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A STUDY OF SOME FACTORS AFFECTING SOIL TEMPERATURE IN SOME SOILS OF EGYPT.

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ABSTRACT

A field study was carried out at El-Menia and El-Sharkia regions. Two locations were chosen for each region. Each one was divided into two areas. One of them was cultivated and the other was left without cultivation. Daily soil temperature for 2.5 ,5,10 and 20 cm soil depths at 8 A.M. and 14 P.M. was estimated during two seasons of (1999/2000) years in three cases of soil moisture levels which are 100%, 75% and 50% of the soil field capacity.

The obtained results indicated that :

1- There is a positive significant correlation between air and soil temperature. The soil temperature values made the following ascending order: July> Aug.>Jane> May for summer season and Nov.>March>Dec. > Feb.> Jan. for winter season.
2- The previous relation was affected by the soil texture according to the following ascending order sandy > clayey for El-Sharkia soil and loamy sand > clayey for El-Menia one.
3- The soil temperature decrease with soil depth increase.
4- Also, highly significant correlation was obtained between soil and air temperature where the maximum values were recorded at 14 P.M. Soil temperature variations were noticed for the unplanted soils than in planted soils.
5- Highly significant relation was obtained for soil temperature at lower moisture levels at 50% of field capacity.

INTRODUCTION

Soil temperature is one of the most affecting environmental conditions on plant growth. Hence, several researches were carried out to reach optimum conditions of the soil temperature to plant growth; and to modify any soil characteristic that may affect soil temperature for this purpose (Bonhan and Fye (1970), Acharya and Gupta (1975) and Awadalla (1977).

The main soil characteristics, which affecting soil temperature are, soil texture, soil depth, growth season, soil moisture content, air temperature and plant cover; Awadalla and Tadros (1982), Gupta et al (1983), Horton et al (1984) and Arshad and Azooz (1996).

The present study aims to identify the role of some of the previously mentioned main soil characteristics in modifying the soil temperature of some soils of Egypt.

MATERIALS AND METHODS

The current study was carried out to achieve the research purpose on two sites varied in their environmental conditions at El-Menia and El-Sharkia governorates. Two locations were chosen for each governorate

differed in their soil texture classes. Every location was divided into two plots, one of them was for representing the cultivated (planted) condition; while the other was for representing the uncultivated (unplanted) soil conditions. The environmental condition measurements were carried out at every location during the winter and summer seasons of (1999-2000) years. Also soil temperature was estimated daily at 2.5, 5, 10 and 20 cm soil depths at 8 A.M. and 14 P.M. Three moisture levels (100%, 75% and 50%) of field capacity were the soil moisture content through the study duration. Surface soil samples (0- 30 cm depth) were collected from each soil location and subjected to the physical, chemical and thermal analysis according to Black (1965). All the research estimations were replicated three times and statistical by analysed.

The estimated soil properties are listed in table (1).

RESULTS AND DISCUSSION

Data of table (2) illustrate that the variation in soil temperature during season can be arranged for El-Menia clayey soil planted with Maize as the following order of July > August > June > May, while for Wheat plant followed the order of Nov.>March > Dec.> Feb.> Jan. The maximum soil temperature for the winter season reached 25.5 °c in Nov. and reached 18.8C° at January. The same conclusion was confirmed with those obtained by El-Awady (1981) who found that in general maximum soil temperature occurred at June to August whereas minimum soil temperature occurred at December to February.

Regarding the effect of different air temperature on soil temperature at El-Sharkia clayey soil planted with Maize. Table (2) showed the increase of soil temperature according to the following order, July > Aug. >June > May whereas the values of the winter season followed the order of Nov. > March > Dec. > Feb. > Jan.

The difference in soil temperature at the different depths are shown to be highly significant, table (3). The mean temperature of the top 2.5 centimeter is higher than the other depths where soil temperature decreases with depth from soil surface down to 20 cm. Soil temperature values decreased from 42.33 °C at 2.5 cm. depth to 37.26 °C at 20 cm. depth in El – Menia loamy sand soil planted with Maize. While in El-Sharkia sandy soil reached 46.86 °C at 2.5 cm. depth and 35.5 °C at 20 cm. depth. These findings agreed with those obtained by Lugo and Capiel (1972).

The relationship between soil temperature at 8 A.M. and 14 P.M. is found to be highly significant, where the higher values were recorded at 14 P.M. than 8 A.M. especially in the top 2.5 cm. compared with the other depths table (4). The soil temperature values ranged between 29.0 and 40.0 °C at 8 A.M. and 14 P.M. respectively during the summer growth season at El-Menia clayey soil, whereas the mean values were 29.37 and 41.85 °C. at the same time of reading for El-Sharkia clayey soil respectively.

Table (1) : Analysis of the investigated soil samples.

Soil depth (0-30cm)	Particle size distribution %			Texture class	O.M%	$CaCo_3$%	pH	Ec mmohs /cm	Soil porosity %	Hydraulic conductivity (k) m/day	Specific heat cal. g.c	Moisture content % at different pressure			A.W %
	Sand	Silt	Clay									0	0.33	15	
El-Meni (1)	45.5	13.2	41.8	Clayey	2.4	1.4	7.5	0.46	49.0	0.36	0.29	88	43.83	13.3	30.53
El-Menia (2)	75.5	18.5	6.0	Loamy sand	0.6	1.2	7.9	0.36	43.5	4.32	0.19	44	18.1	2.8	15.3
El-Sharkia (1)	37.5	14.1	48.4	Clayey	2.5	1.7	7.9	0.65	52.0	0.29	0.31	93	44.3	14.1	30.2
El-Sharkia (2)	88.5	8.2	3.3	Sandy	0.3	1.1	7.9	0.42	42.7	6.24	0.18	36	16.0	1.8	14.2

(1) location one
(2) location two
A . W% = Available water

Table (2) Soil temperature as affected by growth season(air temperature) in the investigated soils*

Growth season / Soil location	Nov.	Dec.	Jan.	Feb.	Mar.	May.	June	July	Aug.	L.S.D 5%	L.S.D 1%
El- Menia clayeysoil (Maize)	-	-	-	-	-	33.6	35.8	38.5	36.4	2.6	3.77
El-Menia clayey soil (Wheat)	25.5	22.3	18.8	19.2	22.9	-	-	-	-	1.17	2.41
El-Sharkia clayey soil (Maize)	-	-	-	-	-	34.6	35.7	36.9	36.3	2.3	3.35
El-Sharkia clayey soil (Wheat)	22.8	21.2	19.2	19.9	22.0	-	-	-	-	1.5	2.2

Table (3): Soil temperature values in relation with soil depths of the investigated soils.

Soil location \ Soil depth(cm)	2.5	5	10	20	L.S.D 5%	L.S.D 1%
El- Menia clayey soil (Maize)	41.9	41.9	39.23	35.73	0.062	0.08
El-Menia clayey soil (Wheat)	22.5	22.13	15.13	14.96	0.071	0.096
El-Menia loamy sand soil (Maize)	42.33	41.86	39.13	37.26	0.011	0.15
El-Menia loamy sand soil (Wheat)	22.8	22.5	17.1	16.07	0.013	0.18
El-Sharkia clayey soil (Maize)	45.93	42.56	38.66	34.23	0.11	0.15
El-Sharkia clayey soil (Wheat)	20.16	19.97	19.1	17.1	0.12	0.16
El- Sharkia sandy soil (Maize)	46.86	46.6	42.6	35.5	0.07	0.10
El- Sharkia sandy soil wheat (Wheat)	21.13	20.76	19.53	18.96	0.12	0.17

Table (4): The investigated soil temperature as affected by time of its estimation / day

Soil location \ Time of reading /day	8 A.M.	2 P.M.	L.S.D 5%	L.S.D 1%
El- Menia clayey soil (Maize)	29.0	40.0	0.035	0.046
El-Menia clayey soil (Wheat)	12.56	19.43	0.036	0.047
El-Sharkia clayey soil (Maize)	29.37	41.85	0.24	0.35
El-Sharkia clayey soil (Wheat)	13.54	20.44	0.033	0.044

Concerning the effect of soil texture and vegetative cover on soil temperature, data presented in table (5) indicate that the highest soil temperature was found in the unplanted loamy sand while the lowest was at the planted clayey soil for El-Menia governorate. The same trend was found for El-Sharkia soils. Generally, it is observed from the data that soil temperature was higher in the unplanted light textured soil than the planted heavy textured ones for both studied areas.

Table (5): The investigated soil temperature as affected by soil texture and vegetative cover

Soil texture / Soil location	Loamy sand		Clayey		L.S.D 5%	L.S.D 1%
	Planted	Unplanted	Planted	Unplanted		
El- Menia (Maize)	41.46	42.73	40.56	41.3	0.14	0.18
El-Menia (Wheat)	22.83	24.56	22.2	22.7	0.11	0.15
	Sandy		Clayey		L.S.D 5%	L.S.D 1%
	Planted	Unplanted	Planted	Unplanted		
El-Sharkia (Maize)	34.3	39.0	33.4	35.5	0.31	0.45
El Sharkia (Wheat)	21.13	22.67	20.17	20.5	0.10	.144

This result might be due to the open structure of light soil, which have high total drainable pores, hot vapor pressure and high aeration more than the heavy ones. Rodskjer (1977) stated that soil temperature was higher for the uncultivated lands than for the cultivated ones. Highly significant correlation was obtained between soil temperature and soil texture for the uncultivated lands of El-Menia and El-Sharkia regions.

Data in table (6) reveal that presence of various moisture levels in the investigated soils increased the significance of soil temperature changes under the investigated affecting factors. Where the soil which had moisture content equal to 50% of its F.C. were more affected than the treatments of 75% and 100 of F.C.

Table (6): The investigated soil temperature as affected by soil moisture levels at 5 cm depth

Soil moisture levels %	100		75		50	
Plant / Soil texture	Maize	Wheat	Maize	Wheat	Maize	Wheat
El-Menia clayey soil	38.10	17.97	39.65	18.15	40.92	20.30
El-Menia loamy sand soil	39.00	18.70	40.37	19.50	41.07	20.67
El-Sharkia clayey soil	40.65	18.20	39.92	18.70	40.47	20.80
El-Sharkia sandy soil	42.47	19.20	42.25	19.82	43.35	21.27

L.S.D for El-Menia Clayey soil planted with Maize at 5% = 0.055 , 1% = 0.07
L.S.D for El-Menia Clayey soil planted with Wheat at 5% = 0.06 , 1% = 0.08
L.S.D for El-Menia Loamy sand soil planted with Maize at 5% = 0.096 , 1% = 0.13
L.S.D for El-Menia Loamy sand soil planted with Wheat at 5% = 0.11 , 1% = 0.15
L.S.D for El-Sharkai Clayey soil planted with Maize at 5% = 0.094 , 1% = 0.128
L.S.D for El-Sharkai Clayey soil planted with Wheat at 5% = 0.10 , 1% = 0.138
L.S.D for El-Sharkai Sandy soil planted with Maize at 5% = 0.066 , 1% = 0.087
L.S.D for El-Sharkai Sandy soil planted with Wheat at 5% = 0.10 , 1% = 0.14

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دراسة بعض العوامل المؤثرة على حرارة التربه فى بعض الأراضى المصرية

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أجريت تجارب حقلية فى كلا من محافظتى المنيا والشرقية وقد تم اختيار منطقتين فى كل محافظة طبقاً لاختلافها فى القوام حيث قسمت كل مساحة إلى قسمين أحدهما منزرع والأخر غير منزرع وكان ذلك فى موسمين الشتوى والصيفى (١٩٩٩-٢٠٠٠) حيث كانت النباتات المنزرعة هى القمح والذرة على التوالى – تم تسجيل درجات الحرارة للتربة يومياً على أعماق ٢,٥، ٥، ١٠، ٢٠سم من سطح التربة وذلك فى الساعة الثامنة صباحاً والساعة الثانية ظهراً.

ومن النتائج أمكن استنتاج الآتى:

١-كان إرتباط درجة حرارة التربة معنوى موجب مع حرارة الهواء الجوى وكان ترتيب قيم درجات حرارة التربة خلال الموسم الصيفى على النحو التالى يوليو أكبر من أغسطس أكبر من يونيو أكبر من مايو وبالنسبة للموسم الشتوى فقط كان الترتيب كالتالى نوفمبر أكبر من مارس أكبر من ديسمبر أكبر من فبراير أكبر من يناير.

٢-تأثر الارتباط السابق الإشارة إليه بقوام التربة حيث كانت الأراضى الخشنة هى الأكثر والأعلى فى تأثر حرارتها بحرارة الهواء الجوى وكانت الأراضى الطينية الثقيلة القوام هى الأبطئ فى تغير حرارتها بالتبعية لتغير حرارة الهواء الجوى.

٣-لوحظ نقص حرارة التربة مع زيادة عمقها.

٤-أعلى درجات حرارة كانت فى فترة الظهيرة.

٥-أدى ارتفاع نسبة الرطوبة بالتربة الى بطئ تغير حرارتها تحت تأثير التغير فى حرارة الجو.