EFFECT OF FARMYARD MANURE AND POTASSIUM FERTILIZATION ON SOME SOIL PROPERTIES AND PRODUCTIVITY OF SUGAR BEET CROP

By

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ABSTRACT

Two field experiments were carried out in clayey soils during the two successive seasons of 2009/2010 and 2010/2011 at Deyma village, Gharbiya governorate to investigate the effect of organic manure and potassium fertilizers on improving some soil properties, its productivity and quality of sugar beet crop. The experiment included twelve treatments which were three rates of farmyard manure (FYM) (0, 10 and 20 m^3 /fed.) and four levels of K fertilizer (0, 48, 72 and 96 K_2O /fed.). Split plot design with three replicates was used. The obtained results could be summarized as follow:

Application of FYM at any rate improved the soil properties (reduced the bulk density, soil pH, EC and Soluble ions of Na^+, HCO_3^- and Cl^-. However, markedly increased soil organic matter, total porosity, field capacity, available water and soluble ions of Ca^{+2}, Mg^{+2}, K^+ and SO_4^{-2}. The highest rate of FYM surpassed the other treatments in enhancing the determined properties.

The root yield of sugar beet and yield components (top yield, root diameter, root length, Sucrose%, Juice purity % gross sugar yield ton/fed and recoverable sugar percentage as well as NPK uptake in tops, and roots significantly augmented by the application of FYM. Raising the FYM rate gradually increased the quantity and quality of sugar beet.

All studies characteristics were significantly affected by K- Fertilizer: The maximum values were attained from the plants received the highest rate (96 kg K_2O/fed). For all the aforementioned parameters, expect the root diameter and juice purity % were taken the opposite trend application of

FYM and K-fertilizer in combination at the highest rates gave the better nutritive content than the control plants.

There for, it could be concluded that the application of 20 m^3 FYM/fed + 96 Kg K_2O/fed is the best formula for achieving the best crop and improving its mineral content under the condition of the current study.

Key Words: Farmyard Manure (FYM), K- Fertilizers, Sugar, Beet Plants, Soil properties.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is considered as one of the two important sugar crops not only in the world but also in Egypt. In Egypt, the sugar production still insufficient for local consumption. Sugar beet crop in Egypt have considerably higher sugar content compared with sugar cane. Moreover, the growth period of sugar beet is about half that sugar cane. Furthermore, consumed water by sugar beet to produce one ton of sucrose about 1300 m^3, whereas sugar cane needs about 4000 m^3 of water to produce the same quantity of sucrose. Many attempts devoted to improve sucrose quality and quantity in sugar beet crop through improving soil properties and good management of soil fertilization by organic and mineral fertilizers.

It's known that, the organic matter application to improve soil properties and consequently the plant growth. Farmyard manure is the form of organic matter that has the most economical ways to increase organic matter content in soils. Nowadays many investigators tried to utilize the FYM to fertilize sugar beet to release the cost and minimize the pollution of fertilizers for plants and drainage water. Investigators indicated that the application of FYM increased plant growth and the dry matter production (Gazia 2001, EL-Shouny, *et al.* 2008 and EL- Agodi, *et al.* 2011). Organic fertilizer is considered as an important source of humus, macro and micro elements carrier and in the same time it increase the activity of the useful microorganisms. Dahdouh, *et al.* (1999) found that organic manures play an important role in nutrients solubility as activate physiological and biochemical processes in plant which leading to increase the plant growth and nutrients uptake. Sakr, *et al.* (1992). concluded that the best means of maintaining soil fertility and productivity level could be achieved through periodic addition of proper organic material in combination with inorganic fertilizer. Jensen *et al.* (1983) found that land receiving farmyard manure needs an additional 40 kg N/ha. Kapur and Kanwar (1989) concluded that successive application from cattle manure caused to increase the content of Zn, Fe and Cu in sugar beet leaves. Jarvis, *et al.* (1997) they reported that an additional 30–60 Kg N/ha + 6 ton/ha poultry manure applied in the autumn gave the highest root yield and root sugar content and reduced root impurities. Vales and Strand (1991) showed that root yield was higher with FYM application. Ostrowska and Kucinska (1995) demonstrated that organic fertilizers increased root and sugar yields more than mineral fertilizer. AL-Labbody (1998) pointed out that applying FYM significantly increased root diameter, length, fresh weight, yields of root, top and sugar ton/fed. Zalat and Nemeat Alla (2001) found that treatments obtained FYM alone gave the highest values of sucrose % and total soluble solids.

Although potassium is not a structural component of plants, its one of the most important nutrients with respect to its physiological and biochemical functions. Durant *et al.* (1974). Showed that, potassium is very mobile in plant tissues and is found throughout the plant, also it's important to photosynthesis and the sugar which is produced relies on potassium for movement to the storage root. At harvest, plants given potassium have a significantly greater sugar percentage than those given none. Potassium also improves performance by increasing leaf area in May – August. This allows the crop to intercept more radiation (particularly in the spring when a large proportion falls on bare soil) giving proportional increase in sugar yield. Minenko and Tonkal (1980) recorded that, increase in K rate up to 240 Kg K_2O/ha increased sugar content of sugar beet plants. Sabolic (1987) stated that, high K levels increased sugar content of sugar plants. Cooke and Scott (1995) reported that, potassium is taken up rapidly by sugar beet crops from June to August. The amount present in roots and tops throughout growing season for a crop yielding 50 ton/ha roots at 16% sugar content, the amount in roots reaches a maximum at harvest (around 100 Kg/ha K_2O, equivalent to 83 Kg/ha K, for a 50 ton/ha crop); the amount in tops is greatest in late September- early October. Samarendra, Barik (2003) conducted that, potassium regulates many metabolic processes. Also she reported that Potassium plays an important role in many of the vital physiological processes in the plant, such as transpiration, translocation of sugar and starch, protein formation and osmotic regulation. Potassium affected on several enzyme systems requiring (e.g. pyruvate kinase, nitrate reductase and activation of ATPase systems). Osman (2006) showed that used of potassium fertilizer gave significant effects on total soluble solids, top yield, leaf area index, and total dry weight of leaves, root length, root diameter, root sucrose, purity, root/top ratio and sugar yield.

The present study was carried out to investigate the effect of organic manure and K-fertilizers on improving of some soil properties and productivity and quality of sugar beet crop.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons of 2009/2010 and 2010/2011 at Deyma village, Gharbiya governorate to study the effect of FYM and potassium fertilizers on some soil characteristics and its production of sugar beet crop.

Soil samples (0-30 cm depth) were taken before the performance of the experiments. Some physical and chemical analyses were performed according to Page (1982) and Jackson (1973), respectively and presented in Table (1a and 1b).

Table 1a: Some physical properties of the test soil

Characters			Seasons	
			2009/2010	2010/2011
a- physical analysis	Total $CaCO_3$ (%)		2.8	2.6
	Organic matter (%)		1.03	1.49
	Particle size distribution (%)	Coarse sand	0.40	1.60
		Fine sand	17.20	15.50
		Silt	31.40	18.90
		Clay	51.00	64.00
	Texture class		Clayey	Clayey
	Bulk density ($g.cm^{-3}$)		1.25	1.23
	Total porosity (%)		52.83	53.58
	Field capacity (%)		28.90	30.40
	Wilting point (%)		12.10	12.70
	Available water (%)		16.80	17.70

Table 1b: Some chemical properties of the test soil

Characters				Seasons	
				2009/2010	2009/2010
b- chemical analysis	pH (1:2.5)			8.6	8.4
	EC. dSm^{-1}			4.7	4.3
	Soluble ions in soil paste extract (meq. L^{-1})	Cations	Ca^{+2}	8.1	10.3
			Mg^{+2}	5.0	8.7
			Na^{+}	33.2	28.4
			K^{+}	0.5	1.1
		Anions	CO_3^{-2}	-	-
			HCO_3^{-}	2.9	2.4
			Cl^{-}	26.3	29.2
			SO_4^{-2}	17.6	16.9
	Available nutrients (μg^{-1})	N		42	49
		P		8.3	8.1
		K		140	170
		Fe		5.3	5.8
		Zn		2.2	2.5
		Mn		3.1	3.3
		Cu		0.81	0.85

The chemical properties of the used farmyard manure are presented in Table (2). Split plot design with three replicates was used. The plot area 21 m^2 (3 m x 7 m), each plot had five rows 60 cm apart and 7 m in length. The main plots were treated with farmyard manure at 0, 10 and 20 m^3/fed was added before planting. Each plot was randomly subdivided into four subplots which were treated with K-fertilizer as potassium sulfate 48% K_2O at rates of 0, 48, 72 and 96 kg. K_2O/fed, each rate was added in one dose before the first irrigation. Nitrogen and phosphorus fertilization were added at recommended dose of 90 kg N/fed and 15 kg P_2O_5 /fed, respectively. Nitrogen fertilizer was added as urea (46.5 % N) in two equal doses. The first dose after thinning and the second one was after month later. Phosphorus fertilizer was added as calcium super phosphate (15.5% P_2O_5) during land preparation. Other agricultural practices were carried out in the same manner prevailing in the region, except for the factor under study. The sugar beet seeds of cultivar multigerm viz Kawamira were sowing at 7th and 10th November, in both seasons, respectively. At harvest, samples of soil were collected from the surface layer of each plot (0 – 30 cm).

Table 2: Some chemical properties of the use farmyard manure

Properties		Value
pH (1:10 manure suspension)		7.35
EC. dSm^{-1}		1.40
Organic matter (%)		35.1
$CaCO_3$ (%)		1.3
Total C (%)		0.044
Total N (%)		1.05
C/N ratio		1: 24
Total P (%)		0.06
Total K (%)		0.55
Available micronutrient (mg/kg)	Fe	38.5
	Zn	22.3
	Mn	88.7
	Cu	9.1

They were air dried, crushed, sieved through a 2 mm sieve and then analyzed for EC, pH, organic matter, soluble cations and anions according to Jackson (1973). Bulk density, total porosity %, were determined according to Klute (1986) field capacity % and wilting point % were determined according to method described by Black (1965). and available water % was calculated according to the following equation

$$A.W = F.C - W.P$$

Where:-

A.W = available water % F.C= Field capacity (%)

W.P = Wilting point (%)

At harvest, a random sample of ten plants was taken from the central ridges of each plot to determine the following characters: -

1- Root and top yields of the two central ridges of each plot were estimated in kilograms and converted to (ton/ fed)

2- Root length and root diameter in Cm.

3-Sucrose percentage was determined according to Carruthers and Oldfield (1960).

4-Potassium and sodium contents were determined using flame photometer, and α-amino-N was determined according to Carruthers *et al.* (1962).

5- Purity Percentage was calculated according to the following formula:

Purity % = $[(99.36) - 14.27 (V_1 + V_2 + V_3) / V_4]$ (Devillers, 1988).

Where:

V_1 = Sodium as meq /L, V_2 = Potassium as meq /L, V_3 = α-amino-N as meq /L and V_4 = Sucrose %

6- Theoretical sugar yield ton/fed was calculated by multiplying root yield ton/fed by sugar %

7- White sugar yield (sugar extractable) ton/fed was determined according to the equation which described by Reinfeld *et al.,* (1974).

Sugar extractable = $V_4 - [(V_1+V_2)\ 0.343 + V_3 \times 0.094 + 0.29]$.

8- NPK uptake in root and top were determined by methods described by Chapman and Pratt (1961).

The statistically analysis of variance was carried out according to Gomez and Gomez (1984). Treatment means were compared using Duncan's Multiple Range Test (Duncan, 1955). All statistical analyses were performed using MSTAT computer software package

RESULTS AND DISCUSSION

The target of this work aimed to increase sugar beet yield through improving the soil physical, chemical properties by the application of farmyard manure. So, the obtained results included the impact of different rates of farmyard manure on some soil properties as well as sugar beet yield, yield components and NPK uptake in top and root of sugar beet.

Effect of FYM and K fertilization on soil properties:-

Physical properties:

Data in table (3) show that application of different rates of FYM improved soil bulk density at harvesting stage during the two seasons. Since, it decreases at any rate of addition. The relatively high value obtained of bulk density was attained for the untreated soil. Applying different rates of FYM caused gradually decreases for the values of bulk density.

The best improved effect was subjected with the high rate of application. The beneficial effect of FYM in improving the bulk density is due to the increase of organic matter content which consequently encourages soil aggregate. These results are in harmony with those obtained by Nassar *et al* (2004) and EL-Shouny *et al* (2008).

Concerning total porosity%, field capacity %, wilting point %, available water % and organic matter% as affected by different rates of FYM during the two growing seasons, obtained results clear that all mentioned characters were increased with raising the applied rates of FYM up to 20 m^3/fed over the control. The same results were obtained by Salem (2003) and EL-Shouny *et al* (2008). The increase of water retention and available water upon using the FYM may be attributed to the beneficial effect of FYM on soil aggregation. In addition, the humus produced from microbial decomposition of FYM can absorb water more than six times of its own weight, thereby the soil moisture retention capacity increase. (Tester, 1990).

Table (3): Effect of FYM treatments on some physical properties of the tested soil at harvesting stage.

Rate of FYM (m^3/fed)	Bulk density ($g.cm^{-3}$)	Total porosity (%)	Field capacity (%)	Wilting point (%)	Available water (%)	Organic matter (%)
2009/2010						
0	1.25	52.83	28.90	12.10	16.80	0.98
10	1.23	53.58	29.70	12.60	17.10	1.11
20	1.19	55.09	31.80	13.50	18.30	1.17
Mean	1.223	53.83	30.13	12.73	17.40	1.09
2010/2011						
0	1.23	53.58	30.40	12.70	17.70	1.43
10	1.17	55.85	31.60	13.40	18.20	1.49
20	1.14	56.98	33.80	14.50	19.30	1.51
Mean	1.18	55.47	31.93	13.53	18.40	1.48

Chemical properties:

Date in table (4) revealed that the pH values were reduced with the application of FYM to the soil study as compared to control. The high rate of FYM (20 m^3/ fed) was the superior treatment. These finding are agreement with those obtained by EL-Shouny *et al* (2008). The decrease in the soil pH due to the formation of organic and inorganic acids as a result of organic matter decomposition and more CO_2 was formed with increasing the metabolic activity of the root system. The latter plays an important role as H^+ pumping which also contributes to the soil pH decrement (Reda *et al* 2006 and EL-Shouny *et al* 2008). Also, data in table (4) revealed that the initial EC values of the soil at the two seasons dropped at the end of the experiments as a result of FYM addition. In this respect FYM application at 20 m^3/fed was most effective in decreasing EC. This may be due to positive effect of active organic acids that are released from applied organic manure on soil aggregation as wall as creating conductive pores that encouraged the leaching of the excess soluble salts (Reda *et al* 2006).

Also, data in table (4) showed that application of FYM led to increase soluble ions of Ca^{+2}, Mg^{+2}, K^{+} and SO_4^{-2} However, decrease the soluble ions of Na^{+}, HCO_3^{-} and Cl^{-} in the soil paste extract. The same trend was recorded by Nassar *et al* (2004) and EL-Shouny *et al* (2008). On the other hand, it's cleared that, the application of potassium fertilizers by these amounts had no effect on the soil properties.

Table (4): Effect of FYM treatments on some chemical properties of the tested soil at harvesting stage.

Rate of FYM (m^3/fed)	pH (1:2.5)	EC. dSm^{-1}	Soluble ions in the soil paste extract (meq. L^{-1})							
			Cations				Anions			
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
2009/2010										
0	8.5	4.6	8.1	6.4	30.2	0.6	-	2.9	25.7	13.0
10	8.4	4.1	8.2	6.9	23.6	0.7	-	2.7	22.0	15.2
20	8.2	3.7	8.7	7.3	19.8	0.9	-	2.5	19.8	17.6
Mean	8.36	4.13	8.33	6.86	24.53	0.73		2.7	22.5	15.26
2010/2011										
0	8.4	4.3	11.1	7.4	28.4	1.1	-	2.5	28.6	12:9
10	8.2	3.9	10.5	8.5	22.2	1.3	-	2.3	25.6	14.6
20	8.0	3.3	10.0	8.9	18.5	1.5	-	2.0	23.6	17.3
Mean	8.2	3.83	10.53	8.26	23.03	1.3		2.26	25.93	14.93

Effect of FYM and K fertilization on components of sugar beet:-
Root and top yields (ton/fed):-

Data presented in table (5) showed that significant effects were found on root and top yields during the two growing seasons resulted from using FYM and K - fertilization levels The highest average values of root yields (37.50 and 37.20 ton/ fed) and top yields (8.30 and 8.35 ton/fed) were obtained under used 20 m^3/fed of FYM in the first and second seasons, respectively. The positive effect of FYM on root and top of sugar beet due to improving the soil physical and chemical properties, preparing the suitable bed for development of plant growth that reflect on resultant yield. Moreover, FYM is considered as an important source of humus, macro and micro elements carrier and at the same time, increase the activity of the useful microorganisms. These results were in general agreement with those of EL-Kammah and Ali (1996), Gazia (2001), EL-Shouny *et al* (2008) and EL-Agrodi *et al* (2011). Potassium fertilization had a highly significant effect on both root and top yields during the growing seasons. The average values of root yield (35.10 and 35.50 ton/fed.) and the average values of top yield (8.12 and 8.18 ton/fed.) were obtained with addition of 96 Kg K_2O/fed in the first and second seasons, respectively. The beneficial effects of potassium may be attributed to the effect on some physiological and biochemical functions. EL-Sawy *et al* (2000) found that the K application on potato plant caused a significant increase in stem length, number of main stems and number of leaves per plant. Similar results were gained also by Khalifa *et al* (1995); and Ibrahim *et al* (2002). The interaction between FYM and K fertilization on root and top yields were highly significant during the two seasons. These increases were obtained with application of 20 ton/fed of FYM with 96 Kg K_2O /fed during the two growing seasons. The same finding was found by Khalifa *et al* (1995).

Root length and root diameter:-

Data in table (6) showed that increasing the FYM resulted in significantly increase in root length and decrease root diameter in the two seasons. The same finding was found by EL-Sawy *et al* (2000) and EL-Shikha *et al* (2005). Potassium fertilization had a highly significant effect on root length of sugar beet during the two growing seasons. Application of 96 Kg K_2O /fed resulted the highest averages (34.87 and 34.97 cm) of root length in the two seasons respectively.

Table (5) Effect of FYM and K fertilization levels on root and top yields of sugar beet

FYM	Potassium treatments (Kg K_2O / fed)									
	First season (2009/2010)					Second season (2010/2011)				
	0	48	72	96	FYM mean	0	48	72	96	FYM mean
Root yield (ton / fed)										
0	24.60	28.40	29.20	31.20	28.35	22.5	28.56	29.5	31.7	28.06
10	27.59	29.60	31.60	36.60	31.35	27.7	29.74	31.65	37.6	31.67
20	28.90	30.50	30.80	37.50	31.92	29.1	30.6	32. 50	37.2	32.3
K mean	27.03	29.50	30.53	35.10		26.43	29.63	30.57	35.5	
LSD at 5% FYM	2.65					3.55				
LSD at 5% K	1.50					2.20				
LSD at 5% FYM x K	4.60					5.60				
Top yield (ton / fed)										
0	5.7 2	7.60	7.75	7.96	7.26	5.20	7.75	7.82	8.05	7.20
10	6. 28	7.90	7.82	8.10	7.52	6.30	8.02	8.05	8.15	7.63
20	6.70	8.20	8.25	8.30	7.86	6.75	8.10	8.30	8.35	7.88
K mean	6.23	7.90	7.94	8.12		6.08	7.96	8.06	8.18	
LSD at 5% FYM	2.10					1.85				
LSD at 5% K	1.35					1.26				
LSD at 5% FYM x K	3.25					3.40				

Table (6) Effect of FYM and K fertilization levels on root length and root diameter of sugar beet

FYM	Potassium treatments (Kg K_2O / fed)									
	First season (2009/2010)					Second season (2010/2011)				
	0	48	72	96	FYM mean	0	48	72	96	FYM mean
Root length (cm)										
0	29.50	30.60	31.20	32.10	30.85	28.60	31.70	31.85	32.20	31.08
10	33.60	34.75	34.95	35.20	34.63	32.85	34.80	35.05	35.35	34.51
20	34.50	36.50	37.20	37.30	36.38	34.70	36.20	37.30	37.36	36.39
K mean	32.53	33.95	34.45	34.87		32.05	34.23	34.73	34.97	
LSD at 5% FYM	2.15					2.15				
LSD at 5% K	1.38					1.18				
LSD at 5% FYM x K	3.75					3.80				
Root diameter (cm)										
0	11.10	11.65	11.40	11.30	11.36	11.25	11.35	11.60	11.90	11.52
10	11.55	11.80	11.78	11.08	11.55	11.80	11.96	11.35	11.36	11.62
20	11.10	11.40	11.60	11.25	11.34	11.12	11.20	11.48	11.00	11.20
K mean	11.25	11.62	11.59	11.21		11.39	11.50	11.48	11.42	
LSD at 5% FYM	0.66					0.46				
LSD at 5% K	0.05					0.35				
LSD at 5% FYM x K	0.86					1.05				

Data in table (6) also, showed that the interaction between FYM and Potassium fertilization had a highly significant on root length. The longest root of sugar beet was obtained

(37.30 and 37.36 cm) with 96 Kg/fed of K-fertilizers and 20 m^3/fed of FYM. The obtained results were in close agreement with those of Gazia (2001) and EL-Agrodi *et al* (2011). With respect to root diameter in table (6) also showed that the highest average values of root diameter (11.55 and 11.62 cm) were obtained by 10 m^3 of FYM in the two growing seasons respectively. Increase the rate of potassium fertilization resulted significant increase in root diameter. The highest average values of root diameter resulted from addition of 48 Kg K_2O/fed (11.62 and 11.50 cm) in the first and second seasons, respectively. Data also showed that the effect of interaction between FYM and Potassium fertilization on root diameter was highly significant. The biggest root diameter of sugar beet (11.80 and 11.96 cm) was obtained with application of 10m^3 FYM with 48 Kg K_2O/fed. The obtained results were in harmony with Ibrahim *et al* (2002).

Sucrose and Juice Purity Percentages:-

Values of sucrose and juice purity percentages as affected by FYM and Potassium fertilization were illustrated in table (7). The data showed that sucrose and juice purity percentages were significantly increased with increasing the FYM and Potassium addition. The highest average of sucrose percentage (19.44 and 19.51 %) were obtained under the 20 m^3 FYM treatment in the two growing seasons, respectively. Where, juice purity percentages (81.07 and 80.29 %) were obtained under the 10 m^3 FYM treatment in the two growing seasons, respectively. These obtained results were in good agreement with those of Mahmoud, Awatef *et al* (2004), Negm *et al* (2005) and EL-Agrodi *et al* (2011).

Increasing the rates of potassium fertilization up to 96 KgK_2O/fed significantly increased the sucrose percentages during the two growing seasons. The highest average values due to potassium fertilization were found to be (19.40 and 19.52%) for sucrose percentage. while, using 48 Kg K_2O/fed increased juice purity percentages during the two seasons. The highest values of juice purity percentages were (82.17 and 82.16 %) in the first and second seasons, respectively (table 7). The interaction between the 20 m^3 FYM and 96 Kg K_2O/fed resulted the highest values of sucrose percentage (19.70 and 19.76 %) while juice purity percentage (82.60 and 82.72%) obtained by using 20 m^3 FYM and 48 Kg K_2O/fed in the two growing seasons, respectively. The obtained results were in close agreement with those of EL-Kammah and Ali (1996) and EL-Shouny *et al* (2008).

Table (7) Effect of FYM and K fertilization levels on sucrose % and juice purity % of sugar beet

FYM	Potassium treatments (Kg K_2O / fed)									
	First season (2009/2010)					Second season (2010/2011)				
	0	48	72	96	FYM mean	0	48	72	96	FYM mean
	Sucrose %									
0	18.50	18.72	18.90	19.05	18.79	18.30	18.82	18.95	19.20	18.82
10	18.90	19.18	19.35	19.45	19.22	18.92	19.20	19.40	19.60	19.28
20	19.15	19.35	19.55	19.70	19.44	19.20	19.48	19.60	19.76	19.51
K mean	18.85	19.08	19.27	19.40		18.81	19.17	19.32	19.52	
LSD at 5% FYM	0.25					0.40				
LSD at 5% K	0.22					0.22				
LSD at 5% FYM x K	0.48					0.72				
	Juice purity %									
0	80.50	81.72	79.50	79.36	80.27	81.40	81.50	79.15	78.70	80.18
10	81.60	82.15	79.72	80.82	81.07	80.20	82.25	79.80	78.92	80.29
20	81.15	82.60	80.00	80.20	80.98	80.30	82.72	79.10	78.30	80.11
K mean	81.05	82.17	79.74	80.13		80.63	82.16	79.35	78.64	
LSD at 5% FYM	0.32					0.30				
LSD at 5% K	0.42					0.45				
LSD at 5% FYM x K	0.78					0.70				

Theoretical sugar yield and White sugar yield (sugar extractable):-

As shown in table (8) FYM and K-fertilization had highly significant effect on theoretical sugar yield and white sugar yield (sugar extractable) during the two growing seasons. The highest values of theoretical sugar yield (6.66 and 6.81 ton/fed) and white sugar yield (5.84 and 5.82 ton/fed) were obtained under 20 m^3 FYM application during the first and second seasons, respectively. Increasing the rate of potassium appiication resuited significant increase in theoretical sugar yield and white sugar yield. The highest values of theoretical sugar yield (7.16 and 7.28 ton/fed) and white sugar yield (6.05 and 6.23 ton/fed) were obtained by using 96 Kg K_2O/fed in the two seasons, respectively. The effect of interaction between FYM and K-fertilization on theoretical sugar yield and white sugar yield (sugar extractable) were highly significant increase during the two growing seasons. The highest values were obtained from using 20 m^3 FYM and 96 Kg K_2O/fed (7.40 and 7.55 ton/fed) for theoretical sugar yield and (6.39 and 6.42 ton/fed) for white sugar yield (sugar extractable) in the two seasons, respectively. The illustrate results were in general agreement with those of Negm *et al* (2005), EL-Shouny *et al* (2008) and EL-Agrodi *et al* (2011).

Table (8) Effect of FYM and K fertilization levels on Theoretical sugar yield ton/fed and Sugar extractable of sugar beet

FYM		Potassium treatments (Kg K_2O / fed)									
		First season (2009/2010)					Second season (2010/2011)				
		0	48	72	96	FYM mean	0	48	72	96	FYM mean
Theoretical sugar yield (ton/fed)											
0		5.30	6.20	6.32	6.90	6.18	5.35	6.15	6.35	7.10	6.24
10		5.90	6.35	6.48	7.18	6.48	5.92	6.40	6.52	7.20	6.51
20		6.15	6.40	6.70	7.40	6.66	6.20	6.65	6.82	7.55	6.81
K mean		5.78	6.32	6.50	7.16		5.82	6.40	6.56	7.28	
LSD at 5%	FYM	0.52					0.55				
	K	0.32					0.35				
	FYM x K	1.05					0.92				
White sugar yield (sugar extractable) (ton/fed)											
0		4.30	4.96	5.16	5.62	5.01	4.15	4.8	5.2	6.02	5.04
10		4.92	5.1	5.7	6.15	5.47	4.9	5.26	5.8	6.25	5.55
20		5.2	5. 24	5.94	6.39	5.84	5.4	5.38	6.10	6.42	5.82
K mean		4.81	5.03	5.60	6.05		4.82	5.15	5.70	6.23	
LSD at 5%	FYM	0.44					0.42				
	K	0.25					0.32				
	FYM x K	0.72					0.78				

N, P and K uptake by Top and Root:-

Illustrated date in tables (9 and 10) showed that FYM had significant effect on N, P and K up take by top and root of sugar beet during the two growing seasons. It was obvious from the obtained data that the FYM caused increasing in uptake of N, P and K by top and root of sugar beet. The highest mean values of N, P and K in top as found in table (9) were (33.27 and 34.40 Kg/fed), (2.65 and 2.72 Kg/fed) and (69.98 and 71.30 Kg/fed) at harvest during first and second seasons, respectively. This emphasizes the role of FYM in terms of increasing the N, P and K uptake in top of sugar beet via enhancing the availability of plant nutrients, which is rendered to its role in improving some physical, microbiological and chemical properties of soil. Such results came along with those reported by Ahmed *et al* (2004), EL-Shikha *et al* (2005) and EL-Agrodi *et al* (2011).

Table (9) Effect of FYM and K fertilization levels on NPK uptake in top of sugar beet

FYM		Potassium treatments (Kg K_2O / fed)									
		First season (2009/2010)					Second season (2010/2011)				
		0	48	72	96	FYM mean	0	48	72	96	FYM mean
N-uptake (Kg/fed)											
0		25.5	28.60	30.60	40.40	31.27	23.2	31.5	32.1	42.15	32.24
10		26.8	31.6	34.4	42.4	33.80	26.9	32.25	34.9	44.2	34.56
20		26.9	28.4	34.65	43.15	33.27	28.2	30.9	34.6	43.9	34.40
K mean		26.40	29.53	33.22	41.98		26.10	31.55	33.87	43.42	
LSD at 5%	FYM	3.85					3.92				
	K	2.68					2.46				
	FYM x K	5.60					7.25				
P-uptake (Kg/fed)											
0		1.5	2.05	2.5	3.15	2.30	1.42	2.1	2.55	2.95	2.25
10		1.48	2.15	2.62	3.26	2.38	1.55	2.26	2.75	3.15	2.42
20		2.15	2.35	2.68	3.42	2.65	1.96	2.4	2.96	3.56	2.72
K mean		1.71	2.18	2.60	3.28		1.64	2.25	2.75	3.22	
LSD at 5%	FYM	0.56					0.35				
	K	0.42					0.32				
	FYM x K	1.26					0.75				
K-uptake (Kg/fed)											
0		48.2	58.2	62.12	77.9	61.60	51.3	61.2	68.22	80.2	65.23
10		55.6	61.6	68.4	81.5	66.77	58.4	62.3	67.3	82.35	67.58
20		58.4	65.7	71.2	83.6	69.72	61.2	66.7	73.42	83.6	71.23
K mean		54.07	61.83	67.24	81.00		56.97	63.40	69.65	82.05	
LSD at 5%	FYM	5.22					6.32				
	K	3.18					3.42				
	FYM x K	9.15					10.26				

Table (10) Effect of FYM and K fertilization levels on NPK uptake in root of sugar beet

FYM	Potassium treatments (Kg K_2O / fed)									
	First season (2009/2010)					Second season (2010/2011)				
	0	48	72	96	FYM mean	0	48	72	96	FYM mean
N-uptake (Kg/fed)										
0	33.90	34.79	34.90	36.50	35.02	34.20	36.12	38.20	40.60	37.28
10	48.50	44.80	48.60	50.20	48.02	49.60	46.40	48.90	46.20	47.77
20	54.60	56.20	55.60	55.70	55.52	55.50	55.90	57.20	58.20	57.10
K mean	45.67	45.26	46.37	47.47		46.43	46.14	48.10	48.33	
LSD at 5% FYM	1.75					1.48				
LSD at 5% K	3.15					4.05				
LSD at 5% FYM x K	6.35					6.42				
P-uptake (Kg/fed)										
0	6.20	7.55	8.12	8.85	7.68	7.15	7.92	8.5	9.12	8.17
10	8.60	8.82	8.84	9.38	8.75	8.45	8.96	9.15	10.4	9.24
20	9.72	10.40	10.60	10.85	10.39	9.83	10.65	10.85	11.2	10.63
K mean	8.17	8.92	9.19	9.85		8.48	9.18	9.50	10.24	
LSD at 5% FYM	1.25					0.75				
LSD at 5% K	1.30					0.66				
LSD at 5% FYM x K	3.20					1.82				
K-uptake (Kg/fed)										
	28.30	36.20	55.60	66.20	46.57	35.62	45.20	60.60	68.42	52.46
10	32.81	40.22	62.70	72.46	52.05	45.60	48.60	63.72	75.60	58.38
20	42.60	48.60	68.26	75.38	58.71	48.20	55.60	68.20	76.40	62.10
K mean	34.57	41.67	62.18	71.34		43.14	49.80	64.17	73.47	
LSD at 5% FYM	3.60					4.60				
LSD at 5% K	3.18					3.42				
LSD at 5% FYM x K	7.25					8.62				

Data in table (10) showed also that the highest mean values of N, P and K in root as affected by FYM addition were (55.52 and 57.10 Kg/fed), (10.39 and 10.63Kg/fed) and (58.71 and 62.10 Kg/fed) in the two growing seasons, respectively.

The obtained results in tables (9 and 10) showed that potassium fertilization significantly affect the uptake of N, P and K by top and root of sugar beet. Increasing the rate of K-fertilization increased the uptake of N, P and K. by top and root. The highest mean values of N, P and K in top were in table (9) (41.98 and 43.42 Kg/fed), (3.28 and 3.22 Kg/fed) and (81.00 and 82.05 Kg/fed) as affected by the K-fertilization at harvest during first and second seasons, respectively. While the highest mean values of N, P and K in root as found in table (10) were (47.47 and 48.33 Kg/fed), (9.85 and 10.24 Kg/fed) and (71.34 and 73.47 Kg/fed) at harvest during first and second seasons, respectively. These results were harmony with those reported by Ahmed *et al* (2004), EL-Shikha *et al* (2005) and EL-Agrodi *et al* (2011).

The interaction between 20 m^3 FYM and 96 Kg/fed K-fertilizer resulted in highest values of N,P and K uptake by top and root of sugar beet in the two seasons. These obtained results were in close with the results reported by Manni *et al* (1996), Ibrahim *et al* (2000) and Ahmed *et al* (2004).

From the previous results, it could be recommended to use the application of 20 m^3 FYM/fed + 96 Kg K_2O/fed to improving some soil properties and its production of sugar beet crop and its chemical composition under the condition of the current study.

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تأثير اضافة السماد العضوي والتسميد البوتاسي على بعض خواص التربة وإنتاجية محصول بنجر السكر

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أجري هذا البحث لدراسة تأثير اضافة السماد العضوي والسماد البوتاسي على خواص التربة وإنتاجية محصول بنجر السكر وتحسين صفاته. ولتحقيق هذا الهدف أجريت تجربة حقلية في أرض طينية في قرية ديما – مركز كفرالزيات – محافظة الغربية خلال موسمي النمو ٢٠٠٩/٢٠١٠ ، ٢٠١٠/٢٠١١ واشتملت التجربة علي اثنتي عشرة معاملة ممثلة كل منها في ثلاث مكررات استخدم فيها السماد العضوي بمعدلات (صفر ، ١٠ ، ٢٠ م ^{3} / فدان) والسماد البوتاسي بمعدلات (صفر ، ٢٤ ، ٤٨ ، ٩٦ كجم بو$_{2}$ أ / فدان) واستخدم تصمم القطع المنشقة مرة واحدة لتصمم التجربة ويمكن تلخيص أهم النتائج كما يلي :-

أدت اضافة السماد العضوي إلي تحسين خواص التربة حيث انخفضت قيم كلا من الكثافة الظاهرية والأس الهيدروجيني (pH) ودرجة التوصيل الكهربي(EC) وتركيز كلا من ايونات الصوديوم و البيكربونات والكلوريد الذائبة بينما زادت قيم كلا من المسامية الكلية والسعة الحقلية والماء الميسر وتركيز كلا من ايونات الكالسيوم و الماغنيسيوم والبوتاسيوم والكبريتات الذائبة وقد تفوق أكبر معدل من السماد العضوي (٢٠ م ٣ / فدان) علي باقي المعاملات في تحسين هذه الخواص.

كانت هناك استجابة معنوية بالزيادة لمحصول جذور بنجر السكر وكذلك بعض الصفات المحصولية مثل محصول العرش و طول وقطر الجذر ونسبة السكر المئوية ونسبة نقاوة العصير ومحتوى كلا من الجذور والعرش من عناصر النيتروجين والفوسفور والبوتاسيوم نتيجة اضافة السماد العضوي وكانت الزيادة متدرجة مع زيادة معدلات الاضافة.

أدت اضافة السماد البوتاسي الي زيادة معنوية في المحصول ومكوناته ومحتوى الجذور والعرش من عناصر النيتروجين والفوسفور والبوتاسيوم وتحققت أفضل النتائج مع المستوي الاعلي من الاضافة (٩٦ كجم بو$_{2}$ أ / فدان) فيما عدا نسبة النقاوة للعصير وكذلك قطر الجذر أخذت الاتجاه العكسي

أدت اضافة المستويات الأعلي من السماد العضوي والسماد البوتاسي معا أفضل النتائج المتحصل عليها فيما عدا نقاوة العصير وقطر الجذر.

ومن ثم يمكن التوصية باستخدام ٢٠ م ٣ من السماد عضوي مع ٩٦ كجم بو$_{2}$ أ / فدان لتحسين خواص التربة والحصول علي أفضل محصول بنجر السكر كما ونوعا تحت ظروف الدراسة الحالية.