially determined in the laboratory. The soil was allowed to equilibrate for 24 hours before seeding. Each pot was seeded with eight seeds of faba bean (cultivar Giza 3). Two weeks later, the plants were thinned to six plants per pot. The pots were irrigated daily with demineralized water to maintain 60% of field capacity through weighed-pot technique. The soil surface was frequently stirred with a glass rod to prevent surface crusting.

A basal application of 48 mg N, 360 mg P_2O_5 and 360 mg K_2O per pot were applied uniformly and individually to each pot in a solution form following three foliar application treatments were conducted : without spraying (control), one spray, 35 days after sowing and two sprays, 35 days and 45 days after sowing. The treatments were designed in split-plot with six replications, where the main plots were assigned for Fe treatments and the sub-plots for Zn treatments. The concentration of spray solutions were 50 ppm for iron / or Zinc in EDTA chelated form. Number of flowers and pods were counted every four days as an average of four plants, starting at 35 and 42 days-old plants for flowers and pods respectively. Pod set percentage was calculated as follows:

Number of pods/number of flowers per plant X 100

The plant sampling was done once, 60 days after sowing for nutrient determinations, plants were divided into; leaves, stems and pods. Plant samples were washed three times with acidified distilled water and then once with bidistilled water, dried at 70°C for 24 hours, ground in stainless steel mill to pass through 0.5 mm sieve. The samples (1.0 gm) were wet digested in HNO_3-$HClO_4$- H_2SO_4 mixture in a ratio of 8:1:1 (Chapman and Pratt, 1961). Atomic absorption spectrophotometer (Zeiss FMD3) apparatus was used, for nutrient determination. Data were statistically analyzed according to Snedecor and Cocharan (1967). The mean values for studied factors were compared by either L.S.D. or Duncan's test significance.

Results and Discussion

It is clear from the data given in Table 1 that, the number of flowers and pods as well as the pod setting percentage were significantly increased by foliar spraying of 50 ppm Zn. Increasing the number of sprays tended to increase both number of flowers and pods per plant, while pod setting percentage was not changed as compared with control. Two sprays of zinc produced the highest number of flowers and pods per plant and highest pod setting percentage. In contrast to the positive effect of Zn, foliar spraying of Fe significantly decreased the number of flowers and pods as well as the pod setting percentage (Table 1). The interaction effect of both zinc and iron (Table 2) shows that, two sprays of zinc without

Table 1: Effect of spraying Fe and Zn on number of flowers and pods of faba bean plants

Treatments		No. of flowers / plant (%)	No. of pods /plant (%)	Pod setting (%)
Zn	0	79.1 b (100)	4.3 c (100)	5.3 b (100)
	1 spray	88.7 b (112)	5.9 b (137)	6.5 a (123)
	2 sprays	101.4 a (128)	6.3 a (147)	6.8 a (128)
Fe	0	95.1 a (100)	6.2 a (100)	6.6 a (100)
	1 spray	87.5 b (92)	5.3 b (85)	5.9 b (89)
	2 sprays	86.6 b (91)	4.9 c (79)	5.6 b (85)

Values with the same letter are not significantly different.

Table 2: Interaction effect of spraying Fe and Zn on number of flowers and pod setting of faba bean plants

Treatment		No. of flowers / plant (%)	No. of pods / plant (%)	Pod setting (%)
Fe	Zn			
0	0	82.0 (100)	5.2 (100)	6.3 (100)
	1 spray	100.2 (122)	6.7 (129)	6.7 (106)
	2 sprays	103.1 (126)	6.8 (131)	6.8 (108)
1 spray	0	75.5 (100)	4.2 (100)	5.2 (100)
	1 spray	86.3 (114)	5.4 (129)	6.2 (119)
	2 sprays	100.7 (133)	6.4 (152)	6.3 (121)
2 sprays	0	75.3 (100)	3.6 (100)	4.8 (100)
	1 spray	79.7 (106)	5.2 (144)	6.4 (138)
	2 sprays	100.3 (133)	5.7 (158)	5.7 (118)
L.S.D. at 0.05		5.2	n.s	0.7

n.s. = not significant.

Fe resulted in the highest number of flowers (103.1) and pods (6.8) per plant and pod set percentage (6.8%). On the other hand, either one or two sprays of Fe decreased these numbers at all treatments of zinc. These findings are in accordance with the results of other workers (Ewieda *et al.*, 1980; Saber, 1980; El-Sheikh, 1981; Abdel- Aziz *et al.*, 1982; Fawzi *et al.*, 1983; Fouly and Rezk, 1986; Gomaa *et al.*, 1986; Ibrahim and El-Labban, 1986; Amin *et al.*, 1988).

Irrespective of Fe treatments, two sprays of Zn caused the significant increase in zinc concentration of both leaves and stems, but either one or two sprays make a significant increase in pods content of zinc as compared with that of no spray treatment.

Table 3: Effect of spraying Zn and Fe on their concentrations in faba bean plants

Treatments		Leaves (%)	Stems (%)	Pods (%)
Zn concentration (ppm)				
Zn	0	71.2 b (100)	23.6 c (100)	21.8 b (100)
	1 spray	69.6 b (102)	22.9 c (56)	23.3 a (107)
	2 sprays	75.7 a (106)	27.0 a (114)	24.0 a (110)
Fe	0	72.1 a (100)	24.7 a (100)	23.8 b (100)
	1 spray	73.5 a (102)	22.4 a (91)	21.2 b (89)
	2 sprays	70.9 a (98)	24.5 a (99)	22.8 b (96)
Fe concentration (ppm)				
Zn	0	158.6 (100)	25.3 a (100)	49.0 a (100)
	1 spray	156.0 (98)	27.8 a (110)	45.0 b (92)
	2 sprays	149.3 (94)	26.0 a (103)	46.8 b (96)
Fe	0	148.8 (100)	24.8 b (100)	50.9 a (100)
	1 spray	150.5 (102)	25.4 b (102)	45.6 b (90)
	2 sprays	164.6 (111)	28.9 a (111)	46.9 b (92)

Values with the same letter are not significantly different.

Whereas iron treatments had no significant effects on zinc concentration in all plant parts. Gomaa *et al.* (1986) and Fawzi *et al.* (1983) reported similar results. Leaves of faba bean plants had the highest zinc concentration followed by stem and pods (Table 3). The results obtained for zinc concentration of different parts of faba bean plants as affected by foliar application of Zn and/or Fe are illustrated in Table 4. Zinc concentration of leaves and stems increased as the number of sprays with Zn-EDTA was increased (two times), at the first two treatments of Fe. Whereas Zn concentration of leaves was not affected when it was sprayed two times with Fe- EDTA. However, the Zn concentration of stems was increased. No appreciable differences have been found in zinc concentration of leaves, stems and pods due to one Zn treatments at all treatments of iron. But, at two sprays treatments of zinc the differences were distinct and tended to decrease with foliar application of iron. Table 5 shows that the ratio Fe/Zn is closely related with the effect of different treatments on flowering and pod setting. Treatments, which increased flowering and pod setting were characterized by lower Fe / Zn ratio than the control. High Fe/Zn ratios were found in treatments which showed lower flowering and pod setting rates. Spraying the plants with Fe, irrespective of zinc

Table 4: Interaction effect of Fe and Zn spraying on their contents of different parts of faba bean plants.

Treatments		Zn (ppm)				Fe (ppm)			
Fe	Zn	Leaves	Stems	Pods	Total	Leaves	Stems	Pods	Total
0	0	71.1	23.0	21.7	115.8	149.2	22.5	53.6	225.3
	1 spray	70.8	23.1	23.4	117.3	148.7	25.2	46.6	220.5
	2 sprays	75.6	28.0	26.3	129.9	148.3	26.8	47.3	222.4
1 spray	0	70.8	21.3	21.1	112.2	154.2	21.3	46.9	222.4
	1 spray	68.8	21.7	21.0	100.0	151.4	28.9	43.7	224.0
	2 sprays	74.8	24.1	21.7	120.6	145.8	24.1	46.3	216.2
2 sprays	0	71.7	23.6	21.1	115.4	172.4	32.1	46.6	251.1
	1 spray	70.2	23.6	23.3	117.1	167.7	27.4	44.7	239.8
	2 sprays	70.7	26.2	24.0	120.0	153.9	27.2	46.8	227.9
LS.D. at 0.05		4.0	2.4	n.s.		7.8	2.7	n.s.	

n.s. not significant.

Table 5: Effect of Zn and Fe on Fe/Zn ratio in different organs of faba bean plants.

Treatments		Fe/Zn		
		Leaves	Stems	pods
Zn	0	2.23	1.07	2.25
	1 spray	2.24	1.21	1.93
	2 sprays	1.97	0.96	1.95
Fe	0	2.06	1.00	2.14
	1 spray	2.05	1.13	2.15
	2 sprays	2.32	1.18	2.06

0treatments significantly increased the Fe concentration in leaves and stems, and decreased its concentration in pods. The highest Fe concentration in leaves and stems was recorded by foliar application of Fe-EDTA twice. On the other hand, spraying the plants with Zn significantly decreased the iron contents of both leaves and pods in particular at the two zinc spray treatments, while the concentration of Fe in stems was not affected by Zn treatments. The results showed that, iron concentration of leaves and stems decreased significantly as the number of Zn sprays increased. This might be a consequence of the increase in Zn content due to spraying with Zn, indicating a negative interaction between Zn and Fe concentrations in leaves and stems. Whereas, iron concentration in faba bean pods remained more or less constant with the application of iron at all zinc treatments. These findings are similar to those, obtained by Amin *et al.* (1988). They showed that when faba bean plants grown in pots and sprayed 3 times with 0.04% Fe-, Zn -, and Mn- EDTA, Zinc content was slightly increased but Fe and Mn were less influenced.

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References

Abdel-Aziz, I.M., M.H. Mohamed, M.A.A. Amin and I.A. Ibrahim, 1982. Effect of phosphorus and zinc application by different methods on broad bean plants (*Vicia faba* L.) in calcareous soil. Res. Bull. No. 725.

Amin, M.A.A., M.S.M. Baza and F.H. El-Fendy, 1988. Effect of the number of sprays of some micronutrients on the growth, yield and mineral composition of broad bean plants. Ann. Agric. Sci. Moshtohor., 26: 2007–2022.

Amberger, A., 1980. Foliar application of micronutrients uptake and incorporation into metabolism. Proc. 2nd Workshop " Micronutrients and Plant Nutrition ", Mariut- Egypt, 1979, pp. 47-60, Ed. M.M. El-Fouly.

Chapman, H.D. and P.F. Pratt, 1961. Methods of analysis for soil, plant and water. Univ. California, Division of Agric., U.S.A.

El-Fouly, M.M., 1982. Flower and pod drop. In Faba bean improvement. Eds. G. Hawtin and C. Webb. ICARDA, 177-184

El-Fouly, M.M., 1983. Micronutrients in arid and semi-arid areas: Levels in soil and plants and the need for fertilizers with reference to Egypt. Proc. 17th Coll. Int. Potash Institute, pp; 163-173. Rabat and Marrakech/ Morocco, May, 2-6. 1983.

El-Fouly, M.M., A.F.A. Fawzy, A.H. Firgany and F.K. El-Baz, 1984. Micronutrient status of crops in selected areas in Egypt. Commun. Soil. Sci. Pl. Annal., 15: 1175-1189.

El-Fouly, M.M., F. Souror, A.I. Rezk and M.F. El-Masry, 1996. Yield increase in faba beans under field conditions in Egypt through foliar application of Zinc and Iron. Proc. 9th Int. Colloq. Plant Nutrition 8-15., 9.96. Prag. Czeck. Rep. Ed. P. Martin–Prevel and J. Baier, 559-563

El-Fouly, M.M. and A.F.A. Fawzi, 1996. Higher and better yields with less environmental pollution in Egypt through balanced fertilizer use. Fertilizer Research 43,1-40. Kluwer Acad. Pub. Netherlands.

El-Sheikh, M.H., 1981. Studies on faba bean. Effect of major cultural practices and micro elements on faba bean. M.Sc. Thesis, University of Alexandria, Egypt.

Eweida, M.H.T., A.M. Hagras and H.A. Saber, 1980. Effect of inoculation with *Rhizobium sp.*, fertilizer treatments and zinc sulphate on yield and yield components of field bean. Research Bulletin, Faculty of Agric., Ain Shams University, No. 1383; 26 pp.

Fawzi, A.F.A., A.H. Firgany, A.I.Rezk and M.A. Kishk, 1983. Response of *Vicia faba* bean to K and Micronutrient Fertilizers. Egyptian J. Bot., 26: 113-121.

Fawzi, A.F.A., A. Amberger and M.M. El-Fouly, 1987. Nutrient status of field crops in the Valley area. Agrochem., 31: 534-547.

Fouly, M.M. and A.I. Rezk, 1986. Micronutrient status of some food crops increasing yield through micronutrient foliar application in Beheira/Egypt. Proc. 1st Int. Symp. Foliar Fertilization, March 14-16.1985.(Ed.A. Alexander).153-166.

Gomaa, M.A., H.A. Zied and F.I. El-Araby, 1986. The effect of spraying with some micronutrient elements on growth and yield of broad bean (*Vicia faba* L.). Ann. Agric. Sci. Moshtohor, 24: 658-666.

Hadi, A.H.A., K.G. Asy, H.W. Doering, M.S. Kadr, Mohamed, A.A. Moustafa and M.E. Taha, 1985. Effect of foliar fertilization in different crops under Egyptian conditions. Proc. 1st Int. Symp. Foliar Fertilization, March 14-16.1985. (Ed. A. Alexander), p: 126-141.

Ibrahim, A.A. and T.T. El-Labban, 1986. Effect of kinetin, cycocel and some micronutrients on the accumulation of some micronutrients in *Vicia faba*. Ann. Agric. Sci. Moshtohor, 24 : 317-328.

Saber, H.A., 1980. Study on the effect of some cultural treatments on yield quality in field bean. M. Sc. Thesis, University of Al-Azhar, Egypt.

Snedecor, G.W. and W.G. Cocharan, 1967. Statistical Methods. 6th ed. Iowa State University press.

Wallace, A., 1980. Some present and potential micronutrient problems of sandy desert soils of the Near East. Proc. 2nd Workshop " Micronutrients and Plant Nutrition Problems in Egypt ". Mariut (1979) pp: 55-88 (Ed.M.M. El-Fouly).