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Fodderbeet Production from Maryut Calcareous Soil Treated by Organic Manures

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A FIELD trial was conducted at Maryut Agricultural Experimental Station of the Desert Research Center, DRC aiming to participate in solving calcareous soil problems related to mechanical strength and porosity parameters under the effect of organic farming system to raise soil ability for crop production. The experimental treatments comprised three treatments; namely, Farmyard Manure (FYM), mixture of (1:1) FYM and composted Plant Residues, (FYM+PR) and composted Plant Residues (PR), respectively.

The obtained results show that farmyard manure was able to reduce soil bulk density (B_d) more than the other treatments. The combined effect of both manures and their addition methods produced a good reduction in (B_d) especially for the addition of 7.5 tons/fed in hills. The desirable increase in total porosity was associated with different kinds and rates of composting manures. The increase in total porosity, relative to the control, is associated with the application of 2.5, 5.0 and 7.5 ton/fed for FYM, mixture of (PR + FYM) and PR, respectively. The combination between the addition methods and the applied manures reduced the soil penetration resistance and increased the hydraulic conductivity as compared with the control.

The correlation and regression analyses indicated highly significant negative relation between fodderbeet yield, penetration resistance and soil bulk density, as well as highly significant positive response for total porosity and insignificant response for hydraulic conductivity.

Keywords: Calcareous soil, Composting manures, Bulk density, Total porosity, Penetration resistance, Hydraulic conductivity, Fodderbeet crop.

The main objective of this investigation was to study the effect of applying:

1. Composts of plant residues, *i.e.,* bean straw, 2. farmyard manure and 3. mixture of (1:1) from items 1 and 2, on some soil physical properties and Fodderbeet production. The field experiment was conducted at Maryut Agriculture Experiment Station of the Desert Research Center.

The use of organic compost in crop production is receiving considerable attention worldwide. The application of organic manures occasionally influence plant growth physiologically as stated by Kawata *et al.* (1976) because they provide the plants with growth- regulating substances and modify soil physical behavior as reported by Khaled (1993).

Concerning sustainable agriculture with minimum pollution, the organic natural materials such as plant residues, bird residues, animal residues and garbage should be added. Application of organic manures increase soil organic matter content, particularly for the calcareous soils in Egypt, which have less than 1%, therefore improve its physical, chemical and biological properties. Consequently, the availability of nutrients for plants are increased as well as the physical soil characteristics improved such as bulk density, total porosity, hydraulic conductivity, Penetration resistance, water use efficiency and crop production. Zebarth *et al.* (1999) reported that soil water retention increased and soil bulk density was reduced due to the addition of 2% organic matter

It is well known that soils of arid and semi arid regions are poor in organic matter. Maintenance of soil organic matter is a partial problem of soil fertility in Egypt. Organic materials such as crop residue (bean straw) and organic manure such as farmyard manure, town refuse and chicken manure are abundantly available every year. The recycling of these materials to produce organic fertilizers (as compost) is very important for increasing agriculture production, reducing the application rates of chemical fertilizers and therefore control environmental pollution.

Material and Methods

A field experiment was conducted during winter season 2002/2003 at Maryut Agriculture Experiment Station of the D.R.C., West of Alexandria, in the north western coastal zone of Egypt. Physical and chemical characteristics of the investigated soil are presented in Table 1. Data revealed that the soil of the experimental site is calcareous throughout the profile as calcium carbonate content is 33%. It is non saline, mild alkaline with sandy clay texture in the top soil, change into clay loam and then into sandy clay loam in the subsurface soil layers. The natural drainage condition is good since there is no evidence of water logging throughout the soil profile, as shown in Table 2.

Composting manure treatments comprised farmyard (FYM), treated plant residues (PR) and composted mixture (1:1). The composting manure were added and mixed in the soil surface layer (0- 30 cm), in hills and buried in furrows. The rates of application were 2.5, 5.0 and 7.5% tons/ feddan. The experiment included 36 plots arranged in a split- split plot design with four replicates. Each plot area was 3x 3.5 m (1/400 fed). The main plots were assigned for three types of applied composts. The sub main plots were assigned for three methods of application, namely, surface mixing, in hill and buried in furrows. The sub- sub plots were assigned for adding four rates, (0, 2.5, 5.0 and 7.5 ton/fed) one day before cultivation.

TABLE 1. Physical and chemical properties of the studied soil.

Soil Depth, cm.	Particle size distribution				Textural class	$CaCO_3$ (%)	B_d	D_p	pH	EC mmhos/ cm at 25°C	Soluble cations, me/l.				Soluble Anions, me/l.			
	C.S (%)	F.S. (%)	Silt (%)	Clay (%)			g/cm³				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3	HCO_3	Cl^{-}	$SO_4^{=}$
0-15	11.02	44.97	1.52	42.49	S.C.	33	1.42	2.32	7.9	1.26	2.05	2.11	7.80	1.00	-	1.47	5 86	5.63
15-30	11.10	32.12	20.29	36.49	S.C.L	33	1.49	2.33	8.0	0.80	1.03	1.67	5.00	0.80	-	1.48	3 29	3.53
30-45	14.17	42.60	21.95	21.28	S.C.L	33	1.57	2.34	8.0	0.63	1.03	1.67	3.30	0.75	-	2.10	2.38	2.27

TABLE 2. Some basic properties of compost materials.

Property	Bean composting		Farmyard manure composting		Mixture composting	
	Before	After	Before	After	Before	After
C%	60.3	46.5	35.6	33.2	47.95	39.85
N%	2.01	2.11	2.07	2.23	2.04	2.17
C:N	1:30	1:22	1:17	1:15	1:24	1:19
OM	103.72	79.98	61.23	57.10	82.47	68.54

All plots received 30 kg P_2O_5 /fed as super phosphate before cultivation, 75 kg N/fed as NH_4NO_3 and 50 kg K_2O /fed as K_2SO_4. Nitrogen and potassium fertilizers were applied into 3 portions added after 20, 50, 70 days from sowing.

Fodderbeet seeds were planted on October 30^{th} 2002 into rows, 30 cm apart and 50 cm between rows. Irrigation was carried out as furrow irrigation applied when 45% of the soil available water was depleted. This irrigation scheduling based on crop water requirement calculated according to the modified Blaney – Criddle equation (Doorenbos & Pruitt, 1977). The growing season lasted for 180 days from planting. The total amount of irrigation water was 3200 m^3/fed. At the end of the growing season, the fresh weights of beets were recorded:. Disturbed and undisturbed soil samples from 0- 30 cm soil layer were collected for the determination of soil physical properties including bulk density (B_d) and particle density (P_d), consequently calculated % total porosities (St)were recorded. Soil penetration resistances were measured in situ as recommended by Klute (1986). Statistical analysis comprised correlations and regression equations were established for some functions according to Spiegel (1961).

Results and Discussion

Bulk density (B_d)

Data in Table 3 indicate that the total averages of the surface soil bulk density were 1.40, 1.32 and 1.34 g/cm3 as a result of applying organic matter in the 0-30 cm soil layer mixed with the surface, buried in hills or buried in furrows, respectively. Percent reduction from the control was 5.4, 10.8 and 9.5 for the previously mentioned treatments, respectively.

The organic matter burried in hills was superior in decreasing (B_d) than the other methods of organic matter applications. This trend might be related to the degree of mixing the applied organic matter with the soil particles; consequently the degree of its decomposition and the coherence of soil particles forming aggregates was faster compared with mixing in the soil surface and buried in furrow. These results are concomitant with those obtained by Benjamin (1999).The effect of applying 2.5%, 5.0% and 7.5% ton/ fed composted organic matter decreased B_d values to 1.37, 1.36 and 1.33 g/cm^3, respectively. Accordingly, percent reduction from the control treatment reached 7.4, 8.1 and 10.1 respectively. These results were concomitant with those obtained by Chen &

Avnimelech (1986); El- Sersawy (1997) and El- Maghraby (1997) who reported that the applications of composts decreased (B_d) gradually whereas, increasing the application rate to 15 ton/fed tremendously reduced it. The data also show that average soil bulk density decreased to 1.34, 1.36 and 1.36 g/cm^3 as a result of applying farmyard manure, composted plant residues and 1:1 mixture of organic matters, respectively.

TABLE 3. Effect of types, rates and methods of adding compost on bulk density (g/cm^3) of Maryut calcareous soil.

Compost types and rate (ton/fed.)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2.5	1.42	1.32	1.36	1.37
	5.0	1.39	1.31	1.32	1.34
	7.5	1.34	1.30	1.32	1.32
Average		1.38	1.31	1.33	1.34
PR	2.5	1.40	1.33	1.38	1.37
	5.0	1.42	1.35	1.35	1.37
	7.5	1.39	1.31	1.32	1.34
Average		1.40	1.33	1.35	1.36
Mixture (1:1)	2.5	1.41	1.34	1.37	1.37
	5.0	1.44	1.32	1.35	1.37
	7.5	1.38	1.32	1.33	1.34
Average		1.41	1.33	1.35	1.36
General mean		1.40	1.32	1.34	1.35

The bulk density of the control treatment is 1.48 g/cm^3 .
The real density of the control treatment is2.32 g/cm^3 .

Total porosity (ST)

Data in Table 4 and Fig. 1 clarify the effect of composting in increasing soil porosity. The increase percentages relative to the control reached 14.0, 14.14 and 16.32% pertaining to mixture of (PR + FYM), PR and FYM, respectively. Concerning the effect of adding compost manure in soil porosity, The data clarified that the addition of FYM for Maryut calcareous soil was more effective in increasing total soil porosity. The priority was for adding 7.5 ton/fed, which led to 19.03 % increasing percent as compared with the control. Whereas the additions of 5, 2.5 ton/fed led to 16.49 and 13.48 increase compared with the control, respectively. These results are concomitant with those reported by Giusquiani *et al.* (1995) and El - Sersawy (1997) as they observed that a linear relation between soil porosity and the compost application rates.

TABLE 4. Effect of types, rates and addition methods of compost on total porosity (percent) of Maryut calcareous soil .

Compost types and rate (ton/fed)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2.5	38.79	43.10	41.38	41.09
	5.0	40.09	43.35	43.10	42.18
	7.5	42.24	43.96	43.10	43.10
Average		40.37	43.46	42.53	42.12
PR	2.5	39.66	42.67	40.52	40.95
	5.0	38.79	41.81	41.81	40.80
	7.5	40.09	43.53	43.10	42.24
Average		39.51	42.67	41.81	41.33
Mixture (1:1)	2.5	39.22	42.24	40.95	40.80
	5.0	37.93	43.10	41.81	40.95
	7.5	40.52	43.10	42.67	42.10
Average		39.22	42.81	41.81	41.28
General mean		39.70	42.98	42.05	41.58

The total porosity of the control treatment is 36.21 percent.

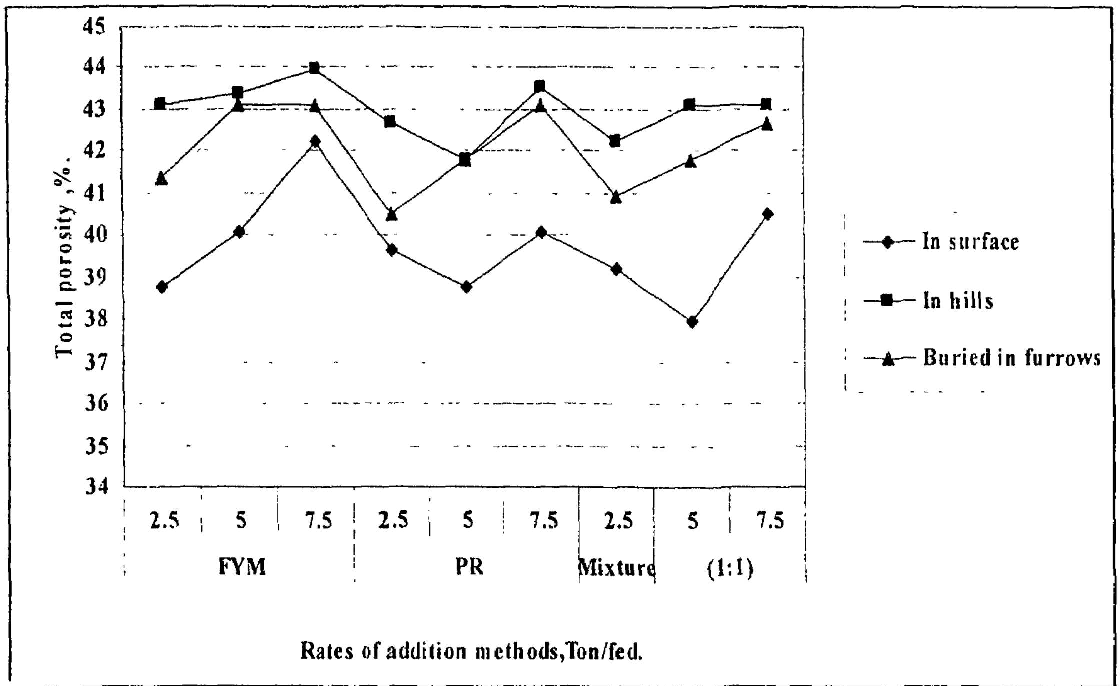

Fig.1. Effect of types, rates and methods of adding on total porosity % of maryut calcareous soils .

In regard to the effect of addition methods of compost manures on total porosity, the data reveal that the methods of burring compost in furrows, in hills and mixed with the soil surface increased total soil porosity to 42.05, 42.98 and 39.70%. Such increase compared to the control treatment reached 16.13, 18.70 and 9.64 %, respectively. These results are in accordance with Benjamin (1999) who reported that applying manures, reduced soil erosion and improve soil structure, which results in an increase in moisture holding capacity and aeration. Besides improving soil structure by reducing compaction, they are an excellent source of energy for microorganisms, which further affect soil structure.

Soil penetration resistance (P)

Calcareous soils are mainly characterized by high resistance to penetration by plant root. This could be rendered to the homogeneity of soil particles originated from lime accumulation for soils high in $CaCO_3$ content and especially its colloidal form. These features led to puddling under wetting and hardness under drying. Table 5 and Fig. 2 pointed out the effect of treatments on soil penetrability resistance. The data reveal that the addition of different compost type, rates or addition methods were able to reduce the resistance by 49.3,%, 43.9% and 31.4 % pertaining to FYM, Mixture (1:1), and PR compared with the control treatment, respectively. Regarding the effect of adding compost rates on soil penetration resistance, the data show that the FYM was superior in reducing (P) to 62% , 51% and 34% for the addition of 7.5, 5.0 and 2.5 ton/ fed comparing with the control treatment. These results agree with those obtained by El-Sersawy (1997) who found that using composted town refuses, farmyard manure and mixture of them in calcareous soil at a rate of 10 ton/ fed led to 39% reduction in penetration resistance. Ismail (1999) found that the addition of sewage sludge, chicken manure and town refuse at a rate of 20 ton/fed. and Tafla in calcareous soil at a rate of 40 ton/ fed reduced soil mechanical characters as shear strength and penetration resistance. The addition method of composting manures in hills was the best treatment in decreasing (P) as compared with burring in furrows and mixing with the soil surface. This treatment reduced (P) by 58% while in furrow and surface led to 41% and 26% respectively. These results align with those reported by Kladivko (1994) who stated that residues are considered the food source for microbial activity and stabilization of soil aggregates. The greatest increase in soil aggregation occurs at a soil depth in which the residues are concentrated.

TABLE 5. Effect of types, rates and methods of adding compost manures on the penetration resistance (kg/ cm^2) of Maryut calcareous soil.

Compost types and rate (ton/fed)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2.5	16.70	7.90	10.90	11.83
	5.0	12.85	5.70	7.70	8.75
	7.5	8.78	4.58	7.10	6.82
Average		12.78	6.06	8.57	9.14
PR	2.5	14.80	8.70	12.66	12.05
	5.0	16.40	10.30	13.40	13.37
	7.5	13.90	8.60	12.60	11.70
Average		15.03	9.20	12.89	12.37
Mixture (1:1)	2.5	15.65	9.10	12.55	12.43
	5.0	11.70	7.20	10.40	9.77
	7.5	9.45	6.80	8.10	8.12
Average		12.27	7.70	10.35	10.11
General mean		13.36	7.65	10.60	10.54

The penetration resistance of the control treatment is 18.03 kg/cm^2.

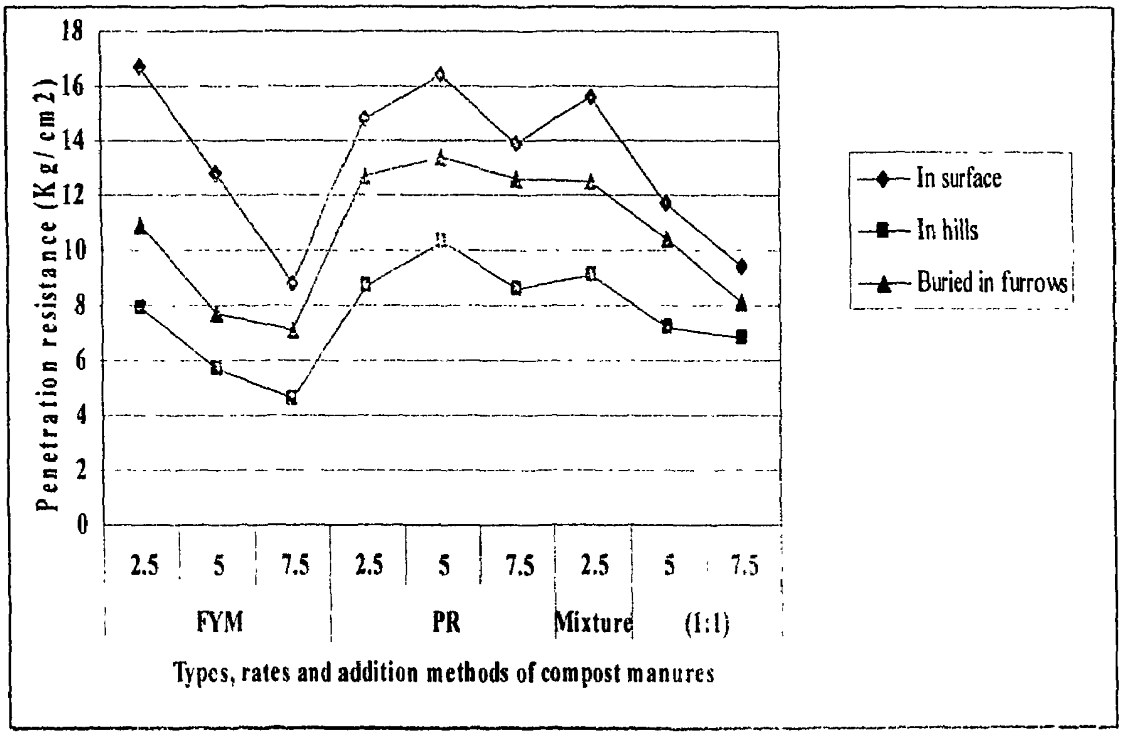

Fig.2. Effect of types, rates and methods of adding compost manures on penetration resistance (Kg/cm^2) .

Soil hydraulic conductivity (K_{sat})

Table 6 and Fig. 3 reveal that soil hydraulic conductivity was markedly increased by applying compost types, rates and methods of addition. The data show for all compost types that the increase of hydraulic conductivity was more clear for farmyard manure as it became 24 times its value for the control. The other two manures, plant residues and mixture of farmyard manure and plant residues, also increased it to 18.5 and 15.5 times its value for the control, respectively. Kladivko (1994) found that crop residues and organic matter additions tend to increase saturated hydraulic conductivity K_{sat} due to increasing soil macropores. This increase was concomitant with increasing the application rates of these composts. In the present study, FYM increased (K_{sat}) to 11.6, 33.7 and 39.4 times its value for the control upon using 2.5, 5.0 and 7.5 ton/fed , respectively. It became 11.8, 13.9 and 29.8 times its value of the control as a result of applying (PR) and 11.8, 15.9 and 18.7 times its value for the control as a result of applying 1:1 compost mixture using 2.5, 5.0 and 7.5 ton/fed, respectively. These results matched that reached by El-Leboudi *et al.* (1976) who showed that hydraulic conductivity increased in calcareous soil by the addition of farmyard manure, compost, town refuse and green manure, particularly at high rates, *i.e.*, 40 tons per fed. This effect may be due to the increase of organic matter content and the improvement of soil structure with consequent increase in soil porosity and root penetration through the soil. Regarding the role of composting manures methods of addition on (K_{sat}), buried in furrows was better than in hills or mixing in the soil surface, respectively. Such increase became 26.3, 19.6 and 12.3 times the values for the control, respectively. These results agree with El- Sersawy (1989) who concluded that mixing town refuse, animal or plant residues and dried sludge in the upper 0 -30 cm layer of calcareous soil improved soil infiltration rate and soil hydraulic conductivity. Stevenson (1994) observed that the frequent addition of easily decomposed organic residues lead to better ability to infiltrate water and percolate downward through the soil. Fortun *et al.* (1989) showed that addition of O.M. improves soil structure and ameliorates hydraulic conductivity and aeration.

Crop production and water utilization efficiency

Data in Table 7 and Fig. 4 reveal the pronounced increase in fodderbeet yield influenced by types, addition methods and rates of applied composts. Percent increase over the control was 100.4, 54.3 and 31.2% pertaining to buried in hill, in furrows and mixed in the surface, respectively. Also, they were 85.9, 63.4 and 36.6% more than the control pertaining to applying FYM, PR and their mixture, respectively. These results are in agreement with Benjamin (1999) who stated that the placement of organic materials largely on the surface as mulch often increases its usefulness. Long term effects tend to improve soil structure in the upper soil layers thereby improve both air and water requirement for the plants. In regard to the effect of compost application rates 2.5, 5.0 and 7.5 ton/fed, led to increase percent fodderbeet yield by 56.4, 67.8 and 61.7, respectively. These results are concomitant with Saleh *et al.* (2003) who found that the application of organic compost materials led to a significant increase in grain yield of cowpea compared with that of the control treatment. This response

TABLE 6. Effect of types, rates and methods of adding compost on hydraulic conductivity (cm/ h) of Maryut calcareous soil.

Compost types and rate (ton/fed.)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2.5	0.81 (MS)	1.56 (MS)	3.36 (M)	1.91
	5.0	2.44 (M)	3.48 (M)	4.67 (M)	5.53
	7.5	4.10 (M)	6.62 (MR)	8.65 (MR)	6.46
Average		2.45	3.89	5.56	3.97
PR	2.5	1.29 (MS)	1.99 (MS)	2.54 (M)	1.94
	5.0	1.89 (M)	2.40 (M)	2.56 (M)	2.28
	7.5	3.12 (M)	4.74 (M)	6.81 (MR)	4.89
Average		2.10	3.04	3.97	3.04
Mixture (1:1)	2.5	1.21 (MS)	1.75 (MS)	2.83 (M)	1.93
	5.0	1.48 (MS)	3.30 (M)	3.02 (M)	2.60
	7.5	1.75 (MS)	3.04 (M)	4.43 (M)	3.07
Average		1.48	2.70	3.43	2.54
General mean		2.01	3.21	4.32	3.18

M: Moderately; MS: Moderately Slow; MR: Moderately Rapid.
The hydraulic conductivity of the control treatment was 0.164 cm/h, therefore slow.

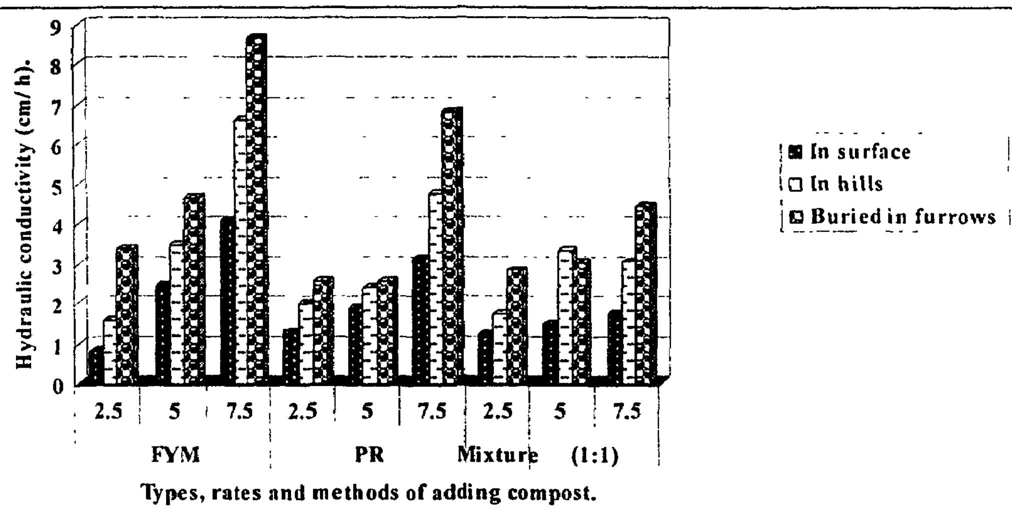

Fig.3. Effect of types, rates and methods of adding compost on hydraulic conductivity (cm/h).

TABLE 7. Effect of types, rates and addition methods of compost on crop production of fodder beet (ton/ fed) for Maryut calcareous soil.

Compost types and rate (ton/fed)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2 5	33 00	49.00	45.00	42.33
	5.0	40.75	71.00	56.00	55.92
	7.5	46.00	60.00	51.00	52.33
Average		39.92	60.00	50.67	50 20
PR	2.5	37.00	55.00	35.00	42.33
	5.0	34.00	59.00	40.00	44.33
	7.5	39.00	58.00	40.00	45.67
Average		36.67	57.33	38.33	44.11
Mixture (1:1)	2.5	30.00	55.00	41.00	42.00
	5.0	30.00	42.00	35.00	35.67
	7.5	29.00	38.00	32.00	33.00
Average		29.67	45 00	36.00	36.89
General mean		35.42	54.11	41.67	43.73

Fodderbeet production of the control treatment is 27.00 (ton/ fed)

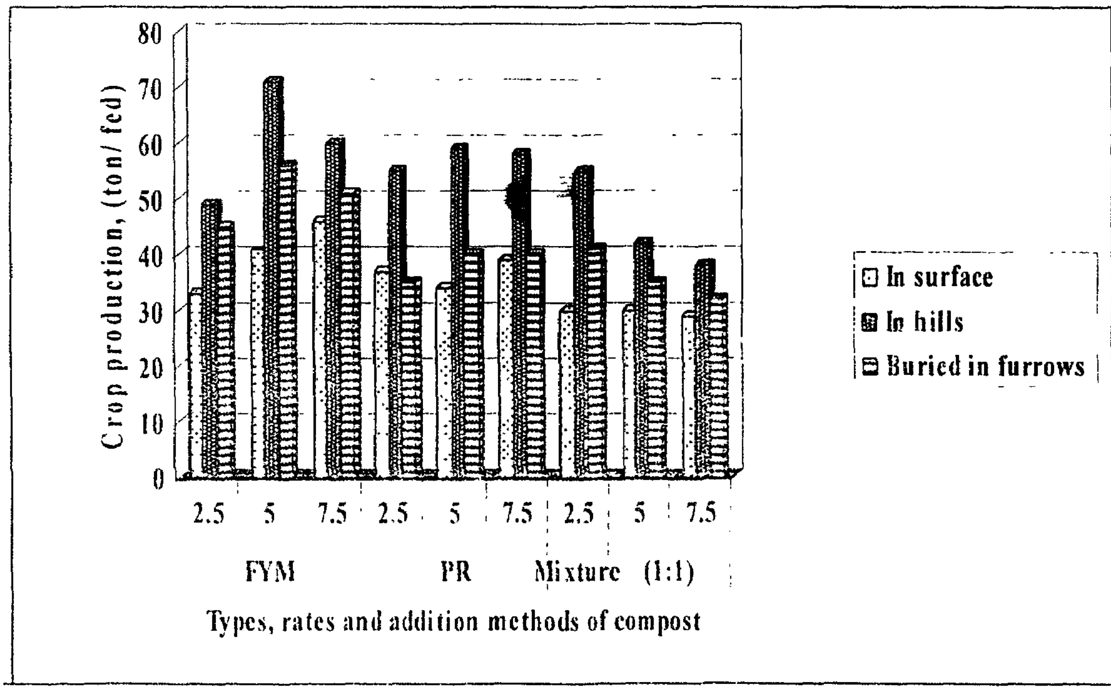

Fig.4. Effect of types, rates and addition methods of compost on crop production, (ton/fed).

may be due to the decomposition of organic matter and release of their available nutrients. Furthermore it has beneficial effect on soil chemical, physical and biological properties. Omran *et al.* (1979). Saleh & Abd El-Fattah (1997) indicated that the application of organic manures increased the yield of plants and their nutrients uptake. The increase of fodderbeet crop depends on the types and rates of applied organic compost. Generally, the use of 7.5 ton/fed farmyard manure in the surface and burried in hills, led to increase crop yield by 88% and 94%, respectively. The response to types, rates and addition methods of compost to fodderbeet crop yield was statistically confirmed. Data indicate a high significant correlation between crop yield (Y) and both hydraulic conductivity (X_1), total porosity (X_2) bulk density (X_3) and penetration resistance (X_4). The correlation coefficients are 0.019 non significant, 0.633**, - 0.668** and - 0.678**, respectively. The corresponding regression equations are:

$$Y = -81.848 + 3.267 (X_2);\ Y = 263.73 - 162.20 (X_3) \text{ and } Y = 63.188 - 1.776 (X_4)$$

These results indicate that fodderbeet production under Maryut condition is significantly increased by increasing, total soil porosity, decreasing soil bulk density and decreasing penetration resistance.

The amount of irrigation water used during fodderbeet growth season was 2800 m^3/ fed. The water utilization efficiency of fodderbeet, recommended by FAO, is 6-9 kg/ m^3.

Concerning water utilization efficiency (WUE), the data in Table 8 reveal a high response of yield to compost application and addition methods FYM took the lead for increasing the efficiency of plants to use water compared with compost PR and their mixture. This trend was attributed to the more beneficial effect of FYM in increasing available water in the cultivated soils. The organic materials produced during its decomposition can influence soil water retention and its availability for the growing plants. The percentages of increase relative to the control amounted 85, 74 and 44 % respectively.

The increasing rates of applied composts were accompanied with better water use efficiencies for the different compost types. The percentages of increase relative to the control amounted to 56, 68 and 63% pertaining to 2.5, 5 and 7.5 ton/fed. composting application rates This effect could be rendered to improve root zone layer by allowing more water to be extracted by cultivated plants.

Concurrently, the combination effect between applying compost and its addition methods induced a better WUE reflected on crop production especially when buried in hills compared with being buried in furrows or mixed in the surface. Gajri *et al.* (1994) reported that deep tillage in coarse textured soils reduces soil strength, enhances rooting, causes greater water extraction from sub - soil and thus increases water use efficiency, particularly under limited water supply conditions. The trends of WUE stood in agreement with those obtained by FAO (1979); Cochran *et al.* (1982); El-Kommos *et al.* (1989) and Omar *et al.* (1989) (Fig.5).

TABLE 8. Effect of types, rates and methods of adding compost on water use efficiency of fodder beet crop production (kg/m^3).

Compost types and rate (ton/fed)		Methods of addition			
		In surface	In hills	Buried in furrows	G. Mean
FYM	2.5	11.79	17.50	16.07	15.12
	5.0	14.64	18.93	17.50	17.02
	7.5	16.42	19.64	18.21	18.09
Average		14.28	18.69	17.26	16.74
PR	2.5	13.21	17.14	14.29	14.88
	5.0	12.14	16.07	14.29	14.17
	7.5	13.93	17.14	15.71	15.59
Average		13.09	16.78	14.76	14.88
Mixture (1:1)	2.5	10.71	16.77	14.64	14.04
	5.0	10.71	17.86	16.07	14.88
	7.5	10.36	18.21	17.50	15.36
Average		10.59	17.61	16.07	14.76
General mean		12.65	17.69	16.03	15.46

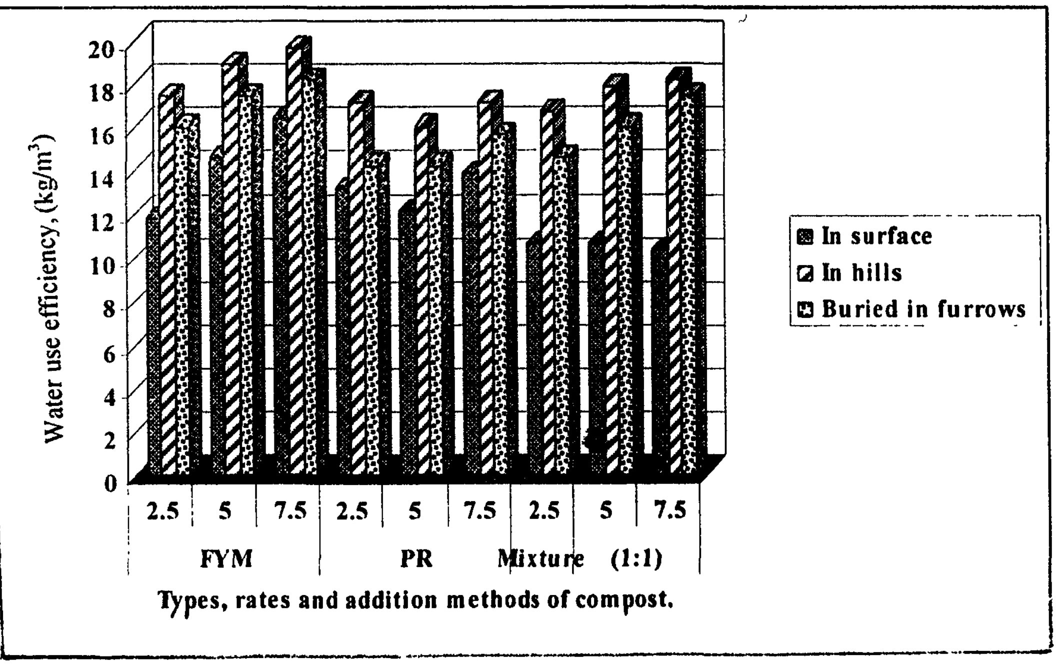

Fig.5. Effect of types, rates and addition methods of compost on water use efficiency, (kg/m^3).

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انتاجية بنجر العلف فى الاراضى الجيرية بمريوط باستخدام السماد العضوى

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اقيمت تجربة حقلية بمحطة بحوث مريوط التابعة لمركز بحوث الصحراء لاستخدام نظام الزراعة العضوية بهدف تنمية انتاجيه محصول بنجر العلف . واشتملت المعاملات على ثلاثة انواع من المخلفات العضوية المكمورة وهى سماد المزرعة ، مخلفات تبن قش الفول البلدى ، ومخلوط منهما بنسبة (١:١) وزنا بالاضافة الى معاملة الكنترول. اضيفت تلك المخلفات بثلاث معدلات (٢,٥، ٥ ، ٧,٥ طن/فدان) وتم اضافة تلك المخلفات بثلاث طرق وهى سطحية ، جور ، وفى خطوط واستخدم محصول بنجر العلف كدليل على زيادة الانتاجية وتحسين الخواص الطبيعية.

ادى استخدام مكمورة سماد المزرعة الى خفض الكثافة الظاهرية وزيادة المسامية الكلية للتربة بدرجة اكبر من مخلفات تبن الفول البلدى ومخلوط منهما بنسبة (١:١) وزنا وخصوصا مع المعاملة (٧,٥ طن/فدان) و طريقة الاضافة فى جور.

كما وجد ان هناك زيادة فى التوصيل الهيدروليكى ونقص فى مقاومة التربة للاختراق تحت تاثير الانواع المختلفة من المكمورات خصوصا بزيادة معدل الاضافة وبلغت قيمة النقص فى مقاومة الاختراق مقارنة بالكنترول بالقيم ٤٩,٣٪ ، ٤٣,٩٪ ، ٣١,٤٪ مع مكمورات سماد المزرعة ، والمخلوط (١:١) ، المخلفات النباتية.

ووجد ان هناك علاقة ارتباط عالية المعنوية السالبة لمحصول بنجر العلف مع الكثافة الظاهرية ، ومقاومة الاختراق والمعنوية الموجبة مع المسامية الكلية ، بينما العلاقة كانت غير معنوية مع التوصيل الهيدروليكى.

كما وجد زيادة فى محصول بنجر العلف وارتبطت تلك الزيادة مع كفاءة استخدام مياه الرى حيث بلغت نسبة الزيادة لكفاءة استخدام مياه الرى ٨٥,٩٪ ، ٦٣,٤٪ ، ٣٦,٦٪ على الترتيب لكل من سماد المزرعة ، المخلوط (سماد المزرعة والمخلفات النباتية) والمخلفات النباتية بمفردها. كما ادت الاضافة من مكمورة سماد المزرعة فى جور الى اعلى زيادة فى كفاءة استخدام المياه بمقدار ٩٤٪ ، ٨٣٪ ، ٧٤٪ مع ترتيب المكمورات سماد المزرعة ، المخلوط (١:١) ومع مكمورة المخلفات النباتية.