J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 8 (11): 605 - 612, 2017

Impact of Some Soil Amendments Application on Soil Properties, Fodder Beet Productivity and Quality under Salt Affected Soil

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ABSTRACT

A field experiment was in Sahl El-Tina site, North Sinai Governorate, during the two successive seasons (2015/16 and 2016/17) to study the of applying some soil amendments (sulphur (S) (0.5 Mg fed^{-1}), gypsum (G) (2 Mg fed^{-1}), compost (C) (5 Mg fed^{-1}) and their combinations, (S+G), (G+C), (S+C) and (S + G and C), comparing with control) in salt affected soil on soil properties, forage yield and quality of fodder beet variety, A randomized complete block design with three replications was applied.Application of soil amendments weresignificantly edsoil EC values in case of the first and second growing seasons. Whereas, the soil pH was significantly decreased by applying all amendments compared to control. The concentrations of N, P and K in fodder plants illustrate a relative increase by decreasing soil salinity as a result of was adding different amendments.The results showed that soil amendment application increased top and root fresh yield, dry matter yield, crude protein content, root length and diameter, while values of Nutrient Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) Generally fodder beet top had higher contents of crude protein, crude fiber and ash than roots and the reverse was true for organic matter and nitrogen free extract contents. The percentage of Total Digestive Nutrients percentage (TDN), Relative Feeding Value (RFV) and Relative Forage Quality (RFQ) overall the studied treatments had a prime performance as a superior intake.

Keywords: Fodder beet (Beta vulgaris), salt affected soils, soil amendment, yield, quality.

INTRODUCTION

In Egypt, improving saline soils is an important part in the agricultural program. Gypsum is usually used for the reclamation of saline-sodic and sodic soils (Amezketa *et al*., 2005). Wong *et al*. (2009) reported that gypsum and organic matter treatments are used for ecreas effects of high sodium irrigation water in agricultural area because of its solubility, low-cost, availability and ease of handling Use of organic treatments may promote sustainability as a result of its long-term ameliorative effects on soil physical, chemical and biological properties (Ould-Ahmed *et al.,* 2010). Application of gypsum and organic matter to the surface soil will reduce spontaneous dispersion and EC down to the subsoil, compared to the addition of gypsum alone (Vance *et al*., 1998). Compost is an organic matter resource resulting from exploiting wastes through the controlled bioconversion process. Many studies have revealed the benefits of organic treatments in improving physical, chemical and biological properties of soil that depending on the quantity and composition (Courtney and Mullen, 2008).

Moreover, sulphur is a good efficient treatment for improving the physical, chemical and nutritional properties of the soil and for rising crops yield production especially when it is combined with organic manure application. Gad and Kandil, (2010) stated that sulphur amendment enhances plant growth parameters by reducing soil pH and consequently increases the solubility of fixed minerals and so its concentration in the root zone.

Fodder beet is popular crop in several countries such as Egypt, United States of America, Denmark and Netherland. In Egypt beet, is known as important forage crop, which the national income (Abd El-Naby *et al.,* 2014). Because fodder beet contains high water and sugar, it increases milk product and is suitable forage for dairy cows. It is used by chipping and by mixing with straw in European countries. It is also reported that fodder beet plant is suitable to make silage (Akyıldız 1983 and Özen *et al.,* 1993). Fodder beet is one of the promising forage crops which is not only recommended as a good source of energy for dairy cows (Gaivoronskii, 1981) but also is suitable for sowing in marginal lands such as saline soil (Abou El- Hassan *et al.,* 1971 and Rammah *et al.,* 1984). Fodder beet is sowing as an annual winter crop and offers a superior yield potential than any other arable fodder crop, when grown under suitable conditions, it can produce about 20 ton ha^{-1} dry matter yield (DAF, 1998). Both the top and the root growth parts are used to feeding the animals but, the main fodder is the tuberous root (Ibrahim, 2005). In summer seasons, fodder beet fulfill the gap of forage production. Abd El-Naby *et al*., (2013) recorded that Rota variety achieve the greatest total fresh yield (43.13 and 39.22 ton fed^{-1}) in Serw (salt clay soil) and Ismaelia (sandy soil) sites, respectively.

The forage feeding value is distinct according to its capacity to promote animal production which depends upon its ability to provide nutrients to the animal. Green forage is very important in dairying as it is a source of carotene, the precursor of vitamin A, and calcium (Abd Alrahman and Ahmed, 2005).

The aim of the present study was to assess some soil amendments and their combinations on soil properties, fodder beet yield and quality in case of salt affected soil of Sahl El-Tina.

MATERIALS AND METHODS

A experiment was in a private farm in Sahl El-Tina site, North Sinai Governorate, during 2015/16 and 2016/17 to study the effect of three soil amendment, sulphur (S) (0.5 Mg* fed^{-1}), gypsum (G) (2 Mg fed^{-1}), compost (C) (5 Mg fed^{-1}) and their combinations;

(S+G), (G+C), (S+C) and (S+G+C); comparing with control treatment on the yield and yield components of exotic fodder beet variety, viz. Rota. Mg* (mega gram) = ton = 1000 kg). The physical and chemical analyses of the soil of the experimental farm are presented in Table 1.

Table 1. Some Physical and chemical properties for the soil of the experimental site.

Particles size distribution								
Coarse sand (%)	Fine sand(%)	Silt (%)	Clay (%)		Textural class	O.M.%		$CaCO_3$%
7.44	68.44	9.60	14.52		Sandy clay	0.41		7.85
pH (1:2.5)	EC (dS/m)	Cations (meq/L)				Anions (meq/L)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_{3}	Cl^{-}	SO^{--}_{4}
8.32	13.5	27.84	23.53	83	0.63	1.93	90.24	42.83
Available Macronutrients (mg/kg)			Available Micronutrients (mg/kg)					
N	P	K	Fe		Mn	Zn		Cu
60	3.10	168	2.13		1.45	0.72		0.008

Soil management

Soil surface was leveled using laser technique. The site was subjected to Deep sub-soiling plough and field drains at a distance of 10 m between each of two drains at a depth of 90 cm at the drain beginning were established in conjunction of irrigation canal in the middle part of the experimental treatment unit. The treatment units were subjected to continuous and alternative leaching processes before fodder beet planting.

The treatments application

Sulphur, gypsum and compost (of 99% purity) were incorporated in soil, ploughed and followed by irrigation. All soil treatments were applied one month before sowing to assure their complete decomposition and soil was irrigated after sowing. The compost chemical properties are shown in Table (2). The compost analysis was according to the standard methods described by Brunner and Wasmer, (1978).

Table 2. Chemical properties of the used compost.

Moisture content %	EC dSm^{-1} (1: 5)	pH (1:2.5)	C	C/N	O.M (%)	N	P	K	Fe	Mn (mgkg^{-1})	Zn
20.25	2.35	7.65	29	1:10	35	2.87	0.73	1.57	215	120	94

Soil analysis

Surface soil samples (0- 30 cm) were collected, air- dried, sieved to pass through a 2 mm sieve and mixed thoroughly. Organic matter, total soluble ions and electrical conductivity (EC) were determined in the saturated soil paste extract while the pH was measured using a pH meter in soil suspension (1: 2.5) as described by Page *et al.*, (1982). Available nitrogen was measured according to the modified Kjeldahal method by Black, (1965). Available P and K were extracted using ammonium bicarbonate (DTPA) as described by Soltanpour, (1985) and determined using Inductively Coupled Plasma (ICP) Spectrometry model 400 also, Na^+/K^+ and Ca^{2+}/Mg^{2+} percentages were measured.

Plant analyses

The plant samples were oven dried at 70°C for 48 h up to constant dry weight, then ground and wet digested using H_2SO_4:H_2O method (Page *et al.*, 1982). The digests were then subjected to the measurement of nutrients N, P and K (Cottenie *et al.*, 1982). The plant content of nitrogen was determined by Kjedahl method (Chapman and Partt, 1961).

Field procedures

The design of the experiment was a randomized complete block with three replications. Surface irrigation system was followed where each treatment consisted of 5 ridges 4.5 m long and 60cm apart with 30cm between hills (two seeds/hill) i.e. treatment area was 4.5 x 3m. Fodder beet *(Beta vulgaris* L.) seeds were sown on 17th and 15th October at 2015/16 and 2016/17 seasons, respectively. Fodder beet was sown after *Zea maize* and after Cow pea *Vigna unguiculata*, in the 1st and the 2nd growing seasons, respectively. Superphosphate was during land preparation at a rate of 200kg fed^{-1} , while urea (46.5 % N) was added at a rate of 60kg N fed^{-1} at three equal doses, after 30 days, 60 days and 90 days from sowing. Whereas, potassium sulphate (50% KP) at a rate of 100 kg fed^{-1} was applied at two equal doses, after 30 days and 60 days from sowing. The normal agricultural practices for growing fodder beet were applied. At harvest time ten plants were taken at random from each treatment for measuring the root , fresh weight of root as kg plant^{-1} Meanwhile, the fresh forage yield of roots tops ton fed^{-1} were recorded.

Forage Evaluation:

- Chemical composition

Laboratory chemical analysis of the fodder roots samples and energy estimation dry matter (DM), ash, ether extract (EE), crude fiber (CF), crude protein (CP) and nitrogen free extract (NFE) were determined according to the procedures of AOAC, (1985). DM of fodder roots was determined by oven drying at 105°C for a period of 12 h and ash at 550°C for a period of 3 h. Total nitrogen was determined by Kjeldahl method and CP was obtained from N where, CP= N×6.25. The metabolic energy concentration (ME) of each feed ingredient was calculated by formula according to (MAFF, 1975). Organic matter % (OM) and nitrogen free extract (NFE) concentrations were estimated using the following equations: OM% =100 – (Ash%) and NFE= 100 – (CP%+ CF%+ EE% + Ash%).

- Cell wall content

Acid Detergent Fiber (ADF), Nutrient Detergent Fiber (NDF) and Acid Detergent Lignin (ADL) were determined using the ANKOM filter bag technique (Komarek, 1993).

- Nutritive values

The total digestible nutrients (TDN) based on dry mater basis was estimated according to Heeney (1978), relative feeding value % (RFV) was estimated according to Uttam *et al*., (2010) and relative forage quality % (RFQ) was estimated according to (Moore and Undersander, 2002).

Statistical analysis

Data were analysis of variance using SAS 9.1 (2004). Data of the two seasons are presented in a combined analysis, because the test of homogeneity of variance (Winer, 1971), when performed, revealed that the error of the variance between the two experimental seasons was not significantly different.

RESULTS AND DISCUSSION

Soil EC, pH and organic matter as affected by soil amendments

In case of the first and second seasons the three and their combined had significantly decreased soil EC values relative to the control (Table 3). In the first season, the EC values more slowly by applying gypsum and sulphur treatments than in compost and other combined treatments, but in the second season the EC values had to a lower level in all treatments. The decrease of soil EC may be due to the improvement in soil porosity and hydraulic conductivity by adding soil amendments, which resulted in enhancing the leaching of salts. is mostly in harmony with Hussain *et al*., (2001); who that only a slight decrease occurred when different amendments were applied alone or in combination with other amendments except in case of using sulphur or its combination with FYM.

The pH decreased among all amendments relative to the control (Table 3) in the first and second seasons. This behavior may be due to the organic matter (compost) fraction where the negative charged surfaces increased due to the dissociation of H^+ from certain functional groups particularly from carboxylic (-COOH) and phenolic (-C_6H_4OH) groups. Also, Khan *et al*., (2006) found that the soil pH decreased by gypsum application from 8.54 to 7.54. Moreover, Mahmoud (2011) recorded relative decreases in soil pH compared to the control which varied from 8.35 to 8.31 and 8.37 to 8.17 in case of the two seasons by applying gypsum and sulphur treatments, respectively.

Soil organic matter contentsignificantly higher in all treatments than the control whereas the highest value exists in compost treatment in the first season than the other ones, (Fig. 1). the second season than in the first one although the same mass of organic matter was to the soils. This may be a result of sowing cowpea between the two growing seasons. This is with Tejada *et al*., (2006), who stated that the of organic on soil organic carbon depends on the chemical nature of the amendments. macronutrients N, P and K significantly increased with applying of soil amendments alone or combined than control in the first and the second seasons, respectively.

Available cations soil as affected by amendments application.

Fig. (2) shows the of available cations in soil in case of the first and second seasons after amendments application and also at the end of the experiment for all treatments including control. The Na^+/K^+ in first season (C), (S+G) and (S +C) treatments; intermediate in case of (G) and (S+G+C) treatments; whereas, the lowest exists in control (Fig.2). But in the second season the more slowly in (G) and (C) treatments than in (S) and other combined treatments. Ca^{2+} / Mg^{2+} tended to be lower in the first season than in the second one, where the in Ca^{2+} /Mg^{2+} was the greatest in (G) treatment. Ca^{2+} / Mg^{2+} in the second season (Fig. 3).

Table 3. Some chemical properties (EC and pH) and macronutrients content in the studied soil after fodder beet harvesting.

Treatment	pH (1:2.5)		EC (dSm^{-1})		Available macronutrients ($mg\ kg^{-1}$) N		P		K	
Season	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	8.10	8.08	12.97	11.50	50	80	4.91	4.73	210	320
Sulpher	7.48	7.70	9.36	6.25	160	170	13.76	12.81	230	410
Gypsum	7.54	7.77	8.99	5.71	130	130	12.78	12.33	130	410
Compost	7.59	7.83	10.21	7.49	160	160	11.08	14.24	180	410
S+G	7.70	7.51	10.99	9.39	150	150	13.22	12.37	230	430
G+C	7.54	7.29	10.38	9.34	150	160	12.97	11.49	240	420
S+C	7.45	7.13	11.02	8.68	130	130	12.77	12.24	190	410
S+G+C	7.46	7.65	10.04	7.24	110	110	10.89	13.37	340	410
Mean	7.61	7.62	10.49	8.20	130.00	136.25	11.55	11.70	218.75	402.50
L.S.D.(0.05)	0.111	0.199	0.331	0.507	1.142	1.930	0.157	0.396	1.321	3.811

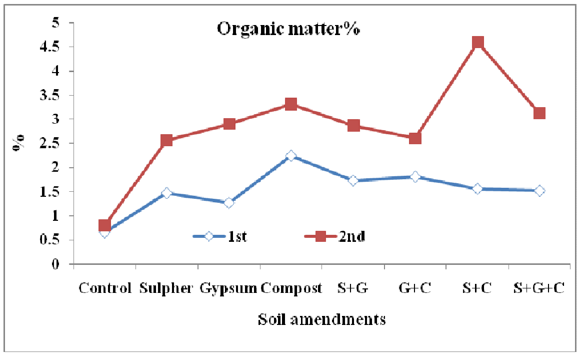

Fig. 1. soil contents of organic matter percentage in first and second growing seasons

Organic amendments would increase the amount of Ca^{2+}derived from $CaCO_3$ because of the formation of organic acids (Wong *et al.*, 2009). Furthermore, potassium and sodium ions on the soil colloids would be replaced by calcium ions and leached from the soil. The results that, by the end of the experiment, the dominant ions changed from Na^+ and K^+ to Ca^{2+} in soil by sulphur and gypsum treatments, respectively.

David and Dimitrios, (2002) demonstrated that Mg^{2+}content tended to decrease in all treatments over time. Previous studies have reported that Ca^{2+} could improve soil structure by forming cationic bridges between clay particles and soil organic matter. In addition, Ca^{2+} can inhibit clay dispersion and the associated disruption of aggregates by replacing Na^+ and Mg^{2+} in clay and aggregates, thereby promoting aggregate stability (Zhang and Norton, 2002). These results indicate that sulphur, gypsum, compost and combined treatments could help in reducing the salt content and improve saline soil properties.

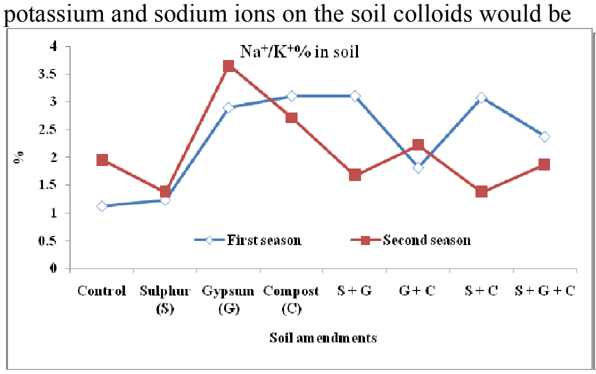

Fig. 2.The relative percentage of Na^+ and K^+ in saline soil

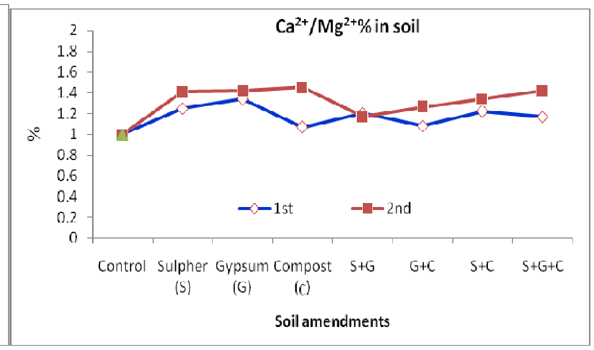

Fig. 3.The relative percentage of Ca^{2+} and Mg^{2+} in saline soil

Botanical and agronomic aspects of fodder beet:

Data in Table (4) show the mean performance of fodder beet, root and top, characters plant^{-1} by applying soil amendment. Significant differences were observed over all treatments. For instance, the tallest root length exits in case of applying (C) treatment. While the tallest top height was recorded in combined (S+G+C) and (S+C) with (65.70 and 59.75 cm, respectively) whereas control and (G) treatments had the shortest top (46.50 and 46.63 cm, respectively). Combined (G+C) gave the biggest root diameter (30.25 cm) whereas control was the lowest one (11.63 cm). The application of combined (S+G+C) gave the highest root and top fresh weight plant^{-1} (2.31 and 0.36 kg plant^{-1}, respectively) Moreover, the control and (S) treatments gave the lowest root and top fresh weight plant^{-1}. The relative relationship between top / root % recorded higher percentage in case of control and (S) treatment (21.01 and 19.55%, respectively), whereas combined (S+G+C) had the lowest one (15.58%). Moreover, combined (S+G+C) produced fresh and dry yield of (43.85 and 6.33 ton fed^{-1}) for root and (8.62 and 1.38 ton fed^{-1}) for top, respectively.

The results are in harmony with Wanas *et al.*, (2007), who proved the importance of adding compost to clay soil for increasing the productivity of root crops such as fodder beet. Also, Sherif *et al.*, (2012) found that compost tea increased root and sugar yields of sugar beet cultivated in saline calcareous soil at Ras Sudr.

Fodder beet root and top contents of macronutrients as affected by the studied treatments.

Data in Table (5) show the of N, P and K in fodder beet root and top. These contents increased by applying of soil amendments and their combinations, whereas the lowest contents of these nutrients were observed in control. The N, P and K in root and top over the two growing seasons were clearly increased by decreasing soil salinity as a result of adding different amendments. The relative increase of the studied N, P and K in fodder beet plants depends mainly on the type of amendments were used compared with control. This finding is in agreement with the results obtained by Gad and Kandil (2010). Lange *et al.*, (2005) found that surface applications of gypsum, sulphuric acid and gypsum + Ca $(NO_3)_2$ were equally effective in improving infiltration rates compared to the control within one year of application.

Chemical composition of the feed (quality)

a- Root

As shown in Table (6-a) it is obvious that applying the studied treatments results in a significant difference in the chemical composition / DM% of fodder beet roots treatments. Organic matter % ranged from 91.51% (G) to 94.88% combined (S+C) with an average of 93.21%. CP recorded its highest percentage with combined (S+G+C) treatment (7.47% / DM) whereas control had the lowest one with (5.86% / DM) of fodder beet roots.

Table 4. Mean performance of top and root agronomical traits plant^{-1} and yield ton fed^{-1} over two growing seasons.

Treatments	Plant^{-1}						Root yield ton fed^{-1}		Top yield ton fed^{-1}	
	Root length cm	Top height cm	Root diameter cm	Root weight kg	Top weight kg	Top / root ratio	Fresh	Dry	Fresh	Dry
Control	28.63	46.50	11.63	1.19	0.25	21.01	24.06	2.92	4.91	0.72
Sulphur (S)	29.33	53.63	12.55	1.33	0.26	19.55	25.16	3.43	6.16	0.79
Gypsum (G)	30.50	46.63	18.30	1.54	0.27	17.53	28.54	4.01	4.96	0.70
Compost (C)	33.88	51.00	20.70	1.86	0.31	16.67	36.55	5.27	6.33	1.05
S + G	30.25	56.75	13.33	1.56	0.28	17.95	31.96	4.69	5.76	0.92
G + C	33.00	54.63	30.25	1.88	0.33	18.75	42.86	5.85	7.26	1.11
S + C	31.50	59.75	13.80	1.76	0.32	17.02	35.94	5.16	7.10	1.05
S + G + C	33.13	65.70	24.82	2.31	0.36	15.58	43.85	6.33	8.62	1.38
Mean	31.28	54.32	18.17	1.68	0.30	18.01	34.12	4.71	6.39	0.97
LSD (0.05)	1.777	3.094	1.767	0.156	0.050	3.561	4.44	0.601	0.801	0.118

Table 5. Fodder beet root and top contents of macronutrients as affected by the studied treatments over two growing seasons.

Treatment	%					
	N	P	K	N	P	K
	Root			Top		
Control	0.96	0.72	0.92	0.66	0.84	1.04
Sulpher (S)	1.14	0.85	2.91	2.84	1.04	3.45
Gypsum(G)	1.09	0.82	2.52	2.19	0.97	3.03
Compost (C)	1.20	0.81	1.97	2.03	0.93	2.34
S+G	1.07	0.88	2.58	2.26	0.95	2.78
G+C	1.14	0.95	2.46	1.80	0.98	2.49
S+C	1.15	0.80	2.96	2.14	0.98	3.87
S+G+C	1.18	0.94	2.99	2.14	1.07	3.46
Mean	1.12	0.84	2.42	2.01	0.97	2.80
L.S.D.(0.05)	n.s.	0.14	1.10	n.s.	0.07	0.57

CF% ranged from 7.38 % in case of (C) treatment and reached 9.18%/ DM of control with an average of 8.57% / DM. On the other hand, the nitrogen free extract (showed its highest value (77.00%) by the application of combined (S+C) treatment whereas, the lowest value (73.84%) was recorded with (G) treatment. Ash content ranged from 5.12% for (S+C) treatment and reached 8.49% for (G) treatment with an average of 6.36%. Combined (S+G+C) treatment gave the highest percentages of ether extraction (and metabolic energy content with (2.03 and 1.27%, respectively).

b-Top

Table (6-b) shows the chemical composition / DM of fodder beet top soil amendments recorded significant differences ($P \leq 0.05$) except for metabolic energy %. The highest organic matter of fodder beet top was recorded (77.86%) in case of (G+C) treatment. Crude protein recorded an average of 12.72% for all treatments. Also control treatment showed the highest value of fiber (13.51%). Control showed the lowest content of nitrogen free extract (50.23%), while (C) treatment performed the highest content (52.90%). Ash % ranged from 22.14% (G+C) to 24.47% of the control with an average of 23.10%. Combined (S+G+C) treatment had the best percentage of ether extraction (1.99%) whereas; the lowest value existed in case of (S) treatment (1.62%).

Top recorded minor values of ether extract (EE) than roots whereas fodder beet root contain higher percentage of metabolic energy (ME/DM%) than top. Fodder top exposed higher contents of crude protein, crude fiber and ash than root.

OM% performed lower values in fodder beet top compared with its values for roots whereas CP% higher values exist in fodder top than roots for all treatments. Fodder top contains higher values of CF% than roots but roots dry matter contain higher values of nitrogen free extract than tops by applying soil amendments alone or combined. The existing highly significant increase in CP% is in accordance with Patel et al., (2007) also, CF% results is in line with those reported by Mustafa, (2007).

Fiber fractionations and root quality

Table (7) presents the results regarding the root dry matter (DM%) content of the analyzed samples. Significant differences ($P \leq 0.05$) were recorded among treatments for Fiber fractions (acid detergent fiber %, nutrient detergent fiber % acid detergent lignin and root quality (total digestive nutrients and).

Acid detergent fiber % % values varied from 13.30% of (S+G) to 14.96% of control. Nutrient detergent fiber % values varied between 19.01% of (G+C) and 21.70% of control whereas, acid detergent lignin% ranged from 1.88% of combined (S+G+C) to 2.48% of control.

For root quality the total digestive nutrients (TDN%) ranged from 55.86 % of control to 57.58% for (C) treatment with an average of 57.15% for all treatments. The relative forage value (RFV%) performed the best percentages across all treatments and ranged from 331.14% for control up to 382.91% for (G+C) with an average of 351.31% overall treatments. The relative forage quality (RFQ%) across all treatments ranged from 194.75 for control up to 427.84% for (S+G+C) treatment, also control treatment had confirmed a prime feeding. Control treatment gave the highest percentage of (ADF, NDF and and the lowest percentage of (TDN, RFV and respectively). All treatments recorded RFV % higher than 151%, and considered as a prime feeding according to

Uzun, (2010) category. The relative feeding value is not a direct measure of the nutritional content of forage, but it is important for estimating the value of forage (Van Soest, 1982). All studied treatments had a prime performance of RFV% as a superior intake%.

Table 6. Chemical and metabolic energy content (%/DM) of root and top fodder beet over two growing seasons (2015/16 and 2016/17).

Treatments	OM%	CP%	CF%	NFE%	Ash%	EE%	ME%
				a-Root			
Control	92.71	5.86	9.18	75.95	7.29	1.72	1.23
Sulpher (S)	92.92	7.16	8.26	75.60	7.08	1.90	1.24
Gypsum (G)	91.51	6.58	9.08	73.84	8.49	2.01	1.22
Compost (C)	92.99	7.39	7.38	76.32	7.01	1.90	1.25
G + S	92.99	7.19	8.55	75.24	7.01	2.01	1.24
C + G	92.86	7.42	8.89	74.63	7.14	1.92	1.24
C + S	94.88	7.41	8.48	77.00	5.12	1.99	1.27
C + G + S	94.84	7.47	8.76	76.58	5.16	2.03	1.27
Mean	93.21	7.06	8.57	75.65	6.36	1.93	1.25
L.S.D (0.05)	0.840	0.416	0.634	1.05	1.27	0.07	0.01
			b-Top				
Control	75.53	10.14	13.51	50.23	24.47	1.65	0.94
Sulpher (S)	76.79	13.18	10.23	51.76	23.21	1.62	0.98
Gypsum (G)	76.95	12.61	11.23	51.4	23.05	1.71	0.98
Compost (C)	77.55	13.23	9.75	52.9	22.45	1.67	1.00
G + S	77.07	13.16	10.03	52.16	22.93	1.72	0.99
C + G	77.86	12.88	11.28	51.97	22.14	1.73	0.99
C + S	77.16	13.27	10.06	51.86	22.84	1.97	1.00
C + G + S	76.31	13.25	10.19	50.88	23.69	1.99	0.98
Mean	76.90	12.72	10.79	51.65	23.10	1.76	0.98
L.S.D (0.05)	0.408	0.725	0.442	0.707	0.408	0.222	n.s.

Abbreviations: OM: Organic mater, NFE: nitrogen free extract, E.E.: ether extract and ME: metabolic energy

Table 7. Percentage of fiber fractionations and root quality% of fodder beet over two growing seasons (2015/16 and 2016/17).

Treatments	Fiber fractions (%DM)			Root quality traits (% DM)		
	ADF	NDF	ADL	TDN	RFV	RFQ
Control	14.96	21.70	2.48	55.86	331.14	194.75
Sulpher (S)	14.31	21.47	2.29	57.28	336.88	231.11
Gypsum(G)	14.39	20.65	2.29	56.62	349.98	269.85
Compost (C)	13.98	20.51	2.20	57.58	353.81	356.91
S+G	13.30	20.95	2.28	57.29	348.73	320.98
G+C	13.67	19.01	2.24	57.50	382.91	398.10
S+C	14.73	20.13	2.27	57.52	357.79	345.40
S+G+C	14.11	20.75	1.88	57.57	349.27	427.84
Mean	14.18	20.65	2.24	57.15	351.31	318.12
LSD (0.05)	0.689	1.18	0.205	0.889	20.23	23.43

Abbreviations: ADF: Acid detergent fiber , NDF%: Nutrient detergent fiber , ADL%: Acid detergent lignin , TDN%: Total digestible nutrients , RFV%: Relative forage value and RFQ%: Relative forage quality.

CONCLUSION

- The addition of sulphur, gypsum and compost led to decreasing soil salinity, as well as soil pH.
- Soil organic matter content was significant higher in all amended treatments than the control.
- T study that soil amendment improved the agronomic characters of fodder beet plan^{t-1}.
- The root yield of fodder beet forage ton fed^{-1} increased over the two growing by applying of soil amendments. Combined (S+G+C) treatment gave the highest forage productivity ton fed^{-1} of root and top in fresh and dry yield.
- The use of soil amendments increased the macro elements content in plant.
- Increasing dry matter yield, crude protein content and yield values in conjunction with decreasing fiber fractions content were realized after using soil amendment in fodder beet production.
- Control treatment revealed the highest percentage of (ADF, NDF and ADL%) whereas it had the lowest percentage of (TDN, RFV and RFQ%).
- All soil amendments in this study had a prime performance for ADF, NDF and RFV% as a superior intake%.
- In this study, we recommend the use of soil amendment (sulfur, gypsum and compost) alone or combined increased soil fertility and increase the productivity, quality and nutrition values of feed in fodder beet growing under conditions of new reclaimed saline soil, taking into account the leaching needs of the soil.

ACKNOWLEDGEMENTS

The researchers are highly thankful to Prof. Mohamed R. El-Zanaty, Soil, Water and Environment Res. Inst. Agric. Res. Center, Giza, Egypt, for providing the necessary facilities and support.

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تأثير بعض محسنات التربة على خصائص التربة وإنتاجية و جودة محصول بنجر العلف تحت ظروف الأراضي المتأثرة بالملوحة

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أجريت تجربة حقلية في قرية جلبانة بمنطقة سهل الطينة التابعة لمحافظة شمال سيناء خلال موسمين زراعيين متتاليين (16/2015و17/2016)، و ذلك لتقييم إضافة بعض محسنات التربة (الكبريت)، (الجبس)، (الكومبوست)،(الكبريت+الجبس)، (الكبريت + الكمبوست)، (الجبس + الكمبوست) و (الكبريت + الجبس + الكمبوست) مقارنة مع الكنترول على بعض صفات التربة وإنتاجية محصول بنجرالعلف وجودته و القيمة الغذائية للعلف. تم إستخدام صنف بنجر العلف (روتا) ، وقد نفذت التجارب بتصميم القطاعات الكاملة العشوائية في ثلاث مكررات.كانت النتائج المتحصل عليها كما يلي:-وجد أن إضافة الجبس والكمبوست والكبريت أدت إلى انخفاض ملوحة التربة (EC) وكذلك رقم حموضة التربة (pH) تم تحسين خصائص التربة و ذلك في موسمي الزراعة الأول و الثاني علي التوالي. حقق استخدام جميع المحسنات التي تم استخدامها في تلك الدراسة سواء بصورة فردية أو مركبة إلي زيادة محتوى التربة و كذلك لنباتات العلف (جذر و قمة) زيادة نسبية من العناصر الكبرى الميسرة (نتروجين ، فوسفور ، بوتاسيوم).أظهرت نتائج هذه الدراسة أن إضافة المحسنات الأرضية من الكمبوست و الجبس و الكبريت (C + G + S) للتربة قد زاد من ناتج العلف الأخضر والجاف لمحصولي الجذور و القمة للنبات و كذلك طول وقطر الجذور. أدت إضافة محسنات التربة سواء بصورة فردية أو مركبة إلي زيادة في محصول الجذور وحاصل المادة الجافة ونسبة البروتين الخام للجذور ، بينما انخفض محتوى (NDF%) ومحتوى (ADF%).حققت أوراق بنجر العلف محتوي من البروتين الخام والألياف الخام والرماد أعلى من محتواها في الجذور، بينما كانت نسب المادة العضوية و المستخلص الخالي أعلي في الجذور عنها في الأوراق.حققت النسبة المئوية للغذاء الكلي المهضوم (TDN%)، والقيمة النسبية للعلف (RFV%) و الجودة النسبية للأعلاف (RFQ%) أداء متميزا مع جميع محسنات التربة المستخدمة مقارنة بالغير معاملة.من خلال هذه الدراسة نوصي بأن إستخدام محسنات التربة (الكبريت – الجبس – الكمبوست) كلا علي حدة أو في صورة تراكيب تؤدي إلي زيادة خصوبة التربة و زيادة الإنتاجية الكلية مع تحسين الجودة و القيمة الغذائية لمحصول بنجر العلف تحت ظروف الأراضي الملحية حديثة الإستصلاح مع مراعاة الغسيلية للتربة.