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EFFECT OF FOLIAR SPRAY WITH SOME MICRONUTRIENTS ON GROWTH, YIELD AND CHEMICAL COMPOSITION OF PIGEON PEA (*Cajanus cajan*) UNDER ISMAILIA REGION CONDITIONS

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ABSTRACT

Spraying pigeon pea plants with Fe, Mn and Zn at 100 or 200 mg/l increased average pod number/plant, total fresh weight and seed yield compared with control (unsprayed). Mn at 100 mg/l gave the highest fresh yield and seed yield/feddan. Also, spraying pea plants with Mn at 100 mg/l increased vine yield as green fresh forage (16.35 ton/fed) followed by spraying pea plants with Zn at 100 mg/l (15.90 ton/fed).
Keyswords: pigeon pea, Fe, Mn, Zn, yield.

INTRODUCTION

Pigeon peas (*Cajanus cajan*, L. Mill sp.) belong Fabaceae, also known as arhar deil (in India), guandula (in Puerto Rico), pois d'angola (in French), arvega de angola (in Spanish), pisello d'angola (in Italian) and taubenerbse (in German). Pigeon peas are used as a food crop (dried, peas, flour or green vegetables peas) and forage/cover crop. They contain high levels of protein and important amino acids methionine lysine and tryptophan. The woody stems of pigeon peas can also be used as firewood, fencing and hatch. Growing pigeon pea as a pure crop is not economically viable due to its low productivity and longer duration (maturity in 180-280 days), therefore, intercropping with short duration pulses (green gram and black gram) and seed oil (gingelly) or with cereals (sorghum, pearl millet, maize) in pigeon pea enhances total productivity (Sarma *et al*, 1995). In a cropping season, pigeon pea plants fix about at 40 kg/ha atmospheric nitrogen and add valuable organic matter to the soil throw fallen leaves. Also, legumes can fix as much as 200 kg N /ha /year under optimal field conditions (Giller, 2001). Mineral nutrient deficiencies limit nitrogen fixation by the legume-rhizobium symbiosis, resulting in low legume yields. Nutrient limitations to legume production result from deficiencies of not only major nutrients but also micronutrients such as molybdenum (Mo), zinc (Zn), boron (B) and iron (Fe) (Bhuiyan *et al*, 1999).

The positive effect of Mn could be due to the present of relatively large number of enzymes are activated by Mn^{+}, to that the existence of only two manganese containing enzymes well established namely the manganese protein in phtosystem II and the manganese-containing superoxide dismutase. Furthermore manganese acts as a cofactor activating about 35 different enzymes (Marschner 1995). Most of these enzymes catalyze oxidation-reduction, decarboxylation and hydrolytic reactions. Manganese

has a primary role in the tricarboxylic acid cycle (TCA) in oxidative or nonoxidative reactions as, for example, the NADPH decarpoxylating malate decarboxylase, malic enzymes and isocitric dehydrogenase (Burnell, 1988). Kamel (2005) on cow pea, Mohammad (2009) on snap bean, and Nadergoli*et al.* (2011) on common bean who reported that micronutrients foliar application increased plant growth parameters. El-Tohamy and El-Greadly (2007), and Mohammad (2009) on snap bean who pointed out that Fe, Mn and Zn had a significant effect on NPK content. Mohammad (2009) who showed that foliar spray of snap bean plants cv. Bronco with Fe and Zn at 50 or 100 ppm increased number of pods/plant, yield/plant and yield /fed compared control. Also, foliar spray of pigeon pea with Fe and Zn increased number of pods/plant compared with control (Wankhade *et al*, 1995). Therefore, the aim of this work was to maximize productivity of pigeon pea plants grown in sandy loam soil with high pod and seed quality by using the foliar spray with some micronutrients; i.e. Fe, Mn and Zn.

MATERIALS AND METHODS

This work was carried out during summer seasons of 2009 and 2010 at Private Farm, Fayed Region, Ismailia Governorate, Egypt, to study the effect of some micronutrients levels on growth, plant chemical composition , yield and its components of pigeon pea growth in sandy loam soil. The physical and chemical properties of the experimental soil are presented in Table (1)

Table (1): Physical and chemical properties of the experimental soil.

Properties	Values
A-Physical properties	
Sand %	78.75
Silt %	4.75
Clay %	16.50
Soil type	Sandy loam
B-Chemical properties	
Available Phosphorus(mg/l)	550
$CaCO_3$%	13.6
E.C.(m.mohs/Cm, 25^oC	2.13
pH	8.2
C- Soluble anions (meq/L)	
Cl^-	5.50
HCO_3^-	6.50
$SO_4^=$	9.30
D-Soluble Cations (meq/L)	
Ca	11.5
Mg	4.00
Na	4.84
K	0.96
E-Available micronutrients (mg/L)	
Fe	13.9
Zn	5.13
Cu	2.40
Mn	8.64

This experiment included seven treatments as follows:

1. Control (sprayed with tap water),
2. Fe at 100 mg /l,
3. Fe at 200 mg /l,
4. Mn at 100 mg /l,
5. Mn at 200 mg /l,
6. Zn at 100 mg /l, and
7. Zn at 200 mg /l.

These treatments were arranged in a randomized complete block design, with three replications. Pigeon pea plants were sprayed five times with solutions of Fe, Mn and Zn at 100 and 200 mg /l of each at 45, 60, 75, 90, and 105 days after sowing. Each plot received 4L solutions of Fe or Mn or Zn using spreading agent in all treatments. The untreated plants were sprayed with tap water and the spread agent. One row was left between each experimental unit together as a guard row to avoid the overlapping of spraying solution. The sources of Fe, Mn and Zn were $FeSO_4$. $7H_2O$, $MnSO_4$. $4H_2O$, and $ZnSO_4.7H_2O$, respectively.

The pigeon pea seeds were sown on April 25^{th}, in both seasons (2009 and 2010) on one side of the row (three seeds/hill) at 75 cm apart, then thinned to leave one plant /hill.

Plot area was five square meters. It contained one row with five meter long and one meter wide.

Data recorded: Two plants from each plot were randomly taken at 180 days after sowing and the following data were recorded:

1. **Growth parameters**: Plant fresh weight and vine yield as fresh green forage ton /fed.
2. **N, P and K contents:** The dry weight of shoots (leaves + branches) after 180 days from sowing were finely ground and wet digested with sulphoric acid and percloric acid (3:1), Nitrogen, phosphorus and potassium were determined according to the methods described by Bremner and Mulvany (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.
3. **Yield and its components:** It was determined as fresh yield (kg/fed.), and seed yield (kg/fed.).

All obtained data were subjected to analysis of variance according to Snedecor and Cochran (1980) and the Least Significant Difference was calculated as mentioned by Gomez and Gomes (1948).

RESULTS AND DISCUSSION

1. Plant growth

1.1. Vine yield (foliage and branches) as fresh grain forage for animals: The obtained results from (Table 2) indicated that effect of foliar spray with Fe, Mn, and Zn on vine yield (foliage and branches) as fresh grain forage for animals. Spraying of pigeon pea plants with Fe at 100 mg /l recorded the maximum values of vine yield as fresh green forage (7.90 ton /fed), followed by Zn at 100 mg /l (7.75 ton /fed) and Mn at 100 mg /l (7.60 ton /fed) in the 1^{st}

season, whereas Mn at 200 mg /l recorded the maximum values of vine yield as green forage (8.75 ton /fed) followed by Fe at 200 mg/l in the 2nd season.

Table (2): Effect of foliar spray with Fe, Mn and Zn on stem diameter, leaf area and plant fresh weight of pigeon pea grown in sandy loam soil at 180 days after sowing during summer seasons of 2009 and 2010.

Micronutrients mg/l	Vine yield as fresh green forage ton /fed		Plant fresh weight(kg)	
	2009	2010	2009	2010
Control (unsprayed)	3.80	4.10	0.76	0.82
Fe at 100 mg /l	7.90	5.10	1.58	1.02
Fe at 200 mg /l	6.35	7.55	1.27	1.51
Mn at 100 mg /l	7.60	8.75	1.52	1.75
Mn at 200 mg /l	7.25	4.80	1.45	0.96
Zn at 100 mg /l	7.75	6.25	1.55	1.25
Zn at 200 mg /l	4.80	2.85	0.96	0.57
LSD at 0.05	**N.S.**	**4.05**	**N.S.**	**0.81**

2. N, P and K contents in shoots (leaves + branches)

2.1. N content: Obtained results in (Table 3) show that pigeon pea plants sprayed with Fe, Mn and Zn at 100 and 200 mg /l of each significantly increased N content in shoots compared with control in both seasons. Foliar spray with Zn at 100 and 200 mg /l recorded the maximum values of N content in seasons, (3.78% for Zn at 100 mg /l in the 1st season, and 3.84 % for Zn at 200 mg /l in both season).

Table (3): Effect of foliar spray with Fe, Mn and Zn on number on N, P and K contents in the shoots (leaves and branches) of pigeon pea grown in sandy loam soil at 180 days after sowing during summer seasons of 2009 and 2010.

Micronutrients	N%		P%		K%	
	2009	2010	2009	2010	2009	2010
Control (unsprayed)	2.65	2.37	1.47	1.77	0.90	1.19
Fe at 100 mg /l	3.15	3.50	2.01	2.09	1.17	1.80
Fe at 200 mg /l	3.28	3.54	2.30	2.18	1.56	1.42
Mn at 100 mg /l	2.96	3.49	2.02	2.19	1.68	1.41
Mn at 200 mg /l	3.11	2.96	2.32	2.38	1.43	1.32
Zn at 100 mg /l	3.78	3.08	2.14	2.36	1.48	1.14
Zn at 200 mg /l	3.52	3.84	1.97	2.06	1.29	1.60
LSD at 0.05	**0.85**	**0.47**	**0.54**	**0.42**	**0.38**	**0.4**

2.2. P content: Spraying pigeon pea plants with Mn, Zn and Fe at100 and 200 mg/l of each increased P content in shoots compared with control (spraying with tab water) in both seasons (Table 3). Spraying with Mn at 200 mg/l, Zn at 100 mg /l and Fe at 200 mg /l gave rise to the highest values of P content in shoots of pigeon pea at 180 days after sowing in both seasons.

2.3 K content: Data in Table 3 indicated that foliar spray of pigeon pea with Fe, Mn and Zn at 100 and 200 mg /l of each reflected a significant effect on K content in shoots compared with control, except Zn at 100 mg/l in the 2nd season. Spraying with Fe and Mn at 100 mg /l of each gave the highest values of K content in shoots in the 1st and 2nd seasons, respectively. (1.68 % for Fe at 100 mg/l in the 1st season, and 1.80 % for Mn at 100 mg/l in the 2nd season). These results are in harmony with those obtained by El-Tohamy and El-Greadly (2007) and Mohammad (2009) on snap bean who pointed out that Fe, Mn and Zn had a significant effect on NPK content.

3 Yield and Its Components

3.1 Fresh yield /fed.: Data presented in (Table 4) indicated that spraying pigeon pea plants with Fe, Mn and Zn at 100 and 200 mg /l of each significantly increased fresh yield except Zn at 200 mg /l in the 2nd season compared to control. Spraying of pigeon pea plants with Mn at 100 mg /l gave the highest values of fresh yield (2514 and 3338 kg /fed in the 1st and 2nd seasons, respectively). The increases in fresh yield were about 1777 and 2419 kg /fed for Mn at 100 mg /l over the control (unsprayed) in the 1st and 2nd seasons, respectively. Nutrient limitation to legume production result from deficiencies of not only major nutrients, but also micronutrients such as Mo, Zn, B and Fe (Bhuiyan *et al*, 1999). These results agree with those reported by Mohammad (2009) who showed that foliar spray of snap bean plants cv. Bronco with Fe and Zn at 50 or 100 ppm increased number of pods/plant, yield/plant and yield/fed compared with control. Also, foliar spray of pigeon pea with Fe and Zn increased number of pods/plant compared with control (Wankhade *et al*, 1995).

Table (4): Effect of foliar spray with Fe, Mn and Zn on fresh yield and seed yield of pigeon pea grown in sandy loam soil at 180 days after sowing during summer seasons of 2009 and 2010.

Micronutrients	Fresh yield (Kg/fed)		Seed yield (Kg/fed)	
	2009	2010	2009	2010
Control (unsprayed)	737	919	304	455
Fe at 100 mg /l	1070	1098	467	620
Fe at 200 mg /l	607	1653	238	772
Mn at 100 mg /l	2514	3338	1163	1202
Mn at 200 mg /l	2251	2719	901	934
Zn at 100 mg /l	1182	1041	773	518
Zn at 200 mg /l	1278	917	542	423
LSD at 0.05	**1195**	**1079**	**745**	**511**

3.3 Seed yield /fed.: Data in (Table 4) illustrated that foliar spray with Mn, Fe and Zn at 100 and 200 mg /l of each significantly increased seed yield/ fed in both seasons. Foliar spray with Mn at 100 mg /l gave the highest values of seed yield /fed (1163 and 1202 kg/fed in the 1st and 2nd seasons, respectively). The increases in seed yield were about 859 and 747 kg/fed for Mn at 100 mg/l over the control in the 1st and 2nd seasons, respectively. The stimulative effect of Mn at 100 mg /l on fresh weight and seed yield may be due to that Mn at 100 mg /l increased average number of pods /plant. From

the foregoing results in the experiment, it could be concluded that spraying pigeon pea plants grown in sandy loam soil during summer season with Fe, Mn and Zn at 100 or 200 mg /l increased average pod weight, average pod number /plant, total fresh weight and seed yield compared with control (unsprayed) and Mn at 100 mg /l gave the highest values of average pod number, fresh yield and seed yield /feddan.

REFERENCES

Bahrani, M.J., F. Salehi, and S.A. Kazemeini (2012). Yield and yield components of two irrigated red bean cultivars and some soil properties as influenced by wheat residues and nitrogen management. Archives of Agronomy and Soil Science. 2012. 58: 2, 179-187.

Bhuiyan, M.A.H.; D. Khanam and M.Y. Ali (1999). Chickpea root nodulation and yield as affected by micronutrient application and rhizobuim inoculation. International Chickpea and Pigeon pea Newsletter 6: 28-29.

Burnell, J.N. (1988). The biochemistry of manganese in plant. In "Manganese in soils and plants" (R.D. Graham, R.J. Hannam, and N. c. Uren, eds.) pp 125-137. Kluwer Academic, Dordrecht.

Bremner, J.M. and C.M. Mulvaney (1982). Total nitrogen. In: Page, A.L., R.H Miller, and D.R. Keeney (Eds.) Methods of Soil Analysis, Part 2 Amer. Soc. Argon. Madison. WI- USA pp. 595-624.

El-Tohamy, W.A. and N.H.M. El-Greadly (2007).Physiologicalresponse, growth, yield and quality of snap beans in response to foliar application of yeast, vitamin E and zinc under sandy soil conditions. Australian Journal of Basic and Applied Science. 1(3): 294-299.

Giller, K.E. (2001). Nitrogen fixation in tropical cropping systems. Cabi publishing, UK, 2: 1969-1970.

Gomez, K.A. and A.A. Gomes (1948). Statistical Procedures for Agricultural Research. 2nd Edition. John Willey and Sons. USA.

Jackson, M.L. (1970). Soil chemical analysis. Prentice Hall, Englewood Cliffs, J.N.

Kamel, A.E. (2005). Studies on some factors affecting growth productivity of cow pea crop. Ph.D. Thesis, Fac. Agric. Zagazig Univ., Egypt.

Marschner, H. (1995). Mineral nutrition of higher plants. Second Edition. Academic Press Limited, Textbook pp. 864.

Mohammad, O.O. (2009). Effect of foliar spray with some organic and mineral materials on yield, quality, and storageability of snap bean. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Nadergoli, M.S.; M. Yarnia, and F. R. Khoei (2011). Effect of zinc and manganese and their application method on yield and yield components of common bean (*Phaseolus vulgaris* L.) cv. "Khomein". Middle East Journal of Scientific Research. 8 (5): 859-865.

Olsen, S.R. and L.E. Sommers (1982). Phosphorus. In: Page, A.L., R.H Miller, and D.R. Keeney (Eds.) Methods of Soil Analysis, Part 2 Amer. Soc. Argon. Madison. WI- USA pp. 403-430.

Sarma, N.N., D. Sarma and R. Paul (1995). Intercropping in greengram, blackgram and sesame in pigeon pea under different seeding method. Indian j. Agron. 40: 386-387.

Snedecor, G.W. and W.G. Cochran (1980). Statistic methods 7th Ed. Iowa state Univ. press, Iowa. USA.

Wankhade, G.S.; R.C. Dakhed; S.S. Wanjaraj, and J. S. Vyas (1995). Micronutrients uptake of legumes. Legume Research 18 (4): 211-214.

تأثير الرش ببعض العناصر الصغرى على النمو و المحصول و المكونات الكيميائية لبسلة الحمام تحت ظروف منطقة الإسماعيلية

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****وزارة الزراعة**

رش نباتات بسلة الحمام بكل من عنصر الحديد، المنجنيز والزنك بتركيز ١٠٠ أو ٢٠٠ ملليجرام /لتر لكل منها أدى إلى زيادة وزن القرن، متوسط عدد القرون على النباتات، المحصول الأخضر، محصول الفدان البذري وأن الرش بالمنجنيز بتركيز ١٠٠ ملليجرام/لتر أعطى أعلى قيم لكل من متوسط وزن القرن، المحصول الأخضر و المحصول البذري للفدان. كذلك أدى رش نباتات بسلة الحمام بالمنجنيز بتركيز ١٠٠ ملليجرام/لتر إلى زيادة محصول العرش كعلف أخضر طازج حيث بلغ المحصول ١٦.٣٥ طن للفدان يليه الرش بالزنك بتركيز ١٠٠ ملليجرام/لتر حيث أعطى الفدان١٥.٩٠ طن عرش كعلف أخضر طازج.

قام بتحكيم البحث

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