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Effect of potassium fertilizer, feldspar rock and potassium releasing bacterium (*Bacillus circulans*) on sweet potato plant under sandy soil conditions

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ABSTRACT

The current study was executed in a newly reclaimed sandy soil at Ali Moubark Farm, South Tahrir Research Station, Horticulture Research Institute, during the two successive growing seasons of 2018-2019, to rationalizing mineral potassium consumption using alternative natural sources like feldspar rock (soluble form) inoculation with potassium releasing bacteria and its impact on production, quality and storability of sweet potato cv. Abees. A randomized complete block design with four replications was used. Treatments (n=6) included four levels of potassium sulphate (KS) (48% K_2O) at 25, 50 and 75% of recommended dose (RD) plus feldspar rock (FR) (10.6% K_2O) with inoculation by potassium releasing bacteria (KRB), i.e. *Bacillus circulans* as well as RD of potassium fertilizer and feldspar rock (singly or combined with KRB).

Results concluded that adding 50% from the RD of KS plus 50% FR with inoculation with KRB had significant effects on vegetative growth, (plant length per plant, number of branches per plant, leaf area and chlorophyll content) total yield, yield properties (tuber root diameter, tuber root weight, tuber root length and tuber root dry matter) and chemical constituents (leaves potassium %, tuber roots total carbohydrate % and tuber roots potassium %). Moreovere, the same treatment had significant negative effects on available soil potassium content, tuber roots weight loss percentage at 30, 60, 90 days after storage and tuber roots decay percentage after storage under ambient temperature. Using 100% FR had reduction effects on all studied criteria except available soil potassium content, tuber roots weight loss percentage at 30, 60, 90 days after storage and tuber roots decay percentage after storage.

Conclusively, the combined application of KS (100 kg fed^{-1}), FR (453 kg fed^{-1}) and inoculation with KRB in sweet potato fields, can be recommended to improve the vegetative growth characters, yield, quality, chemical composition and storability of sweetpotato than the commercial potassium fertilizer (200 kg fed^{-1}) as well as maximizing the utilization of the natural resources available in the Egyptian environment and minimizing the environmental impact of chemical fertilizers.

KEYWORDS: Sweet potato, potassium sulphate, feldspar rock, potassium releasing bacteria and sandy soil

1. INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam.) is a member of *convolvulaceae* family. It considered as tuberous root vegetable crop which grown in the tropical, sub-tropical and frost–free temperate climatic zones of the world and consumed by humans and livestock. In Egypt, it is considered a very important popular vegetable crop, it has been generally cultivated for both food and starch manufactures, while the foliage parts and other waste parts are utilized in feeding. Great efforts have been directed to improve sweet potato production and quality for the purpose of increasing exported yield (El-Seifi, *et.al.*, 2014).

Potassium has a significant role in all processes needed to plant growth and reproduction such as translocation of photosynthesis, protein synthesis, control of ionic balance, stress tolerance and water use, activation of more than 60 enzymes and many other processes (Christian *et al*., 2014). Moreover, K-chemical fertilizers as potassium sulphate contributes in environmental pollution in addition its high price increase production cost.

Whereas, the use of natural potassium fertilizer as feldspar rock is low cost resources for providing plants with K which could alternates the expensive applied K-chemical fertilizers (Labib *et al*., 2012).

The use of potassium releasin bacteria as bio-fertilizer was suggested as a sustainable solution to improve plant growth, nutrition, root growth and responses to external stress factors (Priyanka and Sindhu, 2013). Moreover, bio-fertilizer play an important role in the formation of humus in soil and the cycling of other minerals tied up in organic matter (Zakaria, 2009). Also, it can able to solubilize rock – K powder, such as feldspar through plant production and excretion of soil organic acids or chelate silicon ions to bring K into solution (Bennett *et al*., 1998). On the other hand, soil inoculation with potassium releasing bacteria and the soil feldspar was applied solo or integrated might provide faster and continuous supply of K for improved plant growth, yield and its quality (Abou-el-Seoud, 2012). Finaly, biofertilization is alternative method for fertilization of most plants. Moreover, the biofertilization minimize the addition of inorganic chemical fertilizers and reduced the hazared effects of chemical fertilizers on human health and environment (Salah *et al*., 2020).

Therefore, the target of this research work was to rationalizing mineral potassium production consumption by using natural sources such as feldspar rock inoculated with potassium-release bacteria and its impact on production, quality and storability of sweet potato.

2. MATERIALS AND METHODS

The current experience was executed in a newly reclaimed sandy soil at Ali Moubark Farm, South Tahrir Research Station, Horticulture Research Institute, during the two successive growing seasons of 2018-2019.

Rationalizing mineral potassium consumption by using natural sources such as feldspar rock inoculated with potassium-release bacteria were applied on sweet potato (*Ipomoea batatas* L.) cv. Abees plants and its impact on production, quality and root storability were studied.

The main physical and chemical analysis of the tested soil (Table 1) was determined according to Jackson (1973).

Table 1. Physical and chemical analysis of the soil at experimental field (0-30 cm) depth in 2018 season.

Particle size distribution						
Sand %	**Silt %**	**Clay %**		**Soil texture**	**Organic matter %**	
90.5	5.4	4.1		Sandy	0.45	
Chemical of soil						
Ca^{+2} (meq/L)	**Mg^{+2} (meq/L)**	**Na^{+} (meq/L)**	**K^{+} (meq/L)**	**CO_3^{-} (meq/L)**	**HCO_3^{-} (meq/L)**	**SO_4^{-2} (meq/L)**
1.30	0.75	1.9	1.69	0.13	1.19	1.92
CL^{-}(meq/L)	**N (mg/kg)**	**P (mg/kg)**	**K (mg/kg)**	**EC dS/m**	**pH**	
2.40	10	13	65	0.43	7.2	

Stem cuttings, about 20 cm length, were planted on two lines (70 cm apart) on the ridges (25 cm apart between stem cuttings), in 10/5/2018 and 26/5/2019. The plot area was 10 m^2 (1 m width X 10 m length X 1 row). A randomized complete block design with four replications was used. Other agricultural practices were carried out as recommended for the conventional sweet potato planting.

The experiment included 6 treatments as follows

1. Recommended dose of potassium sulphate (KS) (100%) cosidered as control treatment.
2. Feldspar rock (FR) (100%).
3. FR (100%) + potassium releasing bacteria (KRB).
4. FR (75%) + KS (25%) + KRB.
5. FR (50%) + KS (50%) + KRB.
6. FR (25%) + KS (75%) + KRB.

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

Table 2. Some chemical constitution of feldspar used in the experiment during 2018-2019 seasons.

Components		Components		Components	
Al_2O_2	15.12%	**Fe_2O_2**	0.08%	**TiO_2**	0.01%
K_2O	10.6%	**P_2O_2**	0.05%	**MnO_2**	0.02%
MgO	7.03%	**CaO**	0.36%	**$CaCO_3$**	0.42%
Na_2O	1.91%	**Cl**	0.03%	**SiO_2**	64.37%
pH	8.21	**EC (dS m^{-1})**	0.55		

The source of K_2O was potassium sulphate (48% K_2O) and the recommend rate is 96 kg/ fed.

Potassium sulphate were equally divided two portions and applied before planting and 30 days later, while, feldspar rock (10.6 K_2O) was added during soil preparation. Bio-fertilizer contains *Bacillus circulans* bacteria at a concentration of ($5X10^{-1}$ cfu), provided by the unit of bio-fertilizer, Fac. Agric., Ain Shams University. It was applied three times during the cultivation season at the root absorption zone of plants, (adding soil). The first was after 21 days from germination and then two times 21 days interval.

2.1. Measurements

2.1.1. Vegetative growth

Five plants were taken randomly from each plot after 105 days from planting to record the average of following data:

1. Plant length (cm).
2. Number of branches/ plant.
3. Leaf chlorophyll content was measured in the fresh fifth top fully leaf. (A digital Chlorophyll meter, model Minolta Chlorophyll meter SPAD-502, manufactured by Minolta Company was used). SPAD unit = 10 mg/100g fresh weight of leaves (Netto *et al.*, 2005).
4. Leaf area/ plant of the 5^{th} top fully leaf (determined using the LI-3100 area meter (LI-COR. Inc. Lincoln, Nebraska, USA)).

2.1.2. Yield and its components

At harvesting time (135 days from planting) all plants tuber root of each plot were measured

1. Total yield ton /fed.
2. Tuber root diameter (cm).
3. Tuber root weight (g).
4. Dry matter percentage.
5. Tuber root length (cm).

2.1.3. Chemical

1. Soil sample was taken after harvesting for each treatment then was determined available potassium mg/ kg described by Jackson (1973).
2. Potassium (%) was determined in leaves described by Brown and Lilliland (1946).
3. Samples of tuber root were dried at 70 º C till constant weight then were used for the chemical determinations and were calculated according dry weight basis.
   a. Potassium (%) described by Brown and Lilliland (1946).
   b. Total carbohydrate percentage described by Dubois *et al.* (1956).

2.1.4. Tuber root of storage period

Random samples of cured roots (each 10 kg of tuber roots) were collected from each plot, cleaned, packed in plastic boxes and stored for 90 days at normal room conditions. The average of normal room temperature and relative humidity during storage months are shown in Table (3).

Table 3. The average of normal room temperature and relative humidity during storage months.

Months	Temperature (ºC)		Relative humidity (%)	
	2018	2019	2018	2019
Octobar	25	25.8	55.4	58.6
November	23	22	64.1	57.8
December	17	16.8	64.4	64.7
January	13.6	13.5	50.9	62.5

- Samples were chosen after 30, 60 and 90 days of storage to determine weight loss percentage according to the equation:

Weight loss (%) =Initial weight of tuber roots – weight of tuber roots at sampling date X100
Initial weight of tuber roots

- Decay: All tubers were inspected in terms of fungal or bacterial infections, decayed tubers were counted and removed. The percentage of decayed tubers was calculated at the end of storage period in relation to the total initial number of stored tubers.

2.2. Statistical analysis

All data analyses were performed using the STATISTIX version 8.0 software. The comparisons of treatment means were done with Duncan Multiple Range Test (Duncan, 1955).

3. RESULTS AND DISCUSSION

3.1. Vegetative growth

Data in Table 4 showed that the effect of potassium sulphate doses and feldspar rock + inoculated potassium releasing bacteria on plant growth parameters (plant length per plant, number of branches per plant, leaf area and chlorophyll content). It is obvious that, potassium fertilizer treatements had enhancing effect on all studied morphological characters of sweet potato plants. Application 50% potassium sulphate (KS) plus 50% feldspar rock (FR) with inoculation by KRB followed by addtion 75% KS plus 25% FR with inoculation by KRB gave the highest values of plant length per plant, number of branches per plant, leaf area and chlorophyll content, while the lowest values were obtained when application 100% FR (10.6 kg/ fed.) preceded it adding 100% FR with inoculation by KRB were used during the two seasons.

In this respect, the superiority of plant growth might be attributed to the availability and speed solubility of chemical potassium form and this reflect on its role in cell multiplication and photosynthesis in conjunction with N, which gave rise to increase in length of vine, number of leaves and branches, this consequently gave heavier dry weight of vine (Trehan *et al.*, 2009). The recorded data pointed that feldspar wasn't enough source of K

Table 4. Effect of potassium sulphate doses and feldspar rock with inoculated potassium releasing bacteria on vegetative growth of sweet potato (Abees) during 2018 and 2019 seasons.

Treatments	Plant length (cm)		Branch number/ plant		Leaf area (cm^2/ plant)		Chlorophyll content (SPAD)	
	2018	2019	2018	2019	2018	2019	2018	2019
100% FR*	124.3D	144.0D	6.0D	8.6E	192.6D	243.0E	39.9D	43.4D
100% KS**	157.0AB	161.6BC	8.3B	12.3C	296.6B	321.3B	46.5B	48.5B
100% FR + KRB***	141.6C	153.3CD	7.3C	10.3D	195.3D	268.0D	44.2C	45.6C
75% FR+25%KS + KRB	150.0BC	147.3D	6.3D	11.0D	216.3C	302.6C	45.5BC	43.8CD
50% FR+50%KS + KRB	164.0A	176.0A	9.6A	14.3A	323.3A	337.3A	49.9A	54.0A
25% FR+75%KS + KRB	161.6AB	171.6AB	9.3A	13.3B	313.3A	331.3AB	48.8A	52.5A

Means within the same column followed by the same letters are not significantly different at 5% according to Duncan's Multiple Range Test.
*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans.*

to supply grown plant by its requirements due to the fact that potassium ion is tightly bound within its minerals structure and little release appeared to have occurred with its application (Hellal et al., 2009). In this regard such increments in growth parameters due to inoculation with KDB (potassium dissolving bacteria) with potassium sulphate and feldspar might be attributed to the fact that, bacteria can solubilize them and thus provide faster and continuous supply of K for optimal plant growth (Abou-el-Seud, 2012 and Priyanka and Sindhu, 2013). Also, growth enhancement by bacteria may relate to its ability to produce extensive root length and can improve root development and increase the rate of water and mineral uptake (Saghir et al., 2007).

Obtained results are in harmony with those reported by Shams and Wafaa Fekry (2014) and Saif Eldeen and Baddour (2016) on sweet potato, they indicated that, using 50% potassium sulphate + 50% feldspar + bio fertilizer recorded maximum values of plant length, number branches/ plant and chlorophyll content.

3.2. Yield and its components

Data presented in Tables (5 and 6) represent the effect of potassium sulphate KS doses plus feldspar rock FR + inoculated potassium releasing bacteria KRB on yield and components of sweet potato. Applying plant fertilizer with 50% KS plus 50% FR + inoculated by KRB next that fertilizer plants with 75% KS plus 25% FR with inoculation by KRB increased sweet potato total yield (ten/ fed.), tuber root diameter, tuber root weight, tuber root length and tuber root dry matter. The applying fertilizer with 100% FR alone recorded the lowest values of the same previously mentioned traits in both seasons. These results may be due to that potassium could be directly linked to the well-developed photosynthetic surfaces and increased physiological activities leading to more assimilates being produced and subsequently translocate and utilized in rapid tuber development and production. Moreover, Habibi *et al.* (2011) strongly suggested that using biofertilizers plus half dose of feldspar and chemical fertilizers have resulted in the greatest yield. They revealed that 50% of required potassium fertilizer could be replaced by bio and feldspar fertilizers, because bio and feldspar fertilizers improved the efficiency use of recommended potassium fertilizer and reduced the cost of chemical fertilizer, also reduced the environment pollution from extensive application of chemical fertilizer. These results are in agreement with Shams and Wafaa Fekry (2014) and Saif Eldeen and Baddour (2016) on sweet potato, they stated that using 50% potassium sulphate + 50% potassium feldspar and biofertilizer gave the best yield and it's component.

5.3. Chemical

Advanced results in Tables (6 and 7) introduced that the applying of potassium sulphate doses and feldspar rock + inoculated potassium releasing bacteria on chemical analysis of sweet potato had a significant effect. It is showed that plants fertilized with 50% KS plus 50% FR with inoculation by KRB gave the higest results for leaves potassium percentage, tuber roots total carbohydrate % and tuber roots potassium % as well as recorded the lowest results for available soil potassium content. The lowest results noticed with plants fertilized by 100% FR for the leaves potassium percentage, tuber roots total carbohydrate % and tuber roots potassium % as well as showed the higest results for available soil potassium content. The addition of FR only, showed low obtained chemical compostion of sweet potato. This can be explained by the slow and long release of K from FR through stages of growth (Labib *et al*., 2012). These results agreeded with Labib *et al*. (2012) on potato, Shams and Fekry (2014) and Saif Eldeen and Baddour (2016) on

Table 5. Effect of potassium sulphate doses and feldspar rock with inoculated potassium releasing bacteria on yield and components of sweet potato (Abees) during 2018 and 2019 seasons.

Treatments	Total yield (ton/ fed.)		Tuber root diameter (cm)		Tuber root weight (g)		Tuber root length (cm)	
	2018	2019	2018	2019	2018	2019	2018	2019
100% FR*	6.133E	9.033E	3.7D	4.8D	237.7C	246.0D	11.6E	15.3C
100% KS**	12.800B	15.167B	5.4B	6.3AB	366.1A	280.3B	17.0B	20.0A
100% FR + KRB***	7.800D	12.933D	4.2C	5.4C	253.3C	251.6D	13.6D	16.3BC
75% FR+25%KS + KRB	10.833C	14.100C	4.7C	6.0B	279.3B	263.1C	15.3C	17.6B
50% FR+50%KS + KRB	14.300A	16.533A	6.0A	6.8A	280.6A	290.8A	18.3A	21.3A
25% FR+75%KS + KRB	13.333AB	15.800AB	5.9AB	6.6A	375.5A	284.9AB	17.6AB	20.6A

Means within the same column followed by the same letters are not significantly different at 5% according to Duncan's Multiple Range Test

*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans*

Table 6. Effect of potassium sulphate doses and feldspar rock with inoculated potassium releasing bacteria on tuber root dry matter and chemical of sweet potato (Abees) during 2018 and 2019 seasons.

Treatments	Tuber root dry matter %		available soil potassium mg/ kg		Leaves potassium %		Tuber root total carbohydrate %	
	2018	2019	2018	2019	2018	2019	2018	2019
100% FR*	18.8D	16.1E	82.7A	76.7A	1.23E	1.17D	63.9C	69.2C
100% KS**	25.8B	25.1BC	64.0C	61.4CD	1.41C	1.28B	69.6AB	73.5B
100% FR + KRB***	20.1CD	19.6D	76.4B	71.4AB	1.30DE	1.19CD	65.9C	71.1BC
75% FR+25%KS + KRB	22.3C	22.9C	72.3C	67.3BC	1.36CD	1.24BC	68.9B	72.8B
50% FR+50%KS + KRB	29.1A	28.9A	55.7F	46.8E	1.62A	1.38A	71.9A	78.5A
25% FR+75%KS + KRB	27.0B	26.9AB	61.9E	58.0D	1.51B	1.29B	70.2AB	78.0A

Means within the same column followed by the same letters are not significantly different at 5% according to Duncan's Multiple Range Test

*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans*

sweet potato, they mention that adding 50% both from KS and FR with inoculation by KRB recorded the high values for chemical analysis of plant.

3.4. Tuber root of storage period

Data presented in Table (7) and figer (1) indicated that adding fertilizer 100% FR then 100% FR with inoculation by KRB increased weight loss percentage in tuber roots of sweet potato at 30, 60, 90 days during the storage period and tuber roots decay percentage after storage under ambiment temperature condition while, the adding fertilizer 50% KS of RD plus 50 % FR inoculation with KRB decreased tuber roots weight loss percentage and tuber roots decay percentage in 2018 and 2019 seasons. These results may be due to that inoculation with *Bacillus circulans* bacteria reduced the susceptibility of root tissues to the infection of bacterial and fungal diseases as well as best attacks. Also, weight loss may be reduced by developing storage root with better skin and develop flash with more pound water which restricts water loss during the early storage periods (Hassan *et al.*, 2005). These results are in agreement with Saif Eldeen and Baddour (2016) on sweet potato, they mention that the lowest weigth loss % during the storage period recorded by moderate rate of potassium sulphate of recommended dose plus 50 % K-feldspar inoculation with *Bacillus circulans* bacteria.

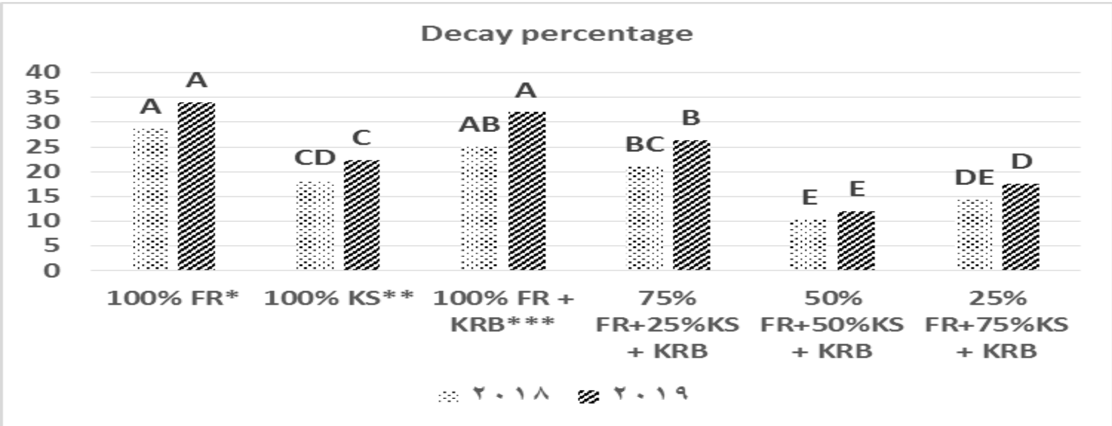
Table 7. Effect of potassium sulphate doses and feldspar rock with inoculated potassium releasing bacteria on tuber root potassium % and tuber root weight loss of sweet potato (Abees) stored roots during 2018 and 2019 seasons.

Treatments	Tuber roots potassium %		Tuber roots weight loss					
			30 days		60 days		90 days	
	2018	2019	2018	2019	2018	2019	2018	2019
100% FR*	2.95C	2.25D	18.4A	25.0A	26.8A	38.3A	38.7A	47.5A
100% KS**	3.40B	3.00B	14.1D	20.0C	22.9C	31.8C	31.7C	40.2D
100% FR + KRB***	3.00C	2.67C	17.0B	23.8A	25.5AB	37.5A	37.0AB	45.5B
75%FR+25%KS + KRB	3.35B	2.67C	15.6C	22.0B	24.3B	34.7B	35.7B	42.2C
50%FR+50%KS + KRB	3.67A	3.20A	10.6F	15.6D	19.4D	24.5E	26.4E	31.9F
25%FR+75%KS + KRB	3.60A	3.02AB	12.6E	18.9C	20.6D	28.6D	28.4D	34.1E

Means within the same column followed by the same letters are not significantly different at 5% according to Duncan's Multiple Range Test

*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans*

Fig. 1. Effect of potassium sulphate doses and feldspar rock with inoculated potassium releasing bacteria on tuber roots decay percentage of sweet potato (Abees) stored roots during 2018 and 2019 seasons.



Means within the same column followed by the same letters are not significantly different at 5% according to Duncan's Multiple Range Test

*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans*

3.5. Apendix

Table 8. Chemical analysis of the soil after harvesting for each treatment at experimental field (0-30 cm depth) in mean two seasons 2018-2019.

Soil Treatment	PH	dS/m EC	Cations meq/L				Anions meq/L				Sp	N Mg/kg
			Ca^2	Mg^{+2}	Na^+	K^+	CO_3^{--}	HCO_3^-	CL	SO_4^{--}		
100% FR*	7.20	1.30	5.88	2.30	4.26	1.56	0.00	2.36	3.13	8.52	20.0	98.0
100% KS**	7.40	1.36	5.88	2.30	4.78	0.32	0.00	2.83	2.50	7.95	21.0	77.5
100% FR + KRB***	7.50	1.34	3.92	2.44	4.78	1.27	0.00	2.83	2.50	7.08	19.0	87.5
75% FR+25%KS + KRB	7.30	1.26	5.88	5.03	1.52	1.31	0.00	4.25	2.50	7.00	23.0	84.0
50% FR+50%KS + KRB	7.50	1.20	4.90	1.46	3.74	1.48	0.00	2.36	2.50	6.72	20.0	73.5
25% FR+75%KS + KRB	7.20	1.33	5.88	3.21	4.61	0.37	0.00	2.83	2.50	8.74	19.0	73.5

*FR: feldspar rock, **KS: potassium sulphate, ***KRB as potassium releasing bacteria i.e. *Bacillus circulans*.

4. CONCLUSIONS

Conclusively, the combined application of potassium sulphate (100 kg fed^{-1}), K-feldspar (453 kg fed^{-1}) and inoculation with KRB in sweet potato fields, can be recommended to improve the vegetative growth characters, yield, quality, chemical composition and storability of sweetpotato than the commercial potassium fertilizer (200 kg fed^{-1}) as well as maximizing the utilization of the natural resources available in the Egyptian environment and minimizing the environmental impact of chemical fertilizers.

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الملخص العربى

تاثير التسميد بالبوتاسيوم وصخر الفلسبار والبكتريا المحررة للبوتاسيوم على نبات البطاطا تحت ظروف الاراضى الرملية

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أجريت الدراسة الحالية في تربة رملية مستصلحة حديثا بمزرعة علي مبارك بمحطة بحوث جنوب التحرير –معهد بحوث البساتين خلال موسمي الزراعة المتعاقبين ٢٠١٨-٢٠١٩ م، وذلك لترشيد استهلاك البوتاسيوم المعدني باستخدام مصادر الطبيعية مثل صخر الفلسبار والبكتريا المحررة للبوتاسيوم، وتأثير ذلك على صفات النمو الخضرى والانتاجية والجودة والإنتاجية، والقدرة التخزينية لمحصول البطاطا صنف أبيس. تم استخدام تصميم القطاعات كاملة العشوائية في أربعة مكررات. تضمنت المعاملات (العدد=٦) أربعة مستويات من كبريتات البوتاسيوم (٤٨% بو٢أ) عند مستوى ٢٥، ٥٠ ، ٧٥% من الجرعة الموصى بها بالإضافة إلي صخر فوسفات (١٠,٦% بو٢أ) مع التلقيح بالبكتريا المحررة للبوتاسيوم *Bacillus circulans*. بالإضافة الي التسميد المعدني بالمعدل الموصي به من كبريتات البوتاسيوم وصخر الفلسبار (منفردا او مع التلقيح الميكروبي للبكتيريا المحررة للبوتاسيوم).

أوضحت النتائج أن إضافة ٥٠٪ من الجرعة الموصى بها لكبريتات البوتاسيوم بالإضافة إلى ٥٠٪ من صخر الفلسبار مع التلقيح ببكتريا *Bacillus circulans* سجلت أعلى القيم معنوية على النمو الخضري، (طول النبات، عدد الأفرع لكل نبات، مساحة الورقة، محتوى الكلوروفيل) ، المحصول الكلي، مكونات المحصول (قطر، وزن، طول، المادة الجافة للجذر المتدرن) والمكونات الكيميائية (محتوى التربة من البوتاسيوم، نسبة البوتاسيوم في الأوراق والجذور المتدرنه ونسبة الكربوهيدرات الكلية للجذور المتدرنة). بالإضافة لذلك، أعطت نفس المعاملة أقل النتائج التي كانت لها آثار سلبية معنوية على محتوى التربة المتاحة من البوتاسيوم ونسبة الفاقد في الوزن في جذور المتدرنة للبطاطا عند ٣٠ ، ٦٠ ، ٩٠ يومًا ونسبه الاضمحلال للجذور المتدرنه للبطاطا بعد فترة التخزين تحت ظروف درجة حرارة الغرفة العادية. تم الحصول على نتائج معاكسة عن الصفات المذكورة سابقاً باستخدام ١٠٠٪ من معاملة صخر الفلسبار منفردا.

التوصية

يمكن استخدام مركب سلفات البوتاسيوم بمعدل ١٠٠كجم للفدان مع ٤٥٣كجم للفدان من صخر الفلسبار والتلقيح بالبكتريا المحررة للبوتاسيوم فى حقول البطاطا لتحسين صفات النمو الخضرى ومكونات المحصول والجودة والتركيب الكمياوى وقدرتة التخزينية بالمقارنة بسماد البوتاسيوم التجارى وكذلك تعظيم الاستفادة من الموارد الطبيعية المتاحة فى البيئة المصرية وتقليل التأثير البيئى للأسمدة الكمياوية.

الكلمات الدالة: البطاطا – سلفات البوتاسيوم – صخر الفلسبار – البكتريا المحررة للبوتاسيوم – أرض رملية