SOIL FERTILITY STATUS OF CLAYEY SOIL AS AFFECTED BY DIFFERENT IRRIGATION SYSTEMS .

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Abstract

Six soil profiles representing the clayey soil of El - Gemmeiza Experimental Stauion , El-Gharbia Governorate were chosen to study the effect of different irrigation systems (surface , sprinkler, drip) on soil fertility status.

Results show that the values of available phosphorus, potassium and organic matter contents were negatively significant correlated with different irrigation systems. Available nitrogen values were significantly negatively correlated with sprinkler and surface irrigaion systems, however they showed insignificant negative correlation with trickle irrigation system.

On the other hand, it can be stated that no distinct trend could be observed between N, P, K and organic matter contents with the different irrigation systems.

The surface layer of the soil contained the highest available nitrogen , phosphorus, potassium and organic matter contents with a tendency to decrease as soil depth increases.

INTRODUCTION

Water management practices are the key factor for profitable irrigation farming . A simple definition of water managememt is to balance efficient water application to the ability of soils to absorb and release water and soil nutrients. This would

effectively meet plant requirements . Mostaghimi *et al.*, (1983) indicated that a non - uniform water distribution pattern exists at different sections of the soil profile. Tayle *et al.*, (1988) found that the soil moisture is mainly afffected by the amount of irrigation water that can penetrate the soil profile. El-Shafie (1989) found that available N, P and K values werer significantly decreased by increaseing soil depth . The objective of this work is to study the effect of irrigation system on soil fertility status in clay soil.

MATERIALS AND METHODS

The experiment was conducted at El - Gemmeiza Experimental Station , El - Gharbia Governorate. Six soil pofiles were chosen to represent three irrigation systems, namlely, sufrace, sprinkler and trickle irrigations, each irritgaion system was repressented by two soil profiles . Disturbed soil sampes were taken from the different layers of the soil profile (0-20 cm, 20 - 40 cm, 40 - 60 cm and 60 - 80 cm, respecxtively). Soil samples were air dried then ground to pass through a 2 mm sieve and kept for different determinations.

Soil properties of these soil profiles as determined according to Black *et al.,* (1965) were found to be very similar and on average were : textural class clay; total carbonates 2. 3. %; cation exchange capacity 42.5m . e. / 100 g soil, electrical conductivity of soil paste 1. 35 mmhos / cm at 25 ^{o}C and soil pH 7.9.

Available nitrogen was determined using KCl with MgO according to Black (1965). Available phosphorus was determined using the method of Olsen *et al* (1954). Available potassium was estimated by flame photometry using ammonium acetate method (Jackson 1973). Also Organic matter was detemined using the modified Walkely and Black 's method (Jackson 1973).

The results were statistically analyzed according to Dauglas and Lu (1959).

RESULTS AND DISCUSSION

1. Effect of irrigation system and depth of soil sampling on fertility status

A . Available nitrogen :

Data in Table 1 indicate that the available nitrogen values ranged from 18. 85 to 5. 36 ppm and this variation in nitrogen content values depended on the irrigation systems. The highest value of N- content is obtained by sprinkler irrigation system while the lowest one is found with the surface irrigation system . Also it can be noticed that availble nitrogen in the soil samples under different irrigation systems can be arranged according to the following descending order : sprinkler> trickle> surface irrigation systems.

Data presented in Tabe 2 show that negative and high significant correlations are found among available nitrogen and each of surface and sprinkler irrigation systems, meanwhile, negative and insignificant correlations are found between N - content and trickle irrigation system.

Concerning the effect of soil sampling depth on available nitrogen values, data in Table 1 reveal that the values of available nitrogen decreased with increasing the soil sampling depth in all soil profiles under study. This could be related to the fact that most of biological activities and nitrogen increase are located in the surface layer and decrease with soil depth (El - Shafie, 1989) .

The statistical analysis in Table 2 show that negative and significant correlations are found between available nitogen values and soil sampling depth in all studied soil profiles.

B. Available phosphorus :

The values of available phosphorus as shown in Table 1, ranged between 19.4 ppm to 3.1 ppm. These vaues are found in the profiles which represent the trickle irrigation system. However it can be noticed that available phosphorus values in the studied soil samples under different irrigation systems can be arranged in the following descending order: trickle > spinkler> surface irrigation systems.

Table 1. Soil fertility status as affected by either irrigation system or soil sampling depth in clay soil.

Prof. No.	Irrigation System	Soil depth in cm.	Soil fertility status			
			N ppm	P ppm	K meq/100g	O. M. content
1	Surface irrigation	0 - 20	10.72	11.20	5.92	1.94
		20 - 40	10.12	4.40	3.90	1.23
		40 - 60	7.14	4.10	2.60	1.60
		60 80	5.36	4.20	2.25	0.95
2		0 - 20	8.93	14.60	5.25	2.05
		20 - 40	7.74	6.10	3.85	1.15
		40 - 60	7.74	4.70	2.85	0.82
		60 - 80	7.14	4.80	2.55	0.76
3	Sprinkler irrigation	0 - 20	17.85	16.00	4.00	1.99
		20 - 40	16.18	3.60	2.80	1.30
		40 - 60	15.26	3.80	2.35	1.01
		60 - 80	11.95	3.80	2.20	0.95
4		0 - 20	18.56	16.10	5.25	2.20
		20 - 40	17.06	4.40	2.95	1.47
		40 - 60	15.75	3.30	2.07	0.97
		60 - 80	13.21	4.20	2.15	0.94
5	Trickle irrigation	0 - 20	17.85	19.40	4.45	2.02
		20 - 40	16.07	5.30	2.90	1.22
		40 - 60	15.64	4.40	2.20	0.86
		60 - 80	14.85	4.60	2.15	0.80
6		0 - 20	15.28	18.20	4.15	1.89
		20 - 40	13.69	3.80	2.95	1.13
		40 - 60	12.53	3.10	2.20	0.76
		60 - 80	14.45	3.20	2.05	0.66

Table 2. The simple correlation coeficents "r" and linear regression equations between soil fertility status " Y " and soil sampling depth under different irrigation systems "X".

Treatments " X "	Soil fertility status "Y"							
	N		P		K		Organic matter content	
	r	Reg. equ.	r	Reg. equ.	r	Reg. equ.	r	Reg. equ.
Soil depth in cm	-0.400*	Y=16.069-0.062X	-0.764**	Y=16.150-0.180X	-0.862**	Y=5.325-0.043X	-0.903**	Y=2.218-0.019X
surface Irrig.	-0.838**	Y=ll.165-0.061X	-0.789*	Y=13.275-0.130X	-0.949**	Y=6.288-0.053X	-0.896**	Y=2.163-0.018X
Sprinkler Irrig.	-.0949**	Y=20.363-0.092X	-0.773*	Y=16.050-0.183X	-0.857**	Y=4.975-0.040X	-0.923**	Y=2.315-0.019X
Trickle Irrige.	-0.989	Y=16.680-0.033X	-0.792**	Y=19.125-0.228X	-0.928**	Y=4.713-0.037X	-0.925**	Y=2.178-0.020X

Table 3. The simple correlation coeficents "r" and linear regression equations between soil fertily status " Y " and soil sampling depth under different irrigation systems and soil organic matter contents "X" for soil profile samples

O.M. content " X "	Soil nutrient status "Y"					
	N		P		K	
	r	Reg. equ.	r	Reg. equ.	r	Reg. equ.
Surface irrigation	0.686*	Y=5.070+9.924X	0.930**	Y=2.566+7.493X	0.933 **	Y=0.469+2.545X
Sprinkler irrigation	0.841**	Y=10.475+3.898X	0.924**	Y=6.985+10.323X	0.975 **	Y=0.010+2.188X
Trickle irrigation	0.665	Y=12.668+2.036X	0.953**	Y=6.916+12.551X	0.995 **	Y=0.780+1.800X

Data in Tabe 2 indicate that the simple correlation coefficients between available phosphorus values and each irrigation system are negative and significantly correlated with the differnt irrigation systems.

Regarding the effect of soil sampling depth on the values of available phosphorus, the data in Table 2. reveal a gradual decresae in available phosphorus as soil sampling depth increases. This might by attributed to the high organic matter content in surface layers which leads to more available phosphorus than in deeper ones. These findings are in good agreement with El - Saidy (1976) who found that the highest value of available phhosphorus was relaeased from the surface layer of plots treated with farmyard manure.

The simple correlation coefficients in Table 2 reveal that negative and high significant correlations are found between available phosphorus values and soil depths in all soil profiles.

C. Available Potassium :

Data presented in Table 1 show that the available potassium values ranged from 5.9 to 2. 05 m eq/ 100g soil. The highest value of available potassium is realized with surface irrigation system , while the lowest value is found with trickle irrigation system. This may be attributed to the increase of moisture content which enhances solubility of potasium compounds. The available potasium values in the different soil profiles with the different irrigation systems could be arranged according to the following descending oreder: surface> sprinkler> trickle irrigation systems.

Data in Table 2 show the relationship between avalilable potassium values and different irrigation systems. The simple correlation coefficients reveal that the available potassium value is significantly negatively correlated with the different irrigation systems.

As for the effect of soil depth on potassiurn contents, data in Table 1. indicate that the values of potassium content decreased with increasing soil depth . This finding is in good agreement with that of Abdel - Naim *et al.*, (1981) and Kapur *et al.*, (1986) who found that potassium forms decreased by increasing soil depth.

The statistical analysis in Table 2 show negative and higher singificant correlations between available potassium values and soil depths in all soil profiles.

D. Soil organic matter content :

Data presented in Table 1 show that the soil organic matter content values ranged from 2.2. to 0.66 . The highest organic matter content value is realized in soil irrigated by sprinkler irrigation system, while the lowest is found in soil irrigated by the trickle system.

The simple correlation coefficients in Table 2 show negative and highly significant correlation between soil organic matter contents and each irrigation system under study.

Regarding the effect of soil sampling depth on soil organic matter, data in Tabl 1 indicate that the values of soil organic matter decreased with increasing soil depth . This result might be attributed to the high decomposition rate of crop residues under our semiarid condition (Heggy 1976; Steinbrenner and Smukalshi 1984).

II. Effect of soil organic matter on nutrient status :

Data in Table 3 show simple correlation coefficients and linear regression equations between soil organic matter contents and nutrient status under different irrigation systems . It is obvious that the values of available nitrogen are positively and significantly correlated with soil organic matter content for both surface and sprinkler irrigation systems, while this correlation, was positive and insignificant for trichle irrigation system.

Data in Table 3 demonstrate positive and high significant correlations among soil organic matter and avaiable phoshorus and potassium values under different irrigation systems.

From the obtained results it can be concluded that irrigation system, soil samping depth, and soil organic matter content play an important role in the soil fertility status.

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خصوبة الأرض الطينية تحت تأثير نظم الرى المختلفة

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اخذت ستة قطاعات أرضية من محطة التجارب بالجيز ه بمحافظة الغربية لدراسة نظم الرى المختلفة (رى سطحى - رى بالرش - رى بالتنقيط) على العناصر الغذائية للأراضى الطينية . وقد أظهرت النتائج الآتى :

١ - وجدت علاقة معنوية سالبة بين نظم الرى المختلفة وقيم الفسفور والبوتاسيوم والمادة العضوية.

٢ - وجدت علاقة معنوية سالبة بين قيم النيتروجين الميسر وكل من الرى بالرش والرى السطحى بينما كانت هذه العلاقة السالبة غير معنوية مع الرى بالتنقيط .

٣ - لم يظهر أى اتجاه لقيم عناصر النتروجين والفسفور والبوتاسيوم ومحتوى المادة العضوية مع نظم الرى المختلفة تحت الدراسة .

٤ - احتوت الطبقة السطحية على قيم معنوية عالية من عناصر النيتروجين والفسفور والبوتاسيوم والمادة العضوية وتقل هذه القيم مع زيادة العمق.