

EFFECT OF DIFFERENT SOURCES AND LEVELS OF POTASSIUM ON GROWTH, YIELD AND CHEMICAL COMPOSITION OF FABA BEAN PLANTS

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ABSTRACT

A pot experiment was undertaken out door at the farm of Faculty of Agric. El-Mansoura Univ. during the winter season of 2014 to investigate the effect of different sources of potassium fertilization on vegetative growth, chemical composition and yield of faba bean plants (*Vicia faba* L.).

Ten treatments were arranged in a complete randomized block design with 3 replicates, thus, the total number of the experiment was 30 pots as follows: (Control treatment: without K-fertilization), (50 kg $K_2O.fed^{-1}$ as potassium sulphate (RD), 37.5 kg $K_2O.fed^{-1}$ as potassium sulphate, and 62.5 kg $K_2O.fed^{-1}$ as potassium sulphate) and (50 kg $K_2O.fed^{-1}$ as potassium thio sulphate (RD) (137 lit. fed^{-1}), 30 kg $K_2O.fed^{-1}$ as potassium thio sulphate (82 lit. fed^{-1}), and 70 kg $K_2O.fed^{-1}$ as potassium thio sulphate (191.8 lit. fed^{-1}) as well as (200 kg. fed^{-1} feldspar, 100 kg. fed^{-1} feldspar and 300 kg. fed^{-1} feldspar). Results revealed that the mean values of vegetative growth parameters as (plant height, fresh and dry weight as well as leaf area), fresh weight of pods and seeds, N, P, K, Fe in plant foliage and seeds were increased significantly with increasing rates of potassium fertilizers. The highest values were recorded with using 62.5 kg $K_2O.fed^{-1}$ as potassium sulphate. As for the; EC and pH of soil was decreased with increasing rates of potassium sources. The available nutrients in soil (N, P, K and Fe) increased significantly with increasing rates of potassium fertilizers. The highest available values of N, P, K and Fe ppm in soil were recorded with using 62.5 kg $K_2O.fed^{-1}$ as potassium sulphate.

Keywords: Rock potassium, potassium sulphate, potassium thiosulphate, vegetative growth, available nutrients, faba bean.

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the earliest domesticated legumes which represents a very important source of proteins for the human diet in Egypt and/or for animal feed in several countries. Dry seeds of faba bean are a good source of protein (about 25% in dried seeds), starch, cellulose, vitamin C and minerals. Therefore, they have an increasing importance for human and animal food in the future. Faba bean are consumed as fresh faba bean pods, seeds, conservative faba bean and as a dried seeds. The surfaces and grain yields vary from year to year and from location to another (Zewail *et al.*, 2011). Increasing the production of faba bean green pods and dry seeds with high quality is considered an important aim and this aim could be achieved through using some natural materials as different sources of potassium.

Some nutrients such as (K) found in natural materials which present as elemental bearing rocks in many parts in the world. In Egypt, these rocks i.e.: potassium sulphate, potassium thiosulphate and potassium rock are spread in many sites in western and eastern desert. These rocks contain amounts of nutrients differ from little to huge amount also are cheaper than mineral fertilizers and have less pollution effect for land and water resources.

K plays a vital role as a macronutrient in plant growth and sustainable crop production (Baligar *et al.*, 2001). It maintains turgor pressure of cell which is necessary for cell expansion. It helps in osmo-regulation of plant cell, assists in opening and closing of stomata. It plays a key role in activation of more than 60 enzymes (Bukhsh *et al.*, 2011). Goals aimed toward increasing crop productivity and improved quality dictate either increased potassium supply or more efficient use of potassium. Developing plants that more efficiently use potassium might be a worthwhile goal for geneticists (Pettigrew, 2008).

On the other hand, rock in the long term improvement of their soil structure and increased productivity crops without negative effects on the environment. The highest growth, yield, yield components, protein, N and K plant and seeds contents of legumes crop were obtained by adding 360 kg fed^{-1} natural rock potassium and no significant increase with recommended treatments (Ezzat *et al.*, 2005). This study aimed at evaluating the efficiency of some potassium fertilizers; i.e. sulphate, thiosulphate and rock potassium and their effects on vegetative growth, yield and its components, chemical composition of faba bean plants as well as their effects on some chemical properties of soil.

MATERIALS AND METHODS

A pot experiment was undertaken at out door the Farm of Faculty of Agric. Mansoura Univ. during the winter season of 2014 to investigate the effect of different sources of potassium fertilization on vegetative growth, chemical composition and yield of faba bean plants (*Vicia faba* L.).

Ten treatments were arranged in a complete randomized block design with 3 replicates, thus, the total number of the experiment was 30 pots as follows: (Control treatment: without K-fertilization), (50 kg $K_2O.fed^{-1}$ as potassium sulphate (RD), 37.5 kg $K_2O.fed^{-1}$ as potassium sulphate, and 62.5 kg $K_2O.fed^{-1}$ as potassium sulphate) and (50 kg $K_2O.fed^{-1}$ as potassium thio sulphate (RD) (137 lit. fed^{-1}), 30 kg $K_2O.fed^{-1}$ as potassium thio sulphate (82 lit. fed^{-1}), and 70 kg $K_2O.fed^{-1}$ as potassium thio sulphate (191.8 lit. fed^{-1}) as well as (300 kg. fed^{-1} feldspar, 200 kg. fed^{-1} feldspar and 100 kg. fed^{-1} feldspar).

30 polyethylene pot of 25 cm. in diameter and 30 cm. length were used. Each pot was filled with 10 kg. air⁻¹ dried soil which was brought from the surface layer of special farm near El-Mansoura city. The experimental soil was fertile and clay in texture; some chemical properties of the experimental soil are illustrated at Table 1.

On 10th November 2014, 10 seeds of faba bean (C.V. Giza 843) were sown at equal distances in each pot., Two weeks later; faba bean plants were thinned to the most five uniform plants per pot .

Soil moisture was kept at field capacity by watering to the constant weight every 7 days.

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

Items	Value	
Mechanical analysis (%)	Coarse sand	2.9
	Fine sand	23.1
	Silt	36.7
	Clay	37.3
	Texture class	Clayey
E.C. dS.m ⁻¹ (1:5)	0.88	
pH(1:2.5)	8.07	
% S.P.	52.5	
% O.M.	1.39	
% CaCO ₃	2.19	
Anions meq100g soil ⁻¹	Ca ⁺⁺	0.96
	Mg ⁺⁺	0.68
	Na ⁺	2.66
	K ⁺	0.21
	CO ₃ ⁻	0.00
	HCO ₃ ⁻	1.09
	Cl ⁻	2.48
	SO ₄ ⁻	0.94
	N	42.3
	P	4.95
Available mg. kg ⁻¹	K	173
	Fe	9.62
	Mn	6.15
	Zn	1.38

Mineral fertilizers used in this investigation were added to soil of pots cultivated with Faba bean plants at rates recommended by the Ministry of Agriculture and Land Reclamation; 20 kg.fed⁻¹ ammonium nitrate (33.5 % N), 150 kg.fed⁻¹ calcium super phosphate (15.5 % P₂O₅).Phosphorus fertilizer was added to the soil before planting, while N & K fertilizers were added in two doses; the first dose was after 21 days from sowing and the other 2 weeks later. Three different sources of potassium fertilization were used: Potassium sulfate 50% K₂O (50 kg K₂O.fed⁻¹(RD), 37.5 kg K₂O.fed⁻¹ & 62.5 kg K₂O.fed⁻¹) and Thiosulfate-potassium 36.5% K₂O (50kg K₂O.fed⁻¹ (RD) (137 lit.fed⁻¹), 30 kg K₂O.fed⁻¹ (82 lit.fed⁻¹) & 70 kg K₂O.fed⁻¹ (191.8 lit. fed⁻¹) as well as Rock-potassium (feldspare) KAlSi₃O₈ 8.79% K₂O (200 kg K₂O.fed⁻¹, 100 kg K₂O.fed⁻¹ & 300 kg K₂O.fed⁻¹)

After 40 days from sowing of faba bean seeds, 3 plants were randomly taken from each treatment and immediately the plant growth parameters were measured.; fresh weight, dry weight, plant height and leaf area. Then after harvesting, another plant samples were taken from each treatment. All plant samples and seeds were weighed and oven dried at 70°C till constant weight was reached. Then, dry weight was calculated in g.Pot⁻¹ and the dried plant materials and seeds were thoroughly ground and stored for chemical analysis. To determine N, P, K and Fe concentrations in plant tissues, 0.2 g crude dried kept powder from each sample was wet digested with a mixture of concentrated sulphoric (H₂SO₄) and perchloric (HClO₄) acids, then heated until become clear solution. This solution was quantitatively transferred into

50 ml measuring flask and kept for determinations (Peterburgski, (1968). Also determination N, P, K, protein, Fe concentration and content mg.pot⁻¹ in seeds after harvesting.

The following data were recorded; N, P, K and Fe in plant tissues and seeds as well as content of nutrient in seeds.

Soil samples were taken from soil surface 0-10 cm after cultivation for determination of; EC (1:5), pH (1:2.5), available N, P, K and Fe.

Crude protein percentage was determined in the digestic of the dry seeds powder by determination of N% and multiplied in 6.25.

Soil analysis:

- The electrical conductivity in soil 1:5 extract was measured by EC meter according to the method of US Salinity Lab, (1954).
- Soil reaction (pH) was measured in 1:2.5 soil water suspension, organic matter content, soluble cations and aions in soil 1:5 as well as calcium carbonate were described by Jackson, (1967).
- Soil particle size distribution and Saturation percentage were determined according to (Klute, (1986).
- Available N, P and K were determined as Bremner and Mulvany, (1982), and Olsen and Sommers, (1982) respectively.
- For available micronutrients content determination in the soil; Fe, Mn and Zn were extracted with diethylene-triamine-penta acitic acid (DTPA) according to Mathieu and Pieltain, (2003).

Plant analysis: Total N, P and K were determined as described by Jones *et al.*, (1991), and Peters *et al.*, (2003). As for estimated Fe was described by Kumpulainen *et al.*, (1983), respectively.

All data were statistically analyzed according to the technique of analysis variance (ANOVA) and the least significant difference (L.S.D) method was used to compare the difference between the means of treatment values to the methods described by Gomez and Gomez, (1984). All statistical analyses were performed using analysis of variance technique by means of CoSTATE Computer Software.

RESULTS AND DISCUSSION

Vegetative growth parameters:

Data in Table 2 show the effect of using different sources of potassium fertilizers as (potassium sulphate, potassium thio-sulphate and potassium rock) at different levels as well as their interactions on vegetative growth parameters such as fresh, dry weight g. pot⁻¹, plant height (cm) and leaf area after 40 days from planting.

With respect to the effect of using different sources of potassium fertilizers on vegetative growth, data in Table 2 reveal that the mean values of fresh, dry weight g. pot⁻¹, plant height (cm) and leaf area were significantly increased due to adding different sources. The highest values were observed with adding potassium sulphate followed by potassium thio-sulphate and finally potassium rock.

As for, the effect of using different levels of potassium fertilizers on vegetative growth parameters,

data in Table 2 indicated that the mean values of these parameters under study were significantly increased with increasing levels of fertilization by sources of potassium kg.fed^{-1} and the highest increase was recorded with using $62.5\text{kg K}_2\text{O.fed}^{-1}$ comparing with the untreated plants.

These results could be attributed to the role of potassium element in metabolism and many processes needed to sustain and promote plant vegetative growth and development. Moreover, K plays a major role in many physiological and biochemical processes such as cell division and elongation and metabolism of carbohydrates and protein compounds (Marschner, 1995).

These results could be supported with those obtained by Ayub *et al.*, (2012), Xiang *et al.*, (2012), Biswash *et al.*, (2014), Motaghi and Nejad (2014) and Shokoohfar, (2015) were found the same investigation.

The effect of potassium sulphate in the soil may be attributed to the role of sulphate played by this acidic component for minimizing the values of soil pH and, subsequently facilitate the absorption of nutrients by the roots of faba beans.

These results could be enhanced with those obtained by Mahrous *et al.*, (2010) and Shaban *et al.*, (2012)

Table 2: vegetative growth parameters as affected by different sources and levels of potassium fertilization.

Treat.	Char.	Plant height cm	F.W g. pot ⁻¹	D.W g. pot ⁻¹	Leaf area cm ² . pot ⁻¹
Control without potassium		41.37	64.13	8.93	488.53
37.5 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(75%)		48.70	72.40	10.72	565.53
50 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(RD)		62.67	94.80	12.94	695.47
62.5 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(125%)		65.67	98.63	13.65	713.13
30 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (82 lit.fed ⁻¹)		46.20	71.87	10.08	539.27
50 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (137 lit.fed ⁻¹)		55.83	85.23	11.47	645.77
70 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (191.8 lit.fed ⁻¹)		59.17	89.50	12.21	671.63
100 kg.fed ⁻¹ (feldspare)		43.67	67.90	9.53	513.87
200 kg.fed ⁻¹ (feldspare)		50.97	76.50	10.25	591.77
300 kg.fed ⁻¹ (feldspare)		53.67	80.87	10.86	617.27
LSD _{at5%}		0.90	11.02	0.20	8.48

Fresh weight of pods, seeds and dry weight of seeds g. pot⁻¹:

Referring the effects of using different sources of potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock), different levels of sources as well as their interactions a long with control on fresh weight of pods, seeds and dry weight of seeds in Table 3.

In respect with application of different fertilizers of potassium (potassium sulphate, potassium thio-sulphate and potassium rock) on fresh weight of pods, seeds and dry weight of seeds after harvesting; data in Table 3 show that the mean values of the previous parameters were significantly increased with using these sources of potassium. After harvesting, the plants gave the highest values with adding

potassium sulphate which recorded as 87.30 g. pot^{-1} , 37.52 g. pot^{-1} and 4.88 g. pot^{-1} for fresh weight of pods, seeds and dry weight of seeds, respectively.

The comparisons between the means of the various treatments of different sources of potassium fertilizers and its levels are shown in Table 3 reflecting a significant difference between the average values of fresh weight of pods, seeds and dry weight of seeds g. pot⁻¹ after harvesting. Data illustrated that under any level of fertilization with different sources on faba bean plants were superior for increasing the values of all

mentioned traits than those obtained from the untreated plants. The highest values of fresh weight of pods and seeds g. pot⁻¹ were connected receiving the treatment with using $62.5\text{kg K}_2\text{O.fed}^{-1}$ potassium sulphate.

Also, potassium element is very important in overall metabolism of plant enzymes activity, it was found to serve a vital role in photosynthesis by direct increasing in growth and total yield. Also, potassium has a beneficial effect on water consumption (Mansour, 2006).

The obtained results are in a good accordance with those recorded by Beiknejad, (2007), Ibrahim *et al.*, (2008), Hussain *et al.*, (2011), Rosa, (2012) and Shokoohfar, (2015) who studied the effect of different levels of potassium sulphate (0, 60, 100 and 140 kg.ha^{-1}) on cow pea plant. Results recorded that statistically significant on weight of 1000 seeds and seeds in pod with the maximum level (140 kg.ha^{-1}).

The effect of potassium sulphate in the soil may be attributed to the role of sulphate played by this acidic component for minimizing the values of soil pH and, subsequently facilitate the absorption of nutrients by the roots of faba beans.

These results could be enhanced with those obtained by Mahrous *et al.*, (2010) and Shaban *et al.*, (2012)

Table 3: Fresh weight of pods and seeds as affected by different sources and levels of potassium fertilization.

Treat.	Char.	Fresh weight of pods g. pot ⁻¹	Fresh weight of seeds g. pot ⁻¹	Dry weight of seeds g. pot ⁻¹
Control without potassium		45.88	25.63	3.33
37.5 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(75%)		55.78	29.41	3.82
50 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(RD)		75.35	36.14	4.70
62.5 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium sulphate(125%)		87.30	37.52	4.88
30 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (82 lit.fed ⁻¹)		52.54	28.22	3.67
50 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (137 lit.fed ⁻¹)		66.20	33.48	4.35
70 kg $\text{K}_2\text{O.fed}^{-1}$ as potassium thio sulphate (191.8 lit.fed ⁻¹)		69.47	34.81	4.53
100 kg.fed ⁻¹ (feldspare)		49.12	26.87	3.49
200 kg.fed ⁻¹ (feldspare)		58.89	30.61	3.98
300 kg.fed ⁻¹ (feldspare)		62.72	32.17	4.18
LSD _{at5%}		0.97	0.49	0.07

N, P, K and Fe in plant foliage after harvesting:

Data in Table 4 show the effect of using different sources of potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock) at different levels as well as their interactions on N, P, K and Fe concentration after harvesting.

It is clear from the data in Table 4 that the mean values of N, P, K and Fe after harvesting increased significantly by using different potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock). The highest values of N, P, K and Fe were recorded with using potassium sulfur.

Based on the data presented in Table 4, the average values of N, P, K and Fe after harvesting were significantly affected due to using the different levels of potassium fertilizers. Generally, it was noticed that application of using 62.5kg K₂O.fed⁻¹ potassium sulphate significantly increased N, P, K and Fe content as compared to the untreated plants.

An increase in mineral elements might be due to the role of K in nutrients uptake and nutritional balance, which increase the biosynthesis of photosynthesis.

Similar, results were observed by Shaban *et al.*, (2012), Kherawat *et al.*, (2013), Biswash *et al.*, (2014) and Elazab, (2014).

Table 4: N, P, K% and Fe (ppm) concentrations in plant foliage after harvesting as affected by different sources and levels of potassium fertilization.

Treat.	Char.	N%	P%	K%	Fe ppm
Control without potassium		2.90	0.254	2.03	29.87
37.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.12	0.280	2.31	31.93
50 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.52	0.316	2.81	36.17
62.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.59	0.329	2.94	37.23
30 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (82 lit.fed ⁻¹)		3.08	0.270	2.24	31.23
50 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (137 lit.fed ⁻¹)		3.38	0.304	2.61	33.20
70 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (191.8 lit.fed ⁻¹)		3.46	0.313	2.69	35.10
100 kg.fed ⁻¹ (feldspare)		2.98	0.262	2.13	30.70
200 kg.fed ⁻¹ (feldspare)		3.23	0.290	2.41	32.93
300 kg.fed ⁻¹ (feldspare)		3.30	0.296	2.51	33.80
LSD _{at5%}		0.07	0.008	0.06	1.81

The effect of potassium sulphate in the soil may be attributed to the role of sulphate played by this acidic component for minimizing the values of soil pH and, subsequently facilitate the absorption of nutrients by the roots of faba beans.

These results could be enhanced with those obtained by Mahrous *et al.*, (2010) and Shaban *et al.*, (2012)**N, P, K, protein % and Fe ppm in seeds as well as its content after harvesting:**

N, P, K, protein and Fe as well as its content mg.pot⁻¹ in seeds of faba bean after harvesting as influenced by using different sources of potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock) at different levels of potassium as well as their interactions are presented in Table 5 and 6.

Obtained data in Table 5 and 6 indicate that the average of all the above mentioned nutrients were significantly increased due to using different sources of potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock). The highest values recorded with using potassium sulfur after harvesting.

With respect to the effect of potassium

fertilization levels, it can be noticed from the data in Table 5 and 6 that application of different levels of potassium to soil significantly affected N, P, K, protein and Fe as well as its content mg.pot⁻¹ by seeds of faba bean. The highest values of N, P, K, protein % and Fe ppm by seeds of faba bean were recorded with adding 62.5kg K₂O.fed⁻¹ potassium sulphate comparing with the untreated plants.

An increase in mineral elements might be due to the role of K in nutrients uptake and nutritional balance, which increase the biosynthesis of photosynthesis.

Similar results were observed by Shaban *et al.*, (2012), Kherawat *et al.*, (2013), Biswash *et al.*, (2014) and Elazab, (2014).

The effect of potassium sulphate in the soil may be attributed to the role of sulphate played by this acidic component for minimizing the values of soil pH and, subsequently facilitate the absorption of nutrients by the roots of faba beans.

These results could be enhanced with those obtained by Mahrous *et al.*, (2010) and Shaban *et al.*, (2012) .

Table 5: N, P, K and protein % and Fe concentration(ppm)in seeds as affected by different sources and levels of potassium fertilization.

Treat.	Char.	N%	Protein %	P%	K%	Fe ppm
Control without potassium		3.17	19.81	0.278	2.18	35.77
37.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.42	21.38	0.308	2.49	38.20
50 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.89	24.31	0.356	2.96	41.50
62.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		3.97	24.83	0.368	3.04	43.23
30 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (82 lit.fed ⁻¹)		3.32	20.75	0.296	2.41	37.37
50 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (137 lit.fed ⁻¹)		3.69	23.08	0.332	2.77	40.73
70 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (191.8 lit.fed ⁻¹)		3.81	23.79	0.346	2.82	41.50
100 kg.fed ⁻¹ (feldspare)		3.22	20.13	0.288	2.28	36.50
200 kg.fed ⁻¹ (feldspare)		3.55	22.17	0.318	2.56	39.17
300 kg.fed ⁻¹ (feldspare)		3.62	22.63	0.326	2.65	39.90
LSD _{at5%}		0.06	0.37	0.008	0.07	1.20

Table 6: N, P, K and Fe content mg.pot⁻¹ in seeds as affected by different sources and levels of potassium fertilization.

Treat.	Char.	N- content mg.pot ⁻¹	P- content mg.pot ⁻¹	K-content mg.pot ⁻¹	Fe- content mg.pot ⁻¹
Control without potassium		105.61	9.25	72.64	1191.59
37.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		130.76	11.79	95.08	1460.54
50 kg k ₂ O.fed ⁻¹ as potassium sulphate		182.76	16.73	139.06	1949.74
62.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		193.81	17.95	148.28	2108.93
30 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (82 lit.fed ⁻¹)		121.78	10.85	88.28	1370.62
50 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (137 lit.fed ⁻¹)		160.74	14.46	120.41	1772.80
70 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (191.8 lit.fed ⁻¹)		172.29	15.65	127.63	1878.10
100 kg.fed ⁻¹ (feldspare)		112.48	10.06	79.64	1275.18
200 kg.fed ⁻¹ (feldspare)		141.14	12.67	101.72	1558.71
300 kg.fed ⁻¹ (feldspare)		151.42	13.65	110.99	1668.73
LSD _{at5%}		3.52	0.43	3.30	60.26

Some chemical properties of the studied soil after harvesting:

Data illustrated in Table 7 indicate the effect of using different potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock) at different levels as well as their interactions on soil availability after harvesting of faba bean plant.

Regarding the effect of using some different sources of potassium fertilizers (potassium sulphate, potassium thio-sulphate and potassium rock) it can be observed that using potassium sulphur significantly affected the EC, pH, N, P, K and Fe ppm.

As for the effect of different treatments on EC, data in Table 7 reveal that with increasing levels of different sources of potassium EC was decreased comparing with the control treatment, the rate of 62.5kg K₂O.fed⁻¹ potassium sulphate recorded the lowest values of EC comparing the other treatments.

In the same Table, the effect of the treatment on pH, decreasing was found significantly in pH as affected by adding different sources from potassium fertilization at different levels comparing with the untreated soil. The lowest values of pH recorded with using 62.5kg K₂O.fed⁻¹ potassium sulphate.. Such data in the same Table also reveal that application of different sources of potassium at different levels significantly increased available N, P, K and Fe. Under previous data, the highest values of N, P, K and Fe in soil were recorded with using 62.5kg K₂O.fed⁻¹ potassium sulphate.

' The effect of potassium sulphate in the soil may be attributed to the role of sulphate played by this acidic component for minimizing the values of soil pH and, subsequently facilitate the absorption of nutrients by the roots of faba beans.

Table 7: Some chemical characteristics of soil as affected by different sources and levels of potassium fertilization.

Treat.	Char.	EC 1:5	pH 1:2.5	N ppm	P ppm	K ppm	Fe ppm
Control without potassium		1.12	8.14	34.70	4.82	192.67	7.98
37.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		1.04	7.95	38.50	5.52	220.67	8.69
50 kg k ₂ O.fed ⁻¹ as potassium sulphate		0.84	7.73	45.20	6.44	266.00	10.03
62.5 kg k ₂ O.fed ⁻¹ as potassium sulphate		0.78	7.70	47.20	6.63	274.00	10.29
30 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (82 lit.fed ⁻¹)		1.05	7.99	37.17	5.33	210.33	8.42
50 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (137 lit.fed ⁻¹)		0.91	7.83	42.27	6.06	246.33	9.51
70 kg k ₂ O.fed ⁻¹ as potassium thio sulphate (191.8 lit.fed ⁻¹)		0.88	7.77	43.53	6.25	256.33	9.77
100 kg.fed ⁻¹ (feldspare)		1.07	8.07	35.90	5.19	203.33	8.18
200 kg.fed ⁻¹ (feldspare)		0.99	7.91	39.53	5.72	229.67	8.93
300 kg.fed ⁻¹ (feldspare)		0.95	7.87	40.90	5.87	239.33	9.27
LSD _{at5%}		0.04	0.05	1.06	0.19	8.76	0.10

Mahrous *et al.*, (2010) indicated that application of different sources of potassium significantly decreased soil pH and EC. Also, Shaban *et al.*, (2012) stated that, the soil pH and EC decreased as K fertilizers rates were increased. Also, the application of 75 kg K₂O rates caused an appreciated increase in the availability N, P and K in the soil as well as their contents were maximized with increasing the applied rates. On the other hand, the micronutrients (Fe, Mn and Zn) content in soil tested was increased with increasing rates of mineral K₂O fertilizers application.

CONCLUSION

Under the same condition of this investigation it can be concluded that soil addition of 62.5 kg k₂O.fed⁻¹ as potassium sulphate as a source of K-fertilization from recommended dose is considered to be the most suitable treatment for realizing the highest safe yield of faba bean plant.

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تأثير مصادر ومستويات مختلفة من البوتاسيوم على النمو و المحصول و التركيب الكيماوي لنبات الفول أحمد عبد القادر طه, محمود موسى عمر و هدير راشد خضر قسم الأراضي – كلية الزراعة – جامعة المنصورة – مصر

نفذت تجربة أصص في كلية الزراعة – جامعة المنصورة خلال موسم النمو الشتوي 2014 وذلك لدراسة تأثير صور التسميد البوتاسي المختلفة تحت مستويات مختلفة على النمو الخضري والتركيب الكيماوي والمحصول لنبات الفول البلدي. أشتملت التجربة على 10 معاملات في تصميم قطاعات كاملة العشوائية في 3 مكررات ليصبح العدد الكلي للتجربة 30 إصيص تمثل التفاعلات الممكنة بين: معاملة الكنترول بدون إضافه، بوتاسيوم سلفات 50 كجم. الفدان⁻¹، بوتاسيوم سلفات 37.5 كجم. الفدان⁻¹، بوتاسيوم سلفات 62.5 كجم. الفدان⁻¹، بوتاسيوم ثيوسلفات 50 كجم. الفدان⁻¹ (137 لتر. الفدان⁻¹)، بوتاسيوم ثيوسلفات 30 كجم. الفدان⁻¹ (82 لتر. الفدان⁻¹)، بوتاسيوم ثيوسلفات 70 كجم. الفدان⁻¹ (191.8 لتر. الفدان⁻¹)، فليسبار 200 كجم. الفدان⁻¹، فليسبار 100 كجم. الفدان⁻¹ وفليسبار 300 كجم. الفدان⁻¹. أظهرت النتائج ان: متوسط النمو الخضري (طول النبات، الوزن الجاف والطازج، المساحة الورقية) ووزن القرون والبذور بالإضافة إلى النسبة المئوية للنيتروجين، الفوسفور، البوتاسيوم، البروتين والحديد في الأوراق والبذور جميعها بالإضافة إلى محتوى العناصر في البذور زادت زيادة معنوية بزيادة معدلات البوتاسيوم المختلفة وكانت أفضل معاملة هي بوتاسيوم سلفات 62.5 كجم. الفدان⁻¹. أما بالنسبة لصلاحيات التربة فقد وجد نقص معنوي في نسبة الملوحة وحموضة التربة بزيادة مستويات البوتاسيوم أما بالنسبة لصلاحية النيتروجين، الفوسفور، البوتاسيوم والحديد في التربة فقد زادت معنويًا بزيادة معدلات البوتاسيوم وخاصة عند إضافة بوتاسيوم سلفات 62.5 كجم. الفدان⁻¹.