

## EFFECT OF FOLIAR SPRAY TECHNIQUE FOR MACRO AND MICRONUTRIENTS ON GROWTH AND YIELD OF FABA BEAN PLANTS, GROWN ON NEWLY RECLAIMED SOILS

Mohamed, H. Rabie; Ahmed, A. Khalil and Salah, E.M. El-Sisi  
Soil, Water and Environment Research Institute, ARC, Egypt.

### ABSTRACT

Two field trials were conducted on Sandy loam and calcareous soils at Agric. Res. Stations of Ismailia and Nubaria, during the growing season 2003/2004 to study the effect of spraying NPK with or without micronutrients on the growth, yield, yield components and seed protein percentage of faba bean crop.

Generally, foliar spray with P and/or K with or without micronutrients, increased dry matter production, nutrients uptake, seed yield and seed protein percentage. However, the maximum figures were obtained when the mixture of 2% N as urea + 2% P as superphosphate + 1 % K as potassium sulphate + chelate of Fe, Mn, and Zn was used, two times (after 50 and 70 days from sowing). Results, also showed that the response of faba bean, in general, varied according to the location, soil fertility, kind and rate of the added fertilizers.

**Key words:** N as urea, P as Superphosphate K as potassium sulphate, Chelate of Fe, Mn, and Zn and Foliar spray

### INTRODUCTION

Desert soils, either sandy or calcareous soils, have some constraints e.g. low organic matter and low available nutrients contents. (El-Saadani *et al.*, 1987 and Rabie *et al.*, 1997). Fababean (*Vicia faba* L.) is very important leguminous crop cultivated in Egypt. Increasing the quantity of the yield and improving the seed quality could be attained by various factors including the proper fertilization managements.

Concerning faba bean fertilization, conflicting outlooks and conclusions were claimed by numbers of workers e.g. Behairy *et al.* ( 1988), Hamissa *et al.* (1988), Monged *et al.* ( 1992), Hussein *et al.*( 1993), and Rabie *et al.*( 1997).

The current work was an attempt to elucidate the response of faba bean to P and/or K with or without a mixture of urea plus micronutrients added as foliar spray, in newly reclaimed soils.

### MATERIALS AND METHODS

Two field experiments were conducted on faba bean plants (*Vicia faba* L) grown on both sandy loam and calcareous soils at Agric. Res. Stations, of Ismailia and Nubaria, respectively, during the growing season of 2003/2004 to study effect of P and / or K with and without a mixture of urea plus some micronutrients, as a foliar spray, on the quantity and quality of faba bean seed yield.

Surface soil samples were taken from the two experimental fields under study, air dried and prepared for some physical and chemical analysis, by using

the standard procedures, according to Klute, (1986) and Jackson (1973). The studied soil properties are listed in Table (1).

**Table ( 1 ) Some physical and chemical analyses of the investigated soils**

Soil characteristics	Soil samples	
	Ismailia	Noubaria
<u>Chemical analysis</u>		
pH (1:25)	7.9	8.3
ECe (dS.m <sup>-1</sup> )	0.46	1.38
Calcium carbonate %	2.1	35.0
Available N (mg kg <sup>-1</sup> )*	68	18
Available P (mg kg <sup>-1</sup> **)	14.4	9.2
Available K (mg kg <sup>-1</sup> ***)	260	150
Available Fe (mg kg <sup>-1</sup> ****)	6.3	2.3
Available Zn (mg kg <sup>-1</sup> ****)	1.3	0.4
Available Mn (mg kg <sup>-1</sup> ****)	2.6	1.2
<u>Mechanical analysis</u>		
Coarse sand %	74.8	79.5
Silt%	13.1	12.0
Clay%	12.0	6.8
Texture class	Sandy loam	Loamy Sand

\*:By using 1% potassium sulfate extract..

\*\* : By using sodium bicarbonate extract. (Olsen et. al. (1954)

\*\*\*: By using ammonium acetate extract. (Klute, 1986)

\*\*\*\*: By using DTPA extract. (Lindsay & Norvell, 1978)

The field trials were designed, as randomized complete block with four replicates and the plot area was 7.2 m<sup>2</sup>. Faba bean seeds (Giza 716 and Giza Blanca in Ismailia and Noubaria soils, respectively) were planted in the fixed plots of each field experiment after treated with specific rhizobia. Basal doses of phosphorus and potassium were added to all plots before sowing in the form of superphosphate (15 % P<sub>2</sub>O<sub>5</sub>) at the rate of 30 kg P<sub>2</sub>O<sub>5</sub> /fed and potassium sulphate (48% K<sub>2</sub>O) at a rate of 24 kg /fed in a respective order. While, stimulating dose of nitrogen was added after 15 days from sowing at a rate 33.5 kg N/fed, in the form of ammonium nitrate (33.5% N). Moreover, the other local recommended cultural practices were successfully applied.

After 50 and 70\_days from sowing the foliar spray treatments were comprised as follows:

1- Control treatment.

2-Urea (U, 2%) + micronutrient (M) as chelate fertilizer containing nutrients of Fe, Mn and Zn (UM)

3- Superphosphate (SP, 2% P<sub>2</sub>O<sub>5</sub>).

4- Potassium sulphate (KS , 1% k<sub>2</sub>O).

5-UM+SP

6- UM + KS

7- SP+KS.

8- UM + SP + KS.

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Four plants were taken from each plot after 80 days from sowing; the plants were oven-dried at 70°C, and dry matter of plants were recorded, The plant samples were ground for determining NPK uptake, according to **Jackson (1973)**, While the micronutrient contents were estimated by the Atomic Absorption Spectrophotometer.

At harvesting, seeds yield for each plot was recorded, composite seed samples were taken, dried at 70°C, fine-grounded and digested using concentrated sulphuric acid and hydrogen peroxide (**FAO, 1980**). Seed Nitrogen content was determined using the micro Kjeldahl technique (**A.O.A.C. 1970**) and seed protein content was calculated. Potassium and phosphorus contents were determined Flamphotometrically and Spectrophotometrically, in a respective order. Fe, Mn and Zn were determined by the atomic Absorption Spectrophotometer.

The obtained results were statistically analyzed according to **Snedecor and Cochran (1980)**.

### **RESULTS AND DISCUSSION**

The effect of urea, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O, with and without micronutrients added as foliar spray on the dry weight production and nutrients uptake by faba bean plants grown on sandy loam and calcareous soils at Ismailia and Noubaria, respectively, are shown in Tables (2) and (3).

Results show that N, P and K with or without micronutrients significantly increased the dry weight production of fababean grown on a sandy loam soil at Ismailia, while the reverse was obtained when SP was used either alone or plus UM in the Noubaria calcareous soil, while the enhancing effects of other treatments were noticed. **Hamisa et al., (1983)** confirmed that these negative effects on the base of soil low fertility status, and applying foliar spray of certain nutrients increased the growth of faba bean. It is worthy to mention, that the positive effects are mainly due to the great necessity of these poor soils to nutrients addition.

In the sandy loam soils of Ismailia, data show that the positive effect of the above-mentioned treatments on dry weight production follows the order: (UM + KS + Sp) > (UM + SP) > (SP) > (SP + KS) > (UM + KS) = KS > UM > control. While, in the calcareous soil, the effect of the used treatment could be arranged as follows: (UM + KS + SP). > KS > UM > (SP + KS) > (UM + KS) > SP = (UM + SP) = control.

**Table (2). Effect of spray treatments of urea, superphosphate and potassium sulfate with or without micronutrients on shoot dry weight of faba bean plant after 80 days from sowing, under sandy soil condition, at Ismailia Governorate.**

No.	Treatments	Shoots dry wt. (g/plant)	Dry wt. Increasing %	Nutrients uptake ( mg/Plant)					
				N	P	K	Fe	Mn	Zn
1	Control	12.5	0.0	153	15.2	146	4.30	0.50	1.25
2	UM	13.3	6.4	301	16.5	112	5.63	0.73	1.64
3	SP	14.4	15.2	201	25.2	181	5.20	0.54	1.41
4	KS	13.7	9.6	256	17.9	222	5.86	0.75	1.47
5	UM+ SP	14.8	18.4	261	31.7	95	6.81	0.89	2.21
6	UM + KS	13.7	9.6	270	19.7	194	5.80	0.71	1.63
7	SP + KS	14.0	12.0	247	26.4	241	6.87	0.62	1.53
8	UM + SP + KS	14.9	19.2	309	33.9	258	7.21	0.91	2.26
	LSD (5%)	1.7	.....	49.3	4.8	42.2	0.87	0.12	0.20

Note: Control = water spray; **UM** = mixture of urea 2%+ micronutrients chelates (Fe, Mn,Zn) **SP** = superphosphate; **KS** = potassium sulfate

**Table (3). Effect of spray treatments of urea, superphosphate and potassium sulfate with or without micronutrients on shoot dry weight of faba bean plant after 80 days from sowing under calcareous soil condition at Noubarea.**

No.	Treatments	Shoots dry wt. (g/plant)	Dry wt. Increasing %	Nutrients uptake (mg/Plant)					
				N	P	K	Fe	Mn	Zn
1	Control	22.6	0.0	401	39.0	570	3.39	0.59	2.14
2	UM	24.5	8.4	482	46.8	647	5.15	0.79	2.28
3	SP	22.6	0.0	491	53.3	580	3.93	0.74	2.16
4	KS	24.7	9.2	516	49.5	871	5.55	1.12	2.25
5	UM + SP	22.6	0.0	474	45.8	677	4.64	1.05	2.22
6	UM + KS	23.0	1.7	504	45.8	795	6.10	1.48	2.37
7	SP + KS	23.6	4.4	551	47.3	903	9.14	0.94	2.17
8	UM+ SP + KS	24.7	9.3	594	49.5	1132	9.34	1.60	2.39
	LSD (5%)	2.3	-----	66.5	6.5	108	0.75	0.45	-----

Note: Control = water spray; **UM** = mixture of urea 2%+ micronutrients chelates (Fe, Mn,Zn) **SP** = superphosphate; **KS** = potassium sulfate

Concerning the nutrients uptake by Faba bean (N,P,K,Fe,Mn,and Zn mg/plant),data in tables (2,3) show significant values for all applied treatments. It's noticed that the treatments including urea achieved the relatively higher values than the others, the highest nutrient contents uptake were observed in treatment No. 8, in which a mixture of urea + micronutrients was mixed with

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both superphosphate and potassium sulphate solutions, in both soils under investigation, except of Pin the calcareous soil which reached the maximum level at SP treatment Many workers, on faba bean reached partial similar results, e.g. added as foliar spray **Hamissa et al. (1988)** , **Amin et al. (1988)** and **Rabie et al. (1997)**.

In general, N, P, and K uptake by faba bean plants (80 days age), reveal that their values significantly increased by the foliar spray addition of whichever.

The data illustrated in the above mentioned Tables also, show significant effects of all treatments under study on Fe, Mn and Zn uptake by faba bean plants. Agron the treatment No. 8 were the superior one, compared with other treatments, in either sandy loam or calcareous soils. However, the highest nutrients uptake was found under calcareous soil conditions. The last result is mainly due to high dry weight of faba bean (Giza Blanca cv), which grown on that soil. **Monged et al. (1992)** conducted field experiments on faba bean under four governorates conditions, and found that the response of micronutrients addition, in general, varied according to soil type, the used element and its source.

Whether or not, on both sandy loam and calcareous soils, the highest magnitude of average dry matter accumulation and nutrients uptake, either macro- or micronutrients, can be achieved by treating faba bean plants by a mixture of 2% urea + micronutrients + superphosphate (2%) + potassium sulfate (1%), two times (after 50 and 70 days from sowing). The beneficial effects of micronutrients could be referred to the influence on selection transfer reaction including those in the Krebs's cycle and subsequently on energy production in the plants (**Hussein et al., 1993** and **Rabie et al, 1997**).

Data concerning faba bean seed yield, yield components and seed protein content in sandy loam and calcareous soils under investigation are illustrated in Tables (4 and 5), respectively. These data show that when faba bean plants were treated only with superphosphate or potassium sulfate, the number of pods were increased by 7.7 and 8.8% over the treatment control in sandy loam soil and uptake about 8.4% over the control in calcareous soil. Similar percentage increases were found in both studied soils when treated a mixture of urea plus micronutrients .

The number of seeds per plant were paralleled to the aforesaid results in both soils under study. It was noticed, that treatments Nos. 5,6 and 8 produced a significant increases in seed yield in sandy loam and calcareous soils, as compared with the control treatment, However, the highest seed yield was obtained by spraying a mixture of urea + micronutrients + superphosphate + potassium sulfate, two times (after 50 and 70 days from sowing), specially under sandy loam soil condition of Ismailia.

In spite of, the high dry matter, production and consequently the high nutrients uptake of faba bean plants grown on calcareous soil, at Nubaria, compared with those grown on sandy loam soil at Ismailia, lower faba bean seed yield and its components were obtained in calcareous soil than sandy loam soil (Tables, 4 and 5). These conflicting results may be due to the differences in plants genetically characteristics and the low fertility that is affected by the occurrence of CaCO<sub>3</sub> which restrict the availability of nutrient, and in tarn seed

yield and its protein content.

The effect of the applied treatments on seed yield could be arranged as follows: treatment No. 8 > 7 = 6 > 5 > 4 = 3 > 2 in the sandy loam soil, the corresponding categories in the calcareous soil they were as follows: treat. No.8 > 5 > 7 = 6 > 3 > 4 > 2.

**Table (4). Effect of added as foliar spray urea, superphosphate and potassium sulfate with or without micronutrients on yield, yield components and seeds protein content of faba bean grown on Ismailia .sandy loam soil**

No.	Treatments	Pods No./ plant	Increasing rate %	Seeds No./ Plant	Increasing rate %	Seed yield (ton/fed)	Increasing rate %	Seeds protein Content %	Increasing rate %
1	Control	17.0	-----	40.8	-----	1.37	-----	28.3	-----
2	UM	18.5	8.8	43.5	6.2	1.38	0.7	29.0	2.5
3	SP	18.3	7.7	44.5	9.1	1.42	3.6	29.0	2.5
4	KS	18.5	8.8	44.8	9.8	1.43	4.4	29.2	3.2
5	M+SP	20.5	20.5	53.8	31.9	1.48	15.3	30.1	6.4
6	UM+KS	21.5	26.5	54.5	25.1	1.62	18.3	32.2	13.8
7	SP + KS	22.8	34.1	58.3	42.9	1.63	18.9	29.4	3.9
8	JM + SP +KS	23.3	37.1	59.5	45.8	1.67	21.9	32.2	13.9
	LSD (5%)	2.9	---	7.9	-----	0.14	-----	0.98	----

**Table (5). Effect of added as foliar spray urea, superphosphate and potassium sulfate with or without micronutrients on yield, yield components and seeds protein content of faba bean grown on Nubaria, calcareous soil.**

No.	Treatments	Pods No./ plant	Increasing Rate %	Seeds No/plant	Increasing Rate %	Seeds yield (ton/fed)	Increasing rate %	Seeds protein content %	Increasing Rate %
1	Control	8.3	---	37.8	---	0.99	---	17.5	---
2	UM	9.0	8.4	40.4	6.9	1.05	6.0	18.0	2.9
3	SP	9.0	8.4	38.3	2.7	1.08	9.0	19.2	9.8
4	KS	9.0	8.4	38.2	1.1	1.06	7.1	19.1	9.1
5	UM + SP	12.8	54.2	44	17.5	1.24	25.3	19.3	10.3
6	UM + KS	12.5	50.6	48.4	28.0	1.22	23.2	19.7	12.6
7	SP + KS	11.6	39.8	45.3	19.8	1.22	23.2	19.2	9.8
8	UM+SP+KS	13.3	60.2	53.0	40.2	1.32	38.4	20.0	14.3
	LSD (5%)	0.8	----	2.9	----	0.21	---	1.7	----

Tables (4 and 5) also, show that all treatments using spraying P, K with or without micronutrients, show significant increases in seed protein content in both studied soils. Thereby, in sandy loam soil, faba bean protein content achieved an increase of 13.9 and 13.8%, over the control for treatments No. 8 and 6, respectively. While in the calcareous soil, the seed protein increased by

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14.3 and 12.6 % in the same treatments mentioned before.

Finally, the maximum dry weight production, nutrients uptake, seed yield and seeds protein percentage were obtained, when the spraying treatment include mixture of urea (2%) + chelate micronutrients, (Fe, Mn and Zn) + superphosphate (2%) + potassium sulfate (1%), in both sandy loam and calcareous soils. These results are partially in agreement with those obtained by **Rabie *et al.* (1997)**. Moreover, results show that the response of faba bean, in general, varied according to status soil types, soil fertility and the rates of the applied nutrients. **Monged *et al.* (1992)** obtained similar results.

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أثر التسميد الورقي ببعض المغذيات الكبرى والصغرى على نمو و محصول الفول النامي فى أراضي  
حديثة الاستزراع

محمد حسن ربيع - أحمد أبو الوفا خليل - صلاح الدين محمد عويس السيسى  
معهد بحوث الاراضى والمياه والبيئة - مركز البحوث الزراعية - الدقى - الجيزة - مصر

أجريت تجربتان حقليتان على أرضين أحدهما رملية طمييه والاخرى جيرية. بمحطتى البحوث الزراعية بالإسماعيلية والنوبارية خلال الموسم الزراعى ٢٠٠٣ م - ٢٠٠٤ م. لدراسة تأثير إضافة الأزوت، والفسفور، والبوتاسيوم، بمفردهم أو مع العناصر الصغرى رشاً على النمو الخضري، والمحصول، و مكونات المحصول، ونسبة البروتين في الحبوب لمحصول الفول البلدي. بصفة عامة أظهرت النتائج أن الرش بالفوسفور والبوتاسيوم معاً أو كلاً على حده مع أو بدون العناصر الصغرى قد أدى إلى زيادة المادة الجافة، وامتصاص العناصر، وكذلك محصول الحبوب، ونسبة البروتين بالحبوب، ولكن كان التأثير فى أفضل حالاته عند استخدام خليط من ٢% يوريا + ٢% فوسفات في صورة سوبر فوسفات + ١% بوتاسيوم في صورة سلفات بوتاسيوم مع مخلبات الحديد و المنجنيز والزنك بنسبة ٢:٢:٢ مرتين (بعد ٥٠ ، ٧٠ يوماً من الزراعة). بالإضافة إلى ذلك فإن استجابة نبات الفول قد تأثرت بنوع التربة، خصوبة التربة، نوع ومعدل الأسمدة المضافة.