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SOME NUTRITIONAL TRIALS TO INCREASE BROAD BEAN YIELD AND QUALITY

Allam, S.M.M.; H.G. Abu EL Fotoh; A. A. Abd El-Magid and Nadia O. Monged

Plant Nutrition Res. Section., Soil & Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Three field experiments were conducted on broad bean plants in Sakha Agric. Res. Station during three successive seasons (2000-2003). The first two experiments were carried out to study the effect of K, B, and the combination of (Fe, Mn, Zn) on two varieties of broad bean (G 461 and G 843). The third experiment was conducted to study the effect of the integrated fertilizing using mineral and biofertilizer treatments.

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

The most important results were as follows: -

1. K application (with 24 Kg K_2O/fad.) increased the yield significantly where, the increases ranged between (8.8-13.6 %) over the contol. Its effect increased when it was used with either micronutrients or biofertilizer.
2. Micronutrients combination (Fe, Mn, Zn), spraying twice, increased the yield significantly and the increases ranged between (7.7-33.7 %) over the control.
3. Boron has an effective and significant effect on broad bean plants. When it was used alone it increased the yield (16.2 %). It was more effective when it was used with the treatment of the combined micronutrients, the increase reached 50.3 % (experiments 1 and 2).
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 (experiments 1 and 2).
5. Inoculation with the phosphorus solubilizing bacteria (*Bacillus megatherim var. phosphaticum)* was effective, it increased the yield significantly (21.1 %) over the control when used alone. But it was more effective when it was used with either K (36.2 %) over the control or with micronutrints (32.9%) increase in yield over the control.

6. The best treatment was the integrated treatment including mineral and biofertilizer inoculation, it recorded (45.3 %) significant increase in broad bean yield. (experiment 3).
7. 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 using the integrated fertilization programs increase the quality and quantity of broad bean 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 Egyptians.

The area planted for production of dry beans was 336,000 Fad. producing 428,000 t during 1995-1999. The imports averaged 105,000 t 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/fad. increased faba bean yield 24.45 %. They found also that the high K-rate of 48 kg K_2O/fad. was not the proper rate for fababean 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 effects of micronutrients application in Egypt was reported by **Monged et al., (2003)** who stated that the need to micronutrients is true.

El-Habbal et al., (1995) concluded that balanced fertilization system including micronutrients can optimize 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 trials 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 three successive seasons in Sakha Agri. Res. Station. The first two experiments were conducted during the seasons; (2000-2001) and (2001-2002) 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 leter. The third experiment was don during the season of (2002-2003) to study the effect of the inoculation with the biofertizer, phosphorus solubilizing bacteria (*Bacillus megatherim var. phosphaticum) (B.M.)* beside the previous treatments in the first two experiments but on the variety G.843. It is worth to mention that all the treatments of the three experiments received recommended treatments; inoculation the seeds with (*Rhizobium leguminosarum ficia) (R.L.*), was done 30 kg N and 30 kg P_2O_5/Faddan.

The treatments of the first two experiments were as follows:

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

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

The third experiment was designed according to the results of the previous experiments. The treatments were as follows: -

1. *(R.L.),* NP (the control).
2. *(R.L.),* NP + K (24 Kg K_2O/fad.).
3. *(R.L.),* NP + (Fe +Mn + Zn + B).
4. *(R.L.),* NPK + (Fe +Mn + Zn + B).
5. (R.L.), NP + *(Bacillus megatherim var. phosphaticum) (B.M.).*
6. (R.L.), NPK + *(B.M.).*
7. *(R.L.),* NP + (Fe +Mn + Zn + B) + *(B.M.).*
8. *(R.L.),* NPK + (Fe +Mn + Zn + B) + *(B.M.).*

Each treatment was replicated 8 times, using the variety (G 843) and the complete randomized block design was used.

Soil surface samples (0-30 cm) were taken before sowing and after harvest to determine soil properties according to **Jackson (1973)** as shown in Table (1) and (9).

At harvest, seed yield was determined as ardab/fad. (ardab = 155 kg), and straw yield was determined as ton/fad. Seed index was also determined. 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 determined according to **John et al., 1975)** and micronutrients (Fe, Mn, Zn and Cu) were measured by Atomic Absorption Spectrophotometer.

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

Properties	Value	Available nutrients ($mg\ kg^{-1}$)				Anions and cations ($mg100g\ soil^{-1}$)	
C.S.	2.41						
F.S.	17.28	N		22.40		HCO_3^-	0.36
Silt (%)	52.30	P		41.70		CL^-	0.79
Clay (%)	28.02	K		364		SO_4^{--}	0.17
$CaCO_3$ (%)	3.28	Fe		10.32		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	0.44	Cu	3.86	K^+	0.02

RESULTS AND DISCUSSION

A- Seed yield: -

Effect of treatments on seed yield:

1- Potassium effect: -

Data presented in Tables (2 & 3) showed the significant increase in seed yield as affected by K application in all the experiments done. That because Sakha has a hravy 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-Effet of mictonytrientw:-

The foliar spray with the combination of (1Fe: Mn: 1Zn) showed highly significant incrases in broad bean seed yield than the cintrol (Tabnles 2&3) .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 value of most Egyptian soils which hinders the utilization of most of micronutrients by plants **(Hamissa and Abdel-Salam1999).**

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 Tables (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 (Tables 2 & 3).

4-Effect of biofertilizer inoculation: -

Inoculation the seeds with the biofertilizer ((*Bacillus megatherim*

Table (2): Broad bean seed yield of two varieties (ardab/faddan), and seed index, as affected by different treatments during two successive seasons (2000-2001) & (2001-2002)

Treatment	Season (2000-2001)			Season (2001-2002)			Mean of the two seasons			
Variety	G.461	G.843	Mean	G.461	G.843	Mean	G.461	G.843	Mean	Increase %
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 tretments 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	
	0.317	0.591	0.360	

Ardab =155 kg.
Faddan = 4200 m^2

increased the broad bean seed yield significantly (21 %). However, The increeases were 36 % and 33 % using NPK and combination with micronutrients, respectively. The greatest increase in yield were obtained by using integrated fertilizing treatment with balanced mineral nutrition where the increase was 45 % over the control, Table (3).

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 **Monged et al., (2004c)** on wheat.

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

5. The effect of treatment 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 G461 fit best than G.843 in Sakha conditions specially when using the integrated fertilization. Similar result was mentioned by **Mortvedt et al., (1991)** who stated that, tailoring the plant to fit the soil appears more practical than changing the soil to fit the plant.

Table (3): Broad bean seed, straw yield and seed index in Sakha during (2002-2003) season.

Treatment	Seed yield ardab/fad.	% Incr.in seed yield	Straw yield ton/fad.	Seed index
NP	9.122	-----	2.075	83.0
NPK	10.363**	13.604	2.159*	70.7
NP+(Fe,Mn,Zn,B) spray	9.820**	7.652	2.268**	72.0
NPK+(Fe,Mn,Zn,B)	10.909**	19.590	1.873	68.9
NP + biofertilizere	11.049**	21.125	2.058	81.5
NPK + Bio.	12.426**	36.220	2.268**	66.9
NP+Bio. +(Fe,Mn,Zn,B)	12.122**	32.888	2.299**	78.8
NPK +Bio. +(Fe,Mn,Zn,B)	13.250**	45.253	2.258**	72.2
L.S.D. 0.05		0.244	0.072	
0.01	0.326	0.096		

Bio. = Biofertilizer (*Bacillus megatherim var. phosphaticum)*

Table (4): Broadbean staw yield of two varieties (ton/faddan), and seed index, as affected by different treatments during two successive seasons (2000-2001) & (2001-2002)

Treatment	Season (2000-2001)			Season (2001-2002)			Seed index		
Variety	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 tretments 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		

Table (5): Effect of the nutritional treatments on concentration and uptake of NPK in broad bean seeds (Sakha 2000-2001).

	Concentration (%)								
Variety	G. 463			G.843			Mean		
Treatment	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 (K fad^{-1})								
Variety	G. 463			G.843			Mean		
Treatment	N	P	K	N	P	K	N	P	K
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 (6): Effect of nutritional treatments on concentration and uptake of micronurtients of broad bean seeds (Sakha 2000-2001).

	Concentration (ppm)														
Variety	G.463					G. 843					Mean				
Treatment	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
NP+(Fe,Mn,Zn)	54	14	14	76	10	67	13	15	66	9	61	14	15	69	10
NPK+(Fe,Mn,Zn)	87	16	15	81	9	62	16	14	82	9	75	16	15	82	9
NP+B+(Fe,Mn,Zn)	87	16	16	74	12	53	15	13	75	10	70	16	15	75	11
NPK+B	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 Fad^{-1}														
Variety	G.463					G. 843					Mean				
Treatment	Fe	Zn	Mn	B	Cu	Fe	Zn	Mn	B	Cu	Fe	Zn	Mn	B	Cu
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
NP+(Fe,Mn,Zn)	126	33	33	178	23	156	30	35	154	21	141	32	34	166	22
NPK+(Fe,Mn,Zn)	213	39	37	198	22	147	38	33	194	21	180	39	35	196	22
NP+B+(Fe,Mn,Zn)	230	42	42	196	32	136	38	33	192	26	183	40	38	194	29
NPK+B	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

Table (7): NPK concentration and uptake of broad bean seeds as affected by nutritional treatments (Sakha 2003).

	N		P		K	
Treatment	%	kgfad^{-1}	%	kgfad^{-1}	%	kgfad^{-1}
NP	3.92	55.425	0.44	6.221	1.47	20.784
NPK	4.62	74.209	0.41	6.586	1.38	22.166
NP+(Fe,Mn,Zn,B)	3.85	58.605	0.22	3.349	1.19	18.113
NPK+(Fe,Mn,Zn,B)	2.94	49.712	0.28	4.735	1.31	22.151
NP+Biofertilizer	3.36	57.543	0.26	4.453	1.19	20.380
NPK+Bio.	3.01	57.974	0.42	8.089	1.38	26.579
NP+Bio. +(Fe,Mn,Zn,B)	3.22	60.501	0.42	7.891	1.38	25.929
NPK+Bio. +(Fe,Mn,Zn,B)	2.94	60.380	0.56	11.50	1.50	30.806

Bio. = Biofertilizer (*Bacillus megatherim var. phosphaticum)*

Table (8): Micronutrients concentration and uptake of broad bean seeds as affected by nutritional treatments (Sakha 2003).

	Fe		Zn		Mn		B		Cu	
Treatment	mg kg^{-1}	g fad^{-1}	mg kg^{-1}	g fad^{-1}	mg kg^{-1}	g fad^{-1}	mg kg^{-1}	g fad^{-1}	mg kg^{-1}	g fad^{-1}
NP	109	154	20	28	16	23	12	17	21	30
NPK	85	137	18	29	14	22	10	16	14	22
NP+(Fe,Mn,Zn,B)	61	93	18	27	15	23	11	17	11	17
NPK+(Fe,Mn,Zn,B)	69	117	22	37	14	24	13	22	13	22
NP+Biofertilizer	80	137	13	22	16	27	10	17	12	21
NPK+Bio.	67	129	16	31	16	31	10	19	12	23
NP+Bio. +(Fe,Mn,Zn,B)	94	177	19	37	14	26	16	30	15	28
NPK+Bio. +(Fe,Mn,Zn,B)	82	168	15	31	15	31	12	25	14	29

Table (9): Available minerals (mg kg^{-1}) in soil after harvest of broad bean (Sakha 2003).

Treatment Mineral	N	P	K	Fe	Zn	Mn	B	Cu
NP	28.0	10.5	278	10.5	2.3	3.2	0.78	3.8
NPK	30.8	4.0	418	11.0	1.4	5.0	0.82	4.2
NP+(Fe,Mn,Zn,B)	39.2	6.1	364	10.3	2.6	4.2	0.80	4.1
NPK+(Fe,Mn,Zn,B)	30.8	4.4	278	9.0	1.7	4.3	0.58	3.9
NP+Biofertilizer	28.0	10.4	301	10.0	1.7	3.0	1.10	4.01
NPK+Bio.	28.0	3.7	356	10.9	2.0	4.2	0.72	4.2
NP+Bio. +(Fe,Mn,Zn,B)	30.8	4.2	391	10.1	1.8	5.1	0.74	3.9
NPK+Bio. +(Fe,Mn,Zn,B)	44.8	5.6	776	9.1	3.2	4.5	0.68	3.7

The effect of treatments on straw yield and seed index: -

It was found, that in the experiments; 1 and 2, that the straw yields of broad bean were increased significantly as a result of all treatments used. However, no clear effect was found in the third experiment. (Tables 3&4)

Tables (3&4) illustrate that no clear trend can be noticed in seed index of broad bean as a result of the treatments used in all the experiments.

B- Yield quality:

Data in Tables (5 &7) 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 6 & 8). Similar results were found by **Monged et al., (2003b) and Monged et al., (2004b).**

Concerning the residual effect of minerals after harvest no obvious increase could be found as a result of treatments.

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

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بعض معاملات التغذية لتحسين محصول و جودة بذور الفول البلدي

سيد محمد علام، عبد المجيد أبو المعاطي عبد المجيد، و ناديه عمر منجد

معهد بحوث الأراضي و المياه و البيئة – مركز البحوث الزراعية – الجيزة – مصر.

أجريت ثلاث تجارب حقلية خلال ثلاث مواسم زراعية متتالية من ٢٠٠٠ حتى ٢٠٠٣ في محطة البحوث الزراعية بسخا. التجربتان الأوليتان أجريتا خلال الموسمين (٢٠٠٠-٢٠٠١)، و(٢٠٠١-٢٠٠٢) لاختبار تأثير التسميد بالبوتاسيوم والرش بالبور ون منفرداً، والرش بمخلوط من الحديد والمنجنيز والزنك وتباديل من هذه المعاملات على نبات الفول البلدي من حيث المحصول والجودة. وذلك على صنفين من الفول، جيزة ٤٦١ وجيزة ٨٤٣ ، مع ملاحظة أن جميع المعاملات كانت البذور تلقح بالبكتريا الخاصة بالفول البلدي,(*Rizobium leguminozarium ficia*) والتسميد بالمعدلات الموصى بها من النيتروجين (٣٠ كج ن/فدان) والفوسفور (٣٠ كج فو٢أ٥/فدان).

أما التجربة الثالثة فقد أجريت خلال الموسم (٢٠٠٢-٢٠٠٣) وذلك بناءاً على نتائج التجربتين السابقتين، مع إضافة المعاملة بالتسميد الحيوي بسماد مذيب للفوسفات (*Bacillus megatherim var. phosphaticum*) مع استعمال أفضل المعاملات السابقة وذلك للحصول على أعلى محصول ممكن مع الأخذ في الاعتبار العامل الاقتصادي والتلوث البيئي.

ومن أهم النتائج التي تم الحصول عليها: -

١- أدى التسميد بالبوتاسيوم إلى زيادة مؤكدة إحصائياً تراوح بين (٨,٨-١٣,٦ ./.) ويزداد تأثيره مع استعمال المعاملات الأخرى.

٢- كذلك وجد أن استعمال الرش بخليط من العناصر الصغرى (حديد ومنجنيز وزنك) أدى إلى زيادة مؤكدة إحصائياً تراوحت بين (٧,٧-٣٣,٧ ./.).

٣- وجد أن الرش بالبور ون منفرداً كان له تأثير إيجابي ومؤكد إحصائياً حوالي (١٦,٢ ./.) وازداد تأثيره عندما أضيف مع مخلوط العناصر السابق وصل إلى زيادة في المحصول قدرت ب (٥٠,٣ ./.) (تجربة ١،٢).

٤- وجد أن استخدام التسميد المعدني المتزن من عناصر (النيتروجين والفوسفور والبوتاسيوم بالإضافة للرش بالعناصر الصغرى (حديد ومنجنيز وزنك والبور ون) كان له تأثير إيجابي على زيادة المحصول تراوحت الزيادة بين (١٩,٦-٥٠,٧ ./.) زيادة مؤكدة إحصائياً.

٥- وجد أن إضافة السماد الحيوي المذيب للفوسفور (*B.M.*) أدى إلى زيادة في المحصول تصل إلى (٢١,١ ./.) وكانت الزيادة أكبر عندما استخدم مع التسميد البوتاسي أو الرش بالعناصر. وكانت أعلى زيادة عندما استخدم مع التسميد المعدني المتزن وصلت الزيادة المؤكدة إحصائياً إلى (٤٥,٣ ./.).

ويمكن القول أن استعمال برامج التسميد المتكامل يؤدي إلى الحصول على افضل محصول للفول البلدي كماً ونوعاً مع الإفادة اقتصادياً وبيئياً.