Cairo Univ. Afr. Stud. Rev. 19 (1997): p27 - 42.

INTERACTION EFFECT OF IRRIGATION WATER SALINITY AND SOIL MOISTURE DEPLETION ON WATER CONSUMPTIVE USE OF SUDAN GRASS

BY

FAWZIA I. MOURSY*, A.S.EI-HASSANIN*, M.H.EL-DOSOUKY AND EVON. K. RIZK****

This study aims to study the interaction effect of both irrigation water salinity and soil moisture depletion on the water consumptive use of Studan grass grown on sandy and calcareous soils of El-Nubaria and Burg El-Arab respectively. A pot experiment was carried out in summer season, 1997, under greenhouse conditions. Four salinity levels were applied for irrigation (tap water. 2000, 4000, and 6000 PPM). and three soil moisture depletin levels were employed (25, 50 and 7% of available soil water).

Results revealed that the lowest ETo values were obtained with the modified Blaney-Criddle equation followed by Penman-Monteith at El-Nubaria area and Penman-Monteith and modified Penman equations for Burg El-Arab area A decrease in actual evapotraspiration (ETa) was noticed with increasing irrigation water salinity ETa) values of calcareous soil gave higher values than sandy soil. Moreover. (ETa) values decreased with increasing soil moisture depletion (SMD) for sandy soil and the reverse was true with calcareous soil.

A decease in wate use efficienc (WUS) of Sudan grass was obtained with increasing irrigation water salinity and the maximum WUE of Studan grass was obtained at 50 and 75% S.M.D. in sandy and calcareous soil, espectively. A decrease

(*) Dept of Natural Resources. Inst. Of African Research & Studies. Cairo univ.

(**) Desert Research Center. Matarya. Cairo Egypt.

in crop coefficient (KC) values was also noticed. The highest (KC) values were obtained with Blaney - Criddle equation while the lowest ones were associated with Penman - Monteith and modified penman equations for both soils (KC) deceased with inceasing S.M.D in sand soil, while the opposie was true in calcareous soil.

INTRODUCTION

The interaction of climate, soil, plant and water management influences crop growth. One of the best approaches to achieve good water management program is knowing how to estimate actual evapotraspiration or consumptive use for improving water use efficiency. In addition, growing salt tolerant crops, particularly forage crops, is of great benefit in summer season in order to face the animal feed which is seemingly a must.

Water availability caused by soil water stress and salinity led to great reduction in evapotraspiration of plants, consequently crop yield diminished (Russo. 1985). Consumptive use of sugar beets and actual evapotraspiration of barley and wheat grown on calcareous soil decreased with increasing irrigation water salinity (El-Dosouky and El-Hassanin, 1988 and El-Boraie, 1997). As soil moisture stress increased, evapotraspiration rates decreased (Tawadros 1984; Sharma et al., 1990. Anton, 1991). Increasig et al., irrigation water salinity progressively decreased the crop use efficiency (Holloway and Alsron. 1992; El-Boraie, 1997) Crop coefficient (KC) was found to be influenced by crop characteristics, sowing date, crop development rate, length of growing season, climatic conditions, and soil moisture depletion (Doorenbos and Pruitt, 1984; Ahmed et al., 1990).

There fore, the objective of study is to investigate' the interaction effect of both irrigation water salinity and soil moisture depletion on actual evapotraspiration (ETa), water use efficiency (WUE), and crop coefficient (Kc) of Sudan grass grown on sandy and calcareous soils.

MATERIALS AND METHODS

A pot experiment was carried out under open greenhouse conditions at the Desert Research Center, Mataria, Cairo (Lat. 30^0 13, Long. 31^0 40 E. Alt. 64.7 m), during summer season, 1997.

Two surface soil samples (0- 30 cm) were collected from El Nubaria (Lat. 30^0 20 N, Long. 30^0 40 E. Alt. 9.3m) sandy soil and from Burg El- Arab (Lat. 30^0 54, Long. 29^0 33 E and Alt. 20 m) calcareous soil (Fig. 1).

The initial soil properties are shown in Tables (la & b) and were determined according to Richards. (1954). Irrigation water was applied to maintain 25, 50 and 75% depletion of available soil moisture. Irrigation water was delivered to each pot when the required level of soil moisture depletion was reached, irrigation water was calculated and applied to restore soil moisture to available water, by daily weighted. Amount of irrigation water applied is shown in Table(2).

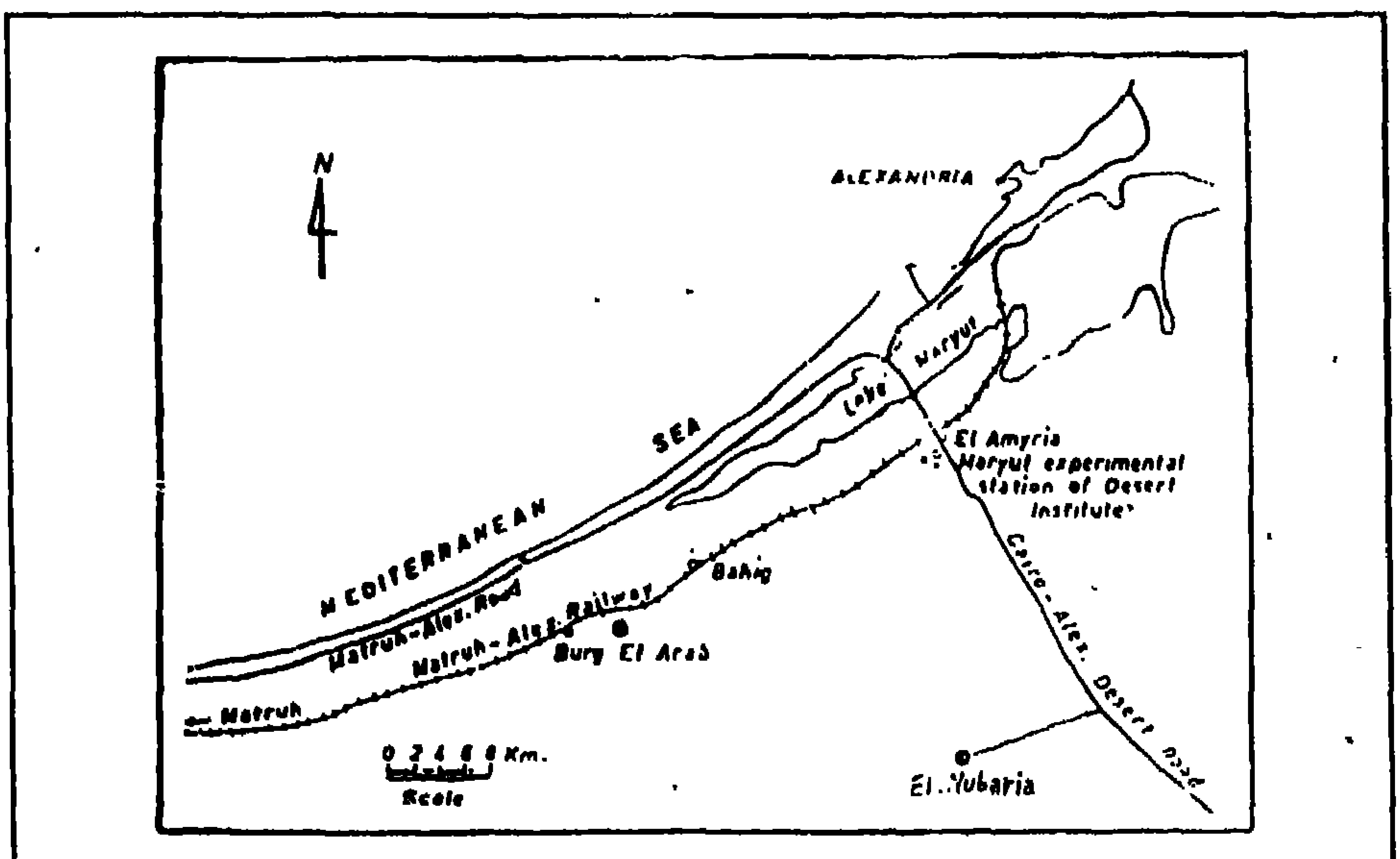

Figure (1): Locations of the collected soil samples

Table (1a) Some physical properties of soils selected for experimental work.

Region	Soil depth (cm)	Particle siz distribution				Texture class	Ca Co3	Particle density g/cm^3	Bulk density g/cm^3	Porosity g/cm^3	Organic matter %	% Mois-ture\retained at		Available soil water %	Hydraulic conductivity	
		Coarse sand	Fine sand	Silt	Clay							Field matter %	Wilting point		cm/hr	class
EL - Nubaria	0.30	46.55	49.18	1.79	2.48	Sandy	13.8	2.17	1.65	23.96	0.21	13.13	6.11	7.02	9.28	M.R
Burg EL-Arab	0.30	7.08	58.c4	19.25	15.63	Sandy loam	36.4	1.92	1.38	28.13	0.57	23.02	9.01	14.01	0.19	S

S = Slow M= Moderate R = Rapid

Table (1b) Some chemical properties of soils selected for experimental work.

Region	PH soil Paste	PH dSm	Solutle cations (me/L)				Solutle Anions (me/L)				CEC me/ 100.g soil	Exchanqeable cations (me/100 9 soil)			
			Ca*	Mg*	Na*	K*	CO*	HCO_3	CI*	SO_4		Ca*	Mg*	Na*	K*
EL - Nubaria	8.43	091	2.53	1.57	4.69	0.25	-	1.31	4.43	3.30	2.19	1,7	0.3	0.1	0.1
Burg EL-Arab	8.38	1.27	2.73	2.23	7.20	0.50	-	2.16	5.8	4.7	16.0	7,3	5.0	1.9	1.8

Water salinization was achieved by dissolving a mixture of sodium sulfate. Calcium chloride. magnesium chloride and potassium chloride having SAR= 75 and Ca Mg (11) Tables (3a.b and c) show the four various salinity levels. ie (2000.4000.6000 PPM and tap water) All pots were firstly irrigated with fresh water for five days. then after germmination they were irrigated with different saline water Four replicates for each treatment were used Water analvsis was determined using the aforementioned standard methods.

Three cuttings were taken through the growth period the plants were cut above the ground surface by 15 cm to give more tillers.

The first cut was taken on May 29. after 44 days from cultivation. the second cut on une 29. after 31 days for 2 nd vegetative stage and the third cut on July 24. 1997. after 25 days for 3 rd vegetative stage.

At each cut date samples of Sudan grass shoots were taken and the characters were recorded.

A complete set of daily meteorological data for the three stations. Cairo. El- Nubaria and Burg El- Arab during the growing season of Sudan grass 1997 was obtained from Meteological Authority. Cairo. Egypt.

Potential evapotranspiration (ET,) rates were calculated using three equations Modified Blaney-Criddle (FAO, 1984): Penman-Monteith (FAO. 1993) and modified Penman (FAO. 1986) for the three stations. according to Doorenbos and Pruitt (1984) and smith (1992 and 1993).

*** Potential evapotranspiration equations:**

1- Modified Blaney - Criddle:

$$ET_o = C\left[P\,(0.46\,T + 8)\right] \quad mm/day$$

Where

ET., refêrence crop evapotraspiration in mm/day for the month considered

T mean daily temperature in °C over the month considered

P mean daily percentage of total annual daytime hours.

C adustment factor which depends on minimum relative humidity. sunshine hours and daytime wind estimates.

2 - Modified Penman:

$$ET_0 = C\left[W.R_n + (1-W).f\,(u).\,(ea-ed)\right]$$

where

ET_0: reference crop evapotraspiration in mm/day

W : temperature- related weighting factor.

R_0 : net radiation in equivalent evaporation in mm/day.

F (u): wind - related function.

e_a-e_d: difference between the saturation vapour pressure at mean air temperature and the mean actual vapour pressure of the air both in mbar

C : adustment factor to compensate for the effect of day and night weaher conditions

Table (2) Amounts of applied irrigation water at different depletion levels from available soil water.

Soil Moisture Depleticon Levels %	Sany			Calcareous		
	Cm^3/Pot	mm	m^3/fed	Cm^3/Pot	mm	m^3/fed
25%	140	1.98	8.32	280	3.96	16.63
50%	280	3.96	16.63	560	7.93	33.31
75%	420	5.95	24.99	840	11.89	4994

Table (3 a) Chemical composition of tap water used for irrigation.

Treatment		pH	E C dSm^{-1}	SAR	Soluble cations me/1				Soluble anions me/1			
					$Ca^{••}$	$Mg^{••}$	$Na^{•}$	$K^{•}$	$CO_3^{•}$	HCO_3	Cr	SO_4
Tapwater	C,S,	72	0.39	1.28	1.68	0.69	1.39	0.16	-	2.08	1.50	0.34

Table (3b) Chemical composition of the saline irrigation waters (cations in me /L).

Salinity & Sodicity	Salinity on ppm	SAR	me / 1			
			$Na^{•}$	$Ca^{••}$	$Mg^{••}$	$K^{•}$
$C_1 S_1$	250	1. 28	1. 39	1. 68	0. 69	0 .16
$C_3 S_2$	2000	7. 5	18. 75	6. 25	6. 25	0 . 17
$C_4 S_2$	4000	7. 5	29. 24	15. 2	15. 2	2 . 35
$C_5 S_3$	0000	7. 5	38. 36	26. 14	26.1 4	3 . 8

Table (3c) Chemical composition of the saline irrigation waters (saits in ppm).

Salinity & Sodicity	Salinity concentrati on ppm	SAR	Salt in ppm			
			$Na_2 SO_4$	$CaCl_2$	$MgCl_2$	KCI
$C_1 S_1$	250	1. 28	98. 69	93. 24	32. 78	13. 41
$C_3 S_2$	2000	7. 5	1331. 25	346. 88	296. 88	26 . 0
$C_4 S_2$	4000	7. 5	2076. 40	843. 6	722. 0	359. 37
$C_5 S_3$	6000	7. 5	2723. 53	1450. 77	1241. 65	581. 1

3- Penman- Monteith: FAO. 1993

$$ET_0 = \frac{0.408 \quad (R_n\text{-}G) + \gamma \quad \frac{900}{T + 273} \; U_2 \, (e_a\text{-}e_d)}{+ \gamma \; (1 + 0.34U_2)}$$

where:

ET_0: reference crop evapotranspiration (mm/day)

R_n: net radiation at crop surface ($MJm^{-2}d^{-1}$)

G: soil heat flux (MJm^2d^{-1})

T: average air temperature (^0C)

U_2: wind speed measured- at 2m height (ms^{-1})

(e_a-e_d) : vapour pressure deficit (Kpa)

: slop vapour pressure curve (kpa $^0C^{-1}$)

γ : psychometric constant (k pa $^0C^{-1}$)

Actual evapotranspiration (ETa) was calculated for the various plant growth stages and for the total growth season using the estimated average soilmoisture contents Moisture content was measured for each segment by using the weighting technique: The amount of depleted moisture was calculated at the end of each irrigation interval for each moisture level and type of irrigation water. Hence moisture depletion is accounted mainly for evaporation from available water treatment or due to evapotranspiration from 25.50 and 75% depletion (Eriksson et al., 1975).

Water consumption was determined by soil moisture depletion method (FAO.1984).

Water use efficiency of crop (W.U.E_c.) was calculated according to Giriappa (1983) by dividing the crop yield by the amount of seasonal evapotranspiration.

Crop coefficient (Kc) was calculated for each treatment according to Yaron et al (1973) by dividing the actual evapotranspiration (ET_4) by potential evapotranspiration (ET_4).

Data were subjected to the proper analyses of variance of the split split plot desing according to the method described by Snedecor and Cochran. (1982) and the treatments were compared using the Lest Significant Difference (LSD) at 0.05 probability level.

4. RESULTS AND DISCUSSION

4.1. Potential Evapotranspiration (ET0):

The present work is mainly concerned with three common methods used in determining ETo, i.e. modified Blaney- Criddle (FAO, 1984), Penman-Monteith (FAO.1993) and modified (FAO. 1986).

Table (4a & b) show the values of daily, stage and seasonal potential evapotranspiration (ETo) computed according to modified Blaney- Criddle, Penman- Monteith and modified Penman methods during the growth season (1997) of Sudan grass plant for Cairo, Egypt These data reveal that lowest Eto values are those of modified Blaney-Criddle equation followed by modified Penman, or Penman- Monteith equations for Cairo, El-Nubaria and Burg El- Arab areas. respectively.

It is obvious that the modified Penman and Penman-Monteith methods gave ETo values higher than the seasonal average of ETo, while those obtained by modified Blaney- Criddle method were usually below the seasonal average of ETo.

Moreover the daily ETo during the growing season increased gradually up to the end of Sudan grass growth while monthly and stagy ETo decreased in July and 3rd vegetative in season 1997. as plants were harvested in July 24. 1997. These may be due to the high temperature in summer months and the active stage of vegetation for all regions Table (4b) shows the variations in potential evapotranspiration (ETo) during the growing season of Sudan grass plant It is obvious that the highest values were at the 2nd vegetative for Cairo and they reach 33.7,33.4 and 33.3% of total seasonal ETo for modified Blaney Criddle. Penman- Monteith and modified Penman methods, respectively. while the lowest values at initial stage were followed by Ist vegetative and 3 rd vegetative stages where they reach 10-14, 26-29 and 25-28% of total seasonal ETo. respectively at the all regions. For the three equations. in the other words. the values of ETo in cairo were the highest values while the lowest values were obtained at Burg El-Arab region. These findings may be due to the high temperature and low humidity that cause more evaporation and increase evapotranspiration. respectively, in Cairo followed by El-Nubaria regions.

These results are in agreement with those of El-Naggar (1980), Gad El-Rab et al (1988) and Seidhom (1995).

Table (4a) Computed daily and monthly potential evapotranspiration (ETo mm) at different regions durins during the growing season of sudan grass (1997).

Regions	Months / Equations	April		May		June		Juiy		Season 1997	
		Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Seas-onally
Cairo	Blaney - Criddile	5. 0	75. 0	6. 80	210.8	7. 60	228.0	7. 50	180.0	6. 73	693. 8
	Penman - Monteith	5. 83	87. 45	7. 21	223.51	7. 78	233.4	7. 30	175.2	7. 03	719.56
	Modified - Penman	5. 73	85. 95	7. 27	225.37	7. 73	231.9	7. 23	173.52	6.99	716.74
El- Nubaria	Blaney - Criddle	4. 20	63. 0	4. 70	145.7	5. 30	159.0	4. 80	115.2	4. 75	482.9
	Penman - Monteith	5. 39	80. 85	5. 20	161.2	5. 84	175.2	5. 49	131.76	5. 48	549.01
	Modified - Penman	7. 55	113.25	7. 03	217.93	8. 37	251.1	9. 0	216.0	7.99	798.28
Burg El- Arab	Blaney - Criddle	3. 30	49. 50	4. 40	136.40	5. 10	153.0	5. 20	124.8	4. 50	463. 7
	Penman - Monteith	4. 35	65. 25	5. 21	161.51	6. 09	182.7	6. 36	152.64	5.50	562.10
	Modified - Penman	4.30	64. 50	5. 27	163.37	6. 10	183.0	6. 40	153.6	5.52	564. 47

Table (4b) Computed daily and monthly potential evapotranspiration (ETo mm) at different regions durins during the growing season of sudan grass (1997).

Regions	Equalions	April		May		June		Juiy		Season 1997	
		Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Seas-onally
Cairo	Blaney - Criddle	5. 00	75. 00	6. 80	197.20	7. 55	234.00	7. 50	187.60	6. 94	693.80
	Penman - Monteth	5. 83	87. 45	7. 21	209.09	7. 74	240.04	7. 32	182.98	7. 20	719.56
	Modified - Penman	5. 73	85. 95	7. 27	210.83	7. 70	238.71	7. 25	181.25	7.17	716.74
El- Nubaria	Blaney - Criddle	4. 20	63. 00	4. 70	136.30	5. 26	163.10	4. 82	120.50	4. 83	482.90
	Penman - Monteith	5. 39	80. 85	5. 20	150.80	5. 80	179.76	5. 50	137.60	5. 49	549.01
	Modified - Penman	7. 55	113.25	7. 03	203.87	8. 28	256.79	8. 98	224.37	7.99	798.28
Burg El- Arab	Blaney - Criddle	3. 30	49. 50	4. 40	127.60	5. 06	156.70	5. 20	129.90	4. 64	463. 70
	Penman - Monteith	4. 35	65. 25	5. 21	151.09	6. 03	187.03	6. 35	158.73	5. 62	562.10
	Modified - Penman	4.30	64. 50	5. 27	152.83	6. 05	187.44	6. 39	159.70	5. 65	564. 47

Table (5) Amounts of irrigation water applied in mm of sudan grass plants grown on sandy and calcareous soils at different soil moisture depletion levels.

Sandy soil										
Stages	Initial giowth		1st vegetative growth		2nd vegetative growth		3nd vegetative growth		Total	
Soil moisture depletaon %	Daily	Stagelly	Daily	Stagelly	Daily	Stagelly	Daily	Stagelly	Daily	Season Daily
25	1. 51	22. 64	1. 98	57. 42	1. 98	61. 38	1. 98	49. 5	1. 91	190.94
50	1. 51	22. 64	2. 05	59. 40	1. 79	55. 44	1. 90	47. 52	1. 85	185.0
75	1. 51	22. 64	1. 64	47. 56	1. 73	53. 55	1. 91	47. 63	1. 71	171.38
Mean	1. 51	22. 64	1. 89	54. 79	1. 83	56. 79	1. 93	48. 22	1. 82	182.44
Calcareous soil										
25	2.49	37.38	1.64	47.56	1.66	51.54	1.74	43.50	1.80	179.98
50	2.49	37.38	1.78	51.62	1.79	55.49	.2	55.50	2.0	199.99
75	2.49	37.38	1.65	47.71	1.92	59.36	2.38	59.50	2.03	203.08
Mean	2.49	37.38	1.69	48.96	1.79	55.46	2.11	52.83	1.94	194.35

4.2. Irrigation Water Applied (I.W.):

Three water managment treatments were applied. 25.50 and 75% soil moisture depletion (SMD) from available soil moisture in the root zone The average amounts of irrigation water applied per period were 140, 80 and 420 cm^3/pot for sandy soil and 280, 560 and 840 cm^3/ pot for cacareous soil at 25, 50 and 75% S.M.D., respectively. Table (2).

Comparing the applied seasonal irrigation water, determined on basis of three levels of depleted soil moisture (25, 50 and 75%) from available soil moisture (Table 5) , they were 190.49, 185.0 and 171.38 mm for sandy soil and 179.98, 199.99 and 203.08 mm for calcareous soil. respectively for growing season of Sudan grass plant.

In brief. Sudan grass plant grown on sandy soil needs 22.64, 57.42. 61. 38 and 49. 5 mm for 25% soil moisture depletion (S.M.D.); 22. 64, 59. 40, 55. 44 and 47. 52 mm for 50% depletion and 22. 64, 47. 56, 53.55 and 47. 63 mm for 75% depletion at the initial lst, 2nd and 3rd vegetative stages. respectively.

On the other hand, Sudan grass grown on calcareous soil needs 37.38, 47.56. 51. 54 and 43.5 mm for 25% depletion: 37 38, 51. 62, 55.49 and 55.5mm for 50% depletion and 37.38, 47.71. 59. 36 and 59.5mm for 75% depletion at its initial, Ist 2nd and 3rd vegetative. stages respectively. Worth mentioning that irrigation water applied in this study is equal to the actual evapotranspiration.

4.3. Actual evapotranspiration (ETa):

Regarding the interaction effect between irrigation water salinity and soil moisture depletion in Sandy soil, data in Table (6a) and Fig (2) show that the highest interaction was associated with tap water at 25% S.M.D. while irrigation with highly saline water (6000 PPM) at 75% S.M.D. gave the lowest one. The reduction in the ETa reached 18% at 75% depletion and 6000 PPM water salinity compared to tap water and 25% depletion.

Table (6a) Computed dailg, stagelly and Scasonally actual evapotranspiration (ET a mm) of sudan grass plants grown on sandyy soil at Cairo, Egypt.

Soil moisture depletion %	Stages Water Salinity (ppm)	Initial giowth		1st vegetative growth		2nd vegetative growth		3nd vegetative growth		Total ETa	
		Daily	Stagelly	Daily	Stagelly	Daily	Stagelly	Daily	Stagelly	Daily	Season aily
25	Control	1.60	24.05	2.04	59.26	2.05	63.65	2.07	51.75	1.99	198.71
	2000	1.53	23.02	2.0	58.0	2.01	62.41	2.02	50.5	1.94	193.93
	4000	1.47	22.12	1.96	56.94	1.95	60.55	1.94	48.5	1.88	188.11
	6000	1.42	21.36	1.91	1.90	1.90	58.90	1.89	47.25	1.83	183.0
50	Control	1.60	24.05	62.30	62.30	1.88	58.20	1.98	49.42	1.94	193.98
	2000	1.53	23.02	2.08	60.28	1.82	56.40	1.94	48.42	1.88	188.12
	4000	1.47	22.12	2.02	58.52	1.76	54.50	1.87	46.74	1.82	181.88
	6000	1.42	21.36	1.95	56.50	1.70	5.64	1.8	45.50	1.76	176.01
75	Control	1.60	24.05	1.72	48.88	1.81	65.11	1.99	48.6	1.80	179.65
	2000	1.53	23.02	1.67	48.43	1.76	54.56	1.94	48.38	1:74	174.39
	4000	1.47	22.12	1.61	46.69	1.7o	52.70	1.89	47.1	1.69	168,63
	6000	1.42	21.36	1.56	45.24	1.64	50.84	1.82	45.38	1.63	162.63

L.S.D.O.05	0.08	0.14	0.08	0.15	0.07	0.14	0.08	0.15	0.09	0.16

Table (6b) Computed dailg, stagelly and Scasonally actual evapotranspiration (ET a mm) of sudan grass plants grown on sandyy soil at Cairo, Egypt.

Soil moisture depletion %	Stages Water Salinity (ppm)	Initial giowth		1st vegetative growth		2nd vegetative growth		3nd vegctative growth		Total ETa	
		Dailv	Stagelly	Dailv	Stagelly	Dailv	Stagelly	Dailv	Stagelly	Dailv	Season aily
25	Control	2.54	38.10	1.73	50.17	1.76	54.56	1.85	46.25	1.89	189.08
	2000	2.51	37.65	1.67	48.43	1.69	52.39	1.78	44.50	1.54	182.97
	4000	2.48	37.20	1.62	46.98	1.64	50.84	1.70	42.50	1.78	170.37
	6000	2.44	36.60	1.54	44.66	1.56	48.36	1.63	40.75	1.70	177.52
50	Control	2.54	38.10	1.87	45.23	1.89	58.59	2.33	58.25	3.09	20.9.17
	2000	2.51	37.65	1.81	52.49	1.82	56.42	2.25	56.25	2.03	202.81
	4000	2.48	37.20	1.75	50.75	1.76	54.56	2.18	54.50	1.97	197.01
	6000	2.44	36,60	1.69	49.01	1.69	52.39	2.12	53.00	1.91	191.00
75	Control	2.54	38.10	1.75	50.75	2.01	62.31	2.48	62.0	2.13	213.16
	2000	2.51	37.65	1.68	48.72	1.94	6.014	2.41	60.25	2.07	206.76
	4000	2.48	37.20	1.61	46.69	1.88	58.28	2.34	58.50	2.01	200.67
	6000	2.44	36.60	1.54	44.69	1.83	56.73	2.29	57.25	1.95	194.66

L.S.D.O.05	0.04	0.11	0.05	0.16	0.04	0.15	0.05	0.14	0.08	0.18

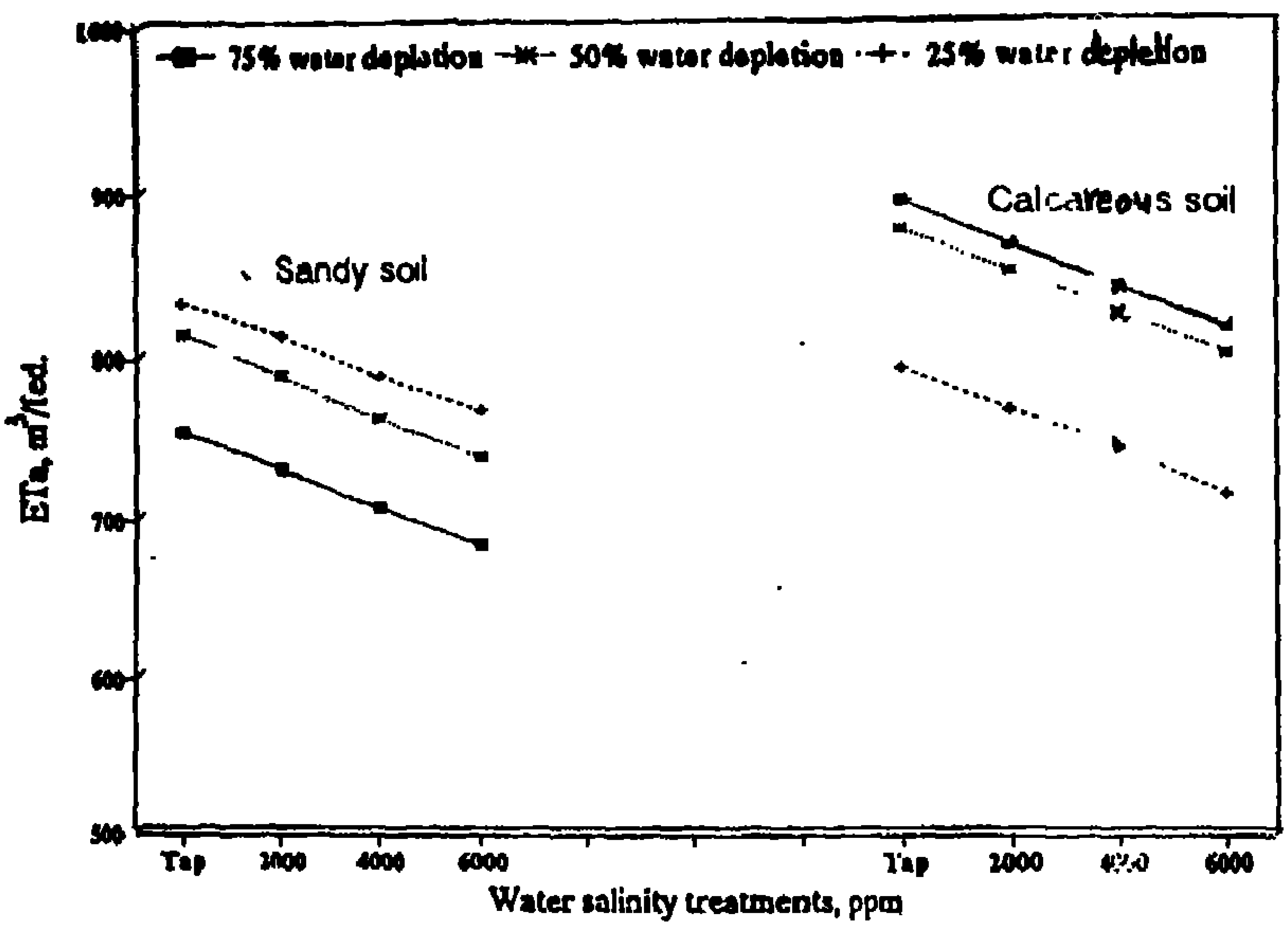

Fig. (2) Total actual evapotranspiration (ETa m^3/fed) of sudan grass grown on sandy and calcareous soils as affected by irrigation water salinity and soil moisture depletion levels.

these findings may be due to the decrease of tensions by which water is held to soil and the higher evaporation from the water rather than from the dry surfaces these results are in agreement with those findings obtained by Demmead and Show (1960) who stated that plant transpiration rates declined with decreasing soil moisture content. The results also confirmed those obtained by Eagleman and Decker (1965). Shahin (1982); Gad El-Rab et al. (1988); El-Dosouky et al. (1988). Abdel-Nassar (1991); El-

Dosouky and Gaber (1992), Seidhom (1995) and El- Boraie (1997)

In case of Sudan grass grown on the calcareous soil, the interaction effect between irrigation water salinity and soil moisture depletion. table (6b) and fig. (2) revealed that the highest value of ETa was associated with tap water under 75% S.M.D., while the lowest value was associated with saline irrigation water (6000 PPM) under 25% S.M.D. with a difference of 20.1% and a unique pattern for all cuts. Meanwhile, ETa values increased with increasing the number of cuts up to the 3rd cut. This increase relative to lst cut reaches about 14.8% at 41.7% at 2nd and 3rd cuts of daily ETa of Sudan grass, respectively. at tap water under 75% depletion .

This behavior may be interpreted on the basis that increasing salinity of irrigation water increased tensions with which soil and a relative slow rate of water conductivity through the soil compared hold water to the great evaporative power of the atmosphere. This may be attributed to the increase of vegetaive growth and subsequently the evapotranspiration and water consumptive use during the growing season of Sudan grass.

Similar results were obtained by Bhatanagar and Kundu (1990). Anton (1991). El-Dosouky and Gaber (1992) and El-Boraie (1997).

4.4 Water use efficiency of Sudan grass (W.U.E.) plants:

Concerning the interaction effect of irrigation water salinity and soil moisture depletion on water use efficiency of Sudan grass grown on sandy soil, data in Table (7a) and (3a & 3b) show that the highest W.U.E. for fresh and dry weights and total yield was associated with the combined treatment of tap water at 50% S.M.D.while the lowest W.U.E was associated with 6000 PPM water salinity at 5% S.M.D. Moreover, at 50% depletion and tap water the WUE in the 2nd cut was greater than those of the 1st and 3rd cuts and mean season by 0.7.96 and 10.% for fresh yield and 24.15.5 and 9.7% for dry yield, respectively. These results are in agreement with findings of El-Sabbagh 1993). Awad et al (1996) and El-Boraie (1997).

In calcareous soil, data in Table (7b) and Figs (3a & 3b) show that the highest W.U.E. of fresh and dry weights and mean season was associated with the combined treatment of tap water at 75% S.M.D. and 2000 PPM water salinity at 75% S.M.D. while the lowest WUE was associated with 6000 PPM water salinity at 50% S.M.D. and 4000 PPM water salinity 25% S.M.D.

Furthermore. W.U.E. values decreased by increased by increasing the number of the cuts up the 3rd cut The decreases were 9.4, 373 and 0.3 % for fresh weights and about 3.8, 29.5 and 15.2% for dry weights at the 2nd 3rd cuts and mean season relative to the 1st cut at (75% depletion tap water) and (75% depletion + 2000 PPM) water salinity treatments. respectively. This decrease is due to the increase of actual evapotranspiration at summer months.

This finding supports those obtained by El-Dosouky et al (1988). Gad El-Rab et al (1988). Seidhom (1995) and El-Boraie (1997). Noteworthy to mention that W.U.E. of Sudan grass plants in this study is equal to water economy because the water applied equals actual evapotranspiration.

4.5. Crop coefficient (Kc) of Sudan grass plants:

Concerning the interaction effect. data in Table (8a) and Fig (4a) on Sandy soil reveal that the highest Kc value of the vegetative growth stages of Sudan grass (the three cuts) was associated with tap water at 25% S.M.D. for Blaney-Criddle equation. followed by Penman-Monteith and modified Penman while the lowest Kc value was associated with irrigation by 6000 PPM water salinity at 75% S.M.D. for Penman- Monteith and modified Penman equations.

This finding may be due to the increases of ETa at 25% SMD of sandy soil and the decreases of ETo of Blaney- Criddle equation . while Eto of Penman- Monteith and modified Penman equations increased and ET a decreased with irrigation water salininity.

Similar results were obtained by Doorenbose and Priuitt (Pruitt (1984) and Seidhom (1995).

Table (7b) Woter use efficencg (Kgim3) of Sudan grass Plants grown on Sandy Soil as affecteduy irrigation water salinity and soil moisture depletion levels.

Soil moisture depletion %	Cuts Water Salinity (ppm)	1St cut		2nd cut		3nd cut		Total season	
		Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
25%	Tap water	5.50	1.73	5.50	1.87	4.99	1.79	5.31	1.80
	2000	5.05	1.64	5.11	1.83	4.86	1.78	5.0	1.76
	4000	4.77	1.67	5.07	1.85	4.92	1.85	4.92	1.80
	6000	4.33	1.59	4.25	1.62	4.23	1.63	4.27	1.61
	Mean	4.91	1.66	4.98	1.79	4.75	1.76	4.89	1.75
50%	Tap water	6.19	[illegible]	7.81	2.37	7.06	2.24	7.01	2.14
	2000	5.53	74	6.97	2.20	6.30	2.17	6.25	2.04
	4000	5.37	1.75	6.68	2.18	6.12	2.14	6.05	2.03
	6000	5.06	1.77	6.38	2.13	5.95	2.10	5.79	2.0
	Mean	5.54	1.77	6.96	2.22	6.36	2.16	6.29	2.06
75%	Tap water	6.44	1.96	6.75	2.21	5.92	2.01	6.32	2.05
	2000	6.29	1.97	6.50	2.27	5.60	2.0	6.08	2.08
	4000	5.97	1.99	6.51	2.26	5.64	2.03	6.0	2.09
	6000	6.0	2.05	6.28	2.30	5.64	2.03	5.80	2.112
	Mean	6.18	1.99	6.51	2.26	5.66	2.02	6.07	2.08
L.S.D.0.05		0.06	0.04	0.06	0.03	0.05	0.03	0.06	0.04

Table (7b) Woter use efficencg (Kgim3) of Sudan grass Plants grown on calcarrous Soil as affected uy irrigation water salinity and soil moisture depletion levels.

Soil moisture depletion %	Cuts Water Salinity (ppm)	1St cut		2nd cut		3nd cut		Total season	
		Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
25%	Tap water	9.07	2.52	9.38	2.79	6.83	2.06	8.16	2.39
	2000	8.36	2.51	8.86	2.86	6.41	2.03	7.63	2.39
	4000	7.75	2.43	8.29	2.81	5.92	2.06	7.08	2.37
	6000	7.46	2.40	8.07	3.0	5.73	2.16	6.85	2.46
	Mean	8.16	2.47	8.65	2.87	6.22	2.08	7.45	2.41
50%	Tap water	9.31	2.77	9.47	2.89	6.35	2.03	7.99	2.45
	2000	8.85	2.77	9.20	2.87	6.09	2.05	7.67	2.47
	4000	8.26	2.67	8,73	2.88	5.74	2.08	7.22	2.45
	6000	7.73	2.58	8.27	2.95	5.42	2.02	6.97	2.42
	Mean	8.54	2.70	8.92	2.9	5.9	2.05	7.43	2.45
75%	Tap water	11.26	3.38	10.20	3.25	7.06	2.40	8.98	2.88
	2000	10.80	3.42	9.86	3.29	6.83	2.41	8.65	2.90
	4000	10.35	3.42	9.19	3.19	6.25	2.24	8.06	2.79
	6000	9.70	3.46	8.52	3.15	5.68	2.18	7.45	2.76
	Mean	10.53	3.42	9.44	3.22	6.46	2.31	8.34	2.85
L.S.D.0.05		0.13	0.06	0.11	0.08	0.12	0.07	0.13	0.08

Figure (1): Locations of the collected scil samples.

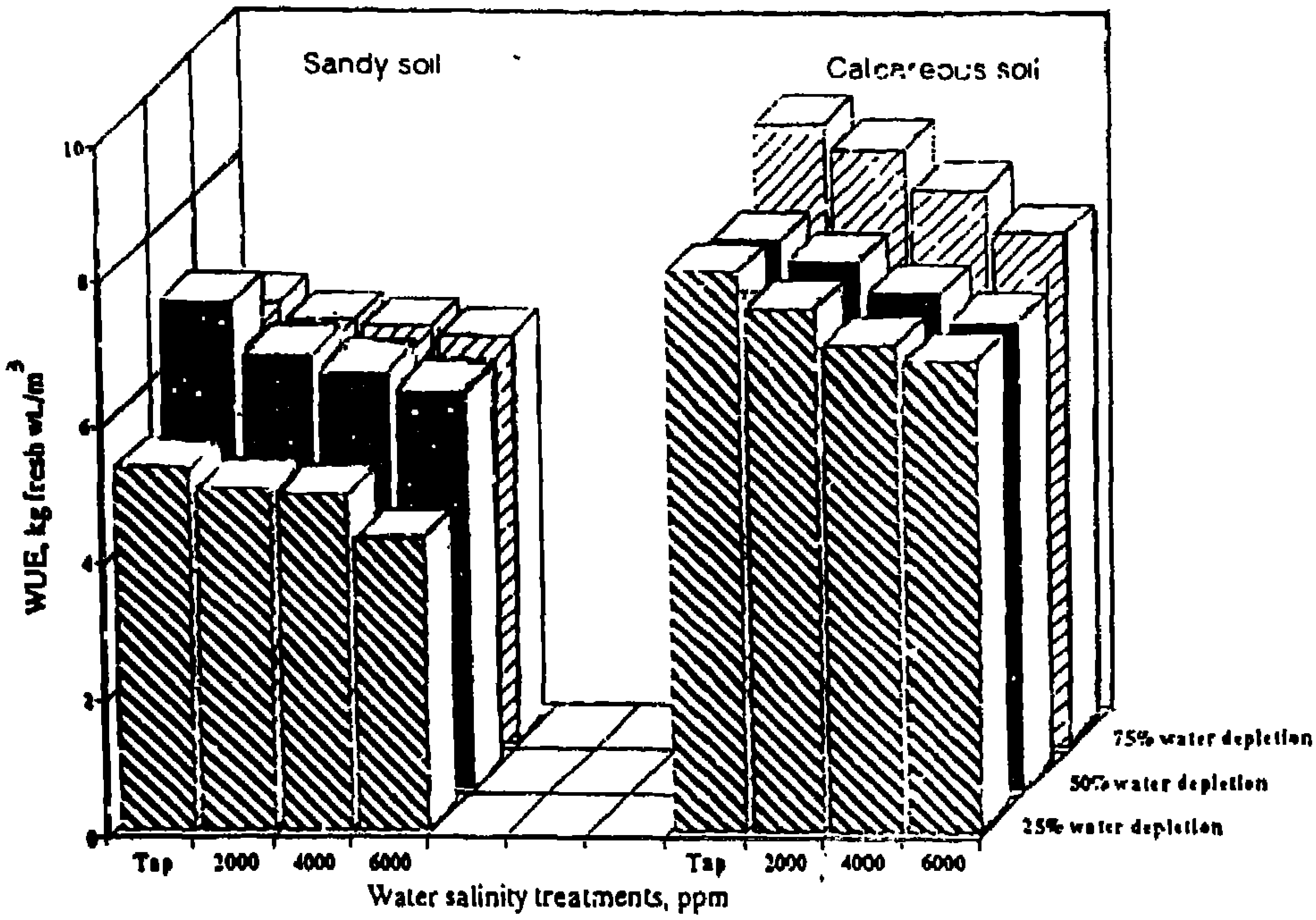

Fig. (3a) Water use efficiency (kg/m^3) of fresh sudan grass grown on sandy and calcareous soils as affected by irrigation water salinity and soil moisture depletion levels

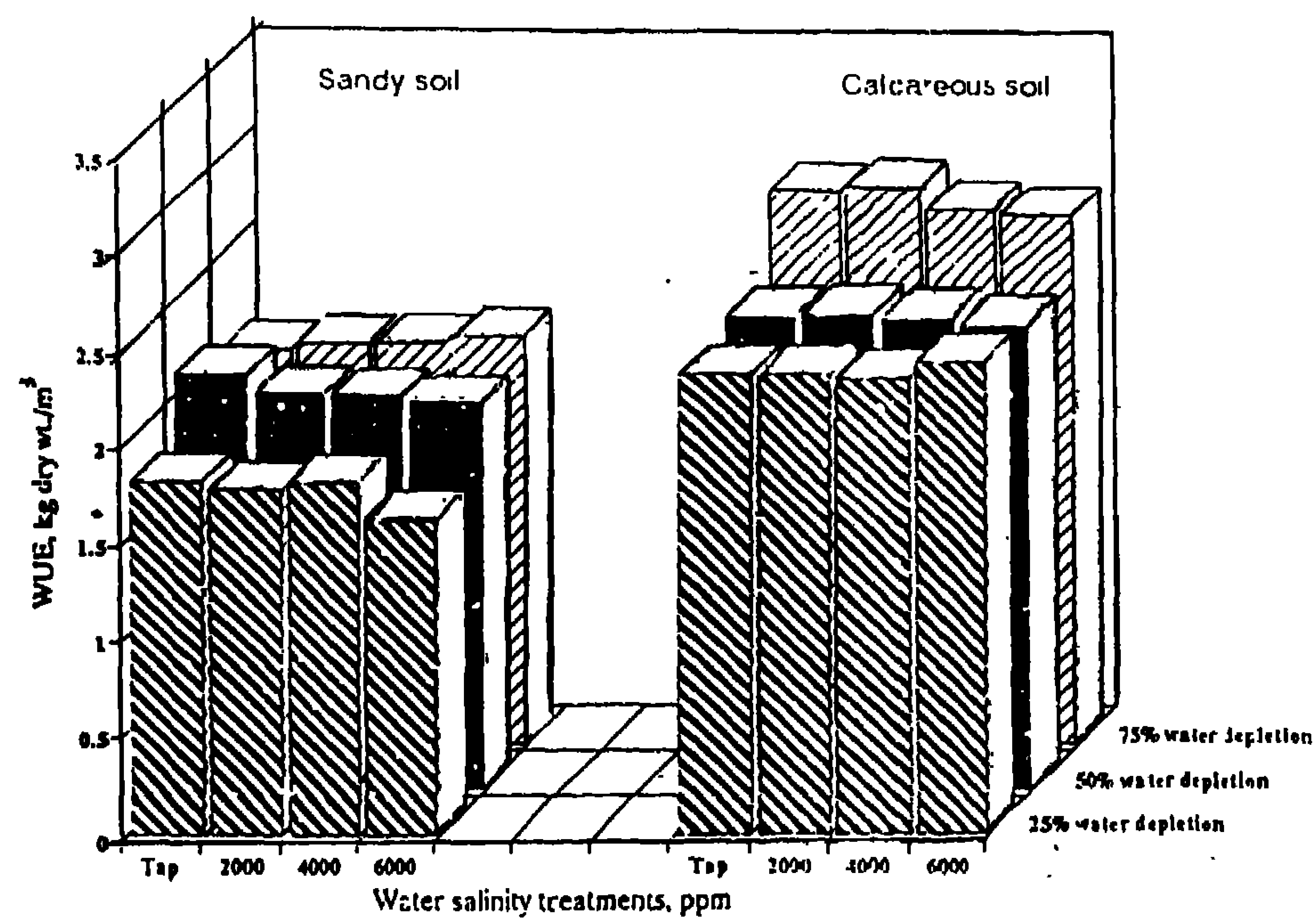

Fig. (3b) Water use efficiency (kg/m^3) of dry sudan grass grown on sandy and calcareous soils as affected by irrigation water salinity and soil moisture depletion levels.

Table (8a) crop coefficient (kc) of sudan grass plants grown on sandy soil as affected by irrigation water salinity and soil moisture depletion levels at Cairo. Egypt.

Depletion levels %	Equ3 tions	Blaney-Cniddle					Blaney-Cniddle					Blaney-Cniddle				
	Stages	Initial growth	Blaney-Cniddle			Total season	Initial growth	Blaney-Cniddle			Total season	Initial growth	Blaney-Cniddle			Initial growth
	Water Salinity (ppm)		1 st	2 nd	3 rd			1 st	2 nd	3 rd			1 st	2 nd	3 rd	
25	Control	0.32	0.30	0.27	0.27	0.29	0.27	0.28	0.27	0.26	0.28	0.28	0.28	0.27	0.29	0.28
	2000	0.31	0.29	0.27	0.6	0.28	0.26	0.28	0.25	0.28	0.27	0.27	0.28	0.26	0.28	0.27
	4000	0.29	0.29	0.26	0.25	0.27	0.25	0.27	0.26	0.27	0.26	0.26	0.27	0.25	0.27	0.26
	6000	0.28	0.28	0.25	0.24	0.26	0.24	0.27	0.25	0.26	0.25	0.25	0.26	0.25	0.26	0.26
	Mean	0.30	0.29	0.26	0.26	0.28	0.26	0.28	0.26	0.27	0.27	0.26	0.27	0.26	0.27	0.27
50	Control	0.32	0.32	0,25	0.27	0.28	0.27	0.30	0.24	0.27	0.27	0.28	0.30	0.34	0.27	0.27
	2000	0.32	0.31	0.24	0.26	0.27	0.26	0.29	0.24	0.27	0.26	0.27	0.29	0.24	0.27	0.26
	4000	0.29	0.30	0.23	0.25	0.26	0.25	0.28	0.23	0.26	0.25	0.26	0.28	0.23	0.26	0.25
	6000	0.28	0.29	0.23	0.24	0.25	0.24	0.27	0.22	0.25	0.24	0.25	0.27	0.22	0.25	0.25
	Mean	0.30	0.30	0.24	0.26	0.27	0.26	0.28	0.23	0.26	0.26	0.26	0.28	0.23	0.26	0.26
75	Control	0.32	0.25	0.24	0.27	0.26	0.27	0.24	0.23	0.27	0.25	0.28	0.24	0.24	0.28	0.25
	2000	0.31	0.25	0.25	0.26	0.25	0.26	0.23	0.23	0.27	0.24	0.27	0.23	0.23	0.27	0.24
	4000	0.29	0.4	0.23	0.25	0.24	0.25	0.22	0,22	0.26	0.24	0.26	0.22	0.22	0.26	0.24
	6000	0.28	0.23	0.22	0.24	0.24	0.24	0.22	0,21	0.25	0.23	0.25	0.22	0.211	0.25	0.23
	Mean	0.30	0.24	0.23	0.26	0.25	0.23	0.23	0.22	0.26	0.24	0.26	0.23	0.23	0.26	0.24
Average						0.27					0.26					0.26
L.S.D.O.05		0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02

Table (8b) crop coefficient (kc) of sudan grass plants grown on Calcareaus soil as affected by irrigation water salinity and soil moisture depletion levels at Cairo. Egypt.

Depletion leveis %	Equ3 tions	Blaney-Criddle					Blaney-Criddle					Blaney-Criddle				
	Stages / Water Salinity (ppm)	Initial growth	Blaney-Criddle 1 st	2 nd	3 rd	Total season	Initial growth	Blaney-Criddle 1 st	2 nd	3 rd	Total season	Initial growth	Blaney-Criddle 1 st	2 nd	3 rd	Total season
25	Control	0.51	0.25	0.23	0.25	0.27	0.44	0.24	0.23	0.25	0.26	0.44	0.24	0.23	0.26	0.26
	2000	0.50	0.25	0.22	0.24	0.26	0.43	0.23	0.22	0.24	0.25	0.44	0.23	0.22	0.25	0.26
	4000	0.50	0.24	0.22	0.23	0.26	0.43	0.23	0.21	0.23	0.25	0.43	0.22	0.21	0.24	0.25
	6000	0.49	0.23	0.21	0.22	0.25	0.42	0.21	0.20	0.22	0.24	0.43	0.21	0.20	0.23	0.24
	Mean	0.50	0.24	0.22	0.24	0.26	0.43	0.23	0.22	0.24	0.25	0.44	0.23	0.22	0.25	0.25
50	Control	0.51	0.28	0.25	0.31	0.30	0.44	0.25	0.24	0.32	0.29	0.44	0.26	0.25	0.32	0.29
	2000	0.50	0.27	0.24	0.30	0.29	0.43	0.25	0.24	0.31	0.28	0.44	0.25	0.24	0.31	0.28
	4000	0.50	0.26	0.23	0.29	0.28	0.43	0.24	0.23	0.30	0.27	0.43	0.24	0.23	0.30	0.23
	6000	0.49	0.25	0.22	0.28	0.28	0.42	0.23	0.22	0.29	0.27	0.43	0.23	0.22	0.29	0.27
	Mean	0.50	0.27	0.24	0.30	0.29	0.43	0.25	0.23	0.31	0.28	0.44	0.25	0.24	0.31	0.28
75	Control	0.51	0.26	0.27	0.33	0.31	0.44	0.24	0.26	0.34	0.30	0.44	0.24	0.26	0.34	0.30
	2000	0.50	0.25	0.26	0.32	0.30	0.43	0.23	0.25	0.33	0.29	0.44	0.23	0.25	0.33	0.29
	4000	0.50	0.24	0.25	0.31	0.29	0.43	0.22	0.24	0.32	0.28	0.43	0.22	0.24	0.32	0.28
	6000	0.49	0.22	0.24	0.31	0.28	0.42	0.21	0.24	0.31	0.27	0.43	0.21	0.24	0.32	0.27
	Mean	0.50	0.24	0.26	0.32	0.30	0.43	0.23	0.25	0.33	0.29	0.44	0.23	0.25	0.33	0.29
Average						0.28					0.27					0.27
L.S.D.O.05		0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02

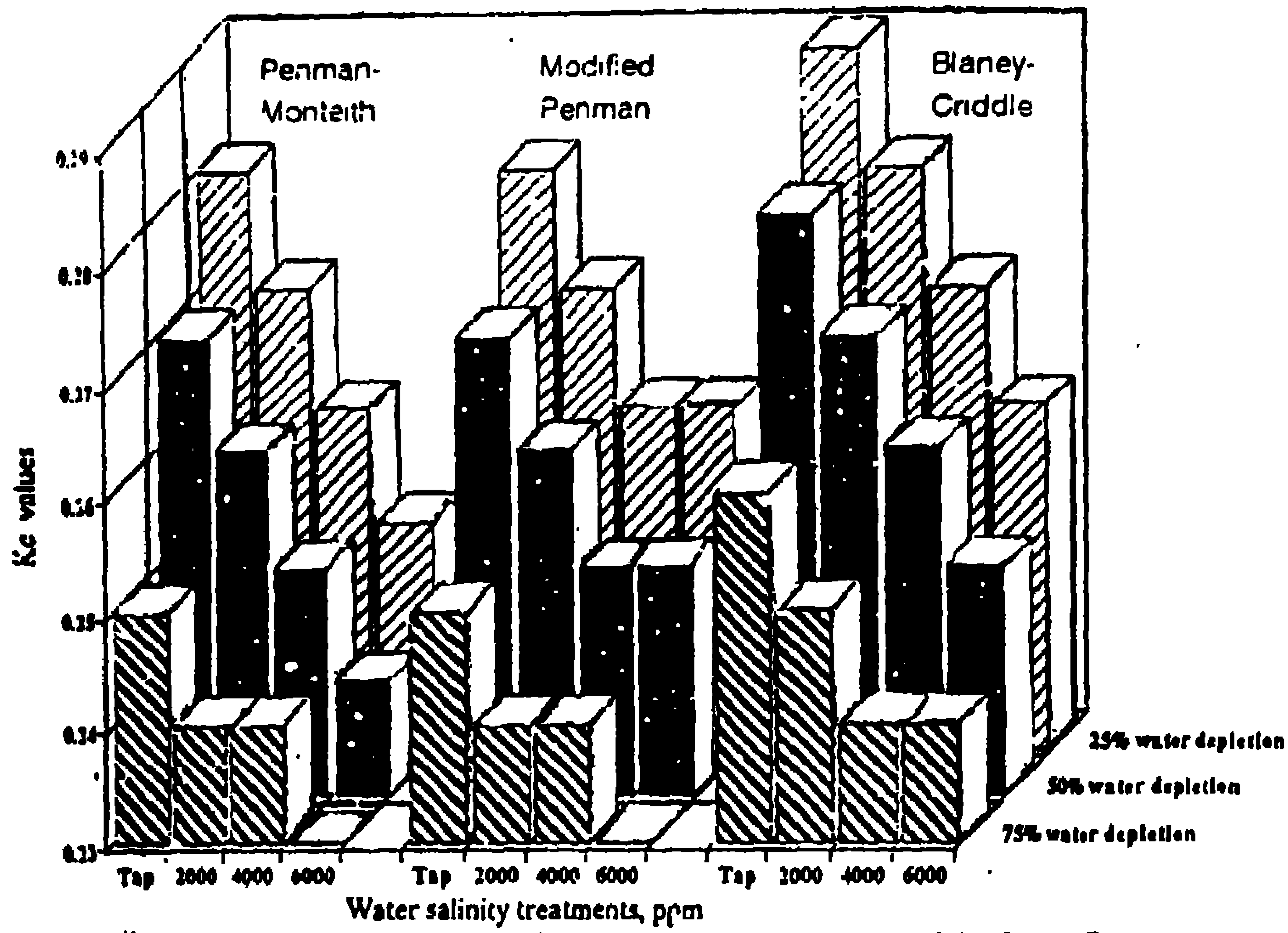

Fig (4a) Crop coefficient (Kc) of sudan grass grown on sandy soil in Cairo, Egypt as affected by irrigation water salinity and soil moisture depletion levels.

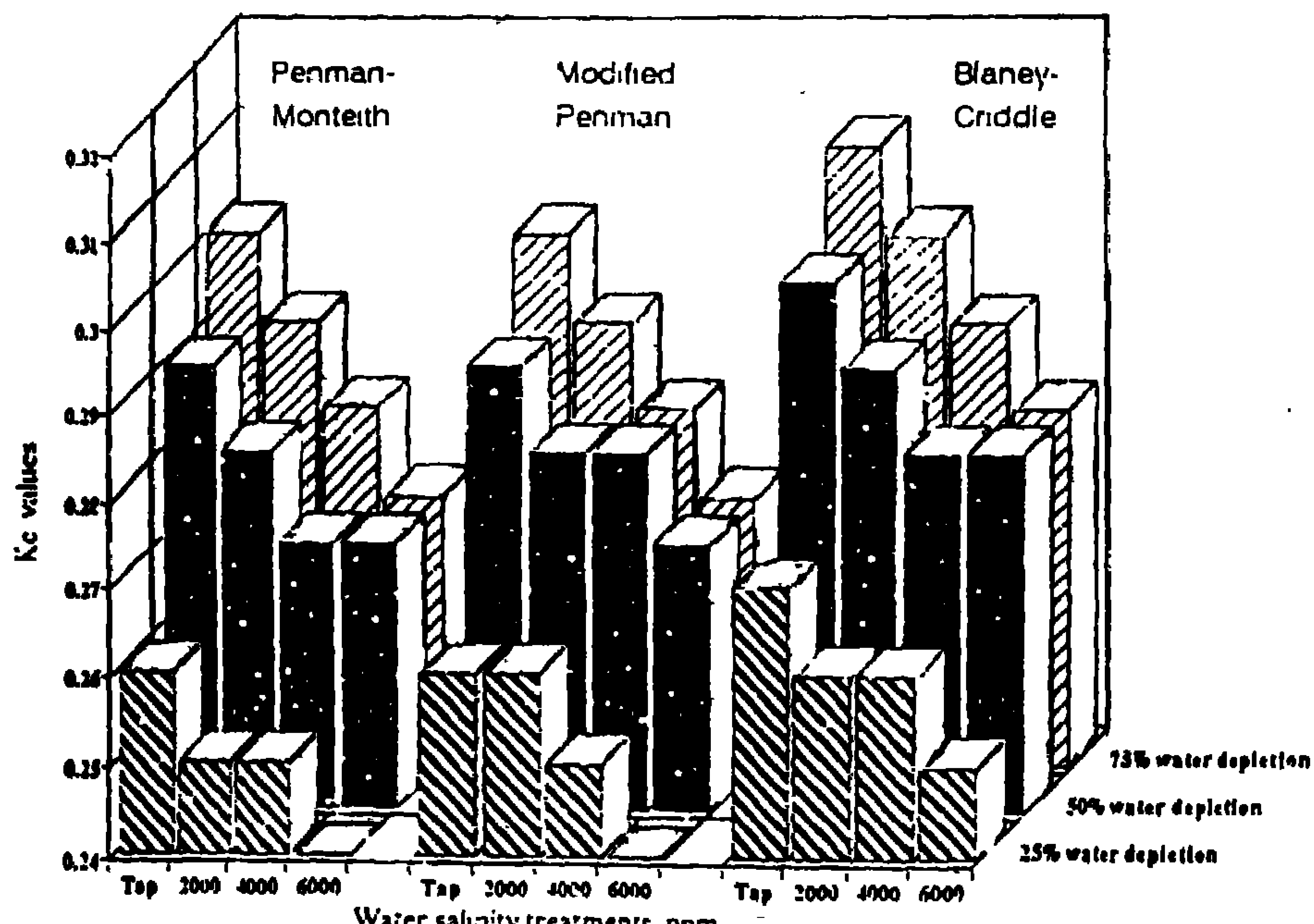

Fig. (4b) Crop coefficient (Kc) of sudan grass grown on calcareous soil in Cairo, Egypt as affected by irrigation water salinity and soil moisture depletion levels.

In calcareous soil. data presented in Table (8b) and Fig (4b) reveal that the highest kc value for the 3 cuts of the vegetaive growth stages was associated with tap water at 75% S.M.D for Blaney Criddle followed by Penman-Monteith and modified Penman equations. while the lowest value was associated with irrigation by 6000 ppm water salinity at 25% S.M.D for Penman-Monteith and modified penman equations .

This finding may be due to the increase of ETa at 75% S.M.D compared to 25% S.M.D. and the decrease of ETo of Blaney-Criddle equation. while ETa deceased at 25% S.M.D compared to 75% S.M.Dand ETo increased with Penman-Mnteith and modified Penman equations

Similar results were obtained by Doorenbos and Kassam (1986) and Abdl-Nasser (1991 and 1996).

The differences in (Kc) values may be due to the estimated factors used in the climatological equations and it also depends on the method followed for computing it This conclusion indicates that for the same crop and meteorological conditions. different values of (Kc) should be taken into consideration for different formulae used in estimating actual evaptranspiration . This conclusion is in agreement with Jensen (1973). Erie et al (1976) and Yoshida (1979).

In conclusion. water management under soil moisture depletion 50 or 75% from available soil water in sandy and calcareous soils. respectively. has promotive effect on reducing salt stress in the plant root zone and avoiding loss caused by extended periods of water stress under saline conditions during various stages of Sudan grass growth It is also suggested to use Penman-Monteith equation to calclate the potential evapotranspiration (ETo) for El_Nubaria and Burg el -Arab areas in Egypt.

5. REFERENCES

Abdel-Nasser, G. (1991). Minimzing of water requirements in relation to plant growth and yield og tomatoes. Ph.D. Thesis, Fac. Agric., Saba Bacha, Alexandria Univ., Egypt.

Abdel- Nasser, G. (1996). Determination of water consumptive- use and crop coefficiennt for sweet potato using some climatological equations. Meteorlogy and Integrated Development Conference, Cairo, Egypt. pp: 86-98.

Ahmad, M.; Akhtar, M.E.; Nizami, M.I., Yasin, M., Ahmad, S. and Hussain, Z. (1990). Seasonal crop evapotranspiration moisture stress: Functions for major climatic Zones in pakistan. Soil Physics- application under stress envirinmenents. proceedings to the International Symposium on Applied So physics in Stress Environments, (22-26 january, 1989). Islamabad, Pakistan: 276-85.

Anton, N.A. (1991). Some physiological studies on the growth of fodder Beet. Ph.D. Thesis Fac Agric At Moshtohor, Zagazig Univ., Egypt.

Awad, H.A.; Khalifa, H.E.; Abdel-monem, M.A.S. and Ahmed, M.A.S. (1996). Barley yield and water conumptive use as affected irrigation intervals and nitrogen fertilization under saline soil conditions. Meteorology and Integrated Development Conference, Cairo, Egypt; 99-110.

Bhatnagar, V.K. and Kundu, S. (1990). Evaptranspiration demand and pattern of soil moisture extraction of four rainfed winer crops in mid hills of Uttar Pradesh Ind. J. Agric. Sci., 60 (11): 767-769.

Demead, O.T. and Sgaw, R. H. (1960). The effect of soil moisture stress at different stages of growth on the development and yield of corn. Agron. J. 52:272.

Doorendos. J. and Pruitt, W. O. (1984). Crop water requirements. Irrigation and Drainge Paper, N[. 4. No. 24. FAO, Rome.

Doorendos. J. and Kassam, A.H. (1986). Yield response to water Irrigation and Drainage Paper No . 33. FAO, Rome.

Eagleman, J.R. and Dcker, W.L. (1965). The role of Soil moisture in evaporation. Agron. J., 27; 626-629.

El-Boraie, F.M. (1997). A study on the water management under arid conditions. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

El-Dosouky, M.H. and El-Hassanin, A.s. (1988). Water use efficiency of sugar beet grown in saline careous soils, applying different formulae for calculating the water requirements. Desert Inst. Bull . A.R.E., 38(2): 187-197.

El-Dosouky, M.H. and Gaber, A.M. (1992). Effect of water stress on crop water requiirements and yield of barley. Desert Inst. Bull., A.R.E., 42 (2): 245-260.

El-Dosouky, M.H. and Masoud M.A. and Hussein, M.A. (1988). Evapotranspiration and water use efficiency of aquash and cucumber as affected by soil moisture depletion. Desert Inst.. Bull., A.R.E., 38 (2): 199-211.

El-Nagar, I. (1980). Evaluation of some elements of water balance in irrigates areas. M.S c. Thesis, Fac. AgleX. Univ.,Egypt.

El-Sabbagh, A.A. (1993). Effect of soil moisture stress and foliai application of zinc on some maize varieties. Ph. D. Thesis. Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

El-Sayed. A.A.A. (1982) Water requirements of wheat and its effect on some grain quality characters. Ph.D. thesis, Fac. Agric., Ain Shams Univ., Egypt.

Erie, L., Orrin, F. and Harris (1976). Consumptive use of water by crops in Arizona. Tech. Bull. 1169, Agric. Exp. Sta., Coilege Agric., Univ. of Arizona, Tucson., U.SA.

Eriksson, J., Hakansson, I. and Danfors, B (1975). The effect of soil compaction on soil structure and crop yields. Swedish Inst. Agric. Eng. Bull., 354.

Gad El-Rab, G.M., Ainer, N.G. and Eid, H.M. (1988). Water stress in relation to yield of wheat and some water relations in wheat. Egypt. J. Soil. Sci., 28(4): 43-445.

Giriappa, S. (1983). Water use efficiency in agricultre. Agricultural development and rural transformation unit. Int for Social and Economic Change Bangalore, Oxford & JBH Publ. Co.

Holloway, R.E. and Alstion, A.M. (1992). The effects ofsalt and boron on growth of wheat. Aust. J. Agric. Res., 43 (5); 987-1001.

Jensen. M.E. (1973). Consumptive use of water and irrigation water requirements. Tech. Committee on irrigation water requirements, Irrigation and Drainage Div., ASCE.

Richards. L.A. (1954) (Ed). Diagnosis and Improvement of Saline and Alkali. U.S. Salinity Lab. Staff, Washington, D.C., U.S.A. Agric. Handbook No. 60.

Russo, D. (1985). Leaching and water requirement studies in a gypsiferous desert soil. Soil Sci. Soc. Am. J., 49; 2:43-437.

Seidhom (1995). A study on the water consumptive use by some crops grown under desert conditions. M.S.c. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Shahin, M.M.A. (1980). Study in the effect of cycocel on consumptive use, grain and straw yield, vegetative growth and some chemical characters in wheat. M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.

Sharma, D.K., Kumar, A. and singh, K.N. (1990). Effect of irrigation Scheduling on growth yield and evapotranspiration of wheat in sodic soils. Agric. Water Management. 18 (3): 67-276.

Smith, M. (1992). CROPWAT> A computer program for irrigation planning and management. Irrig.& Drainage Paper. No. 64, F.A.o. Rome.

Smith, M. (1993). CLIMWAT FOR CROPWAT. A climatic database for irrigation planning and management. Irrig. & Drainge Paper, No. 49, F.A.O. Rome.

Snedecor, G.W. (1982). Statical Methods. 7 th Ed. Iowa, State Univ. Press, Ames., Iowa, U.S.A. pp. 593.Tawadros, H.W., Rammah, A.M., Badawi, A.Y.;Abd-Elhafez , S.A., Nasr, M.A. and Miseha, W.I. (1984). Effect of water deficit on some forage crops. Proc. Em CIP Symp. Field Crop Res. Inst., Giza (2): 54-70.

Yaron, B., Danfors, E. and V,aadia, Y. (1973). Arid Irrigation.Springer Verlage, Berlin. Heidelberg, New York, Proc. Egypt. Bot. Sci.

Yoshida, S. (1979). A simplw evapotranspiration model of paddy field in trpical Asia. Soil Sci Plant Nutrifion, 25 (1): 81-91.

تأثير التداخل بين ملوحة مياه الرى واستنفاذ رطوبة التربة على الاستهلاك المائي لحشيشة السودان .

فوزية إبراهيم مرسى ، عادل سعد الحسنين*
مصطفى حسن الدسوقى** وإيفون كامل رزق **

* معهد البحوث والدراسات الإفريقية – جامعة القاهرة
** مركز بحوث الصحراء – المطرية القاهرة

يهدف هذا البحث إلى دراسة مدى تأثير ملوحة مياه الرى على الاستهلاك المائي لمحصول حشيشة السودان ، وكذلك ترشيد استخدام مياه الري ورفع كفاءة استعمالها واقتصادياتها.

لهذا الغرض أقيم تجربة أصص خلال الموسم الصيفى ١٩٩٧ تحت ظروف الصوبة المفتوحة في مركز الصحراء بالقاهرة على عينات تربة من أراضى منطقة النوبارية (تربة رملية) وأراضى منطقة برج العرب (تربة جيرية) وكانت معاملات التجربة لكلا نوعى التربة كالتالى:

(أ) أربع مستويات ملوحة مياه رى (ماء صنبور ٢٥٠ و٢٠٠٠ و٤٠٠٠ و٦٠٠٠ جزء فى المليون)

(ب) ثلاث مستويات استنفاذ رطوبى من ماء التربة الميسر (٢٥ ، ٥٠ ، ٧٥٪)

(جـ) أربع مكررات لكل مستويات المعاملات.

وكانت محاليل أملاح مياه الري عند (SAR معامل أد مصاص الصوديوم = ٧,٥) .

ونسبة كالسيوم إلى ماغنسيوم ١ : ١ .

وقد تم حساب قيم البخر نتح القياسى (ETo) بثلاث معادلات مناخية عالمية هي: بلاني – كريدل المعدلة ، وبنمان مونتيث ، وبنمان المعدلة وذلك للمقارنة مع مستويات الاستنفاذ الرطوبي لمناطق الدراسة .

وتم حساب قيم الاستهلاك المائي الفعلي وأخذت ثلاث حشات من المحصول كعلف أخضر وجاف وحسبت كفاءة إستعمال المحصول للمياه خلال مراحل النمو المختلفة وكذلك معامل المحصول ، وحللت نتائج المحصول إحصائياً .

وكانت النتائج الآتي :

١ – كانت أقل قيم البخر – نتح القياسي تلك المحسوبة من معادلة بلاني – كريدل المعدلة بينما أعطت معادلتي بنمان – مونتيث وبنمان المعدلة أعلي القيم وأقر بهم للمتوسط في القاهرة .

٢ – ماء الري المضاف للأرض الجيرية حوالي ضعف مياه الري المضاف للأرض الرملية .

٣ – نقص الاستهلاك المائي بزيادة ملوحة مياه الري وكان معدل النقص في الرملية أعلي من الجيرية كذلك نقص بزيادة الاستنفاذ الرطوبي في التربة الرملية والعكس في التربة الجيرية .

٤ - نقص كفاءة اسعمال المحصول للمياه واقتصاديات المياه بزيادة ملوحة مياه الري وكانت أعلي كفاءة عند استنفاذ ٥٠٪ في اتربة الرملية ، ٧٥٪ في التربة الجيرية .

٥ - نقصت قيم معامل المحصول (Kc) بزيادة ملوحة مياه الري في كلا نوعي التربة بينما نقصت بزيادة مستوي الاستنفاذ الرطوبي في التربة الرملية والعكس في التربة الجيرية ، وارتبطت أعلي القيم بمعادلة بلاني - كريدل المعدلة وأقلهم لمعادلتي بنمان مونتيث وبنمان المعدلة .

٦ - لذلك ينصح باستخدام معادلة بنمان - مونتيث لحساب البخر - نتح القياسي لمناطق الدراسة والري عند ٥٠٪ ، ٧٥٪ استنفاذ رطوبي من ماء التربة الميسر لكل من التربة الرملية بالنوبارية والجيرية ببرج العرب في جمهورية مصر العربية علي الترتيب .