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Effects of natural potassium source enriched with compost on nutrient uptake and yield of sugar beet grown in newly reclaimed soils

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ABSTRACT

Two field experiments were conducted at farmer's field, Ebshway, El-Fayoum Governorate, Egypt during two seasons (2010-2011 and 2011-2012). The objective of this study was to determine the effect of natural potassium sources (Feldspar) and compost application on growth, yield and nutrient uptake by sugar beet (*Beta vulgaris* L.) *cv. pamela* grown in newly reclaimed soils. The most important results could be summarized as follows: The growth characters (root length, root diameter, root and shoot weight) were significantly increased by application of potassium up to 120 Kg K_2O ha^{-1} applied in the natural K form (Feldspar). On the other hand, the highest values of root yield, sugar yield and sucrose percentages were obtained by application of 120 kg K_2O ha^{-1} as Feldspar combined with 20 ton compost ha^{-1}. Also, it was the most effective treatment with respect to potassium, phosphorus, sulphur and iron uptake by sugar beet shoot. The highest applied level of natural K feldspar did not significantly differed as compare with chemical form of applied potassium (K_2SO_4). Results could be concluded that application of natural K as feldspar enriched with compost at recently reclaimed soil will give high yield and quality close to those obtained by chemical potassium application. Thus, replacing the chemical potassium fertilizers by natural one will help in reducing environmental pollution, cheaper in price and produce safe human food.

Key words: Feldspar - compost - potassium uptake - sugar yield

Introduction

Sugar beet (*Beta vulgaris*) is considered the second important sugar crop in Egypt. Approximately 66% of our local needs are produced locally from sugar cane meanwhile, the rest (33%) is important from foreign countries. Hence, increasing cultivated area and sugar production from unit area considered one of the important national targets to minimize gab between sugar consumption and production. Improvement of sugar beet production can be achieved through application of potassium and sulphur fertilizer. Potassium play an important role in regulating osmotic potential, increasing water uptake ability of sugar beet plants (Zengin *et al.*, 2009). Potassium is essential for growth and is the main element used to maintain cell turgir (rigidity) and to regulate the water content of the plant (Rengel and Damon, 2008). Aparna (2001) added that K is considered to be the most important cation not from the viewpoint of its relative amounts but also from the viewpoint of its physiological and chemical functions. This could be because K^+ is usually absorbed as a single charge cation by an active mechanism and translocation along electrochemical potential gradient (Roghieh and Arshad, 2009). Sohier (2001) reported that increasing potassium fertilizer levels from 0 to 24 and 48 kg K_2O fed^{-1} caused a significant increase in root length and diameter, root and foliage weights per plant, root, top and sugar yields per feddan, TSS and sucrose percentages. Amer *et al.* (2004) found that adding potassium up to 90 kg K_2O fed^{-1} resulted a significant increase in N, P and K content in beet root, as well as root and sugar yield per fed. Sulphur is often referred to as the fourth majors' plant nutrients as it is an essential component of important metabolic and structural compounds. Fayed *et al.* (2011) concluded that potassium application at rate 120 % of RDF with boron fertilizer at different doses particularly at a rate of 120 % of RDF gradually increased the yield and sugar production of sugar beet, as well as, juice purity and sucrose percentage.

The recent major problem facing the farmers is the high coast of chemical fertilizers. The alternative to depending on expensive imported fertilizers is to exploit indigenous resources such as K-bearing minerals. Making use of such minerals is meaningful in increasing crop yield and protecting ecological environment. The main source of K for plants growing under natural conditions comes from the weathering of K minerals (Feldspar, leucite, K-mica such as biotite, plogopite and glauconite and clays such as illite), and organic K-sources such as composts and plant residues. Potassium occurs in feldspars in very weathering-resistant framework lattice positions (Sanz-Scovino and Rowell, 1988). 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 (Feldspar) and no significant increase with recommended treatments (Ezzat *et al.* 2005).

This study aimed to investigate the possible effect from natural potassium sources combined with compost

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on growth, yield and its components as well as nutrient uptake by sugar beet grown in newly reclaimed soil of Egypt.

Materials and Methods

Two field experiments were conducted at farmer's field, Ebshway, El-Fayoum Governorate, Egypt during two seasons (2010-2011 and 2011-2012) to study the role of potassium and compost application on growth, yield and nutrient uptake of sugar beet (*Beta vulgaris L.*) *cv. pamela* grown in calcareous soil. Some physical and chemical properties of the experimental soil were determined before cultivation according to Jackson (1958) as shown in Table 1.

The experimental treatments were arranged in randomized complete block design (RCBD) with three replicates. The main plots were Feldspar levels and the sub-plots as compost application. Potassium source in the form of Feldspar (10.1% K_2O) were applied in four levels (0, 40, 80 and 120 kg K_2O ha^{-1}). Compost was applied in three levels (0, 10 and 20 ton ha^{-1}) during land preparation. Feldspar contains (K_2O 10.1%, P_2O_5 0.10%, SiO_4 66.12 %, CaO 0.2%, Al_2O_3 17.59%). Samples were grinded and sieved through 2-mm sieve. Feldspar was mixed with compost and incorporated into soil surface two weeks before planting. Compost contains: pH 6.76, EC 2.85 d Sm^{-1}, Total N 1.22%, total P 0.24 %, total K 0.64%, C/N 17.33. For comparison with natural K source (Feldspar), Potassium sulfate (48 % K_2O) were applied as recommended dose (120 kg K_2O ha^{-1}) a side dressing in two equal doses at 40 and 70 days from sowing.

Table 1: Some physical and chemical properties of the experimental soil sites

Seasons	pH	EC d Sm^{-1}		OM %	$CaCO_3$ %	Macronutrient (mg kg)			
						N	P	K	
2010/11	8.36	2.15		1.06	8.75	51.8	1.69	43.8	
2011/12	8.41	2.23		1.12	9.11	56.4	1.83	54.8	
	Particle size distribution					Micronutrient (mg kg)			
Seasons	Sand %	Silt %	Clay %		Texture class	Fe	Mn	Zn	Cu
2010/11	24.2	31.2	43.4		Clay	2.71	1.82	0.43	0.31
2011/12	26.8	31.5	40.8		Clay	3.07	2.05	0.52	0.34

The recommended dose of phosphorus fertilizer calcium superphosphate (15.5% P_2O_5) was applied at a rate of 100 kg fed^{-1} (feddan = 0.42 ha) during preparation of the experiment. Nitrogen fertilizer in the form of ammonium nitrate (33.5% N) at the rate of 60 kg N fed^{-1} was added in two equal doses. The first one was applied after thinning and the other one 30 days later. Each experimental basic unit included 5 ridges, each of 60 cm apart and 3.5 m length and the plot area was 10.5 m^2.

Sowing took place on middle of August 2010 and 2011 in the first and second seasons, respectively. Seeds of sugar beet *pamela* variety were sown 3-5 balls per hill using dry sowing method on one side of the ridge in hills 20 cm apart. Plants were thinned at the age of 40 days from planting to obtain one plant per hill. The common agricultural practices for growing sugar beet according to the recommendations of Ministry of Agriculture were followed. Sugar beet plants were harvested after 210 days from sowing date.

Studied characters

Growth components and quality characters:

At vegetative (120 days from sowing) and maturity (195 days from sowing) five guarded plants were chosen at random from the outer ridges of each plot to determine yield components and quality characters as follows:

1. Root fresh weight, 2. Shoot fresh weight, 3. Root length, 4. Root diameter, 5. Sucrose percentage which estimated in fresh samples of sugar beet root by using Saccharometer according to the method described by A.O.A.C. (1995). 6. Total soluble solids (TSS %) in roots was measured in juice of fresh roots by using Hand Refractometer and 7. Juice purity percentage (%) was determined as a ratio between sucrose % and TSS % of roots (A.O.A.C., 1995).

Yield characters:

At harvest (210 days), plants that produced from the two inner ridges of each sub plot were collected and cleaned. Roots and tops were separated and weighted in kilograms, then converted to estimate:

1. Root yield, 2. Shoot yield, 3. Sugar yield calculated by multiplying root yield by sucrose %, 4. Harvest index (HI) = Root yield divided by biological yield (root yield + shoot yield).

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Chemical constituents:

All samples from root and shoot were dried at 70 ^{0}C oven for 48 hr. The dried plant samples were finely grinded and analyzed for P, K, S and Fe according the methods described by **(Cottenie *et al*. 1982).**

Statistical analysis:

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) as published by Gomez and Gomez (1984), using "MSTAT-C" Computer software package. Newly Least Significant Differences (NLSD) according to the producer outlined by Waller and Duncan (1969) was used to test the differences between treatment means.

Results and Discussion

Growth parameters:

Data presented in Table (2) indicated that all the studied growth characters *i.e* root length, root diameter, dry root and shoot weight, were significantly affected by application of natural K source (Feldspar). Application of feldspar at a rate of 120 kg K_2O ha^{-1} combined with compost at a rate of 20 ton ha^{-1} prove the highest root length (22.6 cm/plant), root diameter (13.40 cm/plant), dry root weight (3.37 t ha^{-1}) and dry shoot weight (2.28 t ha^{-1}) as compare to rest of the treatment and control at vegetative stage. Similar results were obtained by El-Kholy *et al*., (2006) reported that potassium application at the rate of, 114 kg ha^{-1} significantly increased all the growth parameters. They also mentioned that this phenomenon could be attributed to the stimulatory effect of potassium on the rate of photosynthesis and translocation of its products from leaves to the storage roots.

Table 2: Effect of K source and compost on root and shoot weight at vegetative growth stage (Data mean of two seasons)

Treatments		Root length (cm/plant)	Root diameter (cm/plant)	Fresh weight (ton ha^{-1})		Dry weight (ton ha^{-1})	
Feldspar	Compost			Root	Shoot	Root	Shoot
0 kg K_2O ha^{-1}	0 ton ha^{-1}	17.2	11.40	17.71	15.63	2.26	1.30
	10 ton ha^{-1}	17.5	11.40	17.95	16.96	2.29	1.41
	20 ton ha^{-1}	17.8	11.60	18.43	17.29	2.35	1.44
40 kg K_2O ha^{-1}	0 ton ha^{-1}	18.6	11.80	17.68	17.05	2.25	1.42
	10 ton ha^{-1}	19.2	12.10	20.01	19.17	2.55	1.59
	20 ton ha^{-1}	19.3	12.20	20.17	20.80	2.57	1.73
80 kg K_2O ha^{-1}	0 ton ha^{-1}	19.1	12.60	20.77	19.79	2.65	1.64
	10 ton ha^{-1}	20.6	12.70	24.27	25.74	3.09	2.14
	20 ton ha^{-1}	21.6	13.30	25.49	27.36	3.15	2.27
120 kg K_2O ha^{-1}	0 ton ha^{-1}	19.7	12.80	21.21	20.89	2.70	1.73
	10 ton ha^{-1}	21.8	12.90	24.42	26.62	3.11	2.21
	20 ton ha^{-1}	22.6	13.40	25.92	27.55	3.25	2.29
RDK as K_2SO_4		22.2	13.35	25.65	27.47	3.37	2.28
L.S.D (0.05)	FS	1.52	0.81	1.66	1.08	0.72	0.38
	C	0.98	N.S	1.37	0.92	0.61	0.17
	FS*C	N.S	N.S	N.S	N.S	N.S	N.S

RDK : Recommended doses of K, FS: Feldspar, C: compost

Yield parameters:

Data in Table (3) revealed that root length, root diameters, fresh and dry weight of root and shoot at harvest highly increased by 24.12, 20.26, 36.86, 36.96, 40.73 and 36.94 % respectively as compared with the control as affected by potassium fertilization in the form of Feldspar at a rate of 120 kg K_2O ha^{-1} combined with compost at a rate of 20 ton ha^{-1}. While, addition of recommended dose fertilizers from potassium sulfate individual led to a significant increased of the studied yield parameters as compare to control and no significant differences observed as compare to the highest applied level of feldspar and compost at sugar beet harvest.

The increase of root length, root diameter, root weight, fresh weight of shoot and dry weight of root and shoot due to k feldspar application could be explained through its need as cofactor (enzymes activator) for different enzymes. In addition, K is needed for vital processes and its beneficial effect in translocation of carbohydrates to the storage organs (Zengin *et al.* 2009 and Hassanli *et al*. 2010).

Quality parameters:

Regarding sugar yield, Table (4) showed significant effects of potassium Feldspar and compost application on sugar yield. The results showed the existence of a significant increase in those qualities affected by compost application at a rate of 20 ton ha^{-1} combined with potassium application in the feldspar form at a rate of 120 K_2O kg ha^{-1}.

Table 3: Effect of K source and compost on root and shoot yield at harvest (Data mean of two seasons)

Treatments		Root length (cm $plant^{-1}$)	Root diameter (cm $plant^{-1}$)	Fresh weight (ton ha^{-1})		Dry weight (ton ha^{-1})	
Feldspar	Compost			Root	Shoot	Root	Shoot
0 kg K_2O ha^{-1}	0 ton ha^{-1}	30.2	18.1	43.11	21.51	5.21	2.10
	10 ton ha^{-1}	30.7	18.7	46.24	23.17	5.64	2.26
	20 ton ha^{-1}	31.1	18.8	47.58	25.18	5.82	2.46
40 kg K_2O ha^{-1}	0 ton ha^{-1}	30.3	18.6	45.62	22.95	5.55	2.24
	10 ton ha^{-1}	32.4	19.3	46.79	26.52	5.71	2.59
	20 ton ha^{-1}	33.6	19.8	48.61	27.53	5.96	2.69
80 kg K_2O ha^{-1}	0 ton ha^{-1}	32.8	20.1	50.93	25.03	6.27	2.44
	10 ton ha^{-1}	35.1	20.8	60.21	27.21	7.53	2.65
	20 ton ha^{-1}	38.6	21.5	66.06	32.69	8.53	3.10
120 kg K_2O ha^{-1}	0 ton ha^{-1}	33.4	20.6	62.49	30.88	7.84	3.01
	10 ton ha^{-1}	38.6	21.2	65.18	31.65	8.21	3.09
	20 ton ha^{-1}	39.8	22.7	68.28	34.12	8.79	3.33
RDK as K_2SO_4		38.9	21.8	67.72	33.46	8.63	3.14
L.S.D 0.05	FS	1.99	1.20	2.75	2.07	1.16	0.77
	C	1.73	1.04	2.11	1.65	0.74	0.32
	FS*C	N.S	N.S	N.S	N.S	N.S	N.S

RDF : Recommended doses of K, FS: Feldspar, C: compost

The positive effect on increasing sugar yield may be due to the role of compost on reducing soil pH and increasing nutrient availability in soil. These results are in agreement with those obtained by El-Kholy *et al.*, (2006) and Abd El-Motagally and Attia (2009). They reported that potassium application at the rate of 114 kg ha^{-1} significantly increased root and sugar yield of sugar beet crop. An increase in sugar yields might be due to the role of K in nutrients uptake and nutritional balance, which increase the biosynthesis of photosynthesis uptake of roots and foliage which were significantly increased by increased K fertilization (Milford *et al*., 2000).

Most quality characteristics (sucrose percentage, Total soluble solid (TSS), juice purity and sugar yield) of sugar beet were significantly increased by increasing K Feldspar and compost application rates. Concerning total soluble solids (TSS), results in Table (4) showed that, total soluble solids were slightly decreased by potassium fertilization. The K application at a rate 120 kg K_2O ha^{-1} as feldspar form combined with 20 ton compost ha^{-1} was generally the lowest. On the other hand, potassium application at the recommended rate in the chemical form did not differed significantly as compared with the application of potassium in the natural form. With respect to the effect of potassium application rates on sucrose and juice purity percentage, data indicated that the potassium application at the rates, 40 and 80 kg K_2O ha^{-1} caused a slight increase in sucrose and juice purity percentage as compared with control. Data also revealed that potassium application at the rate, 120 kg K_2O ha^{-1} as feldspar form combined with 20 ton compost ha^{-1} was the highest sucrose and juice purity percentage as compared with control and the other treatments.

Table 4: Effect of K source and compost on quality parameters (Data mean of two seasons)

Treatments		Sugar yield (ton ha^{-1})	Sugar quality %			Harvest index
Feldspar	Compost		TSS	Sucrose	Purity	
0 kg K_2O ha^{-1}	0 ton ha^{-1}	6.09	21.50	14.12	65.67	0.667
	10 ton ha^{-1}	6.66	20.60	14.41	69.95	0.666
	20 ton ha^{-1}	6.93	19.20	14.57	75.89	0.654
40 kg K_2O ha^{-1}	0 ton ha^{-1}	6.68	18.70	14.64	78.29	0.665
	10 ton ha^{-1}	6.91	18.30	14.76	80.66	0.638
	20 ton ha^{-1}	7.40	17.20	15.23	88.55	0.638
80 kg K_2O ha^{-1}	0 ton ha^{-1}	7.66	17.40	15.04	86.44	0.670
	10 ton ha^{-1}	9.10	16.80	15.12	90.00	0.689
	20 ton ha^{-1}	10.06	16.60	15.23	91.75	0.669
120 kg K_2O ha^{-1}	0 ton ha^{-1}	9.58	16.50	15.33	92.91	0.669
	10 ton ha^{-1}	10.18	16.30	15.62	95.83	0.673
	20 ton ha^{-1}	11.07	16.25	16.21	99.75	0.667
RDK as K_2SO_4		10.92	16.40	16.12	98.29	0.669
L.S.D (0.05)	FS	1.52	0.81	1.66	0.72	
	C	0.98	N.S	1.37	0.61	
	FS*C	2.37	N.S	N.S	N.S	

RDK : Recommended doses of K, FS: Feldspar, C: compost

Such effect might be attributed to K role in sucrose translocation and accumulation in storage tissue of plants. The obtained findings are in line with the results reported by Shaaban *et al*., (2008). In addition, Abd EL-Rahman (1996) mentioned that sucrose percentage of sugar beet was significantly increased by increasing K level up to 48 kg K_2O fed^{-1}. Hassanin (2001) noted that sucrose was significantly affected by potassium rates 24 and 48 kg K_2O fed^{-1}.

Nutrient uptake at vegetative stage:

Data in Table (5) showed that the application of natural K (Feldspar) combined with compost gradually increase of phosphorus, potassium, sulphur and iron uptake by sugar beet at vegetative growth. The addition of potassium fertilizer as feldspar source at a rate of 120 kg K_2O ha^{-1} applied with compost at a rate of 20 ton ha^{-1} was the highest P (7.97 kg ha^{-1}), K (108.24 kg ha^{-1}), S (5.75 kg ha^{-1}), Fe (0.495 kg ha^{-1}) uptake as compared with control and the rest of natural applied feldspar treatments. The chemical form of applied K (K_2SO_4) was higher K and S uptake as compare to natural K sources treatments.

Nutrient uptake at harvest:

I- Phosphorus and Potassium uptake:

Data in Table (6) presented significant increase of phosphorus and potassium uptake by sugar beet root and shoot at harvest as affected by potassium fertilization. Potassium application as feldspar form at a rate of 120 kg K_2O ha^{-1} enriched with compost at a rate of 20 ton ha^{-1} increased P and K uptake where about 37.33 %, 55.46%, 44.98% and 77.36% respectively as compared with the control. The addition of recommended dose fertilizers from potassium sulfate individually led to a significant of P and K uptake as compare to control but not significantly affected as compare to the highest level of applied natural K enriched with compost.

Table 5: Effect of K source and compost on nutrients uptake at vegetative stage (Data mean of two seasons)

Treatments		Nutrient uptake (Kg ha^{-1})			
Feldspar	Compost	P	K	S	Fe
0 kg K_2O ha^{-1}	0 ton ha^{-1}	3.37	35.46	1.70	0.159
	10 ton ha^{-1}	3.89	42.30	2.35	0.185
	20 ton ha^{-1}	4.16	45.51	2.69	0.217
40 kg K_2O ha^{-1}	0 ton ha^{-1}	3.80	47.19	2.22	0.222
	10 ton ha^{-1}	4.51	56.53	3.33	0.272
	20 ton ha^{-1}	5.20	65.03	3.73	0.323
80 kg K_2O ha^{-1}	0 ton ha^{-1}	4.45	75.42	3.01	0.265
	10 ton ha^{-1}	6.57	95.06	4.51	0.433
	20 ton ha^{-1}	7.37	102.10	5.39	0.488
120 kg K_2O ha^{-1}	0 ton ha^{-1}	4.75	86.02	3.40	0.286
	10 ton ha^{-1}	6.90	99.62	4.85	0.466
	20 ton ha^{-1}	7.97	108.24	5.75	0.495
RDK as K_2SO_4		7.57	110.15	5.52	0.486
L.S.D (0.05)	FS	1.05	3.76	0.376	0.025
	C	0.78	3.25	0.325	0.022
	FS*C	N.S	N.S	N.S	0.051

RDK : Recommended doses of K, FS: Feldspar, C: compost

The data showed that, the all studied nutrients (P and K uptake) by root were higher than its uptake by shoots that are related to the essentiality of K to improve photosynthesis. Also, K helps in maintaining a normal balance between carbohydrates and proteins (Monreal *et al*., 2007).

The increasing of P uptake due to natural K application could be attributed to the involvement of P in ATP formation which is stimulated by the presence of K^+ as ATP which is essential in photosynthesis process, thus the presence of P and K promotes the rate of CO_2 assimilation. As well as, the highest rate of the applied compost (20 ton ha^{-1}) was associated with the highest P uptake values. Application of potassium sulphate as per recommendation was significantly higher than natural K applied. Root to shoot ratio decreased with increasing K level of sugar beet crop. The favorable effect of potassium fertilizer improved yields and chemical constituents may be due to the vital role of potassium in building up metabolites and activating starch synthesis enzymes and carbohydrates accumulation which transferred from leaves to developing roots consequently enhanced root and chemical. The better performance of Feldspar plus compost could be attributed to better maintenance of soil nutrients status in the root zone, which in turn helped the plants to utilize nutrients more efficiently; rather release of potassium took place frequently, which favorably affects growth of the crop.

Table 6: Effect of K source and compost on P and K uptake at harvest (Data mean of two seasons)

Treatments		P uptake (Kg ha^{-1})			K uptake (Kg ha^{-1})		
Feldspar	Compost	Root	Shoot	Root/Shoot	Root	Shoot	Root/Shoot
0 kg K_2O ha^{-1}	0 ton ha^{-1}	5.49	2.57	2.14	56.4	21.8	2.58
	10 ton ha^{-1}	6.44	2.88	2.24	61.3	29.9	2.05
	20 ton ha^{-1}	8.72	2.84	3.07	65.4	33.9	1.93
40 kg K_2O ha^{-1}	0 ton ha^{-1}	6.78	3.06	2.22	65.3	44.0	1.48
	10 ton ha^{-1}	7.76	3.42	2.27	74.0	54.0	1.37
	20 ton ha^{-1}	8.07	3.75	2.15	82.3	60.9	1.35
80 kg K_2O ha^{-1}	0 ton ha^{-1}	7.60	3.46	2.20	82.7	63.7	1.30
	10 ton ha^{-1}	8.13	4.20	1.94	87.4	75.8	1.15
	20 ton ha^{-1}	8.22	5.17	1.59	85.4	93.1	0.92
120 kg K_2O ha^{-1}	0 ton ha^{-1}	8.11	4.22	1.92	86.2	87.8	0.98
	10 ton ha^{-1}	8.44	5.12	1.65	93.3	93.8	0.99
	20 ton ha^{-1}	8.76	5.77	1.52	102.5	96.3	1.06
RDK as K_2SO_4		8.82	5.51	1.60	109.1	97.2	1.12
L.S.D 0.05	FS	1.19	1.1		2.71	1.89	
	C	1.03	0.09		2.26	1.43	
	FS*C	N.S	0.018		N.S	N.S	

RDK: Recommended doses of K, FS: Feldspar, C: compost

II-Sulphur and iron uptake:

Concerning the effect of natural K and compost combination on sulphur and iron uptake, data in Table (7) showed that significant increase of sulphur and iron uptake of sugar beet at harvest. The potassium fertilization as feldspar natural form at a rate of 120 K_2O ha^{-1} combined with compost at a rate of 20 ton ha^{-1} increased sulphur and iron uptake by 64.95 %, 59.06 %, 59.63 %, and 64.76 %, respectively as compared with control treatment.

Table 7: Effect of K source and compost on S and Fe uptake at harvest (Data mean of two seasons)

Treatments		S uptake (Kg ha^{-1})			Fe uptake (Kg ha^{-1})		
Feldspar	Compost	Root	Shoot	Root/Shoot	Root	Shoot	Root/Shoot
0 kg K_2O ha^{-1}	0 ton ha^{-1}	2.18	1.22	1.79	0.536	0.228	2.35
	10 ton ha^{-1}	2.49	1.38	1.80	0.699	0.283	2.47
	20 ton ha^{-1}	2.75	1.48	1.86	0.786	0.313	2.51
40 kg K_2O ha^{-1}	0 ton ha^{-1}	2.82	1.25	2.26	0.674	0.267	2.53
	10 ton ha^{-1}	3.49	1.45	2.41	0.813	0.350	2.32
	20 ton ha^{-1}	3.76	1.68	2.24	0.851	0.380	2.24
80 kg K_2O ha^{-1}	0 ton ha^{-1}	3.20	1.54	2.08	0.780	0.301	2.59
	10 ton ha^{-1}	4.30	1.97	2.18	0.922	0.420	2.20
	20 ton ha^{-1}	5.67	2.77	2.05	1.160	0.538	2.15
120 kg K_2O ha^{-1}	0 ton ha^{-1}	4.16	1.87	2.22	0.979	0.452	2.17
	10 ton ha^{-1}	5.43	2.63	2.06	1.170	0.530	2.21
	20 ton ha^{-1}	6.22	2.98	2.09	1.328	0.647	2.05
RDK as K_2SO_4		5.84	2.89	2.02	1.218	0.579	2.10
L.S.D 0.05	FS	0.94	0.061		0.121	0.037	
	C	0.76	0.034		0.083	0.032	
	FS*C	N.S	0.091		N.S	0.072	

RDK : Recommended doses of K, FS: Feldspar, C: compost

The addition of recommended dose fertilizers from potassium sulfate as compared with application of natural K (Feldspar) at same level differed significantly regarding to sulphur and iron uptake by sugar beet crop at harvest stage .

Increasing of sulfur and iron uptake due to K and compost application is important to improve calcareous soil productivity. Malvi (2011) found that Potassium has direct synergistic relationships with iron, which plays important role in chlorophyll formation. The promotion effect of compost on growth beet could be assigned to reduction in rhizosphere pH resulted in enhancing nutrient availability from feldspar which led to better absorption and translocation of nutrients within the plant.

Conclusion:

Application of natural potassium source (feldspar) combined with compost was suited for increasing sugar beet yield grown in newly reclaimed calcareous soil. The equivalent quantity of K_2O from feldspar was available in three to four times cheaper than imported potash. The use of Feldspar combined with compost in the field application is found to be economical as well as eco-friendly as there are no loses of nutrients from feldspar due to drainage, leaching and percolation of potassium from feldspar charged compost are negligible as compared to soluble potassium salts.

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