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EFFECT OF SOME NUTRITIONAL TRIALS ON BROAD BEAN YIELD AND NUTRIENTS UPTAKE

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ABSTRACT

Two field experiments were conducted on broad bean plants in Sherbeen, Dakahlia Governorate during two successive seasons 2004/2005 and 2005/2006. The experiments were carried out to study the effect of K, B and the combination of (Fe, Mn, Zn) on two varieties of broad bean (G461 and G 843).

All the treatments of the two experiments received recommended treatments; inoculation of seeds before sowing with (*Rizobium leguminozarium* ficia), 30 kg N and 30 kg P_2O_5/feddan.

The most important results were as follows:

1. K application (with 24 kg K_2O/fed.) increased the yield significantly where, the increases were 8.8% over the control, its effect increased when it was used with all trials.
2. Micronutrients combination (Fe, Mn and Zn), spraying twice, increased the yield significantly and the increases were 33.7% over the control.
3. Boron has an effective and significant effect on broad bean plants. When it was used alone it increased the yield 16%. It was more effective when it was used with the treatment of the combined micronutrients, the increase reached 50.3%.
4. Using the balanced mineral fertilization [NPK + B + (Fe, Mn, Zn)] was of great and significant effect as it reached 50.7% over the control.
5. The contents of all mineral under investigation were increased as a result of treatments used, which means increasing the seed quality.

It can be concluded that the using integrated fertilization programs increase the quality and quantity of broad been seed yield with economical and less pollution benefits.

INTRODUCTION

Broad bean (*Vicia faba* L.) is generally regarded as an important source of plant proteins that could help in supplementing the meager amount of animal proteins in the diet of averaged Egyptian.

The area planted for production of dry beans was 336,000 fed. producing 428.000 ton during 1995-1999. The imports averaged 105.000 ton annually (Abd El-Salam, 2002).

Efforts to improve productivity of broad bean in Egypt are needed. Fertilization is an important one. As the experts estimate that 30-50% of crop production comes directly from fertilizer nutrient application.

Concerning K fertilization, Genaidy and Hegazy (2001) found that potassium fertilization with 24 kg K_2O/fed. increased faba bean yield 24.45%. They found also that the high K_2O-rate of 48 kg K_2O/fed. was not the proper rate for faba bean crop because of the insignificant increase in yield.

As for the effect of micronutrients application to broad bean, it was found that promising effects were found by many workers; Monged *et al.*

(1988), Baza *et al.* (1989), Monged and Baza (1994). The importance of boron for growth of healthy plants and its beneficial effects for cultivated plants for their yield have been recognized since long. Gopal (1971) reported that boron is applied to deficient soils mixed with fertilizers or as a main fertilizer itself. Baza *et al.* (1992) working on broad bean found that Fe, Mn, Zn and B increased the yield.

The beneficial affects of micronutrients application in Egypt was reported by Monged *et al.* (2003) who state that the need to micronutrients is true.

El-Habbal *et al.* (1995) concluded that balanced fertilization system including micronutrients can optimized the use of N-fertilizers. The same conclusion was also found by El-Akabawy *et al.* (2001).

Concerning the effect of biofertilizers on beans, many recent studies in Egypt insure the beneficial effect of it; Ahmed *et al.* (2002) and Monged *et al.* (2003).

As the great positive effect of using integrated fertilizing program the author and others confirmed it on several crops in Egypt as will be maintained later.

So, fertilization trails were done in this work to increase broad bean yield and quality with increasing the net return and reducing soil pollution by reducing the use of mineral fertilization.

MATERIALS AND METHODS

The experimental work was carried out during two successive seasons in Sherbeen, Dakahla Governorate. The two experiments were conducted during the seasons 2004/2005 and 2005/2006 to examine the response of two broad bean varieties; (Giza 461) and (Giza 843) to K, boron and the combination of (Fe, Mn, Zn) in two sprays the first was 40 days after sowing, and the second was month later. All the treatments of the two seasons received recommended treatments; inoculation the seeds with (*Rhizobium leguminosarum* ficia) (R.L.) was done 30 kg N and 30 kg P_2O_5/feddan.

The treatments were as follows:

1. (R.L), NP (the control).
2. (R.L), NP + K (24 kg K_2O/fed.).
3. (R.L), NP + B (2 foliar sprays with boric acid 0.4 gm L^{-1}).
4. (R.L), NPK + B.
5. (R.L), NP + (Fe + Zn + Mn) (2 foliar sprays, 0.6 gm L^{-1}. 0.2 gm of each chelate).
6. (R.L), NPK (Fe + Zn + Mn).
7. (R.L), NP + B + (Fe + Zn + Mn).
8. (R.L), NPK + B + (Fe + Zn + Mn).

Each treatment was replicated 4 times, using 2 varieties (G 461 and G 843) and the split plot design was used.

Soil surface samples (0-30 cm) were taken before sowing to determine soil properties according to Jackson (1973) as shown in Table (1).

Table 1: Some physical and chemical properties of the experimental soil.

Properties	Value	Available nutrients				Anions and cations	
C.S.	2.40	(mg kg^{-1})				(mg 100 g $soil^{-1}$)	
F.S.	17.28	N		28.43		HCO^{-}_{3}	0.36
Silt (%)	32.30	P		41.70		Cl^{-}	0.79
Clay (%)	48.02	K		368		SO^{--}_{4}	0.17
$CaCO_3$ (%)	3.28	Fe		10.35		Ca^{++}	0.82
OM (%)	2.60	Mn		5.76		Mg^{++}	0.47
pH 1: 2.5	7.61	Zn		0.49		Na^{+}	0.17
EC (1: 5)	0.30	B	0.46	Cu	3.86	K^{+}	0.02

At harvest, seed yield was determined as ardab/fed. (ardab = 155 kg), and straw yield was determined as ton/fed. seed index was also detemriend. The obtained results were exposed to the proper statistical analyses of variance. Samples of seed were subjected to some chemical analyses i.e. total N (according to the A.O.A.C., 1990), P (according to Jackson, 1973) and K by flame photometer (according to Chapman and Pratt, 1961). B was detemriend according to John *et al.* (1975) and micronutrients (Fe, Mn, Zn and Cu) were measured by Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

A. Seed yield:

Effect of treatments on seed yield:

1. Potassium effect:

Data presented in Table 2 showed the significant increase in seed yield as affected by K application in the two experiments done. That because Sherbeen has a heavy texture soil which needs K its fertilizing program. Which was, confirm by the finding of Abdel-Hadi (1988) and Monged *et al.* (2003b), Monged *et al.,* 2004a & b).

2.Effect of micronutrients:

The foliar spray with the combination of (Fe: Mn: Zn) showed highly significant increases in broad bean seed yield than the control Table 2. Similar results were confirmed by many workers; Monged *et al.* (1988), Baza *et al.* (1989 & 1992), Monged *et al.* (1994) and Sabik *et al.* (2001).

Such need of broad bean, and other crops, to micronutrients in Egypt may be due to several reasons; the great nutritional need of the high productivity of the crops, the discontinuity of the precipitation of the Nile mud, the intensive cropping system used and the high pH values of most Egyptian soils which hinders the utilization of most of micronutrients by plants (Hamissa and Abdel-Salam, 1999).

Concerning the effect of B on broad bean it was effective in increasing the yield in highly significant difference (16% than the control), but it was more effective when it was sprayed in combination with (Fe + Mn + Zn) where it increased the yield 50% than the control as illustrated in Table 2.

Similar findings was found by Gopal (1971), Willett *et al*. (1985) who stated that nitrogen induced B deficiency, they found that addition of B to plants resulted in a 3 to 4 fold increase in yield. Monged *et al.* (1993) working on sugar beet found that the highest root and sugar yield were obtained from (Fe + B) treatment.

3. Effect of balanced fertilization with minerals:

The combination of fertilizing with NPK and foliar sprays with micronutrients (Fe + Mn + Zn + B) recorded highly significant increase in broad bean seed yield Table 2.

It can be concluded that using the integrated fertilizing program showed great benefit in increasing broad bean yield. The author and others found the same findings with several crops in Egypt; Monged *et al.* (2002) working on grain crops. Monged *et al.* (2003a) on cotton Monged *et al.* (2003b) on groundnut. Monged *et al.* (2004a) on maize, Monged *et al.* (2004b) on soybean and Mnged *et al.* (2004c) on wheat.

Thus, it seems that using the balanced mineral fertilizer beside the proper biofertilizer, which supply the crop with N in addition to the growth promoting substance produced by the microorganisms is of great benefit to crops.

4. The effect of treatments on the varieties:

It was found that the two varieties behaved the same in response to the treatments used but the different between the means of the varieties was significant. The variety G. 461 was superior than G. 843. That means the high yield variety response well with the fertilization programs. It can be said that the variety G. 461 fit best than G. 843 specially when using the integrated fertilization. Similar result was mentioned by Mortvedt *et al.* (1991) who stated that, tailoring the plant to fit the sol appears more practical than changing the soil to fit the plant.

5. The effect of treatments on straw yield and seed index:

It was found, that in the experiments; that the straw yields of broad bean were increased significantly as a result of all treatments used.

Table 3 illustrate that no clear trend can be noticed in seed index of broad bean as a result of the treatments used in the two seasons.

B. Yield quality:

Data in Table 4 & 5 shows that, generally, N, P and K concentrations and contents in broad bean seeds were increased as a result of all treatments used. The highest increases were obtained with the combined treatments specially the integrated treatment.

As for the micronutrients concentrations in broad bean seeds, they were more or less the same. However, the contents were increased as a result of treatments Tables 4 & 5. Similar results were found by Monged *et al.* (2003b) and Monged *et al.* (2004b).

From the above mentioned results, it is worth mentioning that, using the biofertilizers (R.L.) inoculation beside the mineral fertilization with NPK + (Fe , Mn, Zn and B) increased broad bean yield quality and quantity beside increasing net return and decreasing pollution.

Table 4: Effect of the nutritional treatments on concentration and uptake of NPK in broad bean seeds in the first season.

Variety / Treatment	Concentration (%)								
	G. 463			G. 843			Mean		
	N	P	K	N	P	K	N	P	K
NP	3.36	0.49	0.86	2.59	0.50	0.90	2.98	0.50	0.88
NPK	3.01	0.53	0.90	2.73	0.54	0.90	2.87	0.54	0.90
NP + B	3.43	0.48	0.90	2.52	0.52	0.86	2.98	0.50	0.88
NPK + B	2.31	0.58	0.86	3.29	0.49	0.90	2.80	0.54	0.88
NP + (Fe, Mn, Zn)	1.96	0.54	0.90	2.52	0.58	0.90	2.24	0.56	0.90
NPK + (Fe, Mn, Zn)	2.24	0.46	0.86	3.43	0.55	0.86	2.84	0.51	0.86
NP + B + (Fe, Mn, Zn)	3.36	0.45	0.86	3.01	0.53	0.90	3.19	0.49	0.86
NPK + B + (Fe, Mn, Zn)	2.66	0.46	0.86	2.80	0.57	0.94	2.73	0.52	0.90
	Uptake (Kg fed.$^{-1}$)								
NP	59.60	8.69	15.26	42.84	8.27	14.89	51.22	8.48	15.07
NPK	58.81	10.36	17.58	50.10	9.91	16.52	54.46	10.13	17.05
NP + B	70.47	9.86	18.49	49.68	10.25	16.96	60.08	10.06	17.72
NPK + B	54.05	13.57	20.12	76.61	11.41	20.96	65.33	12.49	20.54
NP + (Fe, Mn, Zn)	47.95	13.21	22.02	59.75	13.75	21.34	53.85	13.48	21.68
NPK + (Fe, Mn, Zn)	59.23	12.16	22.74	87.85	14.09	22.03	73.54	13.13	22.38
NP + B + (Fe, Mn, Zn)	76.40	10.23	19.56	68.64	12.09	20.52	72.52	11.16	20.52
NPK + B + (Fe, Mn, Zn)	69.45	12.01	22.45	73.85	15.03	24.79	81.43	13.25	23.62

Table 5: Effect of the nutritional treatments on concentration and uptake of micronutrients of broad bean seeds in the first season

Variety / Treatments	Concentration (ppm)														
	G. 463					G. 843					Mean				
	Fe	Zn	Mn	B	Cu	Fe	Zn	Mn	B	Cu	Fe	Zn	Mn	B	Cu
NP	111	15	13	65	12	67	20	14	88	8	89	18	14	77	10
NPK	74	21	16	90	11	64	16	13	75	9	69	19	15	83	10
NP + B	61	14	14	76	14	79	18	18	97	10	70	16	16	87	12
NPK + B	54	14	14	76	10	67	13	15	66	9	61	14	15	69	10
NP+ (Fe, Mn, Zn)	87	16	15	81	9	62	16	14	82	9	75	16	15	82	9
NPK+(Fe,Mn, Zn)	87	16	16	74	12	53	15	13	75	10	70	16	15	75	11
NP+B+(Fe,Mn, Zn)	54	17	14	71	11	71	19	17	74	10	63	18	16	73	11
NPK+B+(Fe,Mn, Zn)	104	18	22	81	14	69	15	19	51	8	87	17	21	66	11
	Uptake (g fed.$^{-1}$)														
NP	197	27	23	115	21	111	33	23	147	13	154	30	23	131	17
NPK	145	41	31	176	21	119	30	24	139	17	132	36	28	158	19
NP + B	125	29	29	156	29	156	35	35	191	20	141	32	32	174	25
NPK + B	126	33	33	178	23	156	30	35	154	21	141	32	34	166	22
NP+ (Fe, Mn, Zn)	213	39	37	198	22	147	38	33	194	21	180	39	35	196	22
NPK+(Fe,Mn, Zn)	230	42	42	196	32	136	38	33	192	26	183	40	38	194	29
NP+ B+(Fe, Mn, Zn)	123	39	32	161	25	162	43	39	169	23	143	41	36	165	24
NPK+B+(Fe,Mn, Zn)	272	47	57	211	37	182	40	50	135	21	227	44	54	173	29

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تـأثير بعض معـاملات التغذيـة علـى المحصـول وإمتصـاص العناصـر الغذائيـة لبـذور الفول البلدى

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اقيمت تجربتان حقليتان خلال موسمين زراعيين متتاليين اعوام 2005/2004 ، 2006/2005 بمركز شربين ـ محافظة الدقهلية لدراسة تـأثير التسميد بالبوتاسيوم والرش بالبورون منفردا والرش بمخلوط العناصر الصغرى الحديد والمنجنيز والزنك وتبادل من هذه المعاملات على نبات الفول البلدى من حيث المحصول والجودة وذلك على صنفين من الفول البلدى جيزة 461 ، جيزة 843 مع ملاحظة ان جميع المعاملات كانت البذور تلقح بالبكتريا الخاصة بالفول البلدى (*Rizobium leguminozarim ficia*) والتسميد بالمعدلات الموصى بها من النتروجين (30 كجم ن/فدان) والفوسفور (30 كجم فو2أ5/فدان) ومن اهم النتائج التى تم الحصول عليها:

1- أدى التسميد بالبوتاسيوم الى زيادة مؤكدة احصائيا كانت (8.8%) ويزداد تأثيره مع استعمال المعاملات الاخرى.
2- كذلك وجد أن استعمال الرش بخليط من العناصر الصغرى (حديد ومنجنيز وزنك) ادى الى زيادة مؤكدة احصائيا وكانت (33.7%).
3- وحد أن الرش بالبورون منفردا كان له تاثير ايجابى ومؤكد احصائيا حوالى (16.2%) وازداد تأثيره عندما اضيف مع مخلوط العناصر الصغرى حيث وصلت الزيادة فى المحصول الى (50.3%).
4- وجد ان استخدام التسميد المعدنى المتزن من عناصر النتروجين والفوسفور والبوتاسيوم بالاضافة الى الرش بالعناصر الصغرى (حديد ومنجنيز وزنك) والبورون كان له تأثير ايجابى على زيادة المحصول حيث وصلت الزيادة الى 50.7%) زيادة مؤكدة احصائيا.

ويمكن القول فى خلاصة البحث ان استعمال برنامج تسميد معدنى متكامل مع تلقيح الحبوب بالبكتريا يؤدى للحصول على افضل محصول للفول البلدى كماً ونوعاً مع الافادة اقتصاديا وبيئياً.

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Table 2: Broad bean seed yield of two varieties (ardab/feddan), as affected by different treatments during two successive seasons.

Variety / Treatments	First Season			Second season			Mean of the two seasons			Increase %
	G. 461	G. 843	Mean	G. 461	G. 843	Mean	G. 461	G. 843	Mean	
NP	11.850	11.157	11.504	11.442	10.670	11.056	11.646	10.914	11.280	-
NPK	12.622	11.927	12.275**	12.605	11.840	12.223**	12.670	11.884	12.277**	8.84
NP + B	13.632	12.803	13.217**	13.255	12.720	12.987	13.444	12.761	13.102**	16.15
NPK + B	15.162	14.205	14.684**	14.670	14.712	14.691**	14.916	14.459	14.687**	30.20
NP + (Fe, Mn, Zn)	15.670	14.548	15.109**	15.095	15.023	15.059**	15.383	14.786	15.084**	33.72
NPK + (Fe, Mn, Zn)	16.668	15.387	16.027**	15.782	15.297	15.540**	16.225	15.342	15.784**	39.93
NP + B + (Fe, Mn, Zn)	17.548	16.677	17.112**	17.060	16.523	16.791**	17.304	16.600	16.952**	50.28
NPK + B + (Fe, Mn, Zn)	17.300	16.815	17.057**	16.845	17.015	16.930**	17.072	16.915	16.994**	50.65
Mean of varieties	15.057**	14.190		14.594**	14.225		14.832**	14.207		
L.S.D. for treatments 0.05			0.414			0.466			0.305	
0.01			0.554			0.623			0.403	
L.S.D. for varieties 0.05	0.172			0.321			0.243			
0.01	0.317			0.591			0.360			

Ardab = 155 kg **Feddan = 4200 m^2**

Table 3: Broad bean straw yield of two varieties (ardab/feddan), and seed index, as affected by different treatments during two successive seasons.

Variety / Treatments	First Season			Second season			Seed index		
	G. 461	G. 843	Mean	G. 461	G. 843	Mean	G. 461	G. 843	Mean
NP	1.938	2.008	1.973	2.015	2.070	2.043	75.3	79.7	77.5
NPK	2.260	2.392	2.326**	2.335	2.343	2.339**	85.0	76.0	80.5
NP + B	2.358	2.622	2.490**	2.408	2.683	2.545**	75.1	76.9	76.0
NPK + B	2.612	2.618	2.615**	2.627	2.712	2.670*	73.6	73.2	73.4
NP + (Fe, Mn, Zn)	2.577	2.725	2.651**	2.785	2.790	2.788**	84.3	76.5	80.4
NPK + (Fe, Mn, Zn)	2.590	2.705	2.648**	2.692	2.863	2.778**	78.6	77.7	78.2
NP + B + (Fe, Mn, Zn)	2.952	3.105	3.029**	3.135	3.062	3.099**	77.7	74.2	76.0
NPK + B + (Fe, Mn, Zn)	3.068	3.377	3.223**	3.387	3.188	3.288**	72.9	81.3	77.1
Mean of varieties	2.544	3.377**		2.673	2.714		77.8	76.6	77.3
L.S.D. for treatments 0.05			0.190			0.184			
0.01			0.254			0.246			
L.S.D. for varieties 0.05	0.072			N.S.					
0.01	0.133								