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EFFECT OF FOLIAR APPLICATION WITH SOME MICRONUTRIENTS ON GROWTH, YIELD AND SOME CHEMICAL CONSTITUENTS OF MUNGBEAN GROWN IN SANDY SOIL

BY

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ABSTRACT

Two field experiments were carried out on reclaimed sandy soil in South AL-Tahrir province, AL-Behara Governorate, during the two successive summer seasons of 2003 and 2004 to study the effect of foliar application with some micronutrients (Fe, Zn and Mn) alone or combination of them on growth, yield and some chemical constituents of mungbean plants

The results showed that the high content of chl.a+b value was recorded in mungbean plants spraying with Fe+Zn+Mn. Foliar application with Fe, Zn and Mn alone or combination resulted in better growth parameters i.e. plant height, number of branches and leaves, weights of leaves, stem and total dry weight per plant, leaf area (LA), leaf area index (LAI) as well as specific leaf weight (SLW).

All foliar application treatments increased number of pods, seeds per plant and seed index when compared with control treatment. It could be concluded that the highest yields of seed, straw and biological (416, 1138 and 1554 kg/ fad.) respectively were obtained by foliar spraying with the combination of Fe + Zn + Mn.

Beneficial effects were attained from the combination of Fe + Zn + Mn on protein percentage, N%, K% and P%.

Key words: Mungbean, foliar application with some micronutrients, growth photosynthesis, yield, protein percentage, N%, K% and P%.

INTRODUCTION

Mungbean {*Vigna radiata* (L.) Wilczek} is a summer pulse crop with short duration (70-90 days) and high nutritive value. The seeds contain 22-28% protein, 60-65% carbohydrates, 1-1.5% fat, 3.5 – 4.5% fibers and 4.5-5.5 ash, It can be consumed directly by cooking or as sprouts as well as making popular foods when it is mixed with other cereals (Lawn and Ahn, 1985). Moreover mungbean seeds surpass lentil and faba bean in Fe, Ca and vitamin A contents (Kassab, 2005).

This crop can be used for both seed and forage production. It not only plays an important role in human diet, but also in improving the soil fertility by fixing atmospheric nitrogen.

According to the Food and Agricultural Organization of the United Nations (FAO), despite the improvements in the agricultural production over the past decades, one-third of the world's population is affected by vitamin A, iron, and zinc deficiencies in their diets.

Iron (Fe) is a component of various enzymes and function as a catalyst in the synthesis of chlorophyll (Tang *et al.*, 1992). Zinc (Zn) is essential element for plants and is involved in many cellular processes, including act vation of enzymes, protein synthesis, and membrane stability (Marschner, 1995)

Manganese (Mn) is involved in chlorophyll synthesis, respiration, nitrogen assimilation and photosynthesis. It has a role as an enzyme activator for oxidation –reduction reaction. The soil of the south AL-Tahrir sector like the sandy texture soils are characterize very low organic matter, low water holding capacity and high nutrient leaching losses

Micronutrients added to the sandy soil will be affected by soil environmental factors. Foliar application techniques, as a particular way to supply micronutrients could avoid these factors and results in rapid absorption. If applied properly, foliar spraying can be considered practical to supply nutritional plant requirements.

Foliar application is greatly affect plant growth and crop production .In this respect, Abd-El-Lateef *et al.*, (1998) indicated that foliar spray with Zn, Mn or Fe increased the seed yield and improve the quality of mungbean seeds. Rizk and Abdo, (2001) indicated that foliar application with Zn, Mn, and its combination increased significantly growth parameters, yield and its components.

Currently, foliar application of Fe and Zn increased yield of mungbean plant (Gupta *et al.*, 2003). Moreover, Kassab, (2005) indicated that foliar application of Fe, Mg, Mn and Zn significantly increased growth parameters, yield and its components of mungbean plants.

The objective of this study is to investigate the effect of foliar application with some micronutrients on growth, yield and its components as well as some chemical composition of mungbean seeds under sandy soil.

MATERIALS AND METHODS

Two field experiments were carried out on reclaimed sandy soil in South AL-Tahrir province, AL-Behara Governorate, during the two successive summer seasons of 2003 and 2004 to study the effect of foliar application with some micronutrients on growth, yield and its components as well as some chemical constituents of mungbean plants.

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*FAO reported of (2005)

Mungbean seeds {*Vigna radiata* (L).Wilczek} cv. Kawmy – 1 was used in the both experiments.

The experimental soil (0-30 depth) was analyzed according to the method described by Chapman and Pratt, (1978). Soil texture was sandy and having the following characteristics: sand 94.7%, pH 8.6, Organic matter 0.8 %, CaCO3 2.4%, EC 0.13 mmhos/cm^3, available N 28.0 ppm, available P 18.0 ppm, available K. 94 ppm, available Zn 1.18 ppm available Fe 4.0 ppm and available Mn 3.25 ppm.

Experimental plot was 10.5 m^2 (5 ridges, 3m in length and 0.70 m in width) Complete Randomized Block design with six replicates was used. Calcium superphosphate (15.5% P_2O_5) and Potassium sulphate (48% K_2O) at the rate of 150 and 50 kg/fed., respectively were applied during seed-bed preparation. Mungbean seeds were inoculated with the specific rhizobium strain and immediately sown in both sides of the ridge at 20cm space between hills. Sowing dates were 25 and 30 May in the first and second seasons, respectively. Nitrogen fertilizer was added at the rate of 15Kg N/fed in the form of ammonium nitrate 33% N after sowing. Thinning was carried out 15 days after sowing to secure two plants per hill. The other agronomic practice for growing mungbean was followed as recommended.

The experimental treatments were.
1-Control (tap water)
2-1.0g/L Fe – EDTA (6%)
3-1.0g/L Zn – EDTA (12%)
4-1.0g/L Mn – EDTA (12%)
5-1.0g/L Fe+1.0g/L Zn
6-1.0g/L Fe+1.0g /L Mn
7-1.0g/L Zn+1.0g/L Mn
8-1.0g/L Fe+ 1.0g/L Zn+1.0g /L Mn

Foliar application with some micronutrients was done twice during vegetative stage (30 days after sowing) and at pod development period (45 days after sowing). After 60 days from sowing a representative vegetative sample was taken from each treatment and the following parameters per plant were studied: plant height, numbers of branches and leaves, weights of leaves, stem and total dry weight per plant, leaf area (LA), leaf area index (LAI) as well as specific leaf weight (SLW) were determined.

Leaf area LA was determined as (cm) ^{2}/plant by the discs method according to Johnson, (1967) as follows:
- Leaf area (LA) =dry weight of leaf x discs area / discs dry weight
- Leaf area index (LAI)=unit leaf area /unit ground area.
- Specific leaf weight (SLW) =leaf weight (mg)/leaf area (cm^2)
- Photosynthetic pigments were determined as mg/g dry wt. according to the formula described by Von Wettestein, (1957).

At harvest time, ten graded plants from each plot were taken randomly to determine yield attributes i.e. number of pods /plant, number of seed /pod, number of seed per plant, seed weight per plant and seed index. Whole plot was harvested for determination of seed, straw and biological yields / fed.

Total N content of the seeds was determined and the percentage of crude protein was calculated by multiplying the N content by the factor 6.25. K% and P% in seeds were determined using the methods described by Chapman and Pratt (1978).

The obtained results were subjected to statistical analysis of variance according to method described by Snedecor and Cochran, (1982) and the combined analysis of the two seasons was calculated according to the method of Steel and Torrie, (1980). The least significant differences (LSD) was used to compare the means.

RESULTS AND DISCUSSION

1-Effect of foliar application with some micronutrients on photosynthetic pigments content:

Data presented in Fig. (1) it can be concluded that foliar application with micronutrients significantly increased the content of chl.a+b in the leaves of mungbean plants as compared with the plants spraying with tap water (control).

There was no significantly different in the concentration of chl.a+b between spraying with Fe alone, Mn alone and Fe+ Mn

It is worthy to note that the high concentration of chl.a+b value was recorded in mungbean plants by spraying with the combination of the three micronutrients Fe+ Zn + Mn.

Such increase in chlorophyll content in the leaves of plants may be attributed to the role of these micronutrients for the manufacture of chlorophyll. Numerous studies confirmed our positive response for the foliar application with micronutrients Wiersma, (2005) and Thalooth *et al.*, (2006).

2-Effect of foliar application with some micronutrients on growth parameters:

Table (1) illustrate the effect of foliar application with some micronutrients on growth parameters. The results show that foliar application with Fe, Zn, Mn and its combination caused significant increase in all growth parameters i.e. plant height, number of branches and leaves, weights of leaves and stem per plant, total dry weight, leaf area (LA), leaf area index (LAI) as well as specific leaf weight (SLW).

Foliar application with Zn alone surpassed Fe and Mn alone in plant height. In addition foliar application with Fe+ Zn gave the tallest plants (38.68 cm). The highest number of branches per plant was recorded by mungbean plants sprayed with Fe+ Zn + Mn. While control treatment had lowest number of branches per plant as compared to the other treatments .The same trend was noticed regarding number of leaves per plant.

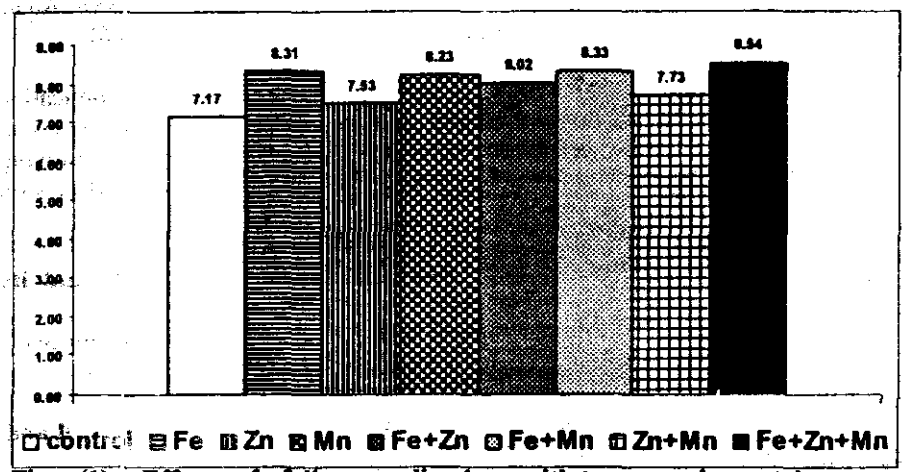

Fig. (1): Effect of foliar application with some micronutrients on photosynthetic pigments content (LSD 5% 0.11

Table (1): Effect of foliar application with some micronutrients on growth parameters of mungbean plants

Characters / Treatments	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Weight of (g) leaves per plant	Weight of (g) stem per plant	Total dry weight per plant(g)	Leaf area $(cm)^2$	Leaf area index	Specific leaf weight mg/$(cm)^2$
Control (tap water)	34.93	1.57	8.17	7.41	7.25	14.66	595	2.64	12.45
Fe	37.15	1.69	8.57	8.71	8.51	17.22	697	3.10	12.50
Zn	37.98	1.74	8.78	8.09	7.47	15.56	649	2.88	12.47
Mn	36.03	1.68	8.40	8.21	7.81	16.02	658	2.92	12.48
Fe+Zn	38.68	1.71	8.68	8.76	8.55	17.31	700	3.11	12.51
Fe+Mn	37.20	1.68	8.41	8.28	7.80	16.08	663	2.95	12.49
Zn+Mn	37.60	1.71	8.59	8.70	8.18	16.88	696	3.09	12.50
Fe+Zn+Mn	38.53	1.75	8.81	8.88	8.67	17.55	708	3.15	12.54
L.S.D.(0.05)	0.63	0.06	0.24	0.26	0.50	0.62	21	0.09	0.06

From the same table, it can be realized that foliar application with Fe, Zn and Mn alone or in combination were able to accumulate greater dry matter content in leaves than the control treatment.

The results also show that foliar application with Fe+ Zn + Mn, Fe+ Zn and Zn + Mn increased significantly the total dry weight per plant but this increments did not significant between them. Foliar application with Fe+ Zn +Mn gave the highest value leaf area (LA) per plant and leaf area index (LAI).

There were found increase in specific leaf weight (SLW) when the plants sprayed with micronutrients, but this increase significantly only in the plants sprayed with Fe+ Zn + Mn and Fe+ Zn treatments as shown in Table (1).

The results coincide with obtained by Abd El-Lateef *et al.*, (1998) Abdo, (2001) Zaghloul *et al.*, (2002) Kassab,(2005) and Thalooth *et al.*, (2006).

From the obtained results, it can be concluded that foliar application with micronutrients had positive effect on increasing all growth parameters of mungbean plants. The beneficial effects of micronutrients on improving mungbean plant productivity may be attributed to their enhancement effects on increasing plant metabolic activity.

3-Effect of foliar application with some micronutrients on yield and its components:-

Data given in Table (2) show that the effect of foliar application with some micronutrients is significant on mungbean yield and its components.

Table (2): Effect of foliar application with some micronutrients on yield and its components of mungbean plants

Characters / Treatments	Number of pod/plant	Number of seed/pod	Number of seed/plant	Seed index(g)	Seed yield g/plant	Seed yield kg/fad	Straw yield kg /fad	Biological yield kg /fad
Control (tap water)	16.15	6.38	98	3.11	2.98	335	953	1288
Fe	17.85	6.85	110	3.27	3.57	381	1049	1430
Zn	17.73	6.58	105	3.19	3.20	347	973	1320
Mn	17.75	6.63	105	3.20	3.40	360	1019	1379
Fe+Zn	18.65	7.60	114	3.33	3.68	403	1114	1517
Fe+Mn	17.95	6.95	110	3.28	3.58	383	1069	1452
Zn+Mn	18.13	7.15	111	3.32	3.61	397	1119	1516
Fe+Zn+Mn	19.15	7.83	120	3.33	3.93	416	1138	1554
L.S.D.(0.05)	1.00	0.91	10	0.13	0.54	14	46	55

The highest number of pod per plant detected when the plants were sprayed with combined Fe + Zn + Mn followed by Fe + Zn. However, the lowest number of pod per plant was observed as a result of foliar spray with tap water (control). The same trend was noticed regarding number of seeds per pod and plant.

All foliar application treatments increased seed index when compared to control. While, foliar application with Zn alone has the lowest value of seed index as compared to the other nutrients.

From the same table, it can be realized that foliar spray with Fe, Zn, Mn alone or in combination increased seed yield per plant compared with the control treatment. Evidently, the data shows that when foliar spray with Fe + Zn + Mn, higher seed yield per faddan(416 kg/ fad.) were obtained. The increase in seed mungbean yield/fad with foliar spraying might be due to the increase in number of pods and seeds / plant, seed yield per plant as well as seed index.

The results of straw and biological yields per faddan show significant differences among foliar treatments. It could be concluded that the highest yields of straw and biological (1138 and 1554 kg/ fad.) respectively were obtained by foliar spray with combination Fe + Zn + Mn

Such favourable effect could be attributed to physiological processes especially photosynthesis and metabolic transportation as result of the effect of micronutrients. The favourable effect of foliar spray with micronutrient on yield component may be attributed to its effect on most vegetative growth.

Several studies pointed out to the positive response of mungbean yield to foliar spray with micronutrients (Abd El-Lateef *et al.*, 1998. Sarkar *et al.*, 1998. Rizk and Atdo, 2002. Ahmed and Mohamed, 2005. and Kassab, 2005).

4-Effect of foliar application with some micronutrients on chemical constituents of seeds:

Data presented in Fig. (2) show that spraying mungbean plants with micronutrients resulted in a significant increase in the percentage of protein in the produced seeds as compared with spraying by tap water (control). There was no significantly different in the protein content spraying mungbean plants with Fe or Mn alone. The highest protein percentage was recorded mungbean plants sprayed with the combination Fe + Zn + Mn. However, the low content of protein value was recorded in mungbean seeds when the plants was sprayed with Zn alone compared with the other nutrients.

Fig (3) show that increase in N%, K% and P% in mungbean seed with foliar application with micronutrients. Foliar spraying with Zn alone or combination with the other nutrients increase in P% in *mungbean* seed, while spraying mungbean plants with Fe or Mn alone or its combination increase N% and K% in mungbean seed . The highest N%, K% and P% in seed were recorded by mungbean plants sprayed with the combination Fe + Zn + Mn.

Such enhancement effect of spraying with micronutrients might be attributed to the favourable influence of these nutrients on photosynthesis, critical for chlorophyll formation and biological activity and its stimulating effect on photosynthetic pigments and enzyme activity which in turn encourage vegetative growth and yield of plants and consequently protein content (Michail *et al.*, 2004).

The obtained results are in great agreement with those obtained by Abd El-Lateef *et al.*, (1998), also Kassab, (2005) who found a slight increase in seed protein content of mungbean.

From these results, it can be concluded that foliar spraying with micronutrients could enhance growth, increase yield and improve quality of seeds mungbean under the condition of this experiment.

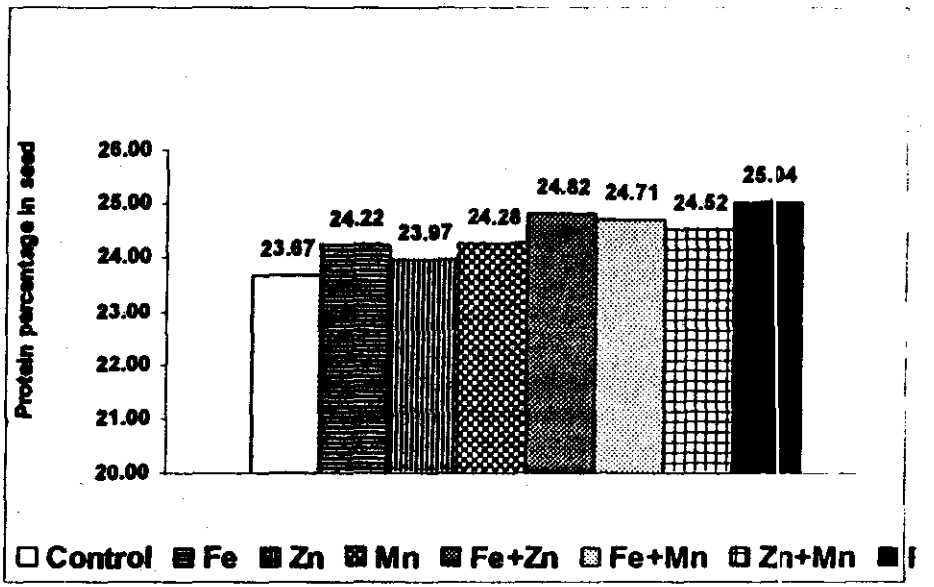

Fig. (2): Effect of foliar application with some micronutrients on protein percentage in seed mangbean (LSD 5% 0.21.

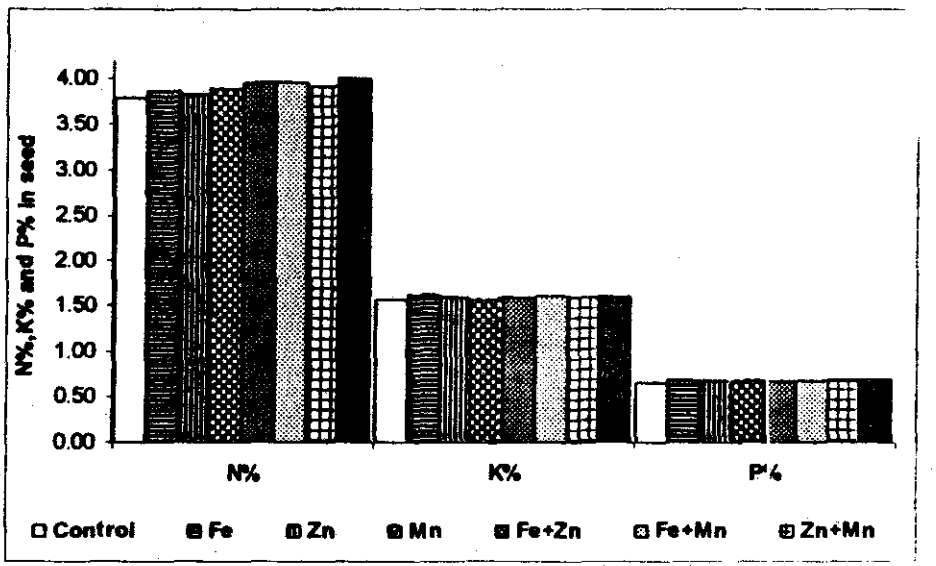

Fig (3): Effect of foliar application with some micronutrients on N% , K% and P% in seed mungbean.
(LSD 5% N 0.03 K 0.02 P 0.01)

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تأثير الرش ببعض العناصر الصغرى على النمو و المحصول وبعض المكونات الكيميائية لفول المانج النامي فى ألا راضى الرملية

ماجدة حسنين محمد محمد

قسم بحوث المحاصيل-المركز القومي للبحوث-الدقي - جيزة – مصر

أقيمت تجربتان حقليتان خلال الموسم الصيفي لعامى٢٠٠٣-٢٠٠٤ بمزرعة خاصة بقرية النجاح قطاع التحدي جنوب مديريه التحرير ـــ محافظه البحيرة بأرض رمليه بهدف دراسة تأثير الرش ببعض العناصر الصغرى على النمو والمحصول ومكوناته وبعض المكونات الكيميائية فى البذرة لفول المانج. ولقد أوضحت النتائج مايلى:

- سجل الرش الورقي بالحديد +الزنك+المنجنيز أعلى محتوى صبغات البناء الضوئي بالأوراق
- أدى الرش بكل من الحديد و الزنك و المنجنيز منفردة أو مختلطة إلى تحسين فى صفات النمو (طول النبات-عدد الفروع والأوراق /النبات-وزن الأوراق والساق /النبات-الوزن الكلى للنبات-مساحة الأوراق-دليل مساحة الأوراق-الوزن النوعي للورقة)
- وأعطت، جميع معاملات الرش الورقى زيادة فى عدد القرون/النبات-عدد البذور/النبات ودليل البذرة مقارنة معاملة الكنترول.
- أمكن الحصول على أعلى إنتاجية من محصول البذور-القش والبيولوجي(٤١٦-١١٣٨ و ١٥٥٤كجم /فدان)بالرش بالعناصر الثلاثة مختلطة.

كما توضح النتائج التأثيرات المفيد ة للرش العناصر الثلاثة مختلطة على نسبة المئوية البروتين و نسبة المئوية لكلا من النتروجين و البوتاسيوم و الفوسفور.