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Effect of Some Natural Potassium Fertilizer Sources on Growth, Productivity and Quality of Sweet Potato (*Ipomoea batatas* L.)

El- Afifi, S. T. *; M. M. Zaghloul*; U. M. Saif Eldeenand Fatma S. Mosaad****
***Dept. of veg. and ornamental, Fac. Of Agric. Mansoura Univ., Egypt.**
**** Hort. Res. Inst.. Agric. Res. Center (ARC), Giza, Egypt.**

ABSTRACT

This study was conducted to estimate whether natural K-feldspar fertilization alone and/or with silicate dissolving bacteria and banana compost as well as application with potassium could replace in full or partial with conventional potassium in sweet potato production with no converse effect on productivity. Thence, two field experiments were carried out during two successive summer seasons of 2013 and 2014 at the Hort. Res. Station of El-Bramoon, Dakahlia Governorate, to investigate the response of applied different sources from potassium fertilizers (potassium sulphate (PS) as conventional fertilizer and feldspar (FL) as natural potassium) at the recommended rate (96kg K_2O/fed.) either single or in combination with others and/or the biofertilizer silicate dissolving bacteria (SDB); i.e. *Bacillus circulans* as well as banana compost on productivity and quality of sweet potato (*Ipomoea batatas* L.) cv. Beauregard. The obtained results indicate that the combined application of this treatment 25% kg K_2O fed as + 25 %feldspar+25%banana compost+ SDB induced vegetative growth characters (vine Length, canopy dry weight and number of branches). Also, application of 25% kg K_2O fed as + 25 %feldspar+25% banana compost+ SDB had the highest significant value among treatments in total yield,2marketable yield, tuber root characteristics (weight, length, diameter and dry matter %), chemical and organic composition (N, P, K, cured protein, total carbohydrates, total sugars and total carotenoids) of sweet potato plants. Therefore, it could be concluded that combined application of 25% kg K_2O fed as + 25 %feldspar+25%banana compost+ SDB in sweet potato fields could be recommended to improve productivity and quality as well as utilization of the natural resources available in the Egyptian environment and minimizing the environmental impact of conventional potassium chemical fertilizers.
Keywords: *Ipomoea batatas; L*, *Bacillus. circulans*,2 potassium nutrition

INTRODUTION

Sweet potato (ipomoea batatas) which belongs to the family convolvulaceae is becoming the most broadly disbursed root crop in maximum growing nations. in Egypt, it's far taken into consideration a completely crucial famous vegetable crop, it has been normally cultivated for both meals and starch manufactures, even as the foliage parts and different refuse roots are utilized in feeding animals (El-Seifi *et al*., 2014). sweet potato is a good source of carbohydrates, antioxidants, vitamins (a and c), minerals, fiber and protein (woolfe, 1992).

one critical aspect throughout cultivation influencing tuber yield and pleasant of sweet potato is ok and balanced vitamins deliver. most of the foremost nutrients, potassium (k) is required in high quantities due to its essential function in plant physiology. k contributes many aspects, as an instance it improves photosynthesis, stimulates enzyme sports, promotes protein synthesis, beginning and closure of stomata,2 helps on osmoregulation, regulates participates on nutrients translocation and garage of carbohydrates, tuber excellent and processing characteristics as well as plant resistance to pressure and illnesses (Ebert, 2009 and Christian *et al*., 2014).

In Egypt, the crop production is based absolutely on imports to meet its annual requirement of k fertilizers; the high cost of cnventional, water soluble of k fertilizers constrains their use with the aid of most of the farmer. as a way to reduce the dependence on imported potash, feldspar natural potash mineral, includes from 10.50 to 11.25 % k2o and therefore it may be a capacity of k-source for crop production. new techniques are had to unlock k from the silicate structure of this mineral with a purpose to render k extra available for plant vitamins. (Abo El-Khair *et al*., 2009 and seddik et al., 2015).

The pass over recycling of banana compost farm wastes, which can be usually disposed with the aid of burning or discarding on the roads facets or canals have caused extreme environmental troubles in Egypt. regardless of its precious as compost and as an organic k-supply, it preserves a considerable complement of n, p and micronutrients in the soil and minimizing the lack of vitamins introduced via fertilization from leaching by using irrigation (Smith *et al*., 2001). amending soils with composted substances has been pronounced to boom pepper yields (Liaven *et al*., 2008). however, combining compost and inorganic fertilizer is greater powerful in generating a positive plant reaction than single application of both fabric on my own (Abu-Zahra, 2012).

The simplest combination of sulphate-k and feldspar-k as a k supply proven undoubtedly increases on yield, macro nutrient uptake (n, p and k) in tubers and shoots in addition to leaf location, starch content material,2 total chlorophyll and discount in weight reduction of potato tubers for the duration of bloodless garage. (Abd-El-Hakeem and fekry, 2014) on sweet potato, (Sayed *et al*., 2014 & 2015) on potato plant.

In many sweet potato producing areas, nitrogen and phosphorus fertilizers are getting used whilst potassium application is left out which reasons severe lower in the status of potassium in the soils of candy potato growing areas (Pervez *et al*., 2013)

many researchers confirmed that microorganisms which are typically known as potassium solubilizing microorganism (ksb) or sdb or potassium dissolving microorganism (kdb) play essential roles in boost up weathering of minerals and rocks by generating organic acids, phenolic compounds, siderophores and likely different metabolites, which have an impact on ph and redox situations. similarly, direct contact among microorganism and minerals can be essential in mineral alteration response, as microbial surfaces may be complicated with steel ions. a few recent reports showed that silicate dissolving bacteria performed a promotion function in the release of Si, Fe and K from feldspar (Labib *et al*., 2012 and Shehata *et al*., 2014).

vegetative growth, yield, average tuber root weight and tuber root quality of sweet potato; i.e, carotenoids, general sugars, total carbohydrates, tss and starch content accelerated with soil utility with k2o (Abou El-Khair *et al*., 2011 and El-Seifi et al.,2014).

consequently, the object of this work became to assess the possibility of partial substitution of the expensive-priced conventional potassium chemical fertilizers (potassium sulphate) by natural alternative fertilizers feldspar combined with bacterial inoculation (bacillus circulans) or banana compost on productiveness and quality of sweet-potato.

MATERIALS AND METHODS

Two field experiments were conducted at EL-Baramoon Res. Station, Mansoura, Dakahlia Governorate, Egypt (+ 7m altitude, 30^o 11- latitude and 28^o 26- longitude), during seasons of 2013 and 2014, to study different sources from of potassium fertilizers (potassium sulphte as conventional fertilizer,2feldspar and banana compost as natural potassium) to evaluate the possibility of partial substitution of the expensive conventional potassium chemical fertilizers (potassium sulphate) by natural alternative fertilizers feldspar combined with bacterial inoculation (*Bacillus circulans*) or Banana compost on productivity and storability of sweet potato (*Ipomoea batatas*).

The soil of the Experimental farm is a clayey - loam texture. Soil analyses were done the method described according to Black (1982).

K-feldspar as a natural local potassium rock powder was produced by Al-Ahram for mining Co., Ltd., Egypt. The chemical properties of the used K-feldspar during 2014 and 2015 seasons according to Soltanpour *et al*. (1996) are presented in Table 2.

Table (1): Some chemical properties of the experimental soil (0 – 30 cm depth)

Season	Mechanical analysis%			pH 1:2-5 soil water suspension	Organic matter %	EC dSm^{-1} 1:5extract	$CaCO_3$ %	Available N, P, and K (mg/kg^{-1})		
	Sand	Silt	Clay					N	P	K
2014	17.6	42.5	39.9	8.0	1.5	1.1	3.2	35.6	5.76	88.9
2015	17.7	43.7	38.6	7.8	1.8	1.3	3.0	48.3	6.03	93.4

Table (2): Some chemical constitution of feldspar used in the experiment during 2014 and 2015 seasons.

Components		Components	(%)
SiO_2	64.37(%)	Fe_2O_2	0.08
Al_2O_2	15.12(%)	P_2O_5	0.05
K_2O	10.6 (%)	CaO	0.36
MgO	7.03 (%)	Cl	0.03
Na_2O	1.91 (%)	TiO_2	0.01
pH	8.21	MnO_2	0.02
EC (dS m-1)	0.55	$CaCO_3$	0.42

Banana compost was prepared according to the method described by Hatem *et al*., (2008) by chopping local banana compost farm residues (leaves) into 1 to 2 inch portions and mixed with fresh nearby farmyard manure at ratio of 4 residues of banana compost: 1 farmyard manure by way of quantity. the pile become lined with polyethylene sheet and protected with banana compost leaves. the moisture was adjusted to 50 % and the pile was flipped every 10 days to enhance aeration, it allowed to decompose for approximately 12 weeks to be fully finished. the very last compost became left extra 4 weeks for curing. Chemical properties of the used banana compost residues compost during 2014 and 2015 seasons are listed in Table 3.

Table 3: Chemical properties of banana compost residue compost used in the experiment during 2014 and 2015 seasons

Character	1st Season	2st Season
N (%)	1.71	1.53
P (%)	0.53	0.48
K(%)	2.98	2.87
pH	7.82	8.06
EC (dS m^{-1})	2.39	2.03
O.M.(%)	47.10	52.19

Sweet potato plants was treated after 45 days of the transplantation with Biofertilizer contains *Bacillus circulans* bacteria (SDB) in a liquid form at a concentration of (10^8 cell/m.g) by injecting it in the root absorption zone with a rate of 10 cm/ plant after two days of irrigating the plants, where the soil was still not dried.

The experimental design was randomized complete block with three replicates. The experiment included 18 treatments as follows:

1- Control (100% K_2O, 100 kg/fed.)
2- 100% feldspar (906 kg/fed.)
3- 100% Banana compost (3.200 ton/fed).
4- *Bacillus circulans* bacteria (SDB, 160 /L/fed.)
5- 50% kgK_2O fed. +50% feldspar +SDB
6- 50% kgK_2O fed. +50% feldspar
7- 50% kgK_2O fed. +25% feldspar +SDB
8- 50% kgK_2O fed. +50% Banana compost
9- 50% kgK_2O fed. +50% Banana compost +SDB
10- 50% kgK_2O fed. +25 Banana compost +SDB
11- 50% kgK_2O fed. +25% feldspar+25% Banana compost
12- 25% kgK_2O fed. +50% feldspar + SDB
13- 25% kgK_2O fed. +50% feldspar +25% Banana compost
14- 25% kgK_2O fed. +25% feldspar +50% Banana compost
15- 25% kgK_2O fed. +25% feldspar /fed. +25% Banana compost / fed + SDB
16- 25% kgK_2O fed. +50% Banana compost / fed +SDB
17- 50% feldspar+50% Banana compost +SDB
18- 50% feldspar+50% Banana compost

Each plot area was 17.5 m^2 and contained 5 rows, with 5 m in length and 0.7 m in width for each row.

The recommended rate of K_2O was 96 kg/fed., the source of K_2O was potassium sulphate (48 % K_2O) and feldspar (10.6 % K_2O).

Potassium sulphate (K_2SO_4) were applied after 30 days of the transplanting. While, feldspar was added during soil preparation.

Banana compost with potassium sulphate fertilizer was used at 100%, 50%, 25% K_2O concentration and respectively applied before transplanting during the preparation of the farm for agriculture.

Biofertilizer contains *Bacillus circulans* bacteria (SDB) at a concentration of (5×10^{-1}cfu), supplied with the unit of biofertilizer, Fac. Agric., Ain Shams University. It was applied to the root absorption zone of plants, 30 days after transplanting.

Cultural practices:

Sweet potato stem cuttings, about 20 cm length, were planted on the third top of slope ridges, at 25 cm apart, on 28 and 30 of April of both growing seasons of the study. Growing plants were fertilized with nitrogen as ammonium sulphate fertilizer (21% N) at rate of 40 Kg N/fed. phosphorus fertilizer (as calcium superphosphate, 15.5% P_2O_5) at rate of 45kg P_2O_5/fed. Other inter-cultural practices including weed and pest control were followed as instructed by the Ministry of Agriculture. Harvesting of tuber roots was done on10 of September and 12 of September (135 days after planting) in both seasons.

Recorded data:

1- Vegetative growth parameters:

Five plants were randomly picked up from each plot, 100 days after planting to measure, plant length, number of branches/plant, leaf area/plant, dry weight per plant according to the method of Koller, (1972).

2- Yield and its components:

After curing for 7 days from planting, all tuber roots plants of each plot were digged up, classified into two categories; i.e., marketable and non- marketable roots then weighted to determine the total yield per feddan (tons). Marketable roots have a diameter of 3.5 to 6.5 cm, while non-marketable roots have a diameter of less than 3.5 cm or more than 6.5 cm according to the method described by Grang, (1963).

3- Tuber root characters:

Tuber root samples (each of 10 storage roots) were randomly chosen at harvesting time from each treatment, to determine average tuber root weight (g), length (cm), diameter (cm) and Dry matter percentage.

4- Chemical constituents:

Samples of cured sweet potato tuber roots were taken to determine total nitrogen (%), phosphorus (%) and potassium (%) following methods described by A.O.A.C. (1995), John (1970) and Brown and Lilleland (1946), respectively.

5-Organic composition

Total carbohydrate contents were determine according to the method of Michel *et al*., (1956), total sugars (%) according to the method of Dubois *et al*., (1956) and total carotene content, following the method described by Booth, (1958).

Statistical analysis:

All recorded data were subjected to statistical Analysis of Variance and least significance differences (Duncan 1955) at 0.05 level of probability to separate means, as mentioned by Snedecor and Cochran (1980)

RESULTS AND DISCUSSION

1-Vegetative growth characteristics:

Potassium fertilizer had positive effect on sweet potato plants as shown in (Table 4). The highest values of vegetative growth characters (vine length, number of leaves and branches, total fresh and dry weight and leaves area) were recorded by the treatment (T15) that received by 25% kgK_2O fed. +25% feldspar /fed. +25%Banana compost / fed + SDB while on the other hand the least values were observed by (T4) (SDB) on all characters of vegetative growth.

Table (4): Vegetative growth parameter of sweet potato plants as influenced by natural, conventional potassium fertilizer sources and silicate dissolving bacteria during 2014 and 2015 growing seasons

Char. / Treat.	Plant length (cm)		Plant Fresh weight (g)		No. of branches/plant		Leaf area/plant (cm2)		Plant Dry weight (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1-100% K_2O fed. (100 kg/fed.)	142.67	145.67	1004	1122	13.7	15.3	742.1	769.5	139.4	145.59
2-100% feldspar (906 kg/fed.)	92.67	92.67	983	1017	16.0	12.7	495.0	507.5	137.6	134.22
3-100% Banana compost (3.2 Ton /fed.)	136.00	137.67	927	1033	13.7	14.7	736.3	720.9	158.6	162.28
4- *Bacillus circulans* bacteria (SDB) (160 L/fed.)	85.67	88.67	895	707	15.3	10.7	732.2	685.0	105.4	106.97
5-50% kgK_2O fed. + 50% feldspar +SDB	131.67	134.00	1034	1146	15.3	16.7	658.0	647.8	154.3	158.50
6-50% kgK_2O fed. + 50% feldspar	103.70	94.00	935	1039	9.3	11.0	588.2	601.2	130.4	133.86
7-50% kgK_2O fed. + 25% feldspar +SDB	92.33	95.00	1012	1082	14.3	15.0	528.3	548.1	153.5	138.91
8-50% kgK_2O fed. + 50% Banana compost	105.67	105.37	947	1118	12.7	14.0	726.3	737.7	129.3	133.33
9-50% kgK_2O fed. + 50% banana compost+ SDB	118.33	119.67	1050	1160	11.7	13.3	1169.3	138.1	164.6	161.71
10-50% kgK_2O fed. + 25 Banana compost +SDB	110.67	113.00	1069	1175	15.3	16.0	839.3	907.4	113.9	117.91
11-50% kgK_2O fed. + 25% feldspar+25%Banana compost	118.00	119.67	1020	1158	11.3	16.0	745.3	746.4	137.1	140.81
12-25% kgK_2O fed. + 50% feldspar + SDB	165.00	167.30	1150	1190	21.0	22.7	975.9	989.6	189.4	195.73
13-25% kgK_2O fed. + 25%Banana compost+50% feldspar	154.33	157.00	1134	1237	16.0	17.0	678.4	664.8	160.3	163.70
14-25 % kgK_2O fed. + 50% Banana compost + 25 feldspar	98.33	100.00	1011	1114	15.0	15.0	594.3	613.2	133.6	138.02
15-25% kgK_2O fed. + 25% feldspar/fed. +25%Banana compost / fed + SDB	191.00	194.00	1360	1465	28.0	29.0	1019.0	1079.6	228.0	233.98
16-25% kgK_2O fed. + 50%Banana compost/fed +SDB	103.00	105.33	924	1028	11.7	16.7	620.4	635.5	137.5	141.97
17-50% feldspar + 50 Banana compost + SDB	104.67	108.67	916	1023	9.3	12.0	577.4	579.3	142.2	146.75
18- 50% feldspar+ 50 Banana compost	91.00	88.67	908	996	13.0	14.0	548.2	576.7	117.0	121.02
L.S.D at 5%	6.86	5.65	130.9	99.27	4.10	3.54	143.13	99.15	13.04	8.158

These results may be due to the role of potassium in stimulate cell division and CO_2 assimilation by photosynthesis and hence increased plant dry matter (Marschner, 2008). Also, K-feldspar is considered as low release K fertilizer sources (Harley and Gilkes (2000) particularly with the combined application of K-feldspar and SDB (Labib *et al*., 2012), they amend plants with a continuance available K element during the successive growth stages (Kamal *et al*., 2013).

The obtained results were in accordance with those obtained by Abou El-Khair, *et al*. (2011) and Abd-El-Hakeem and Fekry (2014) on sweet potato, they indicated that, using 50% potassium sulphate + 50% K-feldspare + SDB recorded maximum values of plant fresh and dry weight, chlorophyll a and total chlorophyll.

2- Yield and its components:

Data presented in Table (4) in both seasons, showed that application of the moderate rate of conventional potassium fertilizer combined with k-feldspar at the moderate rate in the presence of bacterial inoculation mixture of -25% kgK_2O fed. +25% feldspar /fed. +25%Banana compost / fed + SDB, had the highest significant value among treatments in total and marketable yield (ton/fed.) In addition, the same data clearly showed that the lowest value with significant in both seasons compared with control treatment (T_1). On the other hand treating by T4 SDB and T 2: 100% feldspar (906 kg/fed.) Observed the lowest value in all characters.

the positive reaction shown by yield characters to k could be immediately related to the nicely-evolved photosynthetic surfaces (vine period, canopy dry weight, leaf area ,and number of branches,) and increased physiological activity leading to extra assimilates being produced and subsequently trans located and utilized in fast tuber improvement and manufacturing.

additionally, potassium is known to prompt a number of enzymes worried in photosynthesis, carbohydrates and protein metabolism and assists within the translocation of carbohydrates from leaves to tubers and tuberous roots of crops in which carbohydrates are the principle garage fabric (Mengel, 2007). as a result, the positive response of tuber yield and yield components to multiplied rate of K could be attributed to high starch synthesis and translocation activities stimulated with the by k application (Trehan *et al*., 2009). those effects are in agreement with this obtained through el-sawy, 2011 and uwah et al., 2013)on sweet potato and (Salim et al.,2014 and sayed et al.,2014) on potato and abou el-khair and mohsen(2016) on jerusalem artichoke.

Kamal *et al*. (2013) shows that application of 494.6 kg of ok-feldspar (50 kg k2o fed-1) + 1845 kg of banana compost residue compost (50 kg k2o fed-1) with the inoculation of silicate dissolving microorganism in sweet pepper fields may be encouraged to enhance the vegetative growth characters, chemical composition, yield, quality and storability of sweet pepper, giving the very best remarkable net go back and benefit-fee ratio to the farmers than the commercial potassium fertilizer (208.three kg fed-1 of potassium sulphate) as well as maximizing the usage of the natural assets available in the Egyptian surroundings and minimizing the environmental effect of chemical fertilizers.

3-Tuber root characters:

Data in Table (6) show the integrated effect of conventional and natural potassium fertilization either single or in combination and/or SDB and banana compost on tuber root characters of sweet potato plants. Potassium played an important role in yield and quality of sweet potato .It is obvious that the highest value among treatments on average tuber root weight, length, and dry matter percentage of plant were observed by (T12 and T15) with significant increase in average tuber root weight and dry matter percentage in both seasons compared with control treatment. Meanwhile, no significant differences between treatments from (T2 to T4) in root weight of sweet potato tubers in both seasons were found compared with control treatment (T1). Also, no significant differences between treatments from (T5, T6, T8, T9, T10, T11, T13, T14 and T18) in tuber root weight compared with control in the first season and between treatments (T12, and T15) in the second season compared with control treatment .treatment (T5, T9, T2 and T18) had no significant differences on root length fromT15 to T 18), (T10 to T12) and T1. had no significant differences on diameter root) observed the low treatment T8 recorded the high rat on shape root by T4 .These results are confirmed by those obtained by (Abo El-Khair *et al*., 2009 and *Seddik et al*., 2015).

4-Chemical constituents:

As shown in Table (7), the highest significant values in nitrogen, and protein concentrations in tuber roots at harvest were obtained from the application of the moderate rate of conventional potassium fertilizer combined with k-feldspar at the moderate rate in the presence of bacterial inoculation mixture and banana compost (T3to T1 and T15)in both seasons, for nitrogen and cured protein percentage in tubers, no significant differences between this treatments from in the first season and in the second season and k contents in sweet potato tubers the best treatment is T1 and had no significant differences between (T3, T5, T9,T12,T13,T14,T15 and T16). The highest significant values in phosphorus observed by (T7,T8,T12, T14 and T15) on the other hand (T2, T4 and T13) observed the lower values on P.

These results may be described as a result of the promotive role of K in the translocation of assimilates being produced to tuber roots.

Similar results were reported by Kamal *et al*. (2013). on sweet pepper and Abd-El-Hakeem and Fekry (2014) on sweet potato, they showed that the addition of K at 50 % potassium sulphate + 50% feldspar in combination with silicate dissolving bacteria gave the highest N,P and K content. Also, some recent reports showed that silicate dissolving bacteria played a promotion role in the release of Si, Fe and K from feldspar (Shehata *et al*., 2014;Abou El-Khair and Mohsen, 2016).

Table (5): Yield and its components of sweet potato plants as influenced by natural, conventional potassium fertilizer sources and silicate dissolving bacteria and banana compost during 2014and 2015 growing seasons.

Treat. / Char.	Yield / plant: Weight (Kg)		Yield / plant: Number of tubers/plant		Yield / fed: Marketable yield (ton/fed)		Yield / fed: Total yield (ton/fed)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1-100% K_2O fed. (100 kg/fed.)	0.751	0.772	4.03	3.67	6.970	7.01	8.173	8.880
2-100% feldspar (906 kg/fed.)	0.575	0.598	3.3	3.57	5.220	6.050	6.320	6.930
3-100% Banana compost (3.2 Ton /fed.)	0.612	0.657	3.11	3.83	5.040	5.820	6.140	6.680
4- *Bacillus circulans* bacteria (SDB) (160 L/fed.)	0.528	0.614	3.33	4.03	4.370	4.860	5.580	5.980
5-50% kgK_2O fed. + 50% feldspar +SDB	0.822	0.852	5.33	5.34	14.330	15.760	14.503	15.760
6-50% kgK_2O fed. + 50% feldspar	0.683	0.678	3.67	4.00	7.430	7.730	8.230	8.770
7-50% kgK_2O fed. + 25% feldspar +SDB	0.816	0.848	4.33	4.67	11.320	11.580	12.120	12.62
8-50% kgK_2O fed. + 50% Banana compost	0.618	0.638	4.67	4.36	5.440	5.850	6.350	6.880
9-50% kgK_2O fed. + 50% banana compost+SDB	0.623	0.651	4.33	4.15	7.670	7.880	8.970	9.880
10-50% kgK_2O fed. + 25 Banana compost +SDB	0.728	0.753	4.32	4.30	9.280	9.680	10.380	10.720
11-50% kgK_2O fed. + 25% feldspar+25%Banana compost	0.678	0.688	4.67	4.08	8.420	8.670	9.220	9.780
12-25% kgK_2O fed. + 50% feldspar + SDB	0.893	0.988	6.10	4.68	15.430	15.920	16.140	16.610
13-25% kgK_2O fed. + 25%Banana compost+50% feldspar	0.605	0.527	3.67	4.31	8.540	8.620	9.150	9.870
14-25 % kgK_2O fed. + 50% Banana compost + 25 feldspar	0.664	0.685	4.03	3.67	7.460	7.730	8.073	9.670
15-25% kgK_2O fed. + 25% feldspar/fed. +25%Banana compost / fed + SDB	0.972	0.996	6.33	6.03	16.480	16.760	17.663	17.980
16-25% kgK_2O fed. + 50%Banana compost/fed +SDB	0.772	0.788	3.33	3.76	11.720	11.870	12.780	13.950
17-50% feldspar + 50 Banana compost + SDB	0.733	0.752	4.43	4.63	5.980	6.380	6.057	7.840
18- 50% feldspar+ 50 Banana compost	0.732	0.666	4.03	4.03	5.120	5.380	6.460	6.933
L.S.D at 5%	0.0017	0.0016	0.059	0.103	1.0155	1.0224	1.227	1.017

Table (6): Tuber root characteristics of sweet potato plants as influenced by natural, conventional potassium fertilizer sources and silicate dissolving bacteria and banana compost during 2014and 2015 growing seasons.

Treat. / Char.	Average root Weight (gm)		Average root Length (cm)		Average root Diameter (cm)		Root shape (Length/ diameter)		Dry mater %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1-100% K_2O fed. (100 kg/fed.)	135.6	180.3	21.83	21.33	6.333	6.433	3.450	3.317	24.14	24.41
2-100% feldspar (906 kg/fed.)	116.8	108.7	17.97	18.53	4.200	4.200	4.213	4.440	23.19	23.40
3-100% Banana compost (3.2 Ton /fed.)	106.7	110.6	18.67	19.67	4.067	4.533	4.420	4.433	23.33	23.71
4- *Bacillus circulans* bacteria (SDB) (160 L/fed.)	106	138.5	17.20	19.77	3.033	3.233	5.830	6.133	20.68	21.29
5-50% kgK_2O fed. + 50% feldspar +SDB	131.6	127.6	21.30	21.20	4.300	4.400	4.973	4.830	22.22	22.82
6-50% kgK_2O fed. + 50% feldspar	126	140.8	18.67	19.37	5.567	5.733	3.383	3.397	26.37	26.65
7-50% kgK_2O fed. + 25% feldspar +SDB	163.6	180.9	20.67	21.40	5.100	5.167	4.087	4.193	28.17	28.43
8-50% kgK_2O fed. + 50% Banana compost	124.6	125.3	11.33	12.73	4.767	5.033	2.377	2.540	19.61	19.71
9-50% kgK_2O fed. + 50% banana compost+SDB	129.7	135.5	17.03	17.37	4.233	4.533	4.087	3.897	22.37	22.98
10-50% kgK_2O fed. + 25 Banana compost +SDB	182.2	187.6	21.17	20.77	5.600	5.667	3.800	3.887	26.40	26.66
11-50% kgK_2O fed. + 25% feldspar+25%Banana compost	132.5	117.6	22.37	21.60	3.933	4.033	5.680	5.393	24.66	25.30
12-25% kgK_2O fed. + 50% feldspar + SDB	218.9	220.2	22.40	21.43	6.500	6.567	3.450	3.263	28.23	28.46
13-25% kgK_2O fed. + 25%Banana compost+50% feldspar	134.5	134.8	16.03	17.30	4.100	4.467	3.913	3.877	21.36	21.89
14-25 % kgK_2O fed. + 50% Banana compost + 25 feldspar	118.2	123.2	15.20	16.10	4.067	4.367	3.743	3.720	18.43	15.43
15-25% kgK_2O fed. + 25% feldspar/fed. +25%Banana compost / fed + SDB	223.6	222.6	22.30	21.93	6.533	6.567	3.413	3.340	29.59	30.32
16-25% kgK_2O fed. + 50%Banana compost/fed +SDB	198.5	193.6	22.27	22.30	6.133	6.133	3.630	3.657	27.43	27.64
17-50% feldspar + 50 Banana compost + SDB	147.8	157.9	21.03	21.13	5.600	5.700	3.753	3.710	25.29	25.60
18- 50% feldspar+ 50 Banana compost	128.8	156.6	22.47	21.67	5.333	5.300	4.410	4.180	26.69	27.02
L.S.D at 5%	17.68	25.06	2.141	2.009	0.6127	0.7267	0.7542	0.7890	0.26	.023

Table (7): Chemical constituents of sweet potato tubers as influenced by natural, conventional potassium fertilizer sources and silicate dissolving bacteria and banana compost during 2014 and 2015 growing seasons

Treat. / Char.	N%		P%		K%		% Protein	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1-100% K_2O fed. (100 kg/fed.)	1.63	1.69	0.2467	0.2633	2.72	2.58	10.19	10.56
2-100% feldspar (906 kg/fed.)	1.16	1.33	0.1767	0.1533	2.18	2.35	7.25	8.31
3-100% Banana compost (3.2 Ton /fed.)	1.87	1.91	0.2600	0.2867	2.44	2.48	11.69	11.94
4- *Bacillus circulans* bacteria (SDB) (160 L/fed.)	1.12	1.44	0.1533	0.1767	2.17	1.85	7.00	9.00
5-50% kgK_2O fed. + 50% feldspar +SDB	1.54	1.56	0.2467	0.2600	2.69	2.58	9.63	9.75
6-50% kgK_2O fed. + 50% feldspar	1.51	1.52	0.2633	0.2867	2.36	2.43	9.44	9.50
7-50% kgK_2O fed. + 25% feldspar +SDB	1.63	1.70	0.3000	0.3300	2.15	2.23	10.19	10.63
8-50% kgK_2O fed. + 50% Banana compost	1.64	1.68	0.3167	0.3267	2.36	2.29	10.25	10.50
9-50% kgK_2O fed. + 50% banana compost+SDB	1.50	1.59	0.2933	0.3000	2.58	2.60	9.38	9.94
10-50% kgK_2O fed. + 25 Banana compost +SDB	1.36	1.41	0.2333	0.2500	2.26	2.60	8.50	8.81
11-50% kgK_2O fed. + 25% feldspar+25%Banana compost	1.28	1.25	0.2833	0.2867	2.73	2.80	8.00	7.81
12-25% kgK_2O fed. + 50% feldspar + SDB	1.33	1.49	0.3400	0.3567	2.49	2.32	8.30	9.31
13-25% kgK_2O fed. + 25%Banana compost+50% feldspar	1.39	1.47	0.1833	0.2100	2.46	2.30	8.69	9.19
14-25 % kgK_2O fed. + 50%Banana compost + 25 feldspar	1.51	1.55	0.3567	0.3700	2.51	2.90	9.44	9.69
15-25% kgK_2O fed. + 25% feldspar/fed. +25%Banana compost / fed + SDB	1.84	1.88	0.3033	0.1767	2.46	2.62	11.50	11.75
16-25% kgK_2O fed. + 50%Banana compost/fed +SDB	1.48	1.58	0.2600	0.2767	2.45	2.54	9.25	9.88
17-50% feldspar + 50 Banana compost + SDB	1.56	1.62	0.2633	0.2867	2.36	2.43	9.75	10.30
18- 50% feldspar+ 50 Banana compost	1.55	1.63	0.2800	0.2933	2.30	2.22	9.69	10.19
L.S.D at 5%	0.322	0.247	0.04225	0.03732	0.4010	0.4109	1.02	1.84

5-Organic composition

Data in Table (8) clared that total carbohydrates, total sugar and total carotenoids of sweet potato plants were positively responded to the studied treatments. However, the highest values were recorded by (T12) in the both seasons. With no significant differences between treatments from (T_{12},2 T_{15} and T8) on total carbohydrates in the both seasons in the first season and in the second season on total carotenoids of sweet potato tubers compared with control treatment (T_1).

These results go in parallel with those of Abd-El-Hakeem and Fekry (2014) on sweet potato, Abd El-Salam and Shams (2012), on potato and Abou El-Khair and Mohsen (2016) on Jerusalem Artichoke, they showed that carbohydrate and soluble sugar contents had increased due to the inoculation with both *B. circulans* in combination with both potassium sources.

Table (8): Organic composition of sweet potato tubers as influenced by natural, conventional potassium fertilizer sources and silicate dissolving bacteria and banana compost during 2014 and 2015 growing seasons.

Treat.	Total Char.Carbohydrates %		R-sugars %		N.R-sugars %		Total sugars %		Vitamin A (mg)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1-100% K_2O fed. (100 kg/fed.)	60.61	60.86	6.99	7.04	2.987	2.730	9.98	9.77	12.660	12.630
2-100% feldspar (906 kg/fed.)	56.84	58.86	5.72	5.93	2.450	2.397	8.17	8.32	12.040	11.860
3-100% Banana compost (3.2 Ton /fed.)	54.47	55.56	6.53	7.29	2.800	2.703	9.33	10.00	12.263	12.353
4- *Bacillus circulans* bacteria (SDB) (160 L/fed.)	51.59	52.37	7.16	7.85	3.067	3.060	10.23	10.91	12.537	12.330
5-50% kgK_2O fed. + 50% feldspar +SDB	55.72	56.93	6.61	7.15	2.830	2.633	9.44	9.78	12.737	12.533
6-50% kgK_2O fed. + 50% feldspar	62.56	62.83	7.11	7.88	2.927	2.863	10.15	10.75	12.600	12.497
7-50% kgK_2O fed. + 25% feldspar +SDB	53.83	55.00	6.80	7.16	2.913	2.743	9.72	9.90	12.693	12.540
8-50% kgK_2O fed. + 50% Banana compost	65.02	62.57	6.70	7.44	2.870	2.793	9.57	10.23	12.180	12.180
9-50% kgK_2O fed. + 50% banana compost+SDB	53.92	55.40	7.53	7.67	2.890	3.117	10.75	10.58	12.197	12.147
10-50% kgK_2O fed. + 25 Banana compost +SDB	54.10	54.94	7.60	8.64	3.243	3.093	10.85	11.74	12.747	12.763
11-50% kgK_2O fed. + 25% feldspar+25%Banana compost	68.51	70.52	6.54	6.83	2.800	2.563	9.34	9.40	13.110	13.063
12-25% kgK_2O fed. + 50% feldspar + SDB	62.11	63.33	7.01	8.15	3.003	2.940	1.01	11.09	12.663	12.700
13-25% kgK_2O fed. + 25%Banana compost+50% feldspar	56.71	57.08	6.56	7.56	2.87	2.733	9.307	10.29	12.507	12.557
14-25 % kgK_2O fed. + 50% Banana compost + 25 feldspar	53.38	54.97	7.00	7.37	2.997	2.797	10.00	10.17	12.507	12.557
15-25% kgK_2O fed. + 25% feldspar/fed. +25%Banana compost / fed + SDB	69.94	71.69	8.81	7.37	3.563	3.307	11.88	10.68	13.16.3	12.683
16-25% kgK_2O fed. + 50%Banana compost/fed +SDB	55.96	57.04	7.13	7.87	3.200	2.937	10.49	10.81	12.953	12.967
17-50% feldspar + 50 Banana compost + SDB	56.54	57.94	7.31	7.67	3.373	3.200	10.44	10.87	12.687	12.680
18- 50% feldspar+ 50 Banana compost	59.21	59.83	6.65	7.23	2.853	2.703	9.51	9.94	12.473	12.517
L.S.D at 5%	4.044	4.844	1.576	1.524	0.7281	0.5901	2.289	1.879	0.4768	0.5852

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تأثير بعض مصادر التسميد البوتاسى على النمو والإنتاجية و الجودة الإنتاجية ف البطاطا

سمير طه العفيفي*، محمود محمد زغلول*،اسامه محمد سيف الدينو فاطمه السيد مسعد****

*** قسم الخضر والزينة – كليه الزراعة جامعة المنصورة**

****قسم البطاطس والخضر خضريه التكاثر –معهد بحوث البساتين – مركز البحوث الزراعية**

أجريت هذه الدراسة لتقدير ما إذا كان التسميد بالفلسبار الطبيعي بمفرده أو مع بكتريا السيليكات وكذلك التسميد بكومبست أوراق الموز منفرده او مع البكتريا والفلسبارمقارنته بالبوتاسيوم التقليدي في إنتاج البطاطا الحلوة مع عدم وجود تأثيرات عكسية على الإنتاجية والجوده من ثم، تم إجراء تجربتين حقليتين خلال الموسمين الصيفيين المتتاليين من عام٢٠١٤ وعام ٢٠١٥ فى المزرعة البحثية بالبرامون التابعة لمعهد بحوث البساتين بمحافظة الدقهلية. وذلك لبحث استجابة أضافة مصادر مختلفة من الأسمدة البوتاسية (سلفات البوتاسيوم ،٢كمصدر تسميد بوتاسى تقليدى، والفلسبار،٢وكومبست أوراق الموز ،كمصدر تسميد بوتاسى الطبيعي،) وذلك بالمعدل الموصى به (٩٦ كجم بو٢أ / للفدان.) إما منفردين أو مشتركين معا أو مع التسميد الحيوى بالبكتريا المذيبة للسيليكات (باسيلس سيركيولانس) وتأثير ذلك على الإنتاجية والجودة للبطاطا صنف بيورجارد. وكانت النتائج كالأتى: -١-أعطت المعاملة بالتسميد بسلفات بوتاسيوم 25% كجم بو٢أ /للفدان + 25% كجم بو٢أ / للفدان من الفلسبار +السميد بأوراق الموز ٢٥%+ التلقيح بالبكتريا المذيبة للسليكات تحفيز لصفات النمو الخضرى مثل طول النبات والوزن الجاف للعرش وعدد أفرع النبات ، كما اعطت أعلى قيم معنوية بين المعاملات المدروسة فى كلا من المحصول الكلى والمحصول التسويقى وكذلك صفات الجذر الدرنى مثل (الوزن والطول والقطر و النسبه المئوية للمادة الجافة) وايضاً المحتويات الكيماوية والعضوية مثل (النتروجين والفوسفور والبوتاسيوم والبروتين الخام والكربوهيدرات والسكريات والكاروتيدينات الكلية) للنبات البطاطاولا يوجد اى فرق معنوى بينها وبين المعامله (التسميد بسلفات بوتاسيوم 25% بو٢أ / للفدان + 50% بو٢أ / للفدان من الفلسبار + التلقيح بالبكتريا المذيبة للسليكات.)٢- وبالتالي، فإنه يمكن أن نستخلص أن المعاملة بالتسميد بسلفات بوتاسيوم 25% كجم بو٢أ / للفدان + 25% كجم بو٢أ / للفدان من الفلسبار +السميد بأوراق الموز ٢٥%+ التلقيح بالبكتريا المذيبة للسليكات وكذلك المعامله بالتسميد بسلفات بوتاسيوم 25% بو٢أ / للفدان+ 50% كجم بو٢أ / للفدان من الفلسبار + التلقيح بالبكتريا المذيبة للسليكات.) في حقول البطاطا يمكن أن يوصى بها لتحسين الإنتاجية والجوده وكذلك الاستفادة من الموارد الطبيعية المتوفرة في البيئة المصرية وتقليل الأثر البيئي الضار من الأسمدة الكيماوية .