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IMPACT OF AVAILABLE WATER SOURCES AT NORTH DELTA ON YIELD AND YIELD COMPONENTS OF SOME FIELD CROPS.

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ABSTRACT

A field investigation was carried out, during 1997 and 1998 seasons. Eight soil locations were chosen, irrigated for long time with agriculture drainage water, or drainage water mixed with waste water, along drain No.4 (42 Km), in comparsion with two locations of soils, which were irrigated with fresh water.

The obtained results could be summarized as follows:

- Using drainage water, or mixed with waste water caused appreciable reduction in seed cotton yield and some yield characters.
- Applying drainage water for irrigation, led to decrease in rice grain yield and yield components, in comparison with fresh water use for irrigation. Results indicated that, significant negative correlation was found, between salinity of irrigation water used and grain yield of rice crop.
- Applying low quality irrigation water for wheat crop production, caused reduction in grain yield, and 1000 grain weight, in comparison with fresh water applying.
- There were reduction in fresh yield weight of clover crop (ton/fed), at the two cuttings of clover, as a result of applying drainage water only, or mixed with waste water, in comparison with that in the case of using fresh water for irrigation.

INTRODUCTION

Water resources in Egypt have become limited in relation to possible land reclamation, for the horizontal agriclture expansion. At present, great efforts should be implemented, to overcome shortage of water that facing Egypt. Therfore, farmers in many parts of the Nile Delta, use drainage water to irrigate their fields, such drainage water are considered the only source for irrigation purposes. Razzouk and Whittington(1991) noticed a decrease in total yield, seed cotton yield and fiber weight per plant, with increasing salinity of irrigation water. Amer *et al.* (1997) found that the continuous use of drainage water, for five years in irrigation, adversely affected the crop yield. The reduction in cotton yield in first season was 7.0% while, in the last season (5th year) was amounted to be 16.7%, and the reduction in yield of rice in the first season was 7% while, the reduction in the last season (5th year) was amounted to be 8%, comparing to the yield of rice irrigated with fresh water. Abou El-Soud (1987), Omar and Ghowail (1990) and El-Leithi *et al.* (1990) proved that the growth, yield and yield components of wheat were reduced by increasing salinity of irrigation water. Sobh *et al.* (1997) reported that grain, straw yield and 100 grain weight, showed significant reduction by increasing water salinity in the clay and calcareous soils. Khalifa *et al.*, (2003) found that soil salt storage and its components increased, as a result of using drainage water only or drainage water mixed with waste water, in comparison with using fresh water, for irrigation under studied crops. The present work plan had been set up, to investigate the effect of the different available

sources of irrigation water, on yield and yield components of some field crops(cotton, rice, wheat and clover) at North Delta.

MATERIALS AND METHODS

To study and evaluate the different available sources of irrigation water for irrigation purposes, and their effects on yield and yield components of some field crops at North of Delta, a field investigation was performed by chosing ten sites of soils, which irrigated with agricultural drainage water mixed with sewage water, or another waste water, and canal water (Nile water). Eight sites of soil, irrigated for long time with agriculture drainage water, differed in their qualities, were selected, begins at Taneikh village (Dakahlia Governorate) and ends at El-Badrawa village (Kafr El-Sheikh Governorate), along drain No. 4 (42 km) and its branches.Two sites of soil irrigated with fresh water (Nile water), for long time (Table 1). Each location included two fields, which were planted with one of the mentioned crops (cotton Giza 75 or Rice Sakha 172) in summer season 1997, followed by (wheat Sakha 8 or clover berseem Mesqawi) crops, in winter season 1997/1998. Irrigation water samples were collected periodically, from different irrigation water sources before each irrigation, for previous crops. Such samples were chemically analysed(EC, pH and soluble ions) according to Klute (1986). Also, SAR, Ca^{++}/Mg^{++}, SSP and Na^{+}/Ca^{++} parameters were calculated using Richard's equation (1954). Yield and yield component for each crop were measured and recorded at harvesting. Data obtained were subjected to statistical analysis according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of different sources of irrigation water on yield and some yield characters of cotton crop:

The data listed in Table (2) showed that the yield and yield characters of cotton crop, are affected by the different sources of irrigation water. Data showed that mean yield of seed cotton (kentar/fed), decreased in soil irrigated with drainage water or mixed with waste water (locations No. 2, 4, 6, 7 and 8), in comparison with soil irrigated with fresh water (locations No. 9 and 10). There is negative significant correlation, between mean yield of seed cotton yield and salinity of both irrigation water used and soil (Table 6). The highest value of seed cotton yield was obtained in location No. 9, which irrigated with fresh water (class C_2-S_1) followed by that in location No. 10. The yield characters such as lint percent, seed index and lint index, had affected by the different sources of irrigation water, and decreased with increasing salinity of irrigation water. The highest value of seed index was 10.24 in location No. 2 and the lowest value was 7.92 in location No. 7. Also, lint index took the same trend of seed index. From data obtained, it could be concluded that using drainage water, or mixed with waste water caused appreciable reduction in seed cotton yield, and some yield characters, such as lint percent, seed index and lint index, in comparison with fresh water irrigation. These results are confirmed with those obtained by El-Mowelhi *et al.* (1995) and Amer *et al.* (1997).

Table (1):Mean values of chemical analysis of the different sources of irrigation water, used in irrigationof different crops (cotton, rice, wheat and clover).

No	Type ofirrigation water	Source of irrigation water		pH	EC, dS/m	Soluble cations, meq/L				Soluble anions, meq/L				SAR	Ca^{2+}/Mg^{2+}	SSP	Na^{+}/Ca^{++}	Class
						Na^{+}	Ca^{++}	Mg^{++}	K^{+}	Cl^{-}	CO^{-}_{3}	HCO^{-}_{3}	SO^{-}_{4}					
1	Drainage water	At beginning of drain No. 4	S	8.03	0.81	4.03	1.80	1.95	0.26	2.85	0.00	3.70	1.49	2.94	0.92	50.12	2.24	C_3S_1
			W	8.49	0.84	3.31	2.00	2.80	0.28	3.80	0.00	3.83	0.72	2.14	0.71	39.45	1.66	C_3S_1
2	Drainage water + sewage water	Derein drain	S	8.29	0.90	4.23	2.45	1.95	0.39	4.35	0.00	4.45	0.22	2.85	1.26	46.90	1.73	C_3S_1
			W	8.09	1.84	11.46	2.93	3.67	0.44	11.67	0.00	5.27	1.56	6.31	0.79	61.95	3.91	C_3S_2
3	Drainage water + waste products from cheese and milk factory	El-Badrawy drain	S	8.29	0.92	4.15	2.45	2.35	0.34	5.00	0.00	3.90	0.39	2.68	1.04	44.67	1.69	C_3S_1
			W	8.42	2.37	13.19	3.13	6.93	0.45	13.53	0.00	4.87	5.30	5.88	0.45	55.65	4.21	C_4S_2
4	Drainage water	Before pumping No. 4 station (drain No. 4)	S	7.77	1.69	8.75	2.85	4.90	0.30	8.35	0.00	4.35	4.10	4.45	0.58	52.21	3.07	C_3S_1
			W	8.19	2.12	11.48	3.87	5.40	0.45	11.07	0.00	4.20	5.98	5.33	0.66	54.15	2.97	C_3S_2
5	Drainage water + sewage water	Beialla drain	S	8.05	2.04	11.68	3.10	5.00	0.32	11.45	0.00	6.05	2.60	5.81	0.62	58.11	3.77	C_3S_2
			W	8.15	2.05	13.04	3.00	4.20	0.27	13.00	0.00	6.13	1.38	6.87	0.71	63.58	4.35	C_3S_2
6	Drainage water	After pumping station No. 4	S	8.01	1.80	10.29	2.65	4.55	0.31	9.60	0.00	4.30	3.90	5.42	0.58	57.81	3.88	C_3S_2
			W	8.14	2.13	12.07	3.13	5.73	0.43	11.07	0.00	4.13	6.16	5.74	0.55	56.51	3.86	C_3S_2
7	Drainage water + waste products of human activity	Drain No. 3	S	7.74	2.28	13.15	2.90	6.25	0.41	12.15	0.00	4.80	5.76	6.15	0.46	57.90	4.54	C_4S_2
			W	8.10	2.43	14.01	3.67	6.13	0.49	14.13	0.00	4.33	5.84	6.33	0.59	57.65	3.82	C_4S_2
8	Drainage water	At the terminal of drain No. 4	S	7.65	2.07	11.18	3.45	5.60	0.37	10.35	0.00	4.65	5.60	5.26	0.62	54.27	3.24	C_3S_2
			W	8.48	2.09	11.48	3.20	5.77	0.49	10.93	0.00	4.17	5.80	5.18	0.55	54.92	3.58	C_3S_2
9	Fresh water (Nile water)	Bahr Beialla canal	S	8.10	0.53	2.26	1.65	1.15	0.22	2.15	0.00	2.70	0.43	1.91	1.43	42.80	1.37	C_2S_1
			W	8.27	0.63	2.98	1.67	1.43	0.22	3.13	0.00	2.60	0.57	2.39	1.16	47.30	1.78	C_2S_1
10	Fresh water (Nile water)	Bahr El-Banwan canal	S	8.07	0.68	2.83	1.90	1.80	0.25	2.55	0.00	2.50	1.73	2.08	1.06	41.74	1.49	C_2S_1
			W	8.00	0.77	3.60	2.13	1.67	0.30	2.53	0.00	3.47	1.70	2.61	1.27	46.75	1.69	C_3S_1

S= summer season, W = winter season.

Table(2):Effect of different sources of irrigation water on yield, and some yield characters of cotton crop, in the studied area during summer season, 1997.

Location	Type of irrigation water and class	Seed cotton yield (kentar/fed)	Lint percent	Seed index	Lint index
9 F_1	Fresh water (C_2-S_1)	9.610	39.42	9.86	6.42
10 F_2	Fresh water (C_2-S_1)	7.469	38.99	10.16	6.49
2 F_3	Drainage water mixed with sewage water (C_3-S_2)	6.034	39.06	10.24	6.56
4 F_3	Drainage water (C_3-S_1)	7.225	38.43	8.82	5.51
6 F_2	Drainage water (C_3-S_2)	6.391	37.57	9.16	5.51
7 F_1	Drainage water + waste products of human activity (C_3-S_4)	4.776	39.23	7.92	5.11
8 F_3	Drainage water (C_3-S_1)	4.606	37.52	9.27	5.57

Effect of different sources of irrigation water on yield and yield components of rice crop:

Data listed in Table (3) showed that the yield and yield components of rice crop were affected by different sources of irrigation water. Data showed that there is reduction in yield and yield components of rice crop, by using lower quality of irrigation water. The highest grain yield (ton/fed.), was obtained by using fresh water of class (C_2-S_1) location No. 9, and followed by location No. 10. The lowest value of grain yield of rice was obtained in location No. 4, which irrigated with drainage water of class (C_3-S_1).

Concerning the effect of different sources of irrigation water, on yield components such as, 1000 grain weight, pinnacle length and No. of grains at pinnacle, data in Table (3) revealed that, the highest and lowest values of 1000 grain weight were obtained in location No. 9 and 7. The lowest value of pinnacle length and No. of grains at pinnacle were obtained in soil irrigated with drainage water mixed with waste water (products of human activity) of class (C_3-S_4) in location No. 7. Generally, it had been noticed that, applying drainage water for irrigation caused decreasing in rice grain yield, and yield components, in comparison with fresh water irrigation. Data in Table (6) indicated that, significant negative correlation was found, between salinity of irrigation water used and grain yield of rice crop. Non-significant correlation was found with 1000 grain weight and salinity of irrigation water. The work of El-Mowelhi *et al.* (1995) and Amer *et al.* (1997) confirmed these results.

Effect of different sources of irrigation water on yield and yield components of wheat crop:

Data presented in Table (4) showed that, there are reduction in grain yield of wheat crop, and 1000 grain weight (gm) with degraded quality of irrigation water. The highest value of grain yield (ardab/fed) was obtained by applying fresh water of class (C_2-S_1) in location No. 9. The lowest value of grain yield of wheat, was obtained in location No. 7, which irrigated with drainage water mixed with waste water of class (C_4-S_2).

Table(3):Effect of different sources of irrigation water, on yield and yield components of rice crop of the studied area, during summer season, 1997.

Location	Type of irrigation water and class	Grain yield (ton/fed)	1000 grain weight (gm)	Pinnacle length (cm)	No. of grain at pinnacle
9 F_3	Fresh water (C_2-S_1)	2.599	28.3	15.42	83.00
10 F_1	Fresh water (C_2-S_1)	2.534	19.8	16.74	71.20
1 F_1	Drainage water (C_3-S_1)	1.905	18.3	20.08	111.20
3 F_1	Drainage water mixed with waste products from milk and cheese factory (C_3-S_1)	2.167	23.4	20.23	88.33
4 F_1	Drainage water (C_3-S_1)	1.411	22.3	17.46	79.80
5 F_1	Drainage water mixed with sewage water (C_3-S_2)	1.590	23.9	14.41	59.40
6 F_3	Drainage water (C_3-S_2)	1.853	18.7	17.90	97.60
7 F_3	Drainage water + waste products of human activity (C_3-S_4)	1.447	17.0	13.32	51.40
8 F_1	Drainage water (C_3-S_1)	2.217	20.8	17.56	77.20

Table (4):Effect of different sources of irrigation water, on grain yield and 1000 grain weight of wheat crop, of the studied area during winter season, 1997/1998.

Location	Type of irrigation water and class	Grain yield (ardab/fed)	1000 grain weight (gm)
9 F_3	Fresh water (C_2-S_1)	18.962	52.9
10 F2	Fresh water (C3-S1)	12.945	52.3
2 F3	Drainage water mixed with sewage water (C3-S2)	5.964	52.9
3 F1	Drainage water mixed with waste products from milk and cheese factory (C4-S2)	12.811	53.7
4 F1	Drainage water (C3-S2)	8.734	43.8
5 F1	Drainage water mixed with sewage water (C3-S2)	14.853	56.8
7 F3	Drainage water + waste products of human activity (C4-S2)	5.066	41.8
8 F1	Drainage water (C3-S2)	7.860	39.0

Concerning the effect of different sources of irrigation water, on 1000 grain weight of wheat grain (gm), data in Table (4) revealed that, highest and lowest values of 1000 grain weight, were obtained in locations No. 5 and 8. Generally, it was noticed that, applying low quality irrigation water, for irrigation wheat crop caused reduction in grain yield and 1000 grain weight of wheat, in comparison with applying fresh water. Data in Table (6) indicated that, the negative correlations were found between salinity of irrigation water and both of grain yield and 1000 grain weight of wheat crop. These results are in agreement with those obtained by Abou El-Soud (1987), Abo-Soliman *et al.* (1992) and Sobh *et al.* (1997).

Effect of different sources of irrigation water on yield of clover plant:

Data presented in Table (5) showed reduction in fresh weight yield of clover crop (ton/fed), at the two cuttings of clover, as a result of applying drainage water only, or mixed with waste water, in comparison with that in the case of using fresh water for irrigation. Values of fresh weight yield (ton/ha) and % dry matter at second cutting of clover, were higher than that in first cutting of clover. The highest value of dry matter yield, was found in location No. 7 which irrigated with water (class C_4-S_2). This may be due to unability of plant to absorb available water from soil due to the high soil salinity and irrigation water applied. Aziz *et al.* (1993) reported that, the increase of either soil moisture stress, or salinity level of irrigation water decreased the amounts of both free and total water in the plant leaves, and decreased the fresh weight of the above ground part of the studied plants. Data in Table (6) indicate that, negative correlations were found, between fresh weight yield of clover at first and second cuttings, and salinity of irrigation water used. These results are in agreement with those obtained by Ibrahim *et al.* (1991).

Table (5): Effect of different sources of irrigation water, on yield of clover crop of the studied area, during winter season, 1997/1998.

Location	Type of irrigation water and class	Cutting	Fresh yield (ton/fed.)	% dry matter	Dry matter yield (ton/fed)
10 F_1	Fresh water (C_3-S_1)	1	9.88	8.87	0.88
		2	10.07	12.01	1.21
1 F_3	Drainage water (C_3-S_1)	1	7.97	7.92	0.63
		2	9.09	10.11	0.92
6 F_3	Drainage water (C_3-S_2)	1	7.21	10.66	0.77
		2	8.38	14.10	1.18
7 F_2	Drainage water + waste products of human activity (C_4-S_2)	1	8.00	12.40	0.99
		2	9.47	14.79	1.40
8 F_2	Drainage water (C_3-S_2)	1	8.19	9.92	0.81
		2	9.94	11.25	1.12

Table (6): Statistical correlations between yield of crops and salinity of irrigation water.

Particular		Regression equation	R	Crop
Y	X			
seed cotton yield	ECiw	Y = 9.3464 – 1.9411 x	-0.7939 *	Cotton
Seed index	ECiw	Y = 10.78 – 1.0079 x	-0.8630*	Cotton
Lint index	ECiw	Y = 7.0177 – 0.7994 x	-0.9563**	Cotton
Grain yield of rice	ECiw	Y = 2.6407 – 0.4714 x	-0.7281 *	Rice
1000 grain weight	ECiw	Y = 24.246 – 2.0058 x	-0.3914 ns	Rice
Grain yield of wheat	ECiw	Y = 18.735 – 4.3838 x	-0.6376 ns	Wheat
1000 grain weight	ECiw	Y = 55.595-3.6055 x	-0.3819 ns	Wheat
Yield of 1st cutting	ECiw	Y = 9.5434 – 0.7829 x	-0.6235 ns	Clover
Yield of 2nd cutting	ECiw	Y = 9.7494 – 0.2176 x	-0.2490 ns	Clover

** significant at 1%,* significant at 5%, ns = non-significant .

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تأثير مصادر مياه الري المتاحة فى شمال الدلتا على المحصول ومكوناته لبعض المحاصيل الحقلية

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أجريت هذه الدراسة خلال موسمى ١٩٩٧، ١٩٩٨ باختيار ثمانية مواقع تقع على امتداد مصرف نمرة ٤ (٤٢ كم) وروافده فى محافظتى الدقهلية وكفر الشيخ والتي تروى بمياه الصرف الزراعى أو مياه الصرف الزراعى المخلوطة بالمياه العادمة وذلك بهدف تقييم هذه المياه وتأثيرها على المحصول ومكوناته لبعض المحاصيل الحقلية (قطن – أرز – قمح – برسيم) بالاضافة الى اختيار موقعين يرويان بالماء العذب كدليل للمقارنة.

أهم النتائج المتحصل عليها:

- استخدام مياه الصرف الزراعى أو المخلوطة بالمياه العادمة أدت الى انخفاض ملحوظ فى محصول القطن الزهر وكذلك بعض صفات المحصول .
- استخدام مياه الصرف الزراعى أو المخلوطة بالمياه العادمة أدت الى انخفاض ملحوظ فى محصول الحبوب للأرز مقارنة باستخدام المياه العذبة ، ووجدت علاقة ارتباط معنوى عكسى بين ملوحة مياه الري المستخدمة فى رى محصول الأرز ومحصول الحبوب الناتج .
- أدى استخدام مياه الصرف الزراعى أو المخلوطة بالمياه العادمة الى انخفاض محصول الحبوب وكذلك وزن الألف حبة من القمح مقارنة باستخدام المياه العذبة فى الري .
- استخدام مياه الصرف الزراعى أو المخلوطة بالمياه العادمة أدت الى انخفاض ملحوظ فى محصول البرسيم الطازج فى كلا الحشتين الأولى والثانية مقارنة باستخدام المياه العذبة .