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EFFECT OF SOWING DATE AND NITROGEN, POTASSIUM FERTILIZATION ON FABA BEAN PRODUCTIVITY IN NEWLY RECLAIMED SALINE SOIL OF NORTH SINAI

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ABSTRACT

Faba bean (Cv. Nubaria 1) was grown during the two winter seasons 2011/2012 and 2012/2013 in saline soil at North Sinai Governorate, Egypt, to study of the effect of potassium sulfate (48 % K_2O) rates (50 – 75 and 100 kg K_2O fed^{-1}) , urea (46 % N) rates (10 – 20 -40 kg N fed^{-1}) alone or in combination with bio-fertilizers (*Bacillus circulans* potassium solubilizing bacteria) + *Rhizobium radiobacter* nitrogen fixing bacteria strain inoculation, Salt Tolerant PGPR and sowing dates (25 October, 25 November and 25 December) on faba bean productivity and the nutrients content in faba bean grains under saline soil conditions was conducted:

Results showed that the greatest seeds yield was obtained with the rate of 40 kg N +100 kg K_2O fed^{-1} combined with bio-fertilizer and sown on date in 15 November in both seasons. Also, the rates of N, K and sowing date significantly increased P, K, Fe Mn and Zn content in faba bean seed in both seasons, while grain N content showed no significant differences in the first season. Soil contents of N, K, Mn and Zn were significantly affected by N, K and sowing date while the available P and Fe showed not significant differences in the first season. Sowing date (25 November) recorded the highest values of seeds protein content.

It could be recommended that use of 20 kg N + 75 kg K_2O fed^{-1} combined with bio-fertilizers and sowing date of 25 November gave the greatest seed yield and improved nutrients content in grains under saline soil conditions

Keyword: saline soil, faba bean, bio-fertilizers and sowing dates.

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important winter legume crops for human consumption in Egypt as a protein source (28 – 36 %) and has potential N –fixing legume can also play an essential role in enhancing soil fertility, Ragab *et al* .,(2010) and Ali *et al.*, (2011).

Application of Bacillus circulans (potassium solublizing bacteria) alone can improve plant mineral nutrient uptake, Photosynthesis and yield grown under nutrient deficient soils leading to plant growth, Han and lee (2005). Nitrogen and Potassium to increase plant salt tolerance to produce high biomass, Maher, (2004). Zakaria, (2012) showed that the effect of individual mineral K fertilizers at different rates significantly increased seeds and straw yield. On the other hand, Buskiene and Uselis (2008) reported that increasing the rate of nitrogen fertilizer increased from 60 to 90 – 150 kg N ha^{-1}, increased N content in soil by approximately 25 % while increasing potassium fertilizerfrom 90 to 240 kg ha^{-1} increased potassium content in soil by approximately 33 %.

Rugheim and Abd El- Gani (2012) found that the Rhizobium inoculation significantly increased crude protein content and seed yield of faba bean.

Rhizobium inoculation with strain ENRRI 9 significantly increased faba bean seed yield.

In Egypt, higher yields were recorded in lentil cultivar Giza 9 seeded on 31 October than on 15 November or 1 December (Abdel-Rahman *et al.*, 1980). Seed yield of faba bean was influenced significantly by date of sowing. The maximum seed yield of 1047.8 kg /ha was obtained by sowing faba bean on 14 January than 28 January and 12 February, respectively, (Munir and Abd El-Rahman, 2002). Talal and Ghalib (2006) found that the early date of sowing in late November resulted in a significant increase in plant height, root growth, nodules number and nodules dry weight. This was associated with a grain yield increase which was more double than that produced when sowing in January. Shad *et al* (2011) reported that the sowing date up to 4 October produced higher yield, thereafter yield decreased as sowing was delayed and the lowest yield was recorded for crop sown on 27 December. Amer *et al.* (1992) obtained the greatest seed yield from sowing on Nov. 1 in the first season and on Nov. 15 in the second one, whereas sowing on Nov. 30 decreased yield and its components. Hatam *et al.* (1999) indicated that number of seeds/pod, seed weight/plant and seed yield/ha were decreased by 13.35 and 85% respectively, as sowing date was delayed from Oct 22 to Jun 7. Singh and Sharma ,(2001) indicated that the N concentration in grain and straw increased significantly with the application of 120 kg N ha^{-1} over control. The K concentration in grain and straw increased significantly due to the application of 50 kg K ha^{-1} for wheat in saline soil.

The present investigation was conducted to study the effect of sowing date, N, and K fertilization in combination with biofertilizer on faba bean grown in newly reclaimed saline soil of North Sinai.

MATERIALS AND METHODS

A filed experiment was conducted in salt affected sandy loam soil at Gelbana town of North Sinai Governorate during the two winter growing seasons 2011/2012 and 2012/ 2013, to study the effect of different potassium sulphate (48 % K_2O) and urea (46 % N) fertilizers levels alone or in combined with bio-fertilizer, *Bacillus circulans* (potassium solubilizing bacteria) + *Rhizobium radiobacter* (N_2 fixed) strain inoculation, Salt Tolerant PGPR and date of sowing on some soil properties and faba bean productivity under saline soil condition . Upper 0-30 cm soil surface samples were taken before sowing and analyzed as shown in (Table 1). Soil samples were air dried ground, sieved through a 2 mm sieve and kept through dry containers for analysis, according to the methods described by Blacke (1965).

Table (1) Some Physical and chemical properties of the studied soil.

Course sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Textural class	O.M (%)	$CaCO_3$ (%)
1.25	75.47	6.43	16.85	Sandy loam	0.52	8.14

pH (1:2:5)	EC (dS/m)	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{--}_4
8.10	13.40	12.74	21.96	98.52	0.78	8.49	87	38.51

Available						
Macronutrients (mg/kg)			Micronutrients (mg/kg)			
N	P	K	Fe	Mn	Zn	Cu
30	5.93	194	2.59	1.79	0.75	0.68

Faba bean (Cv. Nubaria 1), supplied from Food Legumes Dep. Field Crop Research Institute, Agriculture Research Center, Giza – Egypt. Tthree seeds were sown in each hill and after one month the plants were thinned to two plants per hill, and then were singled to one plant per hill after 35 days from sowing. Treatments were arranged in split split-plot design with four replicates. The mineral N and K fertilizers alone or combined with bio-fertilizer were main plots. The dates of sowing, 25 October (I), 25 November (II) and 25 December (III) were sub main plot and rates of mineral nitrogen and potassium were sub sub main plots. A plot size was 5 X 10 m^2 having 6 rows 5 m, long and 70 cm width. The distance between rows was 40 cm.

Urea (46 % N) fertilizer was at rates of 10, 20 and 40 kg N fed^{-1} and potassium sulphate (48 % K_2O) at rates of 50, 75 and 100 kg K_2O fed^{-1}. Bio-fertilizers with inoculation seeds with *Rhizobium leguminosarum* Viceae, Mixture strains (Icarda 441) as N_2- fixing bacteria and *Bacillus Circulans* for dissolving K in soil was applied by coating seeds with gum media carrying the bacteria strains on the same day of sowing. The inoculated grain plots were applied with liquid bacteria strains three times after 21 and 35 and 50 days from sowing as followed by Shaban and Omar (2006). Calcium super-phosphate (15.5% P_2O_5) was added at rate of 15.5 kg P_2O_5 /fed during soil preparation. In addition to the primary field preparation such as soil surface leveling by leaser technique, sub soiling and drains establishment every 10 m, irrigation was done according to soil leaching requirement calculated after Richards (1954).

Faba bean plants were harvested on 20 April 2012 and 30 April 2013. After 7 days from harvesting, three plants of each plot were collected as a plant samples which were washed, divided into stems, leaves including pods husks and weighed. A suitable part of each sample stems or leaves was taken, at 70 ^{0}C oven dried and weighed. Weight of seeds and pods, 100 seed weight were recorded, suitable part of each seeds and pods were weighed at 70 ^{0}C were oven dried and chemically analyzed to determine their contents of nutrients according to Chapman and Pratt (1961). The obtained data were statistically analyzed according to Snedecor and Cochran (1979).

The following soil and plant analysis were performed: Particle size distribution was determined by the Pipette method, (Piper, 1950) and CaCO3

content was determined by the Calcimeter (Black 1965). Soil organic matter was assayed by the methods described by Black, (1965). Soil pH was measured using pH meter in soil, water suspension (1:2.5) described by Jackson, (1967). Total soluble salt (EC) were measured in soil paste extract (Jackson, 1967) .Available N was extracted from soil using 2N KCl solution and measured according to the modified Kjeldahel method, (Black, 1965).Available P was extracted by using 0.5 N sodium-bicarbonate, and determined colorimetrically according to Olsen's' method (Jackson, 1967) .Available K was determined using the Flame-Photometer, (Soltanpour and Schwab, 1977) . availablel phosphorus as well as Fe, Mn and Zn were determined using Inductively Coupled Plasma (ICP) Spectrometry model 400 as (Soltampour, 1985).

Plant analysis:-

From each sample 0.5 g was digested using 5 cm^3 from the mixture of sulfuric (H_2SO_4) and perchloric (HClO) acids (1:1) as described by Cottenie *et al.*, (1982). Nitrogen was determined by using the Kjeldahel method, (Chapman and Pratt, 1961). Phosphorus was determined colorimetrically and Potassium was determined using Flame-Photometer, according to Jackson, (1967). The concentration of Fe, Mn and Zn in faba bean seed was determined using Inductively Coupled Plasma (ICP) Spectrometry model 400 as (Soltampour, 1985).

RESULTS AND DISCUSSION

Seed yield and yield components of faba bean as influnced bt N, K rates, bio-fertilizer and sowing date.

Data recorded in Table (2) show that aowing dates had significant effects on seed yield (kg fed^{-1}) , seed weight (g) $Plant^{-1}$, 100 seeds (g) and No. of pods $plant^{-1}$ in both seasons , while the pods weight (g $plan^{-1}$) was not significantly affected in the first season and No. of branches $plant^{-1}$ was significant in the first season. The sowing faba bean seeds on 25 November resulted in increasing seeds yield (998 kg fed^{-1}), weight seed (34.58 g $plant^{-1}$) and No. of pods $plant^{-1}$ (33.00), respectively. Increasing the rate of N + K up to 40 N and 100 K_2O (kg fed^{-1}) combined with bio-fertilizer and sowing on 15 November increased seed yield in both seasons. Seed yield, seed weight $plant^{-1}$ and weight of pods $plant^{-1}$, were increased significantly at different rates of application in both seasons, respectively. N plus K fertilizers and bio-fertilizers showed not significant effect on No. pods $plant^{-1}$, weight of pods (g) $plant^{-1}$ and No. of branches plant-1 in both seasons while the weight of seed (g) $plant^{-1}$ and 100 seeds (g) were significantly affected in the first season, respectively. The increase in seeds yield was due to the role and availability of K which regulates the stomata opening and closing and its effect on osmotic potential in plant cells and tissues, Mohamed, (2012)and (Zakaria ,2012).

Table (2) Seed yield and yield components of faba bean as affected by N, K rates, bio-fertilizer application and sowing date.

Treatments	N+K rates (kgfed^{-1})	*Dates of sowing	Seed yield (kg fed^{-1})		Seed weight (g plant^{-1})		100 seeds (g)		Pods No plant^{-1}		Pods weight (g plant^{-1})		Branches No plant^{-1}	
			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Mineral	10N+50K	I	753	759	18.47	20.94	69	72	14	16	28.13	30.86	4	4
	20N+75K		762	766	22.06	22.21	74	76	15	18	31.25	32.40	6	5
	40N+100K		781	785	23.14	23.34	78	82	16	21	32.17	33.00	5	6
	10N+50K	II	821	834	27.49	30.29	70	72	23	28	34.57	36.79	6	5
	20N+75K		823	826	28.88	30.42	73	74	24	25	35.12	35.25	5	7
	40N+100K		831	832	28.96	30.65	75	77	26	27	35.48	36.00	6	7
	10N+50K	III	698	704	23.00	25.66	64	65	19	21	29.10	29.22	5	5
	20N+75K		720	723	23.10	25.72	66	67	20	23	29.17	30.21	6	7
	40N+100K		725	728	23.14	25.78	68	70	23	26	30.25	31.40	6	7
Bio-fertilizer	10N+50K	I	795	7.98	27.58	29.84	76	82	24	25	41.49	43.19	6	7
	20N+75K		814	820	28.10	30.14	80	85	28	31	44.10	45.00	7	8
	40N+100K		823	832	29.85	30.52	85	88	32	33	46.00	48.10	8	8
	10N+50K	II	985	993	29.63	34.58	92	95	26	30	38.75	44.63	7	7
	20N+75K		992	997	30.25	30.62	94	96	29	32	40.58	44.74	7	6
	40N+100K		995	998	30.33	30.58	96	98	31	33	43.10	45.24	8	8
	10N+50K	III	673	679	23.16	23.22	65	68	16	18	25.94	32.25	5	6
	20N+75K		676	681	23.25	23.36	68	71	17	18	25.98	33.10	5	6
	40N+100K		679	682	23.31	23.46	72	75	18	20	25.98	33.24	6	7
LSD % 5 Date			2.36	0.95	0.93	0.80	1.96	2.68	1.74	1.57	ns	1.54	0.38	ns
LSD. 5 % rate			0.94	2.12	0.36	2.06	ns	ns	1.22	ns	1.64	1.76	ns	0.56
LSD. 5 % fertilizer			1.63	1.95	0.31	ns	ns	0.65	ns	ns	ns	ns	ns	ns
Rate X period			*	**	**	**	***	***	***	***	***	***	ns	**
Fertilizer X rate			*	**	**	**	***	***	***	***	***	***	***	ns
Fertilizer X period			**	**	ns	ns	***	***	***	***	ns	ns	**	**
Fert X Rate X period			**	**	**	ns	***	***	***	***	***	***	ns	ns

*Sowing date . I = 25 October , II = 25 November and III = 25 December 1st = first season 2nd = second season

Interaction between different rates of fertilizer and sowing dates significantly affected seed yield (kg fed^{-1}); seed weight (g) $plant^{-1}$; 100 seeds (g) No. of pods plant-1 and weight of Pods (g) $plant^{-1}$, respectively. On the other hand, the interaction between application of N + K with or without bio-fertilizers and dates of sowing, significantly affected seed yield (kg fed^{-1}); seed weight (g) $plant^{-1}$; 100 seeds (g) No. of pods $plant^{-1}$ and weight of Pods (g) $plant^{-1}$, respectively, in both seasons. Concerning, the interaction between dates of sowing and N, K fertilizers application rates significantly affected seed yield (kg fed^{-1}); 100 seeds (g); No. of pods $plant^{-1}$ and weight of pods (g) $plant^{-1}$ in both seasons, respectively. Also, the interaction between N and K alone or in combination with bio-fertilizers plus different rates and sowing dates were significantly affected on the seed yield (kg fed^{-1}); 100 seeds (g); No. of pods $plant^{-1}$ and weight of Pods (g $plant^{-1}$), respectively in both seasons. These results are in agreement with those obtained with Shad *et al* (2012) who found that faba bean seed yield decreased due to sowing on 27 December. The low yield might be due to cold weather during December and January which hindered the normal growth and photosynthetesis. Moreover, the reduction in yield in late sowing may be due to poor growth, shorter seed filling duration and maturity period, less number of fruiting nodes and pods $plant^{-1}$ and minimum seeds pod^{-1}, (Sahile *et al.*, 2008).

Macro-micronutrients and protein content in seeds of faba bean.

Effect of (N + K) fertilizers rates alone or in combined with bio-fertilizer and sowing dates positively affected macro-micronutrients and protein content in seeds of faba bean. Data presented in Table (3) show that the K + N fertilizer alone or combined with bio-fertilizers application significantly increased N and K contents in faba bean seeds in the second season. Also, the rates of N +K fertilizers significantly increased P, K , Fe , Mn and Zn content in of faba bean seeds in both seasons , while the N content in faba bean seed was not significant in the first season. The effect of faba bean sowing dates on P, K, Fe, Mn and Zn contents in seeds was significant in both seasons, while the N content in seeds was not significant in the first season. On the other hand, the effect of (N+ K) fertilizers with or without bio-fertilizer, rates and sowing dates on K, Fe, Mn and Zn contents in seeds were significantly in both seasons. Concerning the interaction between fertilizers rates and sowing dates were significantly increased all nutrients contents in seeds in both seasons expect N content which was not significant in the first season. The interaction between fertilizers and rates were not significant on P, Fe and Zn contents in seeds in both seasons, while the N, K and Mn were significant in the second season. The relationship between fertilization and sowing dates significantly increased N, P and K contents in faba bean seeds in the second season expect Mn and Zn contents in seeds were not significant in both seasons.

The obtained data in Table (3) also, show that, combined treatments of bio-fertilizer with mineral N + K fertilizers at rate of 20 kg N and 75 kg K_2O fed^{-1} led to an increase N, Fe and Mn contents in seeds, while the increase of P, K and Mn content in seeds was in plot treated with N + K_2O fertilizer rate of 40 kg N + 100 kg K_2O fed^{-1} combined with bio-fertilizer.

Table (3) Macro- micronutrients and protein contents in faba bean seeds.

Treatment	N+K rates (kgfed^{-1})	Sowing of date	N (%)		P (%)		K (%)		Protein (%)		Fe (mg kg^{-1})		Mn (mg kg^{-1})		Zn (mg kg^{-1})	
			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Mineral	10N+50K	I	2.85	2.89	0.38	0.41	1.63	1.64	17.81	18.06	78.52	80.12	27.00	30.42	16.45	17.33
	20N+75K		2.96	3.05	0.41	0.44	1.65	1.66	18.50	19.06	82.14	82.34	27.30	30.66	16.55	17.62
	40N+100K		3.04	3.10	0.43	0.45	1.66	1.68	19.00	19.37	83.57	83.45	27.52	30.72	16.74	17.85
	10N+50K	II	2.97	3.02	0.40	0.42	1.69	1.71	18.56	18.88	81.24	82.52	27.62	30.78	16.68	17.84
	20N+75K		3.06	3.10	0.44	0.46	1.71	1.73	19.12	19.37	84.15	85.47	28.59	29.81	17.10	18.10
	40N+100K		3.08	3.12	0.46	0.47	1.74	1.77	19.25	19.50	87.12	88.67	29.10	30.14	17.23	18.15
	10N+50K	III	2.89	2.91	0.39	0.41	1.59	1.62	18.06	18.19	71.28	71.34	25.89	26.10	14.23	14.85
	20N+75K		2.94	2.96	0.40	0.43	1.60	1.64	18.37	18.50	75.49	75.52	26.21	26.36	14.36	15.12
	40N+100K		2.98	3.01	0.42	0.46	1.62	1.66	18.62	18.81	78.29	78.32	26.34	26.45	14.41	15.24
Bio-fertilizer	10N+50K	I	3.25	3.31	0.42	0.45	1.68	1.72	20.31	20.68	81.10	83.60	31.29	33.18	18.76	20.37
	20N+75K		3.41	3.53	0.52	0.53	1.83	1.89	20.00	20.12	89.24	90.32	37.49	39.40	23.45	25.41
	40N+100K		3.35	3.38	0.57	0.59	1.74	1.83	20.94	21.12	86.74	88.49	34.52	36.10	21.96	23.18
	10N+50K	II	3.12	3.18	0.47	0.50	1.69	1.73	19.50	19.87	84.36	84.56	34.25	35.14	18.69	19.85
	20N+75K		3.15	3.20	0.50	0.53	1.74	1.79	19.69	19.87	87.21	87.56	35.59	37.02	21.38	23.58
	40N+100K		3.20	3.22	0.51	0.55	1.78	1.82	21.31	21.12	89.21	89.25	38.25	39.48	22.09	25.10
	10N+50K	III	2.98	3.01	0.45	0.46	1.68	1.71	18.62	18.81	80.69	80.74	30.52	30.45	17.25	18.10
	20N+75K		3.05	3.07	0.48	0.50	1.73	1.74	19.06	19.19	82.41	82.52	33.18	33.41	20.42	20.53
	40N+100K		3.08	3.10	0.52	0.53	1.76	1.78	19.25	19.37	83.10	83.26	34.02	35.10	21.35	21.43
LSD % 5 Date			ns	0.026	0.023	0.010	0.021	0.010	0.560	0.340	1.720	1.660	1.140	0.920	0.780	2.300
LSD. 5 % rate			ns	0.013	0.015	0.040	0.014	0.017	0.360	0.640	2.100	2.240	4.120	3.000	1.570	1.520
LSD. 5 % fertilizer			ns	0.024	ns	ns	ns	0.010	ns	ns	ns	ns	ns	ns	ns	ns
Rate X period			ns	***	***	***	***	**	***	***	***	***	***	***	***	***
Fertilizer X rate			ns	***	ns	ns	ns	**	ns	**	ns	ns	Ns	***	ns	ns
Fertilizer X period			ns	***	*	**	ns	**	ns		**	Ns	ns	ns	ns	ns
Fert X Rate X period			ns	***	ns	ns	**	**	***	***	**	**	***	***	***	***

* Sowing date. I = 25 October, II = 25 November and III = 25 December . 1st = first season 2nd = second season

These results are in agreement with those obtained by Salama (2006) who found that application of bio-fertilizer significantly increased the N, P and K content in wheat grains compared with uninoculated treatment. Wu *et al*, (2006) reported that the activity of bacteria (*Azotobacter chroococcum* and *bacillus circulans)* led to an increase in water dissolved organic carbon concentration and decreasing pH value, which enhanced metal mobility and bio-availability. Shaban *et al* (2012) indicated that micronutrient (Fe, Mn and Zn $mgkg^{-1}$) contents in seeds of faba bean plants were increased with increasing N + K application rates.

Considerable effects of sowing dates on seed protein content were observed (Table 3). Early sowing dates (25 November) recorded the highest values of protein content. Meanwhile, the rates of N + K_2O and sowing dates were significantly with protein content while the N + K fertilizers alone or in combination with bio-fertilizers showed not significantly affected protein content. The interaction between fertilizers rates and sowing data gave not significant on protein content. The interactions between all treatments were significantly affected protein content. The highest values of protein content (22.06 %) was for plot treated with 20 kg N fed^{-1} + 75 kg K_2O fed^{-1} during sowing date of 25 October. These results are in harmony with by El-Matwally *et al* (2013) who found that the high total protein content in seeds from early sowing crop might be due to the fact that the early planted crop had sufficient longer vegetative period and better utilization of water and nutrients where that is very useful in increasing seed protein content. Also, the delay in sowing could lead to a shorter growing period which has bad effect on accumulating dry matter in the seeds.

Macro-micronutrients available in soil.

Effect of N +K_2O fertilizers rates alone or combined with bio-fertilization and sowing dates as shown in Table (4) significantly affected the available N, P , K , Mn and Zn content in soil in both seasons, while Fe has no significant effect in the first season. The rates of N + K were significantly affected soil contents of N, K, Mn and Zn, while the P and Fe were not significantly affected in the first season. On the other hand, the interaction effects between fertilizers rates and sowing dates were significantly affected N, K, Mn and Zn contents in soil in both seasons, while P was not significantly in the first season and Fe was not significantly in both seasons. The highest value of N in soil was obtained by sowing date of 25 October as well as rates of 40 kg N fed^{-1} + 100 kg K_2O fed^{-1} combined with bio-fertilizers. The highest values of K, Fe and Mn contents in were obtained soil by sowing dates 25 December and applying 40 kg N + 100 kg K_2O fed^{-1} combined with bio-fertilizers. The highest values of P content were found in soil treated with 10 kg N + 50 kg K_2O fed^{-1} combined with bio-fertilizers at sowing date 25 December.

Table (4) Available macro- micronutrients contents in soil as affected by studied treatments after harvesting.

Treatments	$N+K_2O$ rates ($kgfed^{-1}$)	Dates of sowing	N ($mgkg^{-1}$)		P ($mgkg^{-1}$)		K ($mgkg^{-1}$)		Fe ($mg\ kg^{-1}$)		Mn ($mg\ kg^{-1}$)		Zn ($mg\ kg^{-1}$)	
			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Mineral	10N+50K	I	38	43	6.04	6.10	210	215	2.69	2.71	1.85	1.90	0.74	0.77
	20N+75K		42	45	6.12	6.17	216	220	2.74	2.77	1.88	1.91	0.77	0.78
	40N+100K		44	46	6.18	6.21	220	224	2.76	2.80	1.91	1.93	0.79	0.81
	10N+50K	II	44	48	6.33	6.34	221	223	2.66	2.70	1.88	1.90	0.74	0.76
	20N+75K		47	51	6.37	6.39	222	225	2.71	2.74	1.90	1.92	0.76	0.78
	40N+100K		49	54	6.43	6.45	223	228	2.73	2.76	1.93	1.95	0.79	0.83
	10N+50K	III	37	39	6.02	6.04	207	208	2.56	2.60	1.71	1.72	0.63	0.65
	20N+75K		39	41	6.05	6.06	209	210	2.59	2.61	1.72	1.74	0.67	0.68
	40N+100K		42	43	6.08	6.10	213	215	2.62	2.64	1.75	1.78	0.69	0.70
Bio-fertilizer	10N+50K	I	48	42	6.42	6.50	234	238	2.74	2.78	1.86	1.95	0.78	0.84
	20N+75K		54	58	6.52	6.61	239	243	2.79	2.81	1.98	2.03	0.82	0.86
	40N+100K		58	62	6.57	6.64	243	247	2.82	2.85	2.03	2.08	0.84	0.88
	10N+50K	II	49	54	6.32	6.37	235	239	2.75	2.78	1.94	1.96	0.82	0.88
	20N+75K		55	59	6.38	6.40	236	240	2.78	2.80	1.96	1.98	0.85	0.89
	40N+100K		57	60	6.43	6.45	238	241	2.80	2.81	1.98	1.99	0.87	0.90
	10N+50K	III	45	48	6.61	6.67	242	244	2.84	2.82	2.01	2.03	0.86	0.85
	20N+75K		46	49	6.52	6.55	243	245	2.85	2.86	2.04	2.06	0.85	0.83
	40N+100K		49	53	6.48	6.54	245	248	2.87	2.88	2.06	2.08	0.80	0.82
LSD % 5 Date			0.94	1.58	0.17	0.033	1.70	1.31	ns	0.027	0.018	0.025	0.028	0.027
LSD. 5 % rate			1.64	1.76	ns	0.061	2.21	2.78	ns	0.011	0.027	0.059	0.051	0.046
LSD. 5 % fertilizer			0.49	1.12	ns	0.019	1.87	1.64	ns	ns	0.012	0.016	ns	0.014
Rate X period			***	***	ns	***	***	***	ns	ns	***	***	ns	***
Fertilizer X rate			***	***	ns	***	***	***	ns	ns	*	*	ns	*
Fertilizer X period			**	**	ns	**	**	**	ns	ns	ns	ns	ns	ns
Fert X Rate X period			**	**	ns	**	**	**	ns	**	**	**	ns	**

* Sowing date. I = 25 October , II = 25 November and III = 25 December 1st = first season 2nd = second season

These results are in agreement with obtained by Singh and Sharma, (2001) who indicated that application of N and K fertilizers led to an increase of available N and K in surface soil. Also, Buskiene and Uselis (2008) reported that application rates of nitrogen fertilizer that increased from 60 to 90 – 150 kg ha^{-1} increased nitrogen content in the soil by approximately 25 %. When the rate of potassium fertilizer was increased from 90 to 240 kg K_2O ha^{-1}, potassium content in the soil increased up to 33 %. Shaban *et al* (2012) showed that, the micronutrient (Fe, Mn and Zn) content in soil increased with increasing rates of N combined with K fertilizers.

Finally, it could be concluded that sowing dates in 25th November with the application rate of 20 kg N + 75 kg K_2O fed^{-1} in combined with bio-fertilizers enhanced faba bean yield in saline soil.

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تاثير مواعيد الزراعة والتسميد النتروجينى والبوتاسى على انتاجية الفول البلـــدى تحت ظروف الأراضى الملحية فى شمال سيناء

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اجريت تجربة حلقلية لزراعة الفول البلدى صنف نوبارية ١ لموسمين شـــتوين ٢٠١١/٢٠١٢ و ٢٠١٢ / ٢٠١٣ فى ارض ملحية بمنطقة جلبانة – شمال سيناء مـــصر لدراســـة تـــاثير تـــاثير التـــسميد البوتاسيوم (سلفات البوتاسيوم) بمعدلات (٠ – ٥٠ – ٧٥ – ١٠٠ K_2O كجم للفدان والتسميد النتروجينى (يوريا ٤٦ % ن) بمعدلات (١٠ – ٢٠ – ٤٠ كجم N للفدان) متحدين او منفردين مع التسميد الحيـــوى البكتريـــا المذيبـــة للبوتاســـيوم (*Bacillus circulans* potassium solubilizing bacteria)) والبكتريا المثبتة للنتـــروجين *Rhizobium radiobacter* (N_2 fixed) strain inoculation, Salt Tolerant PGPR) ومواعيد الزراعة وهى ٢٥ اكتوبر و ٢٥ نوفمبر و ٢٥ ديسمبر) على انتاجية الفول البلدى ومحتوى الحبوب من العناصر تحت ظروف الاراضى الملحية.

كانت النتائج : زيادة انتاجية الحبوب بزيادة معدل التسميد النتروجينى والبوتاسى المتحد مع التسميد الحيوى . كذلك اظهرت المعدلات المضافة من التسميد النتروجينى والبوتاسى تاثير معنوى على زيادة محتوى العناصر فى حبوب الفول فى كلا الموسمين ، بينما كان محتوى النتروجين غير معنوى فى الموسم الثانى.وكذلك وجد ان لمعدلات التسميد ومواعيد الزراعة تاثير معنوى على محتوى التربة من العناصر الميسرة (النتـــروجين و البوتاسيوم و المنجنيز والزنك) بينما الفوسفور والحديد كان تيسرهما غير معنـــوى فـــى الموســـم الاول. زاد محتوى البروتين فى بذور الفول البلدى زيادة معنوية مع ميعاد الزراعة ٢٥ اكتوبر.

التوصية :

من النتائج السابقة لوحظ ان استخدام المعدل ٢٠ كجم نتروجين و ٧٥ كجم سلفات بوتاسيوم للفدان متحدين مع التسميد الحيوى ومعاد الزراعة ٢٥ نوفمبر اعطت افضل محصول وادت الى تحسين محتوى البذور من العناصر الغذائية تحت ظروف الاراضى الملحية.

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