QUALIFICATION OF FERTILIZATION WITH SOME NATURAL SOURCES OF POTASSIUM AND BACTERICAL INOCULATION WITH *Bacillus circulans* FOR YIELD OF BROADBEAN AND THEIR ECONOMICAL UTILITY IN A SANDY SOIL

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ABSTRACT

A pot experiment was carrying out in winter season by using a sandy soil from Ismallia Governorate, at Agriculture research center (ARC) during the winter season of 2007.

Treatments of the experiment were: Potassium sulfate, K2SO4 (M), nature potassium compost rich in K-content (C) and potassium feldspar (K-bearing mineral, KAlSi3O8) (F) were used in a solo or in a mixture forms at rates of 50%, 75% and 100% of the recommended dose (R.D) of potassium (24 Kg K2O / fed.). As well as inoculation seeds of broad bean (Vicia faba.L , cv. Giza 843 variety) with or without K-dissolved bacteria Bacillus circulans (KDB).

Seeds and straw yields, the percent of K that take by seeds from added potassium fertilizers (ADK %) as well as the differences between costs of production and profits of incomes (i.e., Net Gain) were mathematically calculated as LE/fed., to test the qualification of this work and to define the most profitable recommended treatments in this research.

In general, inoculation with Bacillus circulans gave higher yields of seeds and straw of broad bean plants than under non-inoculation condition.

Used of any type of K- fertilizer significantly increased yields of seeds and straw of broad bean plants comparing with non-fertilized treatment (control). On the other hand, increasing the rate of

application from 50% to 100% R.D, in general, significantly increased the yield of seeds and straw of broad bean plants comparing with the rate of 0% K.R.D (control). The results of 75% R.D under inoculation were nearest from the results of 100% R.D.

As for the effect of different types of K- fertilizers on yields of straw and seeds, data defined that:

Mineral fertilizer type K2SO4 (M) was the best treatment followed with (F) treatment, when they added in a solo form, on the previous parameters.

With respect to the dual mixture of K-fertilizers (M+F) followed with (M+C) gave the best effects on straw yield while, (F+C) gave pronounce effect on seed yield.

The triple mixture of (M+C+ F) shows a significant response on the yield of seeds.

Concerning to ADK % of seeds:

Inoculation with KDB and increasing the rate of K- application significantly increased ADK % of seeds.

The treatment of (M), (F) and (M+F) were the best treatments in increasing ADK % of seeds.

Finally, the best treatments which achieved the highest net gain (LE/fed.)-under the circumstance work- were obtained under inoculation with KDB treated with 75% or 100% R.D of (M), (F) or mixture between them.

INTRODUCTION

Potassium considered as a very vital cation for plants not only concerning its high content in plant tissues, but also with respect to its physiological and biochemical functions. It is of utmost important for stimulate early growth, increase protein and carbohydrates production, increase plant lodging resistance as well as improving the efficiency of water uptake, use and balanced in plant tissues. Therefore, potassium known as "quality element" and it was considered as a key factor in crop production (Moussa; 1992, Hassan et al.; 1997 Marschner; 1998, Moussa; 2000, George and Michael; 2002 and Thompson; 2004).

Sandy soils suffer from severe poverty in their potassium content. Aboulroos (1972) and Assal (1981) declared that the concentration of water-soluble potassium in different type of Egyptian soils ranged between 0.02-to 0.5 meq/100g soils. The lower value were for coarse textured soils, while the higher ones for fine texture and salt affected soils and Balba (1979) showed that sandy soils of Egypt contain 3,2 and 0.2-0.25 meq K/100 g soil of concentrated HNO3 + H2SO4 – diluted HCl – and NH4OAC- extractable forms. On the other hand, unbalance programs of mineral fertilization depending on the application of huge amounts of N & P and low amount of K–mineral fertilizers, to meet the nutritional needs of heavy agriculture policy that used high yielding new crop varieties. As well as low contents of organic matter of soil and insufficient plans of fertilization with different organic manures, represent major reasons in the problem of decadence in K- status of sandy soils.

The reuse of plant residues, rich in K–element, after composting as organic manure (Ibrahim; 1989 and Abdel Moez and Saleh; 1999) and the use of K–bearing minerals (K–feldspars) (Seddik; 2006) can be positively contributed in covering a great portion of K- plant need through the release of their potassium contents as a part of K-cycle in soil.

Therefore, this experimental work would be carry out in some Egyptian sandy soils, to test the benefits and economical utility of mineral potassium fertilizer, some natural K- sources added as a solo or in a combination to soil as well as inoculation of seeds with K–dissolved bacteria ***(Bacillus circulans)*** for the yield of broad bean.

MATERIALS AND METHODS

A pot experiment was carried out at Soils, Water and Environment Research Institute (SWERI), Agriculture research center (ARC) in a sandy soil taken from Ismallia Governorate during 2005 season. Soil sample was air dried and analyzed according to Black (1982) and results obtained were presented in Table (1).

The three sources of potassium fertilizers used in this experimental work were:

Mineral fertilizer (M): Potassium sulfate, K_2SO_4 (48 % K_2O).

Potassium Feldspar (F): K–bearing mineral (K–feldspar) (KAlSi3O8), which had taken from the mines of western desert. Some chemical and physical properties of the studied soil are shown in (Table 1).

Potassium Compost (C):

Natural organic compost rich in K-content, which prepared by composting the residues of plants rich in potassium element (i.e. the west of leaves, stem and corms as well as addle and broken fruits of banana tress) for six months under proper conditions of moisture and temperature until it reached a mature stage. Then air- dried crushed finely and chemical analyzed and nature K- fertilizers.

All used seeds of broad bean ***(Vicia Faba. L)***, cv. Giza 843 variety were mixed thoroughly with Rizobia – sugar solution directly before planting. Then half amounts of bean seeds, required for planting the half pots, were inoculated with potassium dissolving bacteria ***"Bacillus circulans"*** (KDB) while the other half of seeds, did not inoculated with KDB (without KDB)

During winter season, ten seeds were planted in plastic pots filled with 7 Kg, of soil, in three replicates. After complete emergence, the seedlings were thinned to four plants in each pot.

After one month from planting, all pots that inoculated with (KDB) received another activation dose from (KDB) added as aqua – solution on the surface of soil adjacent to growing plants.

All pots received the basic doses of N and P mineral fertilizers equals to 200 Kg-super phosphates per fed. (15.5% $P2O5$) added during pot preparation, and 10 – 20 Kg ammonium sulfate (20.5 % N) per fed.that added as activation dose at the beginning of plant growth in two equal doses, the first dose during planting seeds and the other after ten days from planting.

As for the treatments of potassium fertilization, they were add as rates from the recommended dose, R.D (i.e., 24 Kg. $K2O$ / fed.) from the used K-fertilizers equals to 100% R.D, 75% R.D and 50% R.D. These recommended doses were approximately equal to the amounts of:

** 50 Kg/fed. K- mineral (M) in the form of potassium sulfate, $K2 SO4$ (48% $K2O$) as decided in the bulletins of ministry of agriculture.

** 500 Kg/fed. K-Compost, C (4.8% $K2O$).

** 300 Kg/fed. K- Feldspars, F (8.52% $K2O$).

Table (1): Some chemical analyses of the used sandy soil and natural K-fertilizers.

Parameters	Soil sample	Natural K-Fertilizers	
		K-feldspar (F)	K-compost (C)
pH (soil: water susp.)	(1:2.5) 7.70	---	(1:10) 8.50
O.M %	0.08	---	40.40
$CaCO_3$ %	1.40	1.05	---
EC, paste (dS/m)	0.19	0.03	---
Sand %	92.09	---	---
Silt %	2.20	---	---
Clay %	5.71	---	---
O.C %	---	---	23.40
C/N ratio	---	---	16.70
Total Elements			
N %	---	---	1.40
P %	---	---	0.24
K %	---	7.14	4.00
Fe mg. Kg^{-1}	---	---	120
Mn mg. Kg^{-1}	---	---	200
Zn mg. Kg^{-1}	---	---	150
Available Elements (mg .K g $^{-1}$)			
N	11.70	---	---
P	1.32	---	---
K	40.00	820	---
Fe	2.61	---	---
Mn	0.44	---	---
Zn	0.52	---	---
Water Soluble –K (extract 1:5) (mg. Kg^{-1})			
	---	**530**	**---**

In the dual mixture of K- fertilizer treatments, the amounts of K-fertilizers were adding fifty – fifty from the used fertilizers. While these amounts were adding as a third from each used fertilizer, in the triple mixture of K- fertilizer treatments as shown in Table (2). All the K- rates were adding during pot preparation. Then irrigation was carried, using tap water, and maintained throughout the growing season approximately at field capacity.

After 160 days from planting, plants of each pot were harvested by cutting it carefully at 1cm. above soil. Plants were separated to straw and seeds, oven dried at 70 C0 for several days until constant dry weights obtained. The dry weight of straw and seeds of each pot were record as g/pot. Potassium uptake by seeds was determined as Black, (1982).

Table (2): The amounts of K-sources (Kg/fed.) of different treatments.

Treatments	Rates of application, Kg/fed.		
	100% R.D	75% R.D.	50%R.D.
Control	0.0	0.0	0.0
M*	50	37.5	25
C**	500	375	250
F***	300	225	150
M+C	25+250	19+187.5	12.5+125
M+F	25+150	19+112.5	12.5+75.5
C+F	250+150	187.5+112.5	125+75
M+C+F	16.67+167+100	12.50+ 125+75	8.33+83+50

* Mineral fertilizer ** Compost *** Feldspar

The obtained data statistically, analyzed using the analysis of variance (ANOVA) as a complete randomized factorial design in three factors with three replicates by using Minitab program (Barbara and Brain, 1994). The least significant differences (LSD) calculated at levels of 1% as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1) Seeds and straw yield:

As shown in Table (3) and Fig (1) both of seeds and straw yield of broad bean achieved significant increment under inoculation with K.D.B. (***Bacillus circulans***) than those non-inoculated. Whereas, the average values of seeds yield were 10.78 g/pot under inoculation and 7.92 g/pot in the case of without inoculation with relative increment equal to 36.11 %. On the other hand, straw yield (g/pot) of broad bean plants relatively increased 41.16% under inoculation with ***(Bacillus circulans)*** (17.80g/pot) relative to the corresponding value under non-inoculation condition (12.61g/pot). These results may be due to the role of inoculation with KDB in stimulating plant growth and to its role in increasing the amount of available- K in soil (Shady et al., 1984), thus will help in solving the problem of insufficient of available -K in soil through excretion amino acids in the agriculture fields (Mishustin, 1981). Also similar results were obtained by Abdel Ati et al., (1996); El- Ghandur et al., (1997); Hammad and Abdel- Ati (1998); El-Banna and Tolba (2000); Abo El- Soud et al., (2004)); Khalil (2005) who reported that using biofertilizer KDB increased number and weight of tubers/fed., and Zahir et al., (1996) who mentioned that inoculation of wheat seeds with K.D.B caused increasing in grain yield by up to 38.5% and straw yield by up to 18.8% compared with the un – inoculated control.

With respect to effect of different sources of potassium fertilization on the yield of seeds and straw of broad bean, data in the Table (3) and Fig (1) showed that all sources of K- fertilization, in general, significantly increased seeds and straw yield comparing with the control treatment. The superiority increment was found with (M) as the following arrangement (according to the values of relative increment): M (98%) >M+F (77%)> M+F+C (56%)~ F (53%) > F+C (44%) ~ C (41%) > M+C (31%) for seeds and the arrangement of M (187%) > M+F (137%) > F (127%) ~ M+F+C (125%) > F+C (120%) ~ C (117%) ~ M+C (115%) for straw with significant differences between these groups.

The superiority of K- mineral (M) and K- feldspar (F) added in solo or in mixture may be due to increasing available-K in these forms than the other forms. Then, their addition to soil insures adequate supply of potassium along the season of growth which leads to improving the growth yield components and its quality. Similar results were obtained by Abd-EL Moez and Saleh (1999), who reported that the use of different treatments of organic and chemical fertilizers including K- fertilizers significantly increased the yield of roselle plants over control (100 % from the recommended dose). In addition, Badraoui and Agbani (1997) found that KCl and K2SO4 fertilizers had a positive effect on sugar beet.

Data in Table (3) and Fig (1) declared that increasing the level of K- fertilizers, over the control treatment, increased the seeds and straw yield of broad bean. This may be due to enough potassium nutrition increased yield and improved the quality of most crops by stimulating chlorophyll synthesis and by sharing in many vital physiological processes in the plant (Marschner 1998 and Moussa, 2000). The effective role of increasing potassium fertilization rate on different crops grown in different soils were shown in the studies of many authors, such as El- Habbasha et al., (1996) on pea grown in sandy soil, Abou-El Defan et al., (1999) on wheat grown in a sandy soil.

Table (3) Straw and seeds yield (g/pot) of broad bean plant as affected by different sources and rates of K-fertilization and inoculation with K.D.B.

Treatment		Seeds			Straw		
		K-fertilization rates, % R.D					
		50	75	100	50	75	100
Non - Inoculation	Control	5.32	5.32	5.32	4.46	4.46	4.46
	Mineral (M)	9.40	13.02	12.35	13.26	15.56	17.42
	Compost(C)	7.61	6.22	8.08	10.31	11.48	13.96
	Feldspar (F)	8.44	8.36	7.83	12.05	15.19	15.81
	M+C	7.21	5.60	7.46	10.69	11.47	14.80
	M+F	8.21	7.31	10.5	10.20	14.13	16.00
	F+C	6.49	7.68	7.84	13.84	10.98	16.49
	M+F+C	6.50	8.30	9.68	14.20	13.72	17.63
Inoculation	Control	7.21	7.21	7.21	9.63	9.63	9.63
	Mineral (M)	10.30	13.63	15.57	21.00	27.69	26.21
	Compost(C)	8.67	10.74	11.79	15.03	21.31	19.53
	Feldspar (F)	10.84	11.64	10.42	15.00	18.17	19.79
	M+C	8.75	8.88	11.44	15.33	20.87	17.57
	M+F	11.34	13.43	13.20	17.92	20.37	21.28
	F+C	11.26	12.47	8.64	13.67	18.87	18.99
	M+F+C	8.50	11.57	13.97	13.67	16.26	19.71
LSD (0.01)	*Bacteria (B)*	*0.32*			*0.50*		
	Sources (S)	*0.88*			*1.34*		
	Rates (R)	*1.04*			*2.32*		
	BxSxR	*1.84*			*2.79*		

On other side, the lowest increment was achieved in seeds or straw yield were recorded with 50% R.D. While the highest increment values were recorded with 100% and 75% R.D. with insignificant difference between them. Whereas, the average values of yield were 8.5, 9.62 and 10.09 g/pot for seeds and 13.15, 15.63 and 16.83 g/pot for straw at the rates of 50%, 75% and 100%, respectively. This may be due to the un- ability of sandy soil to score high benefit from the high doses of potassium fertilizer because of the poverty in its chemical and physical properties. This trend of non- significant response of plants grown in sandy soil to high dose of K- application was support by the explanation of Grimme (1979) who reported that, the effect of a given amount of K on plant growth depend on clay content and clay mineralogy. Thus, increasing the rate of K- fertilization in a sandy soil gives low significant response than clay soil.

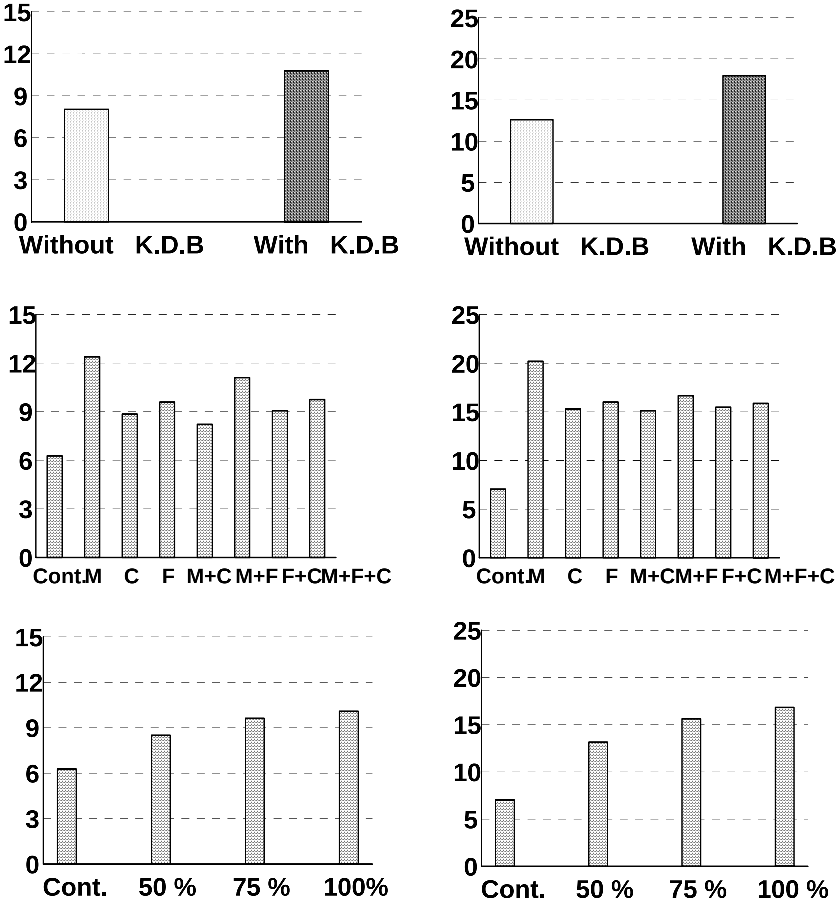

Fig. (1) Seed and Straw yield (g/pot) of broad bean plants in relation to inoculation with K.D.B., sources and rates of potassium fertilization.

With respect to the interaction, data showed that the combine interaction, in general, significantly increased seed and straw yield comparing with the control treatment. This increasing trend more pronounced under inoculation with K.D.B. ***(Bacillus circulans)*** in combine with (M) then (M+F) and (C) sources at rates of 75% and 100% R.D. In general these trend has not obvious significant differences between the rates of 75% R.D. and 100% R.D. Similar results obtained by Khalil (2005) who reported that inoculation with potassium dissolving bacteria **(*Bacillus circulans*)** with mineral fertilizer or compost addition, significantly affected on straw yield of broad bean.

2. Potassium status of broad bean seeds:

2.1. K- uptake by seeds of broad bean:

In logic trend, inoculation with K.D.B ***(Bacillus circulans)*** caused significant increasing in K- uptake by seeds with 101% than the corresponding values in plants did not treated with ***Bacillus circulans*** (Table 4 and Fig 2). Many studies verified the role of microorganisms and silicate bacteria, in mobilization of potassium from non- available, sources through their description the mechanisms of degradation of alumino-silicate mineral by these bacteria, such as Rossi (1990).

This role produced equilibrium between the various potassium fractions in soil. Consequently, insurance of enough supply of potassium in soil, leads to increasing K- uptake by plants during growing season. These results are in agreement with those obtained by Saber and El-Sherif (1975) on sorghum, Saber and Zanati (1981) on clover, barley, maize and horse bean in sandy soil, Shady et al., (1984) on barley grown in sandy soil, Solankey et al., (1998) on soybean and finally with Khalil (2005) on wheat and peanut grown in sandy soil.

With respect to the role of potassium fertilizer sources on K- uptake by seeds, it can be arranged in the descending trend of: (M) > (M + F) ~ (F) > (C) > (M+C) ~ (M + F + C) > (F + C) > control ,with significant differences between the five main groups.These previous trends may be due to that potassium content in the two types of (M) or (F) are more available than in (C) type, These results are in coincide with the trends of many authors such Negm et al., (2002) and Ismail and Hagag (2005).

Table (4) K –uptake (mg/pot) by seeds of broad bean as influenced by inoculation with K.D.B, fertilization with different sources and rates of potassium.

K-fertilizer Types	50%		75%		100%	
	KDB (Bacillus *Circulans)*					
	Without	With	Without	With	Without	With
Control	13.84	28.83	13.84	28.83	13.84	28.83
Mineral (M)	62.03	130.9	90.91	179.1	91.13	215.9
Compost (C)	42.6	92.05	47.88	130.8	53.83	139.9
Feldspar (F)	52.17	127.9	55.09	144.2	54.14	134.0
M + C	41.78	87.51	41.18	103.5	50.75	130.3
M + F	52.52	140.8	48.97	170.9	74.22	170.1
F + C	36.93	108.6	47.06	129.6	50.18	120.7
M +F + C	38.26	92.27	51.69	134.4	70.73	163.0
LSD (0.01)	**Bacteria (B)** 4.24 **Sources (S)** 11.54 **Rates (R)** 20.04 **BxSxR** 24.04					

On the other hand, increasing the application rate of K-fertilizers, in general significantly increased K- uptake in the range of 71.83 - 97.63 mg comparing with K- uptake by the control treatment (21.34 mg). Insignificant differences were noticed with increasing the rate of potassium application from 75% R.D. to 100% R.D. Similar trend was observed by Seedik (2006) who found that feldspar with 100% R.D rate was significant increase K uptake of peanut inoculated with bacteria and by El-Banna et al.,(2004) who revealed that increasing the dose of potassium fertilization were more beneficial in enhancing K- uptake by wheat grains

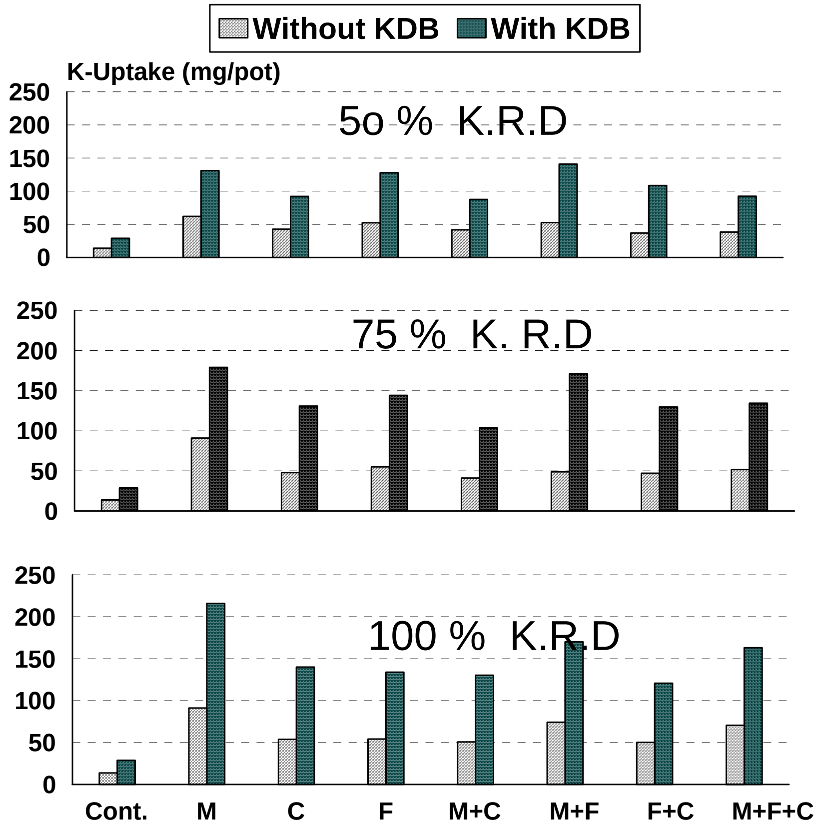

Fig (2) K –uptake (mg/pot) by seeds of broad bean as influenced by inoculation with K.D.B, fertilization with different sources and rates of potassium.

2.2. APPARENT DERIVED POTASSIUM PERCENTAGE (ADK, %) BY SEEDS:

The apparent derived-K is defined as the percent of potassium which taken by seeds from the added fertilizer. It can be calculate by the following equation (Ahmed et al., 1992).

$$ADK\% = \frac{\text{KU - KC}}{\text{KU}} \times 100$$

Whereas: KU: K-uptake by seed of fertilized plants.

KC: K-uptake by seed of control plants.

Data in Table (5) and Fig (3) showed that increasing the rate of potassium fertilization increased ADK % of seeds. In general, ADK%

mean values were 71.32,76.15 and 78.88 for 50% R.D, 75% R.D and 100% R.D, respectively.

Table (5) ADK (%) of broad bean seeds in relation to different experimental treatments.

K-fertilizer Types	50%		75%		100%		
	KDB (Bacillus *Circulans)*						
	Without	With	Without	With	Without	With	
Mineral (M)	77.69	77.98	84.78	83.9	84.81	86.65	82.64
Compost (C)	67.51	68.68	71.09	77.96	74.29	79.39	73.15
Feldspar (F)	73.47	77.46	74.88	80.01	74.44	78.49	76.46
M + C	66.87	67.06	66.39	72.14	72.73	77.87	70.51
M + F	73.65	79.52	71.74	83.13	81.35	83.05	78.74
F + C	62.52	73.45	70.59	77.75	72.42	76.11	72.14
M +F + C	63.83	68.75	73.22	78.55	80.43	82.31	74.52
Mean	69.36	73.27	73.24	79.06	77.21	80.55	

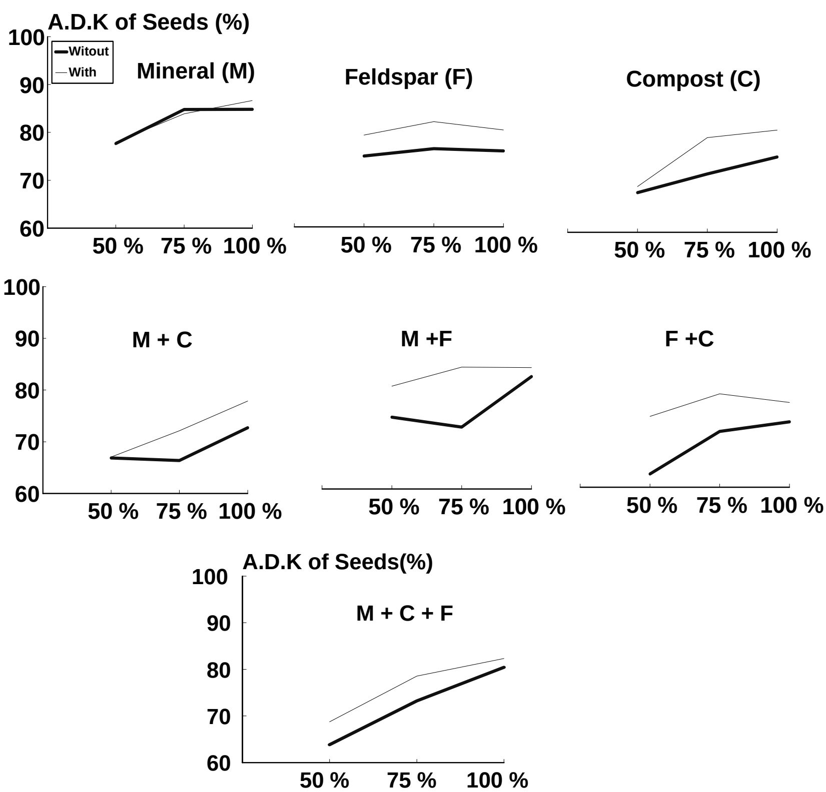

Fig. (3) ADK (%) by Faba bean seeds in relation to different experimental treatments.

Generally, seeds of inoculated plants derived more K (77.63%) than in non-inoculated (73.27%) seeds.

As for the role of K-fertilizer sources, data showed that (M), (M+F) and (F) types occupied the superiority group in increasing ADK (%) of seeds, whereas they achieved ADK (%) mean values equals to 82.64%, 78.74% and 76.46% for the above mention sources, respectively. While (C) type occupied the latest order either in solo or in combine with (F) or (M). The previous discussions were in coinciding with Khalil (2005).

3. Economic evaluation of the experimental treatments:

A theoretically economic evaluation will be carrying out to study the economic ability of the experimental treatments, to choose the best treatments that achieved the highest financial return. This study will be done through mathematically calculations the differences between costs of production (LE /fed) and profits of incomes (LE /fed) to obtain the net gain or return (LE /fed) of all experimental treatments.

It is important to notice that, all costs of production differ only in the prices of buy K-fertilizers as well as the costs of seed inoculation, but equals in the costs of all field practices. In addition, all costs of production and profits of incomes mathematically converted to be per feddan. On the other hand, costs of production and profits of incomes were calculated from the actually prices of buy K-fertilizers and by helping of the Economic (Bulletin of Ministry of Agric., Egypt issued in, 2005). Prices of fertilizers (LE/ Kg) in Table (6) and amounts of the used fertilizers (Kg/fed.) in Table (2) were used to calculate the costs of fertilizers (Le/ fed.), which shown in Table (7).

Table (6): Prices (LE/Kg) of the used K-fertilizers buying

K-fertilizer type	Buying Prices (LE/Kg)
M	**2.00**
C	**0.40**
F	**0.30**
Inoculation. Costs (Le /fed)	**20.0**

The data of this theoretically economic evaluation shown in Table (7) and illustrated in Fig (4) showed that inoculation with KDB achieved increasing in net gain approximately equal to 122% than non-inoculation.

Table (7) Economic evaluation of the experimental treatments.

			Costs of production (LE /fed)					Profits of Incomes (LE /fed)			
			M	F	C	F.Prac*	Total	Straw	Seeds	Total	
		Control	0	0	0		1731	253.1	1140	1393.1	-338
		Mineral(M)	50	0	0		1781	757.7	2014.3	2772	991
		Compost	0	0	100		1831	589.1	1630.7	2219.9	389
		Feldspar(F)	0	45	0		1776	688.6	1808.6	2497.1	721
		M + C	25	0	50		1806	610.9	1545	2155.9	350
		M + F	25	22.5	0		1778.5	582.9	1759.3	2342.1	564
		F + C	0	22.5	50		1803.5	790.9	1390.7	2181.6	378
		M +F + C	16.8	15	33.5		1796.25	811.4	1392.9	2204.3	408
		Control	0	0	0		1731	254.9	1140	1394.9	-336
		Mineral M)	75	0	0		1806	889.1	2790	3679.1	1873
		Compost	0	0	150		1881	656	1332.9	1988.9	108
		Feldspar(F)	0	67.5	0		1798.5	868	1791.4	2659.4	861
		M + C	37.5	0	75		1843.5	655.4	1200	1855.4	11.9
		M + F	37.5	33.8	0		1802.25	807.4	1566.4	2373.9	572
		F + C	0	33.8	75		1839.75	627.4	1645.7	2273.1	433
		M +F + C	25.1	22.5	50		1828.62	784	1778.6	2562.6	734
		Control	0	0	0		1731	254.9	1140	1394.9	-336
		Mineral(M)	100	0	0		1831	995.4	2646.4	3641.9	1811
		Compost	0	0	200		1931	797.7	1731.4	2529.1	598
		Feldspar(F)	0	90	0		1821	903.4	1677.9	2581.3	760
		M + C	50	0	100		1881	845.7	1598.6	2444.3	563
		M + F	50	45	0		1826	914.3	2250	3164.3	1338
		F + C	0	45	100		1876	942.3	1680	2622.3	746
		M +F + C	33.5	30	67		1861.33	1007.4	2074.3	3081.7	1220
		Control	0	0	0		1751	550.29	1545	2095.3	344
		Mineral (M)	50	0	0		1801	1200	2207.1	3407.1	1606
		Compost	0	0	100		1851	858.9	1857.9	2716.7	866
		Feldspar (F)	0	45	0		1796	857.1	2322.9	3180	1384
		M + C	25	0	50		1826	876	1875	2751	925
		M + F	25	22.5	0		1798.5	1025.7	2430	3455.7	1657
		F + C	0	22.5	50		1823.5	781.1	2412.9	3194	1371
		M +F + C	16.8	15	33.5		1816.2	781.1	1821.4	2602.6	786
		Control	0	0	0		1751	550.3	1545	2095.3	344
		Mineral (M)	75	0	0		1826	1582.3	2920.7	4503	2677
		Compost	0	0	150		1901	1217.7	2301.4	3519.1	1618
		Feldspar (F)	0	67.5	0		1818.5	1038.3	2494.3	3532.6	1714
		M + C	37.5	0	75		1863.5	1192.6	1902.9	3095.4	1232
		M + F	37.5	33.8	0		1822	1164	2877.9	4041.9	2220
		F + C	0	33.8	75		1859.7	1078.3	2672.1	3750.4	1891
		M +F + C	25.1	22.5	50		1848.6	929.1	2479.3	3408.4	1560
		Control	0	0	0		1751	550.3	1545	2095.3	344
		Mineral (M)	100	0	0		1851	1497.7	3336.4	4834.1	2983
		Compost	0	0	200		1951	1116	2526.4	3642.3	1691
		Feldspar (F)	0	90	0		1841	1130.9	2232.9	3363.7	1523
		M + C	50	0	100		1901	1004	2451.4	3455.4	1554
		M + F	50	45	0		1846	1216	2828.6	4044.6	2199
		F + C	0	45	100		1896	1085.1	1851.4	2936.6	1041
		M +F + C	33.5	30	67		1881.5	1126.3	2993.6	4119.9	2238

** F.Prac: Field Practices*

*** 20: Costs of seed inoculation per feddan*

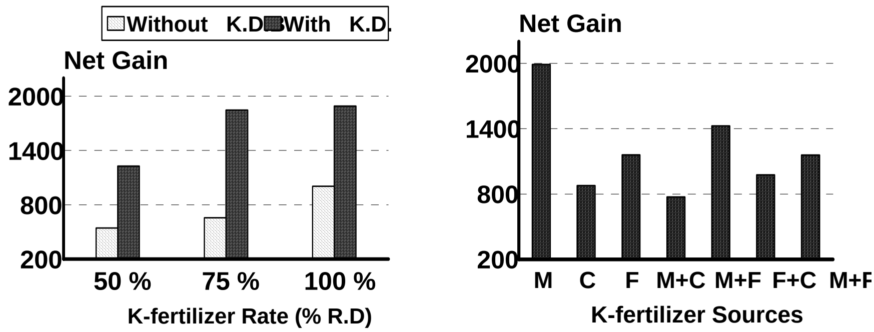

Fig. (4) Net Gains of broad bean (Le/fed.) in relation to rates and type of K-fertilizers under inoculation with KDB.

In addition, increasing the application rate of K-fertilization increased the net gain. With respect to the K-fertilizer types, (M), (F), (M+F) treatments have preponderated net gains than the treatment of (C) and their mixtures which achieved the lowest net gain as shown in Fig (4).

Finally: From the previous discussion, it can be concluded that:

The best treatments which achieved the highest rates of yield, and hence the highest rates of net gain- under the circumstance work- were obtained by growing seeds of faba bean inoculated with KDB and treated with 100% RD of (M) or (F) follow with mixture between them.

Because of the simplest differences between the net gains achieved with using the rate of 100% RD or 75% RD, be possible to suffice with the rate of 75% RD especially under inoculation with Bacillus circulans (KDB). Thus, the hazards of use many chemical fertilizers in soil and costs of production will be reduce, then a suitable increasing on the net gain of seed and straw yields can be obtained.

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كفاءة التسميد ببعض المصادر الطبيعية من الأسمدة البوتاسية والتلقيح البكتيرى بـ *Bacillus circulans* لمحصول الفول البلدى وأهميته الإقتصاديه فى الأراضى الرملية

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أجريت هذه الدراسة البحثية فى صوبة محمية بمركز البحوث الزراعية بمحافظة الجيزة –مصر خلال الموسم الشتوى 2005م فى أرض رملية من محافظة الإسماعيلية بهدف دراسة كفاءة التسميد ببعض المصادر الطبيعية من الأسمدة البوتاسية والتلقيح البكتيرى لمحصول الفول البلدى فى الأراضى الرملية.

وقد أستخدم فى هذه الدراسة سماد سلفات بوتاسيوم (M) بجانب المصادر الطبيعية من الكمبوست الغنى بالبوتاسيوم (C) والفلدسبار البوتاسى (F) وذلك فى الصور المنفردة لهم أو فى صورة مخاليط منفردة منهم وذلك بمعدلات 50% و75% و100% من الجرعة السمادية البوتاسية الموصى بها فى زراعة الفول البلدى)صنف جيزة (843، هذا بجانب تلقيح البذور قبل الزراعة بالبكتريا المذيبة للبوتاسيوم ***Bacillus circulans*** أو تركها بدون تلقيح.

ولتقييم مدى الإستجابة لتلك العوامل التجريبية تم فى نهاية التجربة تقدير محصول البذور والقش للفول البلدى وكذلك تم حساب الـ %للكمية الممتصة من البوتاسيوم بواسطة بذور الفول من السماد المستخدم (ADK%)، كما تم اجراء تقييم اقتصادى للمعاملات التجريبية من خلال حساب صافى الربح)جنيه مصرى/فدان (لتحديد اعلاها فى صافى الربح.

ويمكن تلخيص أهم النتائج المتحصل عليها فى النقاط التالية -:

1) تحققت أعلى إنتاجية من محصول البذور والقش فى المعاملات الملقحة بالبكتريا المذيبة للبوتاسيوم ***Bacillus circulans*** مقارنة بتلك الغير ملقحة.

2) زيادة معدل التسميد بصوره عامه سببت زيادة فى محصول البذور والقش مقارنة بمعاملة الكونترول الغير مسمدة بالبوتاسيوم.

ومن ناحية أخرى كانت الزيادة الناتجة من معدل التسميد بـ 75%من الجرعة الموصى بها قريبة جدا من تلك الزيادة الناتجة من التسميد بـ 100%من الجرعه الموصى بها.

3) بالنسبة لتاثير نوع السماد البوتاسى المستعمل اوضحت الدراسه مايلى

- فى حالة إستخدام السماد فى صورة منفردة كان افضلها التسميد بالصورة المعدنية (M) يليها فى تاثير التسميد بالفلدسبار البوتاسى (F).
- وبالنسبه لتأثيرات الاسمده ذو المخاليط الثنائيه تفوقت المعامله (M + F) تليها المعامله (M + C)فى اعطاء أعلى إنتاجية لمحصول القش ، بينما أعطى المخلوط (F+C)تأثيراً أكثر وضوحاً فى إنتاجية محصول البذور .
- أظهر محصول البذور إستجابة معنوية للمخلوط السمادى الثلاثى (M + F +C)

4) النسبة للـ - (ADK %)النسبة المئويه لكمية البوتاسيوم الممتصه بواسطة البذور-

- زيادة معدل التسميد والتلقيح بالبكتريا المذيبة للبوتاسيوم ادت الى زيادة واضحة فى كمية البوتاسيوم الممتص من السماد المضاف فى محصول

البذور.

- كما كانت معاملات التسميد المعدنى(M)والفلسبار (F) يليها الخليط منهما (M+F)هى الافضل فى تحقيق اعلى امتصاص من بوتاسيوم محصول البذور من السماد المضاف.

5) أوضحت الدراسة الحسابية للتقييم الاقتصادي -من خلال حساب الفرق بين تكاليف الانتاج والعائدات الكليه للدخل وهو ما يسمى بصافى الربح -ان اعلى معدلات لصافى الربح) جنيه مصرى/فدان (تحققت بزراعة البذور الملقحه بالبكتريا المذيبه للبوتاسيوم ***Bacillus circulans*** والمسمده بالسماد البوتاسى المعدنى (M)أوالفلدسبار البوتاسى (F) أوالخليط منهما (M+F) وبمعدل 100% أو 75%من التوصية السماديه.

وعلى ذلك فمن الممكن تحت ظروف التلقيح البكتيرى الإكتفاء بالتسميد بالمعدل 75%من التوصية السمادية والتى تعطى إنتاجية قريبة من إنتاجية المعدل100%من التوصية السمادية. وبذلك يمكن التقليل من كمية الأسمدة المعدنية المستعملة مما يقلل من مخاطر حدوث تلوث كيميائى فى التربة لزيادة معدلات إضافتها ، وكذلك التقليل من تكاليف الإنتاج مما يساعد على إمكانية زيادة معدلات صافى الربح.