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RESPONSE OF BROADBEAN GROWN IN CLAY SOIL OF BAHTIM DISTRICT FOR BIO AND K-FERTILIZATION

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ABSTRACT

A pot experiment was carried out on a clay soil taken from Bahtim Agric. Res. Station (AR C), Kalubia Governorate, during the winter season of 2005 to study the response of broad bean plants for Bio- and K-fertilizers. Experimental treatments were: Potassium sulfate, K_2SO_4 (M), nature compost rich in K-content (C) and potassium feldspar (K-bearing mineral, $KAlSi_3O_8$) (F) ,which added 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 K_2O / fed.). As well as inoculation seed of broad bean (*Vicia faba. L,* cv. Giza 843 variety) with or without K-dissolved bacteria *Bacillus circulans* (KDB).

Seed and straw yields of broad bean and their contents of N, P, K, Fe, Mn and Zn were determined to use as indication for the response of broad bean plants for the experimental treatments.

Data can be summarize as follows

In general, inoculation with *Bacillus circulans* gave higher yields of seed and straw of broad bean as well as increasing their contents of N, P, K, Fe, Mn and Zn than under non-inoculation condition.

Using of any type of K- fertilizer or increasing the rate of application significantly increased yields of seeds, straw of broad bean and increased their nutrients contents comparing with non-fertilized treatment (control). The results of 75% R.D under inoculation were nearest from the results of 100% R.D.

As for the effects of different types of K-fertilizers on yields of seed and straw as well as their nutrients content, mineral fertilizer type K_2SO_4 (M) was the best treatment followed with (F) treatment, when they added in a solo form. With respect to the dual mixture of K-fertilizers (M+F) followed with (M+C) gave the best effects. While, (F+C) and the triple mixture of (M+C+ F) gave pronounced response on the yield of seed and nutrient s contents.

INTRODUCTION

Potassium is considered as a key factor in crop production because it has a lot of vital roles in physiological and biochemical functions of plant growth (Thompson, 2004).

Since the completion of the High Dam, the importance of potassium fertilization in Egyptian agriculture had been arisen because of the deposition of the suspended Nile mud in the upstream of the formed lake. This Nile mud was the main source to enrich the Egyptian soils with K- bearing minerals during the seasonal floods. Though, in general, Egyptian soils are rich in potassium, sporadic responses of several crops to applied K even under higher availability have been reported (Abd El-Hadi et al., 1990). This is due to the existence of a dynamic equilibrium among the various forms of K in soil. However, continuous crop removal without replenishment is likely to cause an irreparable damage from the soil fertility point of view.

The reuse of plant residues, rich in K–element, after composting as organic manure (Abdel Moez and Saleh, 1999) and the use of K–bearing minerals

(K–feldspars) (Seddik, 2006) can positively contribute 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 work is carried out to study the response of broad bean grown in clay soil for the addition of mineral potassium fertilizer, some natural K-sources added as a solo or in a mixture to soil as well as inoculation of seed with K–dissolved bacteria (*Bacillus circulans)*.

MATERIALS AND METHODS

A pot experiment was carried out on a clay soil taken from Bahtim Agric.Res.Station (Agric. Res. Center), Kalubia Governorate during the winter season of 2005.

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

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

Potassium Feldspar (F): K–bearing mineral (K–feldspar) ($KAlSi_3O_8$), which had taken from the mines of the Egyptian western desert.

Potassium Compost (C): Natural organic compost rich in K-content was supplied by organic manure production unit (Soils, Water and Environment Research Institute, Agric. Res. Center (ARC).Some chemical and physical properties of the used soil, K-feldspar and K-compost were analyzed as described by Page et al. (1982) and shown in (Table 1).

Table (1): Some physical and chemical properties of soil and natural K-fertilizers

Parameters	Soil sample	Natural K-Fertilizers	
		K-feldspar (F)	K-compost (C)
pH (soil: water susp.)	(1: 2.5)8.25	—	(1:10) 8.50
O.M %	1.50	—	40.40
$CaCO_3$ %	3.30	1.05	—
EC, paste (dS/m)	1.63	0.03	—
Sand %	17.91	—	—
Silt %	32.02	—	—
Clay %	50.07	—	—
Soil Texture	Silt Clay	—	—
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	39.30	—	—
P	2.75	—	—
K	78.75	820	—
Fe	4.19	—	—
Mn	1.84	—	—
Zn	1.90	—	—
Water Soluble –K (extract 1:5) (mg. Kg^{-1})			
	—	530	—

All used seeds of broad bean *(Vicia Faba.* L*)*, cv. Giza 843 were mixed thoroughly with rizobia – sugar solution directly before planting. Then, a half amount of broad bean seeds, required for planting the half pots, were inoculated with potassium dissolving bacteria *"Bacillus circulans"* (KDB) while the other half of seeds, was served as control (without KDB) inoculation.

During winter season, on the 5^{th} of November 2005, ten broad bean seeds were sown in plastic pots filled with 7 Kg soil, in three replicates. After complete emergence, the seedlings were thinned to four healthy plants in each pot.

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

All pots received the basic doses of N and P mineral fertilizers equal to 200 Kg-super phosphate per fed. (15.5% P_2O_5) 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 was added during seed sowing and the other was added after ten days from sowing. Potassium fertilizers were added at the rates of 100% recommended dose (R.D), i.e., 24 Kg. K_2O / fed., 75% R.D and 50% R.D. The doses for the applied K- fertilizers were approximately equal to the amounts of:

** 50 Kg/fed. K- Mineral (M) in the form of potassium sulfate, K_2SO_4 (48% K_2O) as decided in the bulletin of the Ministry of agriculture and Land Reclamation.

** 500 Kg/fed. K-Compost, C (4.8% K_2O).

** 300 Kg/fed. K- Feldspars, F (8.52% K_2O).

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 was added 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.

Table (2) : The amounts of K-sources (Kg/fed.) for 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*

After 160 days from sowing, at the 15^{th} of April 2006, plants of each pot were harvested, separated to straw and seeds, oven dried. Dry weights of straw and seed of each pot were recorded as g/pot. 0.2g. of dried straw and seed samples were digested using a mixture of $HClO_4$ and H_2SO_4 acids (Chapman and Pratt, 1961). Then digested solutions were used for determination of N, P, K, Fe, Mn and Zn (Ryan et al., 1996).

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

RESULTS AND DISCUSSION

Broad bean seed and straw yield:

The response of broad bean seed and straw yields (g pot^{-1}) to inoculation with KDB, fertilization with different sources and rates of potassium fertilizer are presented in Table (3). Both of seed and straw yields of broad bean achieved significant increments due the inoculation with KDB (*Bacillus circulans*) than those non-inoculated. They increased with 36% (seeds) and 77% (straw) by the inoculation with *(Bacillus circulans)* compared to un-inoculated treatments.

Table (3) Straw and seed yield (g pot^{-1}) of broad bean as affected by different sources and rates of K-fertilization and inoculation with (KDB)

Treatment		Seeds			Straw		
		K-fertilization rates, % R.D					
		50	75	100	50	75	100
Non - Inoculation	Control	6.00	6.00	6.00	6.50	6.50	6.50
	Mineral (M)	10.20	11.50	12.20	15.33	15.40	15.90
	Compost(C)	9.46	10.2	10.60	11.13	11.40	11.70
	Feldspar (F)	8.53	9.49	10.00	12.88	15.20	13.30
	M+C	8.16	9.37	9.72	10.48	10.50	11.70
	M+F	8.36	9.69	10.02	12.06	12.61	16.96
	F+C	7.53	7.89	8.29	11.91	12.88	12.96
	M+F+C	7.03	7.62	8.02	12.77	12.88	13.24
Inoculation	Control	7.40	7.40	7.40	10.06	10.06	10.06
	Mineral (M)	13.63	14.26	14.53	25.10	29.33	31.33
	Compost(C)	11.30	11.69	12.16	19.06	22.13	26.66
	Feldspar (F)	11.93	12.13	12.98	18.10	24.10	29.33
	M+C	12.13	12.46	13.02	18.03	25.10	29.00
	M+F	11.66	11.93	12.20	19.10	23.13	27.66
	F+C	13.63	13.96	13.99	17.13	19.13	22.32
	M+F+C	11.63	12.76	12.93	16.16	18.20	21.18
L.S.D.0.01	Bacteria (B)	0.07			0.29		
	Sources (S)	0.19			0.80		
	Rates (R)	0.33			1.39		
	BxSxR	0.40			1.66		

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., 1983), which in turn will help in solving the problem of insufficient available –K amount in soil through the excretion of amino acids in the fields (Mishustin, 1981). Also similar results were obtained by Zahir et al. (1996) who mentioned that inoculation of wheat seed with KDB caused increases in grain yield up to 38.5% and straw yield up to 18.8% compared to un– inoculated control and by Abo El- Soud et al. (2004)) and Khalil (2005) who reported that using bio-fertilizer of KDB increased number and weight of tubers/fed. of maize.

Due to the effect of K- fertilization sources on broad bean plants, indicate that all these sources increased significantly seed and straw yields in comparison with the control treatment. The order of the applied K can be arranged according to the relative increments, in the descending order of: M>C>F+C>F>M+C >M+F> M+C+F for seed, while for straw yield the order was: M > F >M+ F >M+ C > C > F+ C> M+F+C. The superiority of K- mineral (M), K- feldspar (F) or compost (C) as natural sources for K- fertilization in soil, either added in solo or in a mixture, i.e. (M+F) and (M +C), may due to the increase of available- K in these forms than other applied forms and then their addition to soil ensure adequate supply of potassium along the growth season, which leads to increase growth yield components and its quality. Similar results were obtained by Shady et al. (1983) who studied the potassium releasing capacities from siliceous minerals by strains of *Bacillus circulans.* They found that bacterial inoculation led to a highly remarkable increase in the released amount of potassium. Also, Basyony et al. (2004) found that the pod, seed and straw yields as well as the straw yields of wheat were enhanced by the addition of compost combined with mineral fertilizers, which was exhibited high K-availability in soil as compared to mineral fertilizers only.

Data, also, declare that increasing the level of K- fertilizers, over the control treatment, increased the seed and straw yields of broad bean. On other side, the lowest increments were achieved in seed straw yields, which recorded with 50% R.D. While the highest increment values were recorded with 100% and 75% R.D with non-significant difference between them. Whereas, the average values of yield were 9.91, 10.53 and 10.89 g. for seed and 14.74, 16.80 and 18.50 g. for straw at the rates of 50%, 75% and 100%, respectively. This may due to enough potassium nutrition that increased yield and improved the quality of most crops by stimulating chlorophyll synthesis and by sharing in many vital physiological processes in the plant (Fadl, 2006).Similar results were obtained by Kurdali et al. (2002) who studied the impact of three rates of potassium fertilizer on broad bean, and found that the high rate of K- fertilizer increased the dry matter production.

Generally, increasing trend of seed and straw yields was more pronounced under inoculation with KDB *(Bacillus circulans)* in combination with (M) then (M+F) and (C) sources without obvious significant differences between both applied 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)* combined with mineral fertilizer or compost addition, affected significantly on straw yield of broad bean in a positive trend.

N, P and K-contents:

Table (4) present N, P and K contents (mg plant^{-1}) of seed and straw of broad bean as affected by inoculation with KDB, sources and rates of potassium fertilization. Data indicate that inoculation with KDB increased significantly N, P and K contents of seed and straw as compared with non-inoculation ones. Whereas, the mean values of macro-nutrients contents of seed were 415.61, 47.68 and 126.74 mg plant^{-1} under inoculation with KDB compared with the corresponding values of 280.7, 32.05 and 49.66 mg plant^{-1}recorded by un- inoculated treatments for N, K and P, respectively. Also, mean contents of macro-nutrients of straw as affected by inoculation with KDB were 519.65, 22.22 mg plant^{-1}and 237.02 and were 166.00, 8.00 and 85.23 mg plant^{-1} scored by the un- inoculated treatment for N, P and K, respectively. Rossi (1990) verified the role of microorganisms of silicate bacteria in mobilization of potassium from non-available sources, through degradation of alumina-silicate mineral, this role produced equilibrium between the various potassium fractions in soil, and then insurance of enough supply of potassium in soil and increasing K-uptake by plants along the growing season. As well as, his explanation for other indirect friendly relationships between soil and bio-fertilizers includes K.D.B, leads to the enrichment of the nutrients quantity and quality in soil. On the other hand, Khalil (2005) and Ebtsam et al. (2006) described the role of KDB (*Bacillus Circulans*) in increasing the N-uptake by plants. Leinhos and Vadek (1994) showed the role of bacteria in solubilizing of insoluble-K in the soil.

In general, the highest values of N, P and K-contents (mg plant^{-1}) of seed and straw of broad bean were recorded with (M) treatment when compared to the control treatment, which recorded the lowest N, P and K-contents (mg plant^{-1}). Owing to the effect of K-fertilization type on N-contents of seed and straw , the highest values were noticed with the treatments of (M), (C), (M+C) and (M+F) with non-significant differences between any of them, followed by N-contents of seed and straw recorded due to the treatment of (M+F+C). While, N-contents of seed and straw with the treatments of (F) and (F+C) were lower than N-contents under the previous aforementioned treatments.

The superiority of P-content (mg plant^{-1}) of seed and roots was more pronounced with the treatments of (M), (C), (M+C) and (M+F+C), followed by the treatments of (F), (F+C) and (M+F) with slightly differences between the values of the same group.

The descending order of K-content (mg plant^{-1}) of seed was M (125.46) > M+F (101.89) > F (100.12) >M+C (89.81) >M +F+ C (89.00) >C (88.62) > F+C (88.09) >control (22.60). But the descending order of K-content (mg plant^{-1}) of straw was M (279.17) > F (207.69) > C (195.33)> M + C (175.59) > M+ F (172.07) > M+F+C (128.26) and F+C (122.38). The present results are in agreement with those achieved by El-Shikha et al. (2005) who found that N- uptake by seeds and straw of broad bean plants increased significantly with K-fertilization. Also, Nassar and Ismail (1999) and Ismail and Hagag (2005) found that, potassium application usually increase the broad bean yield and improved P- uptake. Also, El-Shikha et al., (2005) found that K-content in seed, straw and protein content increased significantly with increasing K- fertilization.

In respect to the effect of potassium fertilizers application rate on N, P and K-contents (mg plant^{-1}) of broad bean seed and straw. Data reveled that they were significantly increased with increasing the rate of K-fertilization, the increase percentages in N- content of seed were 111.26%, 126.06% and 137.46% while, they were 203.14%, 255.50% and 302.43%, for straw at the rates of potassium fertilizers of 50, 75% and 100% R.D, respectively. The percentage increases in P-content of seed were 103.6%, 118.2% and 124.0% and they were 229%, 357% and 480.5% for straw at K-rates of 50%, 75% and 100% R.D, respectively. While the percentages increases in K-content K-fertilizers at rates of 50%, 75% R.D and 100% R.D were 262%, 293% and 316% for seed and they were 1442%, 1774% and 2183% for straw. These results are in agreement with those obtained by El-Sawah et al. (1985) who found that the contents of N, P and K for broad bean plants increased with increasing the rate of K-fertilizer addition.

Fe, Mn and Zn-contents:

Data in Table (5) indicated that the values of Fe, Mn and Zn-content of seed and straw of broad bean increased significantly as a result of inoculation with K.D.B. Their contents in seed were 3.58, 0.53 and 0.54 mg and in straw were 44.31, 1.95 and 5.72 mg for Fe, Mn and Zn respectively, due to the inoculation with K.D.B. While the corresponding values that recorded by un- inoculated treatments for seeds were 1.41, 0.27 and 0.32 mg and for straw were 22.94, 0.91 and 2.62 mg for Fe, Mn and Zn, respectively. These results are in accordance with Khalil (2005) who reported that inoculation with *(Bacillus circulans)* affected significantly Fe, Mn and Zn uptake of broad bean, peanut and wheat. This increase may due to the mechanisms of these microbes *(Bicillus circulans)* that dissolve non-soluble nutrients, hence improving their availability to the plants .Also Rabie et al. (1995) and Neeru et al. (2000) supported these findings.

In respect to the role of K-fertilizer type , generally it can be noticed that treated soil with (C), (M) or (M+C) achieved the highest Fe, Mn and Zn-contents, while their lowest contents were recorded with the treatments of (M+F),(F) or (M+F+C) either for seed or straw. These results are in agreement with those achieved by Abdel Moez and Salah (1999), El- Shikha et al. (2005) and Kahlil (2005).

Due to the rates of potassium fertilizers, Fe, Mn and Zn-contents of seed and straw of broad bean plants were significantly affected by increasing the application rates of K- fertilizers. Fe- content of seed were had increased from 0.31 to 2.71 (mg plant^{-1}), while Fe-content of straw increased gradually from 3.16 to 34.25 (mg plant^{-1}) with increasing the rate of K- fertilizers from 0% to 100% R.D. Also, increasing the rate of K- fertilizers from control (0% R.D) to 100% R.D increased Mn-content of seed from 0.09 to 0.46 mg and from 0.26 to 1.64 for seed and straw, respectively. On the other hand, increasing application rate of K- fertilizers from control (0 %R.D) to 100% R.D increased Zn-content of seed from 0.12 to 0.47 mg and from 1.48 to 4.88 mg plant^{-1} for seed and straw .respectively.

Table (4) N,P and K contents of broad bean Seed and Straw as affected by inoculation with (KDB) sources and rates of potassium fertilization

Treatments	Rates	Nutrients Contents (mg plant^{-1})											
		Seeds						Straw					
		N		P		K		N		P		K	
		Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB
Cont	50 %	115.3	194.0	15.9	21.1	15.6	29.6	75.8	118.1	2.6	4.0	5.9	11.1
M		432.5	667.1	52.4	47.7	63.5	169.0	234.0	609.9	7.7	20.1	136.5	351.4
C		357.0	483.3	36.7	46.3	50.2	115.2	143.2	596.1	7.8	19.1	70.1	247.9
F		185.3	266.5	23.7	35.4	49.5	136.0	147.3	281.7	6.4	14.5	92.8	233.5
M+C		275.3	402.4	31.5	77.5	45.0	116.4	166.2	599.9	8.4	18.0	79.7	162.3
M+F		252.8	386.6	25.6	39.1	50.2	140.0	174.1	546.9	6.0	15.3	94.1	168.1
F+C		208.7	397.7	25.9	47.0	40.7	125.4	158.0	246.1	6.0	13.7	76.3	135.4
M+F+C		219.5	381.2	25.2	52.3	39.4	123.0	182.2	424.6	9.0	16.2	95.8	132.6
Cont	75 %	115.3	194.0	15.9	21.1	15.6	29.6	75.83	118.1	2.6	4.0	5.9	11.1
M		490.5	702.8	58.9	48.6	73.9	179.7	239.7	711.8	9.3	26.4	141.0	428.2
C		390.1	506.0	40.0	49.1	56.5	127.5	148.6	696.4	9.1	26.6	73.2	309.8
F		207.8	277.4	27.5	36.4	56.0	140.7	147.7	379.9	7.8	21.7	94.6	320.5
M+C		318.8	418.4	35.6	81.0	53.4	123.4	169.5	842.5	9.5	32.6	81.3	276.1
M+F		299.4	399.2	30.0	41.8	60.1	145.4	186.2	671.6	7.6	20.8	99.6	205.8
F+C		221.0	410.0	27.6	50.3	43.4	132.3	172.1	278.7	7.7	19.1	83.7	158.8
M+F+C		240.0	420.7	27.4	54.9	43.4	139.1	191.1	487.1	10.3	27.3	97.9	154.9
Cont	100%	115.3	194.0	15.9	21.1	15.6	29.6	75.8	118.1	2.6	4.0	5.9	11.1
M		525.0	718.9	59.5	51.1	80.6	186.0	246.4	766.6	11.1	31.3	147.8	470.0
C		411.3	530.0	41.9	51.0	62.0	120.4	157.3	844.4	10.6	34.7	76.5	394.4
F		222.3	331.5	28.3	40.6	61.4	157.1	154.6	468.3	9.3	32.3	100.0	404.8
M+C		331.5	439.8	35.6	81.3	57.4	143.3	190.2	830.5	10.6	40.6	91.8	362.5
M+F		310.8	411.1	30.2	42.7	63.2	152.4	196.2	876.3	9.1	30.4	105.0	359.6
F+C		236.4	413.7	28.8	52.4	48.1	138.5	174.5	349.8	9.1	26.8	88.2	192.0
M+F+C		254.4	727.5	29.0	54.5	47.4	141.7	188.9	607.2	11.9	33.9	102.0	186.3
LSD. 0.01													
Bacteria (B)		4.59		0.97		0.60		18.62		0.01		1.97	
Sources (S)		12.49		2.65		1.61		50.60		0.52		5.37	
Rates (R)		21.68		4.60		2.81		87.90		0.91		9.33	
BxSxR		26.01		5.52		3.37		105.5		1.09		11.20	

Table (5): Fe, Mn and Zn contents (mg/pot) of Seed and Straw of broad bean plants as affected by inoculation with (KDB) sources and rates of potassium fertilization

Treatments	Rates	Nutrients Contents (mg plant^{-1})											
		Seeds						Straw					
		Fe		Mn		Zn		Fe		Mn		Zn	
		Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB	Without	With KDB
Cont	50 %	0.01	0.52	0.05	0.13	0.10	0.15	1.83	4.50	0.12	0.40	1.04	1.92
M		0.90	3.27	0.21	0.50	0.39	0.63	31.03	54.21	1.32	2.21	2.78	5.52
C		1.89	3.27	0.57	1.04	0.39	0.59	29.39	53.19	1.07	2.61	3.12	6.86
F		0.56	2.38	0.17	0.36	0.31	0.50	16.36	25.70	0.67	1.19	2.31	3.58
M+C		2.12	6.06	0.38	0.71	0.28	0.49	26.20	46.88	0.92	1.84	2.09	5.05
M+F		0.61	1.86	0.14	0.31	0.27	0.45	24.13	41.63	0.55	1.10	2.22	3.78
F+C		1.65	6.27	0.14	0.42	0.27	0.60	26.52	40.43	0.98	1.64	2.62	4.45
M+F+C		1.69	2.79	0.10	0.29	0.26	0.56	20.18	29.10	1.10	1.58	3.06	4.36
Cont	75 %	0.01	0.52	0.05	0.13	0.10	0.15	1.83	4.50	0.12	0.40	1.04	1.92
M		1.06	3.71	0.28	0.59	0.46	0.69	31.47	63.94	1.40	2.69	2.85	7.04
C		2.46	3.34	0.69	1.18	0.45	0.64	30.87	61.97	1.14	3.22	3.43	8.41
F		0.68	2.91	0.21	0.47	0.36	0.54	16.59	36.15	0.73	1.68	2.36	5.30
M+C		2.62	6.48	0.46	0.75	0.33	0.53	26.70	67.77	0.97	2.66	2.65	7.33
M+F		0.76	2.17	0.17	0.34	0.33	0.48	25.57	51.35	0.63	1.48	2.37	6.01
F+C		1.89	6.56	0.16	0.45	0.30	0.65	28.72	45.73	1.11	1.91	3.09	5.08
M+F+C		1.98	3.34	0.14	0.36	0.30	0.64	20.61	34.21	1.13	1.86	3.35	5.02
Cont	100 %	0.01	0.52	0.05	0.13	0.10	0.15	1.83	4.50	0.12	0.40	1.04	1.92
M		1.24	3.86	0.35	0.67	0.51	0.76	32.15	69.56	1.53	3.36	2.86	8.14
C		2.80	3.53	0.88	1.32	0.51	0.72	32.15	76.26	1.20	3.57	3.64	10.6
F		0.78	3.25	0.27	0.55	0.40	0.60	17.60	26.98	0.80	1.64	2.53	7.04
M+C		2.91	6.82	0.51	0.84	0.37	0.58	30.24	67.28	1.15	3.13	3.06	8.76
M+F		0.82	2.34	0.20	0.40	0.36	0.52	27.23	62.52	0.70	1.82	2.49	7.24
F+C		2.07	6.76	0.22	0.47	0.34	0.68	29.01	53.58	1.14	2.27	3.26	6.02
M+F+C		2.12	3.41	0.18	0.39	0.37	0.67	22.25	41.51	1.22	1.20	3.51	5.89
LSD(0.01)													
Bacteria (B)		2.24		0.34		0.02		29.45		1.20		0.05	
Sources (S)		2.53		0.40		0.01		30.43		1.44		0.15	
Rates (R)		2.71		0.46		0.02		34.25		1.64		0.26	
BxSxR		0.10		0.08		0.02		0.63		0.02		0.31	

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استجابة محصول الفول البلدى المنزرع فى أرض طينية من منطقة بهتيم للتسميد الحيوى والبوتاسى

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أجريت هذه الدراسة البحثية خلال الموسم الشتوى ٢٠٠٥م على ارض طينية من محطة البحوث الزراعية بمنطقة بهتيم – محافظة القليوبية– التابعة لمركز البحوث الزراعية بهدف دراسة كفاءة التسميد ببعض المصادر الطبيعية من الأسمدة البوتاسية والتقليح البكتيرى ومدى إستجابة الفول البلدى المنزرع فى الارض الطينية لمحطة بهتيم للبحوث الزراعية لهذه الأسمدة. وقد استخدم 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 (43)، هذا بجانب تلقيح البذور قبل الزراعة بالبكتريا المذيبة للبوتاسيوم ***Bacillus circulans*** أو تركها بدون تلقيح.

تم فى نهاية التجربة تقدير محصول البذور والقش للفول البلدى وكذلك تم تقدير محتواها من عناصر النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز وذلك لتقييم مدى استجابة الفول البلدى المنزرع فى أرض طينية لمعاملات التسميد الحيوى والبوتاسى تحت الدراسة.

وكانت أهم النتائج :

تحقق أعلى إنتاج من محصول البذور والقش كما كان محتواها من عناصر النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز فى المعاملات الملقحة بالبكتريا المذيبة للبوتاسيوم ***Bacillus circulans*** مقارنة بتلك الغير ملقحة.

كما أن زيادة معدل التسميد بصوره عامه سببت زيادة فى محصول البذور والقش وكذلك زاد محتواها من العناصر اللكبرى والصغرى –تحت الدراسة– 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.

بالنسبة لتأثير نوع السماد البوتاسى المستخدم على محصولى الحبوب والقش ومحتواهما من العناصر الكبرى والصغرى ، فقد اوضحت الدراسة انه فى حالة استخدلم السماد فى صورة منفردة كان افضلها التسميد بالصورة المعدنية (M) يليها فى تاثير التسميد بالفلدسبار البوتاسى (F).وبالنسبه لتأثيرات الاسمده ذات المخاليط الثنائيه تفوقت المعامله (M + F) تليها المعامله (M+C)فى اعطاء التأثير الأفضل، بينما أظهر كل من المخلوط الثنائى (F+C) والمخلوط الثلاثى (M + F +C) إستجابة أكثر وضوحا فقط فى إنتاجية محصول البذور ومحتواها من العناصر المغذية.