UTILIZATION OF BEAN PLANTS TO ZINC FERTILIZATION

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Abstract

A pot experiment was carried out using an alluvial soil to study the effect of foliar Zn-application as $ZnSo_4$ and ZnEDTA at levels of 0,5 and 10 ppm Zn on dry matter yield and both Zn-content and Zn-uptake by different parts of bean plants grown in soil fertilized with NPK and /or FYM.

The results show that the highest values of dry matter yield and either Zn-content or Zn-uptake by different parts of bean plants were realized by 10 ppm Zn-foliar application with farmyard manure treatment.

INTRODUCTION

Kidney bean (*Phaseolus vulgaris* L.) is one of the most important vegetable crops grown in Egypt not only for local consumption but also for export purposes.

Subba and Ghosh (1981) and Halvorson and Bergman (1983) reported that the dry matter yield of bean plants grown on alluvial soil had linearly increased with NPK and /or FYM . Furthermore, Swarup and Ghosh (1981) found that Zn-content and Zn-uptake were significantly increased by the application of 10 kg $ZnSO_4$ when grown on soil fertilized with NPK or FYM.

The purpose of this study is to clarify the effect of foliar application of different zinc sources and levels on the dry matter yield, zinc content and zinc uptake

by different parts (shoots and pods) of bean plants grown in soil treated with NPK and farmyard manures.

MATERIALS AND METHODS

A pot experiment was conducted under greenhouse conditions using soil samples (0-30cm) taken from Agricultural Experimental Station at Bahtim representing an alluvial soil. Some physical and chemical properties of soil samples were determined according to Black (1965) and available zinc was determined according to Lindsay and Norvell (1978) , Table 1.

Nine kgs of soil were placed in plastic pots. Farmyard manure was added at the rate of 15 m^3/fed. N, P and K fertilizers were added in doses of 150 kg urea (46%N) , 125 kg superphosphate (15% P_2O_5) and 100 kg potassium sulphate (48% K_2O/fed., respectively. Farmyard manure (FYM) , P and K were added before planting while N wa s added in two equal doses at 15 and 45 days from planting . The zinc foliar application treatments were as follows:-

Zn_0 = Control
Zn_1 = 5 ppm of Zn as $ZnSO_4$ - $7H_2O$
Zn_2 = 10 ppm of Zn as $ZnSO_4$ - $7H_2O$
Zn_3 = 5 ppm of Zn as ZnEDTA
Zn_4 = 10 ppm of Zn as ZnEDTA.

Table 1. Physical and chemical properties of the studies soil samples.

Physical properties		Chemical properties	
Mechanical analysis		Soluble anions (meq/ 100g Soil)	
Coarse sand	3.55%	HCO^-_3	3.35
Fine sand	31.60%	Cl^-	2.72
Silt	28.25%	SO_4^{--}	1.85
Clay	36.85%	Soluble anions (meq/100g soil)	
Texture grade	Clay loam	Na+	1.95
pH	8.10	K+	0.61
EC mmohs/cm_3	1.34	Ca+	3.32
O.M.	1.89%	Mg++	2.04
$CaCO_3$	3.89%	Available Zn (ppm)	4.60

Ten seeds of Kidney bean (*Phaseolus vulgaris* L.) were sowed in each pot. The seedlings were thinned to four plants per pot and received the abovementioned Zn treatments. Irrigation was done at 75% of W.H.C. After 75 days from planting the plants were cut at 1cm above soil surface and separated into shoots and pods. Different plant parts were washed, air dried, oven dried at 70 C^{o}, weighed and recorded, then ground and kept for zinc analyses. Zn content was estimated using the atomic absorption according to Page *et al.* (1982).

Statistical analyses were carried out according to Gomez and Gomez (1983).

RESULTS AND DISCUSSION

Dry matter yield

Data in Table 2 showed that the dry matter yield (DMY) of different parts (Shoots and Pods) of bean plants were markedly increased with all Zn-treatments under study. Furthermore, data clarified that the highest mean values of the DMY of shoots and pods were recorded with application of 10ppm Zn as ZnEDTA. Similar results were observed by Coffman and Miller (1973) and Kanwar and Singh (1979) Who found that application of 10ppm Zn increased the DMY of different parts fo soybean plants, also, they reported that ZnEDTA was best source of Zn.

Table 2. Effect of different zinc sources and levels as well as mineral organic fertilizers on dry matter yield of bean plants. (g/pot).

Zinc Sources	Zinc Levels	Shoots			Pods		
		NPK	FYM	Mean	NPK	FYM	Mean
$Zn So_4$	Zno	5.40	5.93	5.67	3.15	3.33	3.24
	Zn1	6.60	7.09	6.85	3.80	4.03	3.92
	Zn2	8.18	8.31	8.25	4.43	4.71	4.57
	Mean	6.74	7.11	6.92	3.79	4.02	3.91
ZnEDTA	Zno	5.40	5.93	5.67	3.15	3.33	3.24
	Zn1	8.40	8.45	8.43	5.18	5.78	5.48
	Zn4	9.62	10.63	10.13	5.82	5.96	5.89
	Mean	7.81	8.34	0.08	4.72	5.02	4.87
L.S.D. at 5%							
Fertilization				0.14			0.15
Zn Sources				0.14			0.15
Zn levels				0.17			0.19

Data in Table 2 also show that the DMY of different parts of bean plant were sigificantly increased by FYM application if compared with NPK addition. Data also revealed that the highest mean values of shoots and pods were obtained in plants grown on soil treated with FYM. These results were in agreement with those obtained by Petrovici and Dumitrescu (1982) who stated that application of FYM at different rates increased the yield of many crops.

Data in Table 2 clarify that the highest DMY values of diiferent parts of bean plants were obtained by 10 ppm Zn as ZnEDTA treatment in soil fertilized with FYM and /or NPK. These results may be attributed to the important balance among nutritional elements to increase the DMY of both shoots and pods of bean plants.

Generally the highest DMY values of different parts of bean plants were found in plants grown on soil treated with FYM than those obtained by plants grown on soil treated with NPK. The beneficial effect of organic manure may be due to the production of chelating agents forming soluble compulexes with Zn which are efficiently utilized by the plants. (Mann *et al.*, 1978).

Zn content and Zn uptake

Results in Table 3 showed that Zn content values in different parts of bean plants were increased with increasing zinc levels.

In addition foliar application of zinc chelate as a source of zinc nutrition appeared mostly to be effective that zinc sulphate. Also data in Table 3 revealed that spraying 10ppm Zn as ZnEDTA resulted in high values of Zn-uptake by different parts of bean plants. Similar results were obtained by Halvorson and Bergman (1983) with *Phaseolus vulgaris* and Hergert *et al.*(1984) with corn plants. Their results showed that under particular sources, levels and methods of zince application resulted in an increase of zinc content and zinc uptake in those plants.

Data in Table 3 show that the values of Zn-content and Zn-uptake of both shoots and pods were significantly increased in bean plants grown on soil treated by farmyard manure if compared with those plants grown on soil fertilized with NPK. These results were in agreement with Mann *et al.* (1978).

Data in Table 3 showed that the highest mean values of Zn-content and Zn-uptake in shoots and pods were obtained by spraying 10ppm zinc as ZnEDTA and $ZnSO_4$ for plants grown on soil fertilized by FYM. Similar trend was obtained by

Gupta and Dobas (1983) and Halvorson and Bergman (1983). Both authors concluded that application of zinc in such certain levels with compost manure has resulted not only increasing Zn-content but also enhancing other nutrients in plants.

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استجابة نبات الفاصوليا للتسميد الورقى بالزنك

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في تجربة أصص استخدمت فيها أراضي رسوبية لدراسة تأثير أضافة الزنك رشا علي صورة كبريتات الزنك و الزنك المخلبي بمعدلات (صفر ، ٥، ١٠ جزء في المليون) علي كل من المادة الجافة الكلية ومحتوي الزنك والكمية الممتصة منه في الاجزاء المختلفة (سيقان وأوراق وقرون) لنباتات الفاصوليا المزروعه في أراضي مسمدة بسماد معدني كامل (ن ، بو، فو) او سماد بلدي وقد أوضحت النتائج ما يلي:

تحققت أعلي القيم من المادة الجافة وكل من محتوي الزنك والكمية الممتصة منه في الاجزاء المختلفة من نبات الفاصوليا باستخدام معدل ١٠جزء في المليون زنك في صورة زنك المخلبي مع أضافة السماد البلدي .