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IMPROVEMENT OF FODDER BEET PRODUCTIVITY AND QUALITY USING GYPSUM AND POTASSIUM FERTILIZER IN ALKALINE SALINE AFFECTED SOILS

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ABSTRACT

Two field experiments were carried out at the Experimental Farm of El-Serw St., Damietta Governorate during 2006/2007and 2007/2008 winter seasons on fodder beet (*Beta vulgaris* c.v. Vorochenger) to study the effect of gypsum and potassium fertilizer on yield and quality of fodder beet. The study included four gypsum levels i.e. zero (control), 5, 10 and 15 ton /fad. and four potassium fertilizer levels (zero (control), 36, 72 and 108 kg K2O/fad.). The experimental design was strip plot design with three replicates. Significant differences were recorded between different treatments and the treatment which received 15 tons gypsum/fad. and 108 kg K/fad. surpassed the other treatments in all the growth characters of fodder beet plants e.g. root length, root diameter, fresh and dry yield of roots and foliages. The same treatment was superior in quality characteristics, crude protein, ash and digestible crude protein but it gave the lowest value of crude fiber and total digestible nutrients. Meanwhile the same treatment was superior in nitrogen content but it gave the lowest values of phosphorus and potassium.

It may be recommended that adding gypsum at a rate of 15 ton/fad and 108 kg K2O/fed improved fodder beet productivity under alkaline saline affected soils.
Keywords: fodder beet, gypsum, potassium fertilizer, yield and quality.

INTRODUCTION

In Egypt, production and distribution of fodder crops have become one of the most problems which lead to shortage in available quantities of fodder crops around the year. So, the increase of cultivated new lands, i.e. marginal lands and salt affected lands, to produce more green fodder has become the most promising solution to close up the gape between production and consumption especially under the limited area of the Nile Valley.

Fodder beet (*Beta vulgaris* L.) is a new winter forage crop in Egypt. It is very successful crop in the salt affected soils, because it is tolerant to high salinity in soil and water. It is whole yield, i.e. above and under-ground parts can directly be used in animal feeding, especially dairy cows or may be processed as qualitative silage. The roots can also be stored in the soil for a period without great damage to be used when it is needed. So, its cultivation may help in overcoming the problem of animal feeding in summer season.

Total salt affected area in the world is about 955 Mega ha out of which 0.9 M ha in Egypt. The majority of salt- affected soils in Egypt are located in the northern- central part of the Nile Delta and on its eastern and western side. However, 55 % of the cultivated lands of northern Delta and 25 % of the Upper Egypt regions are salt- affected soils (FAO 1995).

To improve soil properties where reducing amount of exchangeable sodium to reclaim a sodic soil, gypsum is used to improve soil structure. Gypsum is an excellent kick-starter, gains in crop production and longer- term improvement in soil structure through amelioration of sodicity if application and other soil amendment practices are combined. Many investigators reported that gypsum had a good effect on improving soil physical and chemical properties and led to increasing nutrient availability in soil which reflected on yield (Sandu and Mihaescu 1989; Ali 1990; Gazia 2001 and El-Sharawy *et al.*, 2008).

Potassium is an important element in plant nutrition, especially those having storage organs such as sugar beet and fodder beet. Also, it is a co-factor activating a number of important enzymes which are involved in many processes in the plant such as photosynthesis, respiration and carbohydrates metabolism and translocation. Many investigators reported that K- fertilizers had progressive effect on fodder and sugar beet growth and growth analysis (Sun *et al.*, 1994; Geweifl and Aly 1996; El-Shafei 1997; Mohammed 1997; Mekki and El-Gazzar 1999 and Hassanin 2001).

The objective of this study is to investigate possibility of raising fodder beet yield and quality under saline affected soils by using soil amendment i.e. gypsum and potassium fertilizer.

MATERIALS AND METHODS

Two seasons trails were carried out at the Experimental Farm in El-Serw St., Damietta Governorate, Egypt (31^{O} $22^{\backslash}$ latitude, and $31^{O}.64^{\backslash}$ longitude)during two winter seasons (2006/2007and 2007/2008) on fodder beet (*Beta vulgaris*) c.v. Vorochenger, imported by Seedco Import – Export Company, Egypt from Bio seed Company, Hungary.

The plot of the experiment was not cultivated before and its properties are listed in Table (1).

Table 1: Initial physical and chemical analysis of soil before conducting the experiment (average of two seasons).

Physical characteristics							
Mechanical Analysis					Field capacity (%)	Real density (g/cm^3)	
Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Soil texture			
1.90	12.60	19.70	65.80	Clayey	60.3	2.66	
Chemical characteristics							
EC dSm^{-1}	pH soil paste	OM (%)	$CaCO_3$ (%)	ESP	Available nutrients (mg $100g^{-1}$)		
					N	P	K
10.05	8.58	0.95	2.59	23.4	35.8	7.4	193
Soluble Cation meq/L				**Soluble Anion meq/L**			
Na^{+}	K^{+}	Ca^{++}	Mg^{++}	$SO_4^{=}$	Cl^{-}	HCO_3^{-}	$CO_3^{=}$
53.5	0.4	24.8	21.8	43.03	51.7	5.77	0.0

Each experiment included sixteen treatments which were the combination of 4 rates of gypsum and 4 rates of potassium fertilization. A strip plot design with three replications was used; the vertical plots were laid out for gypsum rates (zero, 5, 10 and 15ton /fad.) and the horizontal plots were devoted to the potassium fertilizer rates (zero, 36, 72 and 108 kg K_2O/fad.). The gypsum was used in the form of calcium sulphate ($CaSO_4.2H_2O$) after soil preparation and before sowing. The potassium rates were added in the form of potassium sulphate (48% K_2O) in two equal portions, the first portion was added before first irrigation and the second was added before second irrigation. The plot area was 10.5 m^2 (3 x 3.5m) and included five ridges of 60 cm apart and 3.5 m long.

Fodder beet seeds were sown at a rate of 3 kg/fad. on 15^{th} Nov. and 23^{rd} Nov. in the first and second seasons, respectively. The plants were thinned at two plants per hill, 20 cm a part, after 30 days from sowing and singled to one plant/ hill after 45 days from sowing. Calcium super phosphate (15.5 % P_2O_5) was added after plots preparation and before sowing. Nitrogen (80 kg N/fad.) was added as ammonium nitrate (33.5 % N) in three equal doses before first, second and third irrigation.

Submersion irrigation system was used with water salinity of 0.82 dsm^{-1}. All cultural practices were carried out as recommended for the crop. Random samples of five plants were taken from central ridges of each plot after 210 days from sowing to estimate growth and yield characters.

The following characteristics were recorded:

I- Vegetative growth characters:

1- Root length (cm).
2- Root diameter (cm).
3- Root and foliage weight (kg/plant)
4- Root and foliage fresh yield (t/fad.): All plants of each plot were taken and weighed in kg/plot, then transferred to t/fad.

II- Chemical characters:

Random samples (3 roots) for each treatment of the first season were cut in flacks, dried at 70oC till a constant weight. Then they were milled to a fine powder and chemically analyzed to determine crude protein (CP %), Crude fiber (CF %) and ash. The chemical analysis followed the conventional methods recommended by A.O.A.C (1980). Total digestible nutrients (TDN %) and digestible crude protein (DCP %) were calculated according to equation of Church (1979)

as: DCP % = CP*0.929 – 3.48.

TDN % = 90.36 – 0.29*CP – 0.86*CF.

Nitrogen, phosphorus, and potassium were determined in the roots according to the method described by Cottenie *et al* (1982). Physical and chemical properties of the soil were determined according to Chapman and Pratt (1961).

Collected data for each season were statistically analyzed according to Snedecor and Cochran (1980) using MSTAT- C computer program Ver.4 (1986). Bartlett test was done to test the homogeneity of error variances. The test was not significant for all traits, thus the data of both years were combined.

RESULTS AND DISCUSSION

1- Root length and root diameter

1-1- Effect of gypsum treatments on root length and root diameter

Results of root length and root diameter of fodder beet as affected by gypsum treatments are presented in Table 2. Among the gypsum treatments the statistical analysis indicated the presence of significant differences in the root length and root diameter. The treatment receiving 15 ton gypsum /fad. gave the highest root length (31.06 cm) and root diameter (12.67cm) as combined over the two seasons.. while, the control treatment gave the lowest values of root length (21.68 cm) and root diameter (8.04 cm). The percentage increases in the root length and root diameter of the treatment were 43.26 and 57.59 %, respectively. Although, sodium is not generally regarded as an essential nutrient for all higher plants. However, sodium can substitute for potassium to a greater or lesser extent in different plant species. Some crops will show a yield response to sodium even in the presence of adequate amounts of potassium. For some species, including sugar beet, red beet and fodder beet, sodium is essential and can not be substituted completely by potassium, whereas, Na soil content (av. 53.5 meq/L) as shown in Table 1 is more enough to face the requirements of fodder beet plants.

1-2- Effect of potassium treatments on root length and root diameter

Results of root length and root diameter of fodder beet as affected by potassium treatments are presented in Table 2. Among the potassium treatments the statistical analysis indicated the presence of significant differences in the root length and root diameter. Results revealed that application of 108 kg K/fad. significantly increased root length (27.71 cm) and root diameter (12.32 cm) while, the control treatment gave the lowest values of root length (23.15cm) and root diameter (8.31 cm). The percentage increases in the root length and root diameter were 19.69 and 48.25 %, respectively.

Such increase in root length and root diameter could be due mainly to favorable effect of K element on function of N, on the vegetative growth of plant through enhancing the photosynthesis process and consequently the accumulation of dry matter in roots.

1-3- Effect of gypsum and potassium fertilizer rates interaction on root length and root diameter

Data presented in Table 2 demonstrated the significant effect of the above- interaction on both root length and root diameter. It is clear from the data that the increase in both root length and root diameter due to the increases of gypsum levels under zero level of potassium were significantly lower than those recorded with the higher levels of potassium application. The data presented in Table 2 indicated that the increase in the root length and root diameter by the application of 15 ton gypsum/fad. with 108 kg K/fad. amounted to 49.73 and 57.31 % as compared by the application of zero level gypsum with 108 kg K/fad. as combined over the two seasons.

Table 2: Effect of gypsum, potassium fertilizer rates and their interactions on root and foliage fresh and dry weight, root length and root diameter of fodder beet (combined over 2006-2007 and 2007- 2008).

Traits / Treatment	Root length (cm)	Root diameter (cm)	Root fresh wt. (kg/plant.)	Foliage fresh wt.(Kg/plant.)	Root dry wt. (kg/plant.)	Foliage dry wt. (Kg/plant)
A- Gypsum treatments (t/fad.)						
Zero(Cont.)	21.68	8.04	0.68	0.40	0.064	0.036
5	23.26	9.87	0.74	0.38	0.072	0.039
10	26.03	11.37	0.84	0.57	0.085	0.053
15	31.06	12.67	1.12	0.84	0.104	0.073
LSD 0.05	**0.32**	**0.23**	**0.01**	**0.04**	**0.003**	**0.002**
B- Potassium treatments (kg/fad.)						
Zero(Cont.)	23.15	8.31	0.59	0.37	0.061	0.035
36	24.83	9.95	0.76	0.46	0.074	0.045
72	26.33	11.36	0.92	0.61	0.087	0.056
108	27.71	12.32	1.12	0.74	0.102	0.065
LSD 0.05	**0.31**	0.26	**0.01**	**0.04**	**0.003**	**0.002**
AXB-Interaction						
Zero G + Zero K	20.05	6.47	0.50	0.24	0.048	0.022
Zero G + 36 K	21.28	7.88	0.62	0.34	0.060	0.032
Zero G + 72 K	22.33	8.52	0.70	0.45	0.067	0.042
Zero G + 108 K	23.06	9.30	0.88	0.56	0.082	0.047
5 G + Zero K	21.21	8.00	0.51	0.23	0.053	0.024
5 G + 36 K	23.02	8.93	0.68	0.31	0.066	0.032
5 G + 72 K	23.92	10.75	0.80	0.44	0.076	0.045
5 G +108 K	24.87	11.78	0.97	0.53	0.094	0.056
10 G + Zero K	23.83	9.10	0.55	0.35	0.065	0.036
10 G + 36 K	25.11	10.67	0.74	0.44	0.075	0.045
10 G + 72 K	26.81	12.15	0.93	0.67	0.092	0.058
10 G +108 K	28.37	13.57	1.16	0.84	0.108	0.071
15 G + Zero K	27.52	9.68	0.78	0.64	0.079	0.059
15 G + 36 K	29.92	12.32	0.98	0.76	0.097	0.070
15 G + 72 K	32.25	14.03	1.26	0.89	0.114	0.078
15 G +108 K	34.53	14.63	1.48	1.06	0.125	0.084
LSD 0.05	**0.44**	0.37	**0.02**	**0.05**	**0.004**	**0.003**

G = gypsum K = potassium

2- Fresh and dry yield

2-1- Effect of gypsum treatments on fresh and dry yield

Results of fresh and dry weight for roots and foliages of fodder beet as affected by gypsum treatments are presented in Tables 2 and 3. Among the gypsum treatments the data indicated the presence of significant differences in the fresh and dry weight of roots and foliages either per kg/plant or per ton/fad. The treatment receiving 15 ton gypsum /fad. gave the highest fresh and dry weight of roots and foliages as combined over the two seasons. The data presented in Table 3 indicated that the same treatment gave the highest total fresh yield (23.84 t/fad.) and total dry yield (2.69 t/fad.) while, the control treatment gave the lowest values of total fresh (13.91 t/fad.) and total dry yield (1.52 t/fad.). The percentage increase in the total fresh and total dry yield was 71.39 and 76.97 %, respectively.

2-2- Effect of potassium treatments on fresh and dry yield

With respect of the effect of the different rates of potassium on fresh and dry weights of roots and foliages, data presented in Tables 2 and 3 indicated the presence of significant differences in the fresh and dry weight of roots and foliages either per kg/plant or per t/fad. It could be noticed that the highest weight of fresh and dry roots and foliages were scored when 108 kg K/fad. was applied. The data presented in Table 3 indicated that the same treatment gave the highest total fresh yield (23.91t/fad.) and total dry yield (2.72 t/fad.), while, the control treatment gave the lowest values (11.96 and 1.36 t/fad.). The percentage increase in the total fresh and total dry yield was 99.92 and 100 %, respectively.

These results are in harmony with those obtained by Abdel-Aal (1990) who found that increasing potassium fertilizer up to 72 kg K/fad. increased significantly root diameter, total weight/plant and total yield/fad. Moreover,

Table 3: Effect of gypsum, potassium fertilizer rates and their interactions on root, foliage and total fresh and dry yield of fodder beet (combined over 2006-2007 and 2007- 2008).

Traits / Treatment	Root fresh wt. (t/fad.)	Foliage fresh wt. (t/fad.)	Root dry wt. (t/fad.)	Foliage dry wt. (t/fad.)	Total fresh yield (t/fad.)	Total dry yield (t/fad.)
A- Gypsum treatments (t/fad.)						
Zero(Cont.)	10.64	3.27	1.14	0.38	13.91	1.52
5	10.84	4.26	1.30	0.45	15.10	1.75
10	15.04	4.79	1.60	0.50	19.83	2.10
15	19.55	4.29	2.03	0.66	23.84	2.69
LSD 0.05	**0.27**	**0.4**	**0.05**	**0.02**	**0.30**	**0.05**
B- Potassium treatments (kg/fad.)						
Zero(Cont.)	9.16	2.80	1.00	0.36	11.96	1.36
36	11.93	3.54	1.24	0.46	15.47	1.70
72	16.11	5.25	1.73	0.55	21.36	2.28
108	18.88	5.03	2.10	0.62	23.91	2.72
LSD 0.05	**0. 26**	**0.3**	**0.09**	**0.01**	**0.29**	**0.08**
AXB-Interaction						
Zero G + Zero K	7.94	2.11	0.80	0.24	10.05	1.04
Zero G + 36 K	9.53	2.54	1.00	0.31	12.07	1.31
Zero G + 72 K	11.49	4.38	1.27	0.45	15.87	1.72
Zero G + 108 K	13.60	4.07	1.49	0.52	17.67	2.01
5 G + Zero K	7.47	2.93	0.85	0.34	10.40	1.19
5 G + 36 K	9.63	4.28	1.03	0.42	13.91	1.45
5 G + 72 K	12.33	5.40	1.50	0.49	17.73	1.99
5 G +108 K	13.95	4.45	1.79	0.55	18.40	2.34
10 G + Zero K	9.30	2.79	0.99	0.37	12.09	1.36
10 G + 36 K	13.70	3.17	1.45	0.47	16.87	1.92
10 G + 72 K	16.17	7.46	1.72	0.54	23.63	2.26
10 G +108 K	21.00	5.74	2.22	0.61	26.74	2.83
15 G + Zero K	11.93	3.36	1.33	0.48	15.29	1.81
15 G + 36 K	14.84	4.15	1.47	0.64	18.99	2.11
15 G + 72 K	24.45	3.75	2.45	0.71	28.20	3.16
15 G +108 K	26.99	5.88	2.89	0.79	32.87	3.68
LSD 0.05	**0.37**	**0.5**	**0.12**	**0.02**	**0.42**	**0.12**

G = gypsum K = potassium

2-3- Effect of gypsum and potassium fertilizer rates interaction on fresh and dry yield

Data presented in Tables 2 and 3 demonstrated the significant effect of the above- interaction on both fresh and dry weight of roots and foliages either per kg/plant or t/fad. It is clear from the data that the increase in both fresh and dry weight of roots and foliage due to the increases of gypsum levels under zero levels of potassium were significantly lower than those recorded with the higher levels of potassium application. The data presented in Table 3 indicated that the increase in the total fresh and total dry yield by the application of 15 ton gypsum/fad. with 108 kg K/fad. amounted 86.02 and 83.08 % as compared by the application of zero level gypsum with 108 kg K/fad.

3- Quality characteristics

3-1- Effect of gypsum treatments on quality characteristics.

Results of crude protein, crude fiber, ash, total digestible nutrients (TDN) and digestible crude protein (DCP) percentages in roots of fodder beet as affected by gypsum treatments are presented in Table 4 .Among the gypsum treatments the statistical analysis indicated the presence of significant differences in crude protein, crude fiber, ash, total digestible nutrients and digestible crude protein percentages in roots of fodder beet. Application of 15 ton gypsum/fad. gave the highest crude protein(9.05 %), ash (6.19 %), TDN (81.62 %) and DCP(4.92 %).While, the control treatment gave the lowest content of crude protein (7.61 %), ash (5.21%), TDN (80.06 %) and DCP (3.59 %) and highest value of crude fiber (9.43%).

3-2- Effect of potassium treatments on quality characteristics.

Results of crude protein, crude fiber and ash in roots of fodder beet as affected by potassium treatments are presented in Table 4. Data indicated the presence of significant differences in crude protein, crude fiber, ash, total digestible nutrients and digestible crude protein percentages in roots of fodder beet. Results revealed that application of 108 kg K/fad. significantly increased crude protein (9.49 %), ash (5.95 %) and DCP (5.34 %) and decreased crude fiber (6.94 %) and TDN (80.63%). The increases in crude protein, ash and digestible crude protein amounted to 83.55, 12.90 and 3.05% as compared with control, respectively.

Increasing K in the soil media of fodder beet plant enhanced plant absorption of more N and hence protein synthesis improved and its percentage increased in plant tissues. Results are similar to those found by El-Khawaga and Zeiton (1993) who found that application of potassium fertilizer up to 80 kg K_2O/fad.significantly affected, crude protein and ash percentages.

3-3- Effect of gypsum and potassium fertilizer rates interaction on quality characteristics.

Results of the crude protein, crude fiber, ash, total digestible nutrients and digestible crude protein in roots of fodder beet as affected by the interaction between gypsum and potassium levels are presented in Table 4. The statistical analysis indicated significant differences among the different treatments. It is clear from the data that the increases in the crude protein, ash and digestible crude protein contents due to increases of gypsum levels under zero levels of potassium were significantly lower than those recorded with the higher levels of potassium application while, crude fiber and TDN took an opposite trend. The data presented in Table 4 indicated that the increases in the crude protein, ash and digestible crude protein contents by the application of 15 ton gypsum/fad. with 108 kg K/fad. amounted to 31.15, 20.19 and 51.09 % as compared by the application of zero level gypsum with 108 kg K/fad.

Table 4: Effect of gypsum, potassium fertilizers rates and their interaction on quality characters of fodder beet roots.

Traits / Treatment	CP %	CF%	Ash %	TDN %	DCP %
A- Gypsum treatments (t/fad.)					
Zero(Cont.)	7.61	9.43	5.21	80.05	3.59
5	8.03	8.08	5.41	81.08	3.98
10	8.47	7.46	5.72	81.49	4.39
15	9.05	7.12	6.19	81.62	4.92
LSD 0.05	**0.06**	**0.14**	**0.08**	**0.14**	**0.04**
B- Potassium treatments (kg/fad.)					
Zero(Cont.)	5.17	8.89	5.27	81.22	1.32
36	7.94	8.38	5.54	80.85	3.89
72	8.95	7.89	5.78	80.97	4.84
108	9.49	6.94	5.95	80.63	5.34
LSD 0.05	**0.07**	**0.07**	**0.06**	0.07	**0.09**
AXB-Interaction					
Zero G + Zero K	4.69	10.70	4.97	79.80	0.87
Zero G + 36 K	7.69	9.89	5.14	79.62	3.66
Zero G + 72 K	8.44	9.17	5.35	80.02	4.36
Zero G + 108 K	9.63	7.97	5.40	80.71	5.46
5 G + Zero K	4.94	8.98	5.07	81.20	1.11
5 G + 36 K	7.75	8.49	5.23	80.81	3.72
5 G + 72 K	8.69	7.97	5.54	80.99	4.59
5 G +108 K	10.75	6.90	5.81	81.31	6.51
10 G + Zero K	5.31	8.03	5.30	81.91	1.46
10 G + 36 K	8.06	7.83	5.61	81.29	4.01
10 G + 72 K	9.13	7.39	5.88	81.36	5.00
10 G +108 K	11.38	6.57	6.10	81.41	7.09
15 G + Zero K	5.75	7.85	5.73	81.94	1.86
15 G + 36 K	8.25	7.30	6.17	81.69	4.18
15 G + 72 K	9.56	7.03	6.34	81.54	5.40
15 G +108 K	12.63	6.30	6.49	81.28	8.25
LSD 0.05	**0.12**	**0.11**	**0.09**	0.12	**0.13**

G = gypsum K = potassium CP % = Crude protein CF % = Crude fiber
TDN% = Total digestible nutrients DCP % = Digestible crude protein

4- NPK content.

4-1- Effect of gypsum treatments on NPK content.

Results of NPK content for roots of fodder beet as affected by gypsum treatments are presented in Table 5. The statistical analysis indicated the presence of significant differences in the NPK% of roots. The treatment 15 ton gypsum/fad. gave the highest N% of roots compared with control. While, the contrast was observed with P and K%, where as the concentration of P and K% decreased with increasing the level of gypsum application.

The decrease in P % may be due to the phosphorus fixation and change of P available to unavailable through the precipitation of insoluble calcium phosphates (Haynes 1982).

4-2- Effect of potassium treatments on NPK content.

Results of NPK% in roots of fodder beet as affected by potassium treatments are presented in Table 5. Among the potassium treatments the statistical analysis indicated the presence of significant differences in NPK % in roots of fodder beet compared with control. Results revealed that application of 108 kg K/fad. significantly increased N, P and K by 1.52, 0.52 and 5.61%, respectively in roots.

Table 5: Effect of gypsum, potassium fertilizer rates and their interaction on nitrogen (N), phosphorus (P) and potassium (K) concentration of fodder beet roots.

Traits / Treatment	N %	P %	K %
A- Gypsum treatments (t/fad.)			
Zero (Cont.)	1.22	0.56	5.95
5	1.29	0.53	5.76
10	1.36	0.49	5.15
15	1.45	0.45	4.82
LSD 0.05	**0.01**	**0.02**	**0.15**
B- Potassium treatments (kg/fad.)			
Zero (Cont.)	0.83	0.47	4.95
36	1.27	0.50	5.26
72	1.43	0.52	5.60
108	1.52	0.52	5.61
LSD 0.05	**0.006**	**0.02**	**0.16**
AXB-Interaction			
Zero G + Zero K	0.75	0.54	5.48
Zero G + 36 K	1.23	0.55	5.87
Zero G + 72 K	1.35	0.56	6.12
Zero G + 108 K	1.54	0.59	6.34
5 G + Zero K	0.79	0.48	5.49
5 G + 36 K	1.24	0.52	5.64
5 G + 72 K	1.39	0.54	5.78
5 G +108 K	1.72	0.56	6.12
10 G + Zero K	0.85	0.45	4.57
10 G + 36 K	1.29	0.48	4.97
10 G + 72 K	1.46	0.51	5.37
10 G +108 K	1.82	0.53	5.68
15 G + Zero K	0.92	0.41	4.27
15 G + 36 K	1.32	0.43	4.57
15 G + 72 K	1.53	0.45	5.12
15 G +108 K	2.02	0.49	5.33
LSD 0.05	**0.007**	**0.03**	**0.19**

G = gypsum K = potassium

4-3- Effect of gypsum and potassium fertilizer rates interaction on NPK content.

Data presented in Table 5 demonstrated the significant effect of the above- interaction on NPK% of roots. It is clear from the data that the increase in P and K% of roots due to the increase of potassium levels under zero levels of gypsum were significantly lower than those recorded with the higher levels of gypsum application under zero level of potassium. The data presented in same table indicated that the highest increase in the N % was found with the application of 15 ton gypsum/fad and 108 kg K/fad.

REFERENCES

Abdel-Aal, S.M. (1990). Effect of nitrogen, phosphorus and potassium fertilization on the productivity of fodder beet (*Beta vulgaris* L.). Egypt. J.Agron.15:159-170.

Ali,L.K.M. (1990). An evaluation of adding different sources of gypsum for improving soil productivity under field conditions. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

A.O.A.C. (1980). Official Methods of Analysis. Association of Analytical Chemists 13th Ed. Washington D.C., U.S.A.

Chapman, H.D. and P.F. Pratt (1961). Methods of Analysis for Soils, Plant and Water. Div.of Agric. Sci. Univ. of Calif, pp: 309.

Church, D.C. (1979). Livestock Feeds and Feeding 4th Ed. pp 79.O&B Books Inc; Corvallis, Dragon 97330, U.S.A.

Cottenie, A., M.L.Verloo, Kiekens, G. Velghe and R. Camerlynck (1982). Chemical Analysis of Plant and Soil. PP. 100 – 129. Laboratory of Analytical and Agrochemistry, State Univ. Ghent. Belgium.

El-Khawaga, A.A.H. and O.A.A. Zeiton (1993) Yield and chemical composition of fodder beet as affected by nitrogen and potassium fertilization under newly reclaimed area. Egypt. J.Appl. Sci.,8(2) 54-62

El-Shafei, M.A.M. (1997). Effect of potassium fertilization on productivity of some fodder beet varieties. M. Sc. Thesis. Fac. Agric. Moshtohor. Zagazig Univ. Egypt.

El-Sharawy,M.A.O.; M.A. El- Bordiny and Sedeka , A.Abdel- Wahed (2008) Improvement of a salt affected soil on Bahr El- Bakar area using certain industrial byproducts: 1- Effect on physical and chemical characteristics. J.Appl. Sci. Res.4 (7) 839-846.

F.A.O (1995). Improvement and Production, Drainage and Salinity. An international source book. Paris.

Gazia, E.A.E.(2001). Effect of farmyard manure, gypsum and nitrogen on sugar beet yield and NPK uptake. Minufia, J. Agric. Res., 26(4)1117-1125.

Geweifel, H.G.M. and R.M. Aly (1996). Effect of nitrogen and potassium fertilization treatment on growth, yield and quality of some fodder beet varieties. Annals.Agric.Sci.Moshtohor, 34(2): 441-454.

Hassanin, M.A.(2001). Effect of hill spacing and potassium fertilization at two sowing dates on sugar beet yield and quality. Bull. Fac. Agric., Cairo Univ.25:27-46.

Haynes, R.J. (1982). Effects of liming on phosphate availability in acid soils. Plant Soil, 68: 289–308.

Mekki, B.B. and M.M. El-Gazzar (1999). Response of root yield and quality of sugar beet (*Beta vulgaris* L.) to irrigation with saline water and foliar potassium fertilization. Annals. Agric. Sci., Ain Shams Univ., Cairo, 44(1):213-225.

Mohammed, S.Th.A.(1997). Effect of some fertilization treatments on yield and chemical composition of fodder beet at Ras Sudr region. M.Sc. Thesis. Fac. Agric. Ain Shams Univ. Egypt.

Sandu, G. and N. Mihaescue (1989). Reclamation of saline and alkali soils on the Romanian plain problem. de agrofitolehnio Teoretica Si Aplicata,6(3):251-258(C.F. CD ROM Computer system)

Snedecor, G.W. and W.G. Cochran (1980).Statistical Methods, 7th Ed. pp. 507. Iowa State Univ. Press, Ames, Iowa, USA.

Sun, S.G.; F.S.Li.; Y.Wan and G.C. Zheng (1994). Effect of zinc and potassium on dry matter accumulation of sugar beet mid-late growing season. China sugar beet. (4)26-29.

تحسين انتاجية وجودة بنجر العلف بأستخدام الجبس الزراعي و التسميد البوتاسي في الأراضي القلوية المتأثرة بالملوحة

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- أشتملت الدراسة على أربعة مستويات من الجبس الزراعي (بدون أضافة,١٠،٥ و١٥ طن جبس/ فدان) و أربعة مستويات من التسميد البوتاسي (بدون أضافة , ٣٦ , ٧٢ و ١٠٨ كجم بو٢أ/ فدان) وكان التصميم المستخدم الشرائح المتعامدة في ثلاثة مكررات.
- اشارت النتائج المتحصل عليها الى وجود إختلافات معنوية بين المعاملات المختلفة و أن أعلى النتائج كانت مع معاملة أضافة الجبس بمعدل ١٥ طن للفدان والبوتاسيوم بمعدل ١٠٨ كجم للفدان أدت إلى زيادة معنوية في صفات النمو الخضري لبنجر العلف طول الجدر و قطر الجذر ووزن العلف الأخضر و الجاف للجذر و الأوراق لكل نبات ولمحصول العلف الأخضر و الجاف الكلي للفدان .
- أشارت النتائج المتحصل عليها إلى زيادة معنوية لصفات جودة المحصول العلفي من حيث (نسبة البروتين الخام و الرماد و البروتين المهضوم) بزيادة معدل إضافة الجبس الى ١٥ طن للفدان والبوتاسيوم الى ١٠٨ كجم للفدان بينما حدث نقص معنوي في نسبة الألياف الخام و المواد المهضومة الكلية بزيادة معدل اضافة الجبس الى ١٥ طن للفدان والبوتاسيوم الى ١٠٨ كجم للفدان.
- كما أشارت النتائج إلى زيادة معنوية في محتوى النيتروجين بزيادة معدل إضافة الجبس الى ١٥ طن للفدان والبوتاسيوم الى ١٠٨ كجم للفدان بينما حدث نقص معنوي في نسبة الفوسفور و البوتاسيوم.

وتوصى الدراسة بإضافة الجبس الزراعى بكمية لا تقل عن ١٥ طن/فدان مع إضافة ١٠٨ كجم بو٢أ/فدان وذلك لتحسين إنتاجية محصول بنجر العلف تحت ظروف الأراضى الملحية القلوية.