J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 7 (3): 243 – 248,2016

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

Taha, A. A.; M. M. Omar and Hadeer R. Khedr
Soils Dept., Faculty of Agriculture, Mansoura University

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 randomize 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 $kg.fed^{-1}$. feldspare, 100 $kg.fed^{-1}$ feldspare and 300 $kg.fed^{-1}$ feldspare). Results reveale 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 sources 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 spreads 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 randomize 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 $kg.fed^{-1}$ feldspare, 200 $kg.fed^{-1}$ feldspare and 100 $kg.fed^{-1}$ feldspare).

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
Available mg. kg^{-1}	N	42.3
	P	4.95
	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 % P_2O_5).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% K_2O (50 kg $K_2O.fed^{-1}$(RD), 37.5 kg $K_2O.fed^{-1}$ &62.5 kg $K_2O.fed^{-1}$) and Thiosulfate-potassium 36.5% K_2O (50kg $K_2O.fed^{-1}$ (RD) (137 $lit.fed^{-1}$), 30 kg $K_2O.fed^{-1}$ (82 $lit.fed^{-1}$) & 70 kg $K_2O.fed^{-1}$ (191.8 lit. fed^{-1}) as well as Rock-potassium (feldspare) $KALSi_3O_8$ 8.79% K_2O (200 kg $K_2O.fed^{-1}$, 100 kg $K_2O.fed^{-1}$ & 300 kg $K_2O.fed^{-1}$)

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 (H_2SO_4) and perchloric ($HClO_4$) acids, then heated until become clear solution. This solution was quantitavely transferred into 50 ml measuring flask and kept for determinations (Peterburgski, (1968). Also determination N, P, K, protein, Fe concenteration 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 62.5kg $K_2O.fed^{-1}$ 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.

Char. / Treat.	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 $k_2O.fed^{-1}$ as potassium sulphate(75%)	48.70	72.40	10.72	565.53
50 kg $k_2O.fed^{-1}$ as potassium sulphate(RD)	62.67	94.80	12.94	695.47
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate(125%)	65.67	98.63	13.65	713.13
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 lit.fed^{-1})	46.20	71.87	10.08	539.27
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137lit.fed^{-1})	55.83	85.23	11.47	645.77
70 kg $k_2O.fed^{-1}$ 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 aforementioned 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 62.5kg $K_2O.fed^{-1}$ 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.

Char. / Treat.	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 $k_2O.fed^{-1}$ as potassium sulphate(75%)	55.78	29.41	3.82
50 kg $k_2O.fed^{-1}$ as potassium sulphate(RD)	75.35	36.14	4.70
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate(125%)	87.30	37.52	4.88
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 lit.fed^{-1})	52.54	28.22	3.67
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137 lit.fed^{-1})	66.20	33.48	4.35
70 kg $k_2O.fed^{-1}$ 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 $K_2O.fed^{-1}$ potassium sulphate significantly increased N, P, K and Fe content as compared to the untreated plants.

An increase in mineral elenments 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 $k_2O.fed^{-1}$ as potassium sulphate	3.12	0.280	2.31	31.93
50 kg $k_2O.fed^{-1}$ as potassium sulphate	3.52	0.316	2.81	36.17
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate	3.59	0.329	2.94	37.23
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 $lit.fed^{-1}$)	3.08	0.270	2.24	31.23
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137 $lit.fed^{-1}$)	3.38	0.304	2.61	33.20
70 kg $k_2O.fed^{-1}$ 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 $K_2O.fed^{-1}$ potassium sulphate comparing with the untreated plants.

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

Simila 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 $k_2O.fed^{-1}$ as potassium sulphate	3.42	21.38	0.308	2.49	38.20
50 kg $k_2O.fed^{-1}$ as potassium sulphate	3.89	24.31	0.356	2.96	41.50
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate	3.97	24.83	0.368	3.04	43.23
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 $lit.fed^{-1}$)	3.32	20.75	0.296	2.41	37.37
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137 $lit.fed^{-1}$)	3.69	23.08	0.332	2.77	40.73
70 kg $k_2O.fed^{-1}$ 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 $k_2O.fed^{-1}$ as potassium sulphate	130.76	11.79	95.08	1460.54
50 kg $k_2O.fed^{-1}$ as potassium sulphate	182.76	16.73	139.06	1949.74
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate	193.81	17.95	148.28	2108.93
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 $lit.fed^{-1}$)	121.78	10.85	88.28	1370.62
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137 $lit.fed^{-1}$)	160.74	14.46	120.41	1772.80
70 kg $k_2O.fed^{-1}$ 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 sulpher 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 $K_2O.fed^{-1}$ 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 $K_2O.fed^{-1}$ 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 $K_2O.fed^{-1}$ 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 $k_2O.fed^{-1}$ as potassium sulphate	1.04	7.95	38.50	5.52	220.67	8.69
50 kg $k_2O.fed^{-1}$ as potassium sulphate	0.84	7.73	45.20	6.44	266.00	10.03
62.5 kg $k_2O.fed^{-1}$ as potassium sulphate	0.78	7.70	47.20	6.63	274.00	10.29
30 kg $k_2O.fed^{-1}$ as potassium thio sulphate (82 $lit.fed^{-1}$)	1.05	7.99	37.17	5.33	210.33	8.42
50 kg $k_2O.fed^{-1}$ as potassium thio sulphate (137 $lit.fed^{-1}$)	0.91	7.83	42.27	6.06	246.33	9.51
70 kg $k_2O.fed^{-1}$ 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 rated were increased. Also, the application of 75 kg K_2O 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 K_2O 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.

REFERENCES

Ayub, M.; M. A. Nadeem, M. Naeem, M. Tahir, M. Tariq and W. Ahmad (2012). Effect of different levels of P and K on growth, forage yield and quality of cluster bean (*Cyamopsis tetragonolobus* L.).. J. of Anim & Plant Sci., 22(2): 479-483.

Baligar, V. C.; N. K. Fageria and Z. L. He (2001). Nutrient use efficiency in plants. Communications in Soil Sci. and Plant Analysis. 32:921.950.

Beiknejad, S. (2007). The effect of the application of different levels of potassium and magnesium on agronomic traits of Soybean Genotypes. Master Thesis in Agronomy, Islamic Azad Univ.,Bojnourd Branch, 78 P.

Biswash, M. R.; M. W. Rahman, M. M. Haque, M. Sharmin, R. Barua. (2014). Effect of potassium and vermicompost on the growth, yield and nutrient contents of mungbean (*BARI Mung* 5). Open Science Journal of Bioscience and Bioengineering. 1(3): 33-39.

Bremner, J. M., and C. S. Mulvany (1982). Nitrogen total P. 595. 616. in Page, A. L. et al., (ed.) "Methods of Soil Analysis". Part2: Chemical and Microbiological Properties. Amer. Soc. of Agron., Inc., Madison, Wis., USA.

Bukhsh, M. A. A. H. A.; R. Ahmad, A. U. Malik, S. Hussain and M. Ishaque (2011). Profitability of three maize hybrids as influenced by varying plant density and potassium application. J. Anim. and Plant Sci., 21(1): 42-47.

Elazab, M. F. S. (2014). Using some natural materials as a fertilizer and its effect on crop growth, yield and nutrients uptake. MS.c. Thesis, Fac. Agric. Mans. Univ. Egypt.

Ezzat, Z. M.; K. M. Khalil and A. A. Khalil (2005). Effect of natural potassium fertilizer on yield, yield components and seed composition of lentil in old and new reclaimed lands. Egypt J. Applied Sci., 20: 80-92.

Gomez, K. A., and A. A. Gomez (1984). "Statistical Procedures for Agricultural Research". John Wiley and Sons, Inc., New York.pp:680.

Hussain, F.; A. U. Malik, M. A. Haji and A. L. Malghani (2011). Growth and yield response of two cultivars of mungbean (*Vigna radiata* L.) to different potassium levels. J. Anim. & Plant Sci., 21(3): 622-625.

Ibrahim, H. A.; U. A. El-Behairy, M. El-Desuki, M. O. Bakry, and A. F. Abou-Hadid (2008). Response of green bean to fertilization with potassium and magnesium. Res. J. of Agric. and Biological Sci., 6(6):834-839.

Jackson, M. L. (1967). "Soil Chemical Analysis" Publisher by the author, Dept. of Soils, Univ. of Wise., Madison 6, Wishensin, U.S.A.

Jones, J.; B. J. B. Wolf, and H. A. Mills (1991). Plant analysis Handbook: A Practical Sampling, Preparation, Analysis, and Interpretative Guide. Micro-Macro Publishing, Athens, Ga.

Kherawat, B.S.; M. Lal; M. Agarwal; H. K. Yadav and S. Kumar (2013). Effect of applied potassium and manganese on yield and uptake of nutrients by Clusterbean (*Cyanosis teragonoloba*). J. of Agric. Physics, 13 (1): 22-26.

Klute, A. (1986)." Methods of Soil Analysis". Part 1: Physical and mineralogical methods (2nd ed) American Soc. of Agron. Madison Wisconsin, USA.

Kumpulainen, I.; A. M. Raittila; I. Lehto, and P. Koiristoinen (1983). Electro thermal Atomic Absorbtion spectrometric determination of heavy metals in foods and diets.J. Associ. Off. Anal. Chem., 66: 1129-1135.

Mahrous, S. E.; L. K. M. Ali and M. M. M. Ahmed (2010). Effect of different sources of potassium fertilization on wheat production and fertility of calcareous soil. Assiut J. of Agric. Sci., 42 (4): 86 – 101.

Mansour, F. Y. O. (2006). Physiological studies on garlic (*Allium sativum* L.). M.Sc. Thesis, Fac. Agric.; Minufiya Univ.; Egypt.

Marschner, M. (1995). "Mineral Nutrition of Higher Plants". 2nd Ed., Academic Press London and New York,ISBN- 10: 200-255.

Mathieu, C., and F. Pieltain, (2003). Chemical analysis of soils. Selected methods, France, pp; 387

Motaghi, S. and T. S. Nejad (2014). The effect of different levels of humic acid and potassium fertilizer on physiological indices of growth. Inter. J. Biosciences. 5 (2): 99-105.

Olsen, S. R., and L. E. Sommers, (1982). Phosphorus. P. 403-130. in Page, A. L. et al. (eds) Methods of Soil Analysis. Part2: Chemical and Microbiological properties. Am. Soc. of Agron., Inc. Madison, Wis, USA.

Peterburgski, A.V. (1968). "Hand Book of Agronomic Chemistry". Kolas publishing House.Moscow. (in Russian, pp. 29-86).

Peters, I. S.; B. Combs, I. Hoskins, I. Iarman, M. Kover Watson, and N. Wolf, (2003). Recommended Methods of Manure Analysis. Univ. of Wisconsin, Cooperative extension Publ., Madison.

Pettigrew, W. T. (2008). Potassium influences on yield and quality production for maize, wheat, soybean and cotton. Physiol. Plant. 133: 670-681.

Rosa, E. (2012). Productivity and quality of lima bean grown in sandy soil as affected by plant densities and NPK applications. Acta Horti., (936):311-319.

Shaban, K. A.; M. G. A. El-Kader, and H. S. Siam (2012). Effect of nitrogen and potassium mixing ratios and cultural practices on faba bean productivity in saline soils. Inter. J. of Academic Res., 4(6A):174-181.

Shokoohfar, S. M. A. (2015). Effect of potassium fertilizer and irrigation intervals levels on yield and yield components of cowpea (*Vigna unguiculata*) in ahvaz condition. Indian J. Fundamental and Applied Life Sci., 5 (1) January-March: 26-32.

U. S. Salinity Laboratory Staff (1954). Diagnosis and Improvement of Saline and Alkali Soils. USDA Agric. Hand Book No. 60, Washington, D.C.

Xiang, D.; T. Yong, W. Yang, Y. Wan, W. Gong, L. Cui, and T. Lei (2012). Effect of phosphorus and potassium nutrition on growth and yield of soybean in relay strip intercropping system. Scientific Res. and Essays 7(3): 342-351.

Zewail, R. M. Y.; Z. M. A. Khder and M. A. Mady (2011). Effect of potassium, some antioxidants, phosphoric acid and napthalen acetic acid (NAA) on growth and productivity of faba bean plants *(faba vulgaris)*. Annals of Agric. Sci., Moshtohor, 49 (1):53-64.

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 فى كلية الزراعة –جامعة المنصورة خلال موسم النمو الشتوى ٢٠١٤ وذلك لدراسة تأثير صور التسميد البوتاسى المختلفة تحت مستويات مختلفة على النمو الخضرى والتركيب الكيماوى والمحصول لنبات الفول البلدى.أشتملت التجربة على ١٠ معاملات فى تصميم قطاعات كاملة العشوائية فى ٣ مكررات ليصبح العدد الكلي للتجربة ٣٠ إصيص تمثل التفاعلات الممكنة بين: معاملة الكنترول بدون إضافه ، بوتاسيوم سلفات ٥٠كجم.الفدان$^{-1}$ K_2O, بوتاسيوم سلفات ٣٧.٥كجم.الفدان$^{-1}$ K_2O ، بوتاسيوم سلفات٦٢.٥كجم.الفدان$^{-1}$ K_2O، بوتاسيوم ثيوسلفات ٥٠كجم.الفدان$^{-1}$ K_2O(١٣٧لتر.الفدان$^{-1}$) ، بوتاسيوم ثيوسلفات ٣٠كجم.الفدان$^{-1}$ K_2O (٨٢لتر.الفدان$^{-1}$) ، بوتاسيوم ثيوسلفات٧٠كجم.الفدان$^{-1}$ K_2O (١٩١.٨لتر.الفدان$^{-1}$) ، فلسبار ٢٠٠كجم.الفدان$^{-1}$ ،فلسبار ١٠٠كجم.الفدان$^{-1}$ وفلسبار ٣٠٠كجم.الفدان$^{-1}$.أظهرت النتائج ان : متوسط النمو الخضرى (طول النبات، الوزن الجاف والطازج ،المساحة الورقية) ووزن القرون والبذور بالإضافة إلى النسبة المئوية للنيتروجين، الفوسفور، البوتاسيوم ، البروتين والحديد فى الأوراق والبذور جميعها بالاضافة الى محتوي العناصر فى البذور زادت زيادة معنوية بزيادة معدلات البوتاسيوم المختلفة وكانت أفضل معاملة هى بوتاسيوم سلفات ٦٢.٥كجم.الفدان$^{-1}$ K_2O. اما بالنسبة لصلاحيات التربة فقد وجد نقص معنوي فى نسبة الملوحة وحموضة التربة بزيادة مستويات البوتاسيوم أما بالنسبة لصلاحية النيتروجين ، الفوسفور، البوتاسيوم و الحديد فى التربة فقد زادت معنويا بزيادة معدلات البوتاسيوم وخاصة عند إضافة بوتاسيوم سلفات٦٢.٥كجم.الفدان$^{-1}$ K_2O.