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PHYSIOLOGICAL BEHAVIOUR OF SOME RICE CULTIVARS UNDER DIFFERET WATER QUALITIES

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ABSTRACT

Two field experiments were conducted at the experimental farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt, during 2010and 2011 summer seasons to investigate the effect of water qualities on some growth attributes, yield, its components and some chemical properties of four rice cultivars namely, Sakha 101and Sakha 102 (short grain and japonica type), and Giza 178 (short grain japonica / indica type) and Giza 182 (long grain indica type). A strip-plot design with four replicates was used in all experiments. The vertical plots were devoted to six water qualities as following: canal water (CW), drainage water (DW), mixed water (MW), and 1 CW: 1DW, 2CW: 1DW, and 1CW:2DW alternatively. The horizontal plots were occupied by the four rice cultivars. (Giza182, Giza178, Sakha 102 and Sakha101).

Results showed that most of growth analysis and attributed and yield components significantly increased when rice plants irrigated with drainage water treatment. In addition the drainage water treatment gave the lowest values of the K^+% but gave the highest value of Na^+% and Na^+/K^+ ratio in straw and grain. The canal water treatment gave the highest values of K^+% in straw and grain.

The results showed that Giza 178 is more stable under drainage water (DW) than the other cultivars. Study indicated that 2CW: I DW treatment is reasonable and save to irrigate rice plants for fields particularly soils at the end of canal.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important grains in the world and it is the most important cereal crop after wheat in Egypt. Rice is not only a stable food, but also contributes the major economic activity and a key source of income and employment for the rural population. The area cultivated with rice in Egypt in the year of 2010 was about 1.6 million feddan (about 0.67 million hectares) mostly located in the northern part of the Nile Delta. This area is grown under flooded conditions throughout the season.

Water is critical factor at any growth stage of the rice plant. It is needed for growth and transport of nutrients from soil to different plant parts. In rice fields, the purpose of water management is to insure a proper growing condition near the roots and better use the supply of soil nutrient. With limited water resources, future increases in rice production require the development of water saving technologies.

Most of Middle Eastern countries will face severe water problem in the near future FAO (1985).

The total annual water use in Egypt was estimated at 55 Billion m^3, of which agricultural use accounted for 84%, industrial, municipal and navigational use accounted for 8%, 5%, and 3% respectively. Current estimates indicated that the total water use would increase to 69.4 billion m^3 by the year 2015. Percentage of water use by agricultural and municipal sectors will remain almost similar to 1990, but the share industry will increase and navigational use will decline very substantially.

In Egypt, water of the River Nile is not sufficient for both reclaiming and irrigation purposes for the soil. So, saving some of irrigation water is a necessity demand to face this problem in the future, through 1): increasing irrigation intervals without any drastic effect or with minimum reduction on grain yield 2): growing drought tolerant varieties which have a capability to grow under shortage of water. Several water saving irrigation techniques for rice have been reported previously (Bouman and Tuong, 2001).

Recycled wastewater or drainage water is the only source of additional water for agriculture, industry and urban non-potable reuse that actually increases in quantity as the population grows, while more and more water is demanded by the urban/industrial sector. Poor quality water and inadequate drainage facilities contribute largely to the salinity problem in rice paddies. Suppression of plant growth under saline conditions may either be due to osmotic pressure reduction or specific ion effect Yaron *et al.* (1973).

Water availability for irrigation could be enhanced through the proper use of drainage water. The most health hazards of great concern and which are due to chemicals in wastewater arise from contamination of field crop like rice by heavy metals. These metals are taken up from soil and bio-accumulated in crop it self Whereas causing damage to plant and degrade of grain quality when reaching high levels and under certain conditions becoming toxic to human and animals feed on metal-enriched plant it self.

The aim of the present study was to define the effect of the water quality on the growth plant rice, grain yield, and its components and on some chemical compositions in grains.

MATERIALS AND METHODS

The present investigation was carried out at the farm of Rice Research & Training Center (RRTC), Sakha, Kafr El-Shiekh during 2010 and 2011 seasons to study the performance of four rice cultivars namely, Sakha 101and Sakha 102 (short grain and japonica type), and Giza 178 (short grain japonica / indica type) and Giza 182 (long grain indica type). These cultivars have a wide range of their characters due to their different genetic background. The water qualities used are, canal water (CW), drainage water (DW), mixed water (MW), and1CW: 1 DW, 2CW: 1DW, and 1CW: 2DW. Every three days, the irrigation water was applied for all plots in equal amounts. Regarding to 1CW: 1DW the water canal was applied first and after three days drainage water was added to plots, and alternated up to end of the season. In case of 2CW: I DW the water was applied as canal water two times and drainage water was applied in the third time. For I CW: 2DW the water was applied as canal water one time and drainage water was applied in the second and third times and so on up to end of the season. A strip plot design with four replications was used. The horizontal plots were devoted to the six treatments of irrigation water qualities, while the vertical plots were assigned to the four rice cultivars. Each plot measured 50 m2. The previous crop was clover in both seasons. The physical and chemical properties of soil and water irrigation were determined according to FAO (1976) and Black (1965) and are presented in Table 1and 2. Rice grains at a rate of 150 kg/ha, was used as recommended, phosphorus fertilizer was added to all plots during land preparation at the rate of 36kg P_2O_5/ha. In addition, nitrogen fertilizer was applied in the form of urea (46.5 N %) at the rate of 150 kg N /ha and Zinc sulphate (22% Zn) at the rate of 50 Kg/ha, was added after puddling and before sowing the nursery. Twenty-five days old, seedlings were transplanted (four seedlings/hill) at 20x20cm spacing among rows and hills. Recommended cultural practices for growing rice except the studied factors were normally conducted.

The two outer rows were excluded to eliminate the border effect and growth attributes, random samples were taken from three inner rows of each plot at panicle initiation for estimating plant height, Leaf area index (LAI),Relative growth rate (RGR)(g/g/week),light penetration, Chlorophyll content (SPAD), and days to heading. At harvest, plants of ten guarded hills were taken at random from the fifth inner row in each plot, for determination of the following characters: number of tillers/m2, number of panicles/m2, panicle weight, unfilled grain percentage and 1000-grain weight (g). In addition, the five central rows of each plot were harvested and left for air-drying about three days. Grain yield "kg/ m^2" was determined (at a grain moisture content of about 15%), then, converted to estimate grain yield in ton/ha and Harvest index.

Relative growth rate (RGR), g/g/ day,

$$R\ G\ R = \frac{LogeW_2 - LogeW_1}{T2 \quad - t1}$$

- Loge— Logarithm Nabarian = 2.303 X e Log
- W $_1$— Total weight of plant. W_2 - Total weight of plant.
- T $_1$ —the first time. T_2 - the second Time T $_2$.

Light penetration was estimated at panicle initiation at 20 cm above the soil surface using Lux /meter Pu 150 (Lux)

Chlorophyll content (SPAD) was estimated at maximum tillering by chlorophyll meter (model SPAD=502) in each plot.

Soluble cations, $Na^+$and K^+ were measured using Atomic Absorption Spectrophotometer (AAS)

The collected data for each character in both seasons were subjected to the standard analysis of variance, according to the procedure outline by Gomez and Gomez (1986), using IRRISTAT Computer program. Differences among treatment means were compared using the Revised LSD at 5% levels of significance.

Table 1. Mechanical and Chemical analysis of the experimental soil before transplanting (0-30 cm)

Soil analysis	2010	2011
Sand %	11.59	11.59
Silt %	32.93	32.91
Clay %	55.48	54.50
	Clay	Clay
Organic matter %	1.50	1.42
E.C. ds/m	1.20	1.28
PH	8.16	8.20
Nitrogen ppm	45.00	61.00
Soluble P ppm	20.00	22.00
Na+ *meg/L*	2.33	2.30
K+ *meg/L*	1.17	1.24

Table 2.Some chemical characteristics and trace metal of the irrigation water used in two rice seasons (element).

parameter	2010			2011		
	CW	MW	DW	CW	MW	DW
PH	7.80	8.14	8.10	7.70	8.16	8.16
EC.	0.79	1.93	2.66	0.75	1.80	2.80
Na+	3.04	15.20	22.88	3.10	14.85	21.96
K+	0.22	0.26	0.32	2.24	0.24	0.35
Ca++	2.20	2.60	3.00	2.40	2.70	3.11

CW = Canal water, DW= Drainage water and MW= Mixed water

RESULTS AND DISCUSSION

I- Growth characters of rice plant

1-Leaf area index (LAI)

Leaf area index (LAI) of some rice cultivars as influenced by water qualities in 2010 and 2011 seasons are presented in Table 3.Highly significant effects on leaf area index (LAI) in both seasons. The highest values of leaf area index were obtained when rice plant received canal water (CW) throughout the season. However, the use of drainage water showed inferiority in leaf area index (LAI) as compared with all other treatments in both seasons, which gave the lowest value of area index. Poor quality water negatively affected leaf expansion thereby reduced the leaf area. The same trend was found by El-Karamity and Atta Allah (1997) and Atwa (1999).

Significant varietal differences were observed regarding leaf area index. (LAI) at 65 days after transplanting (DAT) (Table3). Giza 182 recorded the highest values of leaf area index in both seasons while, Sakha 102 gave the lowest values of LAI in both seasons.

Interaction between water quality and rice cultivars greatly affected leaf area index (LAI) in 2010 and 2011seasons (Table 3).The highest value of leaf area index under drainage water in both seasons respectively were produced by Giza 178 and 2CW: 1DW or ICW: IDW came in the second rank. The lowest values of leaf area index in both seasons respectively under poor water quality were produced by Sakha 102. (Table4).

Table3.Leaf area index, relative growth rate and chlorophyll content of some rice cultivars as affected by irrigation water qualities (65 DAT) during2010 and 2011summer seasons.

Characters / Treatments	Leaf area Index		RGR (g/g/week)		Chlorophyll Content (SPAD)	
Water Qualities	2010	2011	2010	2011	2010	2011
CW	6.49	6.75	0.28	0.41	40.99	42.17
DW	4.73	4.58	4.32	5.53	44.65	44.99
MW	5.44	5.25	3.86	4.50	43.17	43.75
ICW:IDW	5.64	5.97	3.65	4.85	42.78	43.10
2CW:IDW	6.34	6.45	3.28	5.15	42.04	42.67
ICW:2DW	5.22	5.17	4.05	4.33	43.92	44.33
F.test	*	*	*	*	*	*
LSD at 5%	0.59	0.64	0.03	0.02	1.30	1.80
Rice cultivars						
Giza 182	6.22	6.28	0.39	0.45	41.69	42.42
Giza 178	6.16	6.24	0.37	0.42	43.54	44.16
Sakha 102	4.34	4.58	0.41	0.48	41.55	42.38
Sakha 101	5.86	5.59	0.32	0.35	44.92	45.02
F.test	*	*	*	*	*	*
LSD at 5%	0.15	0.26	0.03	0.03	1.2	0.9
Interaction	**	**	**	**	**	**

CW = Canal water, DW= Drainage water and MW= Mixed water

2-RelativeGrowthRate (RGR)(g/g/week)

Data in Table 3 showed that the differences in relative growth rate RGR values among water qualities were highly significant. The highest values of RGR were obtained when plots were irrigated with drainage (DW) water in both seasons, while the lowest values were obtained when plants were irrigated with canal water (cw). Data showed also that increasing of RGR with poor water quality stress it may be due to the increase in the physiological processes of rice plant. These findings are in accordance with those reported by Zeng-LingHe *et al.* (2000) and Aralp *et al*. (2001). Sakha 102 recorded the highest RGR in both seasons compared to the other cultivars. While the lowest values of RGR were found with Sakha 101 in both seasons, respectively. The differences among varieties under study depend on the growth duration of each variety

Regarding the interaction, relative growth rate (RGR) of all cultivars was significantly influenced by water qualities in both seasons (Table 3). The highest values of relative growth rate under drainage water in both seasons respectively were obtained by Sakha 102, while Giza 182 came in the second order after Sakha 102. The lowest RGR values in both seasons, respectively were obtained by Sakha 101 when received poor water quality followed by Giza 178 in both seasons (Table4).

Data showed that the poor quality water relative to other cultivars less affected Sakha101 and Giza 178. This could be attributed to tolerance of both cultivars to salinity and other adverse effects compared to other varieties.

Table4.Leaf area Index, RGR and Chlorophyll content (65 DAT) as affected by the Interaction between water qualities and some rice cultivars during2010 and 2011summer seasons.

Cultivars	Water qualities	Leaf area index		RGR(g/g/week)		chlorophyll content (SPAD)	
		2010	2011	2010	2011	2010	2011
Giza 182	CW	7.33	7.58	0.32	0.42	40.18	41.53
	DW	5.30	4.85	0.40	0.52	43.23	43.45
	MW	5.95	5.73	0.36	0.50	40.85	42.13
	ICW:IDW	6.18	6.38	0.39	0.46	42.15	42.13
	2CW:IDW	6.88	7.18	0.32	0.43	40.95	42.00
	ICW:2Dw	5.65	5.60	0.40	0.50	42.80	42.30
Giza 178	CW	6.88	7.18	0.31	0.38	41.73	42.73
	DW	5.41	5.70	0.41	0.51	45.50	45.45
	MW	6.00	5.93	0.38	0.41	44.13	45.10
	ICW:IDW	6.13	6.35	0.38	0.41	43.08	43.50
	2CW:IDW	6.85	6.80	0.33	0.41	42.65	42.80
	ICW:2Dw	5.70	5.93	0.39	0.49	44.18	45.40
Sakha 102	CW	5.03	5.35	0.32	0.41	39.40	40.95
	DW	3.00	3.12	0.51	0.61	43.38	44.65
	MW	4.15	4.50	0.44	0.54	41.98	42.45
	ICW:IDW	4.70	4.90	0.36	0.47	41.25	41.83
	2CW:IDW	5.03	5.18	0.37	0.45	40.33	41.50
	ICW:2Dw	4.10	4.45	0.45	0.55	42.93	42.95
Sakha 101	CW	6.73	6.88	0.2	0.32	42.63	43.48
	DW	5.20	4.65	0.40	0.41	46.50	46.40
	MW	5.65	4.85	0.35	0.37	45.75	45.30
	ICW:IDW	5.55	6.25	0.32	0.35	44.65	44.93
	2CW:IDW	6.60	6.65	0.29	0.32	44.23	44.38
	ICW:2Dw	5.45	4.68	0.39	0.9	45.78	45.65
F.test		*	*	*	*	*	*
LSD at 5%		1.10	1.23	0.05	0.06	2.31	2.23

CW = Canal water, DW= Drainage water and MW= Mixed water

3-Chlorophvll content (SPAD)

Data in Table 3 showed that chlorophyll content was significantly affected by water qualities in the two seasons. The highest values of chlorophyll content (SPAD) in 2010 and 2011, respectively were found by using drainage water, while chlorophyll content decreased in both seasons, respectively when canal water (CW) was used. The highest chlorophyll content under drainage (DW) water might be due to its shortage in Leaf area similar results were reported by Wang and Liao (1999). Data cleared that Sakha 101 gave the highest values of chlorophyll content in both seasons. On the other hand Sakha 102 variety gave the lowest values of chlorophyll content in both seasons, respectively. It is clear from the data that there is a negative relationship between chlorophyll content and leaf area. Similar trend was found by Abd El-Wahab (1998), Abou Khalifa (2001) and Zayed (2002)

For the interaction between water qualities and rice cultivars, significant effects were found for chlorophyll content in both seasons (Table 3). Data listed in Table4 cleared that Sakha 101 showed higher chlorophyll content in both seasons of chlorophyll content in both seasons, respectively were obtained when Giza 182 received drainage water(DW). That may be attributed to the low quality of water with high salt leve1s and high SAR value which effects on leaf area, and has negative relationship with chlorophyll content. These result stand in harmony with Abd El-Wahab (1998 a).

4-Flag leaf area (cm^2)

Data in Table5 cleared that water qualities had a significant effect on flag leaf area during 2010 and 2011 seasons, whereas, flag leaf area sharply decreased when plants were subjected to poor water quality {drainage water (DW)}. The highest flag leaf areas in both seasons, respectively were obtained when plants were irrigated with canal water (CW). However, the irrigation with drainage water (DW) showed inferiority in flag leaf area as compared with other irrigation treatments in both seasons, which gave the lowest flag leaf area. Poor Water quality (DW) stress severely affected leaf expansion thereby reduced the flag leaf area.

Varieties showed significant variation in their flag leaf area at heading in both seasons. Giza 182 recorded the highest values of flag leaf area, while Sakha 102 gave the lowest values of flag leaf area in both seasons.

Interaction between water qualities and rice cultivars greatly affected flag leaf area in 2010 and 2011 seasons (Table 5). The highest values of flag leaf area in both seasons were produced Giza 178 under poor water quality. On the other hand, Sakha 102 gave the lowest flag leaf area in both seasons when received poor water quality (Table6).These results shown that Giza 178 is more stable under drainage water (DW) than the other cultivars under study.

Table 5.Flag leaf area, Light penetration and days to heading as affected by irrigation water qualities and some rice cultivars during2010 and2011 seasons.

Characters / Treatments	Flag leaf area ($cm)^2$		Light penetration (Lux)		Days to complete heading	
Water qualities	2010	2011	2010	2011	2010	2011
CW	31.89	31.59	2277.69	2292.94	99.25	101.25
DW	24.09	24.68	3080.19	3294.63	95.81	96.91
MW	28.52	29.45	2962.88	3105.94	97.44	98.78
ICW:1DW	28.83	30.02	2815.00	2852.44	98.46	100.69
2CW:1DW	30.16	30.86	2285.56	2293.31	98.78	101.06
ICW:2DW	25.79	27.08	3019.50	3220.69	96.31	98.25'
F.test	*	*	*	*	*	*
LSD at 5%	2.80	3.90	506.70	477.41	1.15	1.16
Rice cultivars						
Giza 182	30.76	32.06	2155.38	2167.50	95.92	97.44
Giza 178	29.19	29.31	2627.17	2681.00	97.71	100.50
Sakha 102	24.83	25.95	3102.17	3016.58	91.83	92.42
Sakha 101	28.08	28.47	2709.17	2688.80	105.25	107.60
F.test	*	*	*	*	*	*
LSD at 5%	1.50	1.60	574.81	471.80	1.01	1.30
Interaction	**	**	*NS*	*NS*	*	*

CW = Canal water, DW= Drainage water and MW= Mixed water

Light penetration (Lux)

The results in Table5 cleared that water qualities had obviously significant effect on light penetration (Lux) in 2010 and 2011 seasons. No significant difference, were found between canal water (CW) and 2 CW: 1 DW treatments, in both seasons. The lowest values of light penetration in both seasons occurred when rice plants were watered by canal water followed by 2CW: 1 DW treatment in both seasons. The highest value of light penetration in both seasons was recorded when rice plants were watered by drainage water (DW). The increase of light penetration could be attributed to the reduction in plant height, number of tillers/m2 and total leaf area at heading as affected by poor water quality stress.

The lowest values of light penetration were found with Giza 182, while Sakha 102 gave the highest values of light penetration (Lux) in both seasons (Table5)

The interaction between the two factors had no significant effect on light penetration (Lux) in both seasons (Table5).

6-Days to complete heading

Data inTable6 cleared that water qualities had a significant effect on number of days to heading .It increased, when canal water (CW) were used followed by 2CW: IDW, while it decreased in 2010 and 2011 seasons when drainage water (DW) was used. This is because salt in drainage water (DW) depresses growth more strongly' than canal water.

It was clear that Sakha 102 was the earliest in heading in both seasons. Sakha 101 variety was the latest in heading in both seasons. This difference among rice varieties is attributed to their genetic make-up. Similar direction was found by Shaalan (1986 and 1987) and Gorgy (1988).

Interaction between water qualities and rice cultivars greatly affected days to heading (Table 5). Sakha 102 was the earliest variety in heading in both seasons, respectively under poor water quality. Giza 182 came in the second rank after Sakha 102 in both seasons. On the other hand, Sakha 101 was the latest one in both seasons, respectively when received poor water quality.

7- Plant height (cm)

Data in Table 7 show that water qualities had obviously significant effect on plant height (cm) in 2011 season. Poor water quality stress sharply reduced plant height (cm) under poor water quality stress as plant growth progress in all trials no significant different between fresh water treatment, ICW: 1DW and 2 CW: 1 DW treatments. The tallest plants in two seasons respectively were given when rice plants were well watered by fresh water treatment. The shortest plants were recorded when rice plants were watered by drainage water (DW) treatment in both seasons. All previous results and the present discussion surely confirmed that drainage water is more effect on rice either growth or yield attributes. The result obtained was harmony with Zeng-LingHe *et al.* (2000).

Table 6. Flag leaf area, Light penetration and days to heading as affected by the interaction between water qualities and some rice cultivars during 2010 and2011seasons.

Cultivars	Water qualities	Flag Leaf area Cm^2		Days to complete heading	
		2010	2011	2010	2011
Giza 182	CW	43.13	34.55	97.00	98.75
	DW	24.80	26.23	94.25	95.89
	MW	32.00	33.18	96.25	97.00
	ICW:IDW	32.13	33.68	96.50	98.00
	2CW:IDW	33.40	34.48	96.75	98.50
	ICW:2DW	28.08	30.25	94.75	96.50
Giza 178	CW	33.03	31.35	98.75	102.75
	DW	26.87	27.23	96.25	96.50
	MW	29.30	29.30	98.00	99.75
	ICW:IDW	29.38	30.23	98.00	102.50
	2CW:IDW	30.43	30.48	98.00	102.50
	ICW:2DW	26.13	27.28	97.25	99.00
	CW	28.10	29.50	94.00	94.50
Sakha 102	DW	19.15	20.11	89.75	89.25
	MW	24.98	26.35	91.50	91.50
	ICW:IDW	25.88	27.03	92.50	94.00
	2CW:IDW	27.50	28.03	93.25	94.25
	ICW:2DW	23.35	24.65	90.00	91.00
Sakha 101	CW	32.33	30.95	107.25	109.00
	DW	25.53	25.13	103.00	106.00
	MW	27.80	28.98	104.00	106.85
	ICW:1DW	27.93	29.15	106.85	108.25
	2CW:IDW	29.30	30.43	107.13	109.00
	ICW:2DW	25.60	26.15	103.25	106.50
F.test		*	*	*	*
LSD at 5%		4.68	4.75	2.31	2.97

CW = Canal water, DW= Drainage water and MW= Mixed water

Table7. Plant height, number of tillers and number of Panicles of some rice cultivars as affected by irrigation water qualities during2010 and 2011 seasons

Characters / Treatments	Plant height (cm)		Number of tillers/m^2		Number of Panicles / ^{m2}	
Water Qualities	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**
CW	103.99	103.29	467	480	439	468
DW	100.01	95.72	405	441	372	428
MW	101.48	99.29	417	454	400	448
ICW:IDW	103.35	102.34	433	472	410	455
2CW:IDW	102.87	100.93	462	475	433	455
ICW:2DW	100.51	99.84	411	449	380	442
F.test	NS	*	*	*	*	*
L.S.D. 5%	-	2.80	22.06	25.96	35.65	37.34
Rice cultivars						
Giza 182	96.14	96.22	435	465	393	451
Giza 178	100.68	97.98	470	494	420	484
Sakha 102	115.54	111.88	385	400	377	385
Sakha 101	95.77	94.86	439	466	417	459
F.test	*	*	*	*	*	*
LSD at 5%	1.70	2.23	26.77	15.78	15.28	15.81
Interaction	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

CW = Canal water, DW= Drainage water and MW= Mixed water

High significant varietal differences were noticed among the rice cultivars in Plant height (cm) in the two seasons. Sakha 102 produced the tallest plants, while Sakha 101 produced the smallest plants in the first and seasons, respectively.

The interaction between the two factors had no significant effect on plant height in both seasons, indicating, thereby, that each factor affected this character independently (Table 7).

II- Yield and its attributes

1- Number of tillers/m^2

Data in Table 7 indicated that water qualities had distinctly significant effect on number of tillers/m^2 in 2010 and 2011 seasons, where poor water quality sharply reduced number of tillers/m2. The highest number of tiliers*1m*^{2} was obtained when the rice plots were irrigated with canal water overall growing seasons. The lowest values of number of tillers/m^2 were recorded when drainage water treatment in 2010 and 2011 seasons respectively. Data indicated that no significant difference between canal water treatment was found and 2CW: IDW treatment in both seasons. These results are in agreement with those reported by Zeng -LingHe *et al.* (2000) and Xu *et al.* (2001).

Significant differences were detected among the studied rice cultivars in number of tillers *1m*^{2} in both seasons (Table 7). Giza 178 variety had the highest of number of tillers/ m^2, while Sakha 102 produced the lowest number of tillers.

The interaction between water qualities and rice cultivars had no significant effect on number of tillers *1m*^{2} in both seasons of the present investigation (Ttable7).

2- Number of panicles/m^2

Data in Ttable7 indicated that water qualities had distinctly significant effect on number of panicles/m^2 in both seasons 2010 and 2011, poor quality water significantly reduced number of panicles/m^2. The highest number of panicles/ m^2 was obtained when the rice plants were irrigated with canal water (CW) throughout growing seasons. The lowest number of tillers/ m^{2}were recorded when drainage water (DW) was used in both seasons, respectively. These results are in agreement with those showed by Zeng LingHe *el al.* (2000) and Xu P *et al.* (2001).

Giza 178 produced the highest number of panicles /m^2, while Sakha 102 variety produced the lowest number of panicles/m^2. The superiority of Giza 178 in all discussed traits clarified that Giza 178 is the most suitable cultivars for adverse conditions (Ttable7).

The interaction between water qualities and rice cultivars had no significant effect on Number of panicles/ m^2 in both seasons of the present investigation (Ttable7).

3- Unfilled grain percentage

Data in Table 8 indicated that water qualities had a significant effect on unfilled grain % in the two seasons, where poor water quality sharply increased unfilled grain as it was progressively subjected to poor water quality. The highest values of unfilled grain percentage were obtained when the rice plants were irrigated with drainage water (DW) throughout the growing season. The lowest values of unfilled grain were recorded under irrigation with canal water (CW). Data showed no significant differences between either canal water treatment or 2CW: IDW in both seasons. This shows that the sensitivity of pollination stage to stress results from using poor quality water. These data are in agreement with those reported by Cabrera *et a1.* (1988), Wang and Yan (1990),Sarkunan *et al.* (1991), Maria (1992) and Datta and Jong (2002).

Data showed that Sakha 102 produced the lowest values of unfilled grain in both seasons, respectively, while Sakha 101 variety gave the highest values of unfilled grain percentage. The highest grain yield was closely correlated with number of panicles and unfilled grain percentage

Table 8.Unfilled grain %, Panicle weight and 1000-grain weight of some rice Cultivars as affected by irrigation water qualities during 2010 and summer seasons.

Characters / Treatments	Unfilled grain %		Panicle weight (g)		1000-grain weight (g)	
Water Qualities	2010	2011	2010	2011	2010	2011
CW	6.00	6.06	3.75	3.99	24.63	26.31
DW	8.78	8.64	2.83	3.39	21.98	23.28
MW	7.03	7.82	3.29	3.53	23.11	25.43
ICW:IDW	6.14	6.28	3.48	3.60	24.46	25.71
2CW:IDW	6.11	6.06	3.62	3.67	24.50	26.20
ICW:2DW	8.19	8.14	2.94	3.50	22.43	24.43
F.test	*	*	*	*	*	*
LSD at 5%	0.83	1.16	0.22	0.32	0.74	0.66
Rice cultivars						
Giza 182	7.40	7.80	3.40	3.76	24.47	25.93
Giza 178	7.19	6.93	3.46	3.84	19.92	21.67
Sakha 102	5.44	5.85	2.77	3.32	24.77	25.55
Sakha 101	8.24	8.72	3.10	f-3.53	24.92	26.76
F.test	*	*	*	*	*	*
LSD at 5%	0.68	1.42	0.20	0.25	1.20	1.04
Interaction	*NS*	*	*	*NS*	*	*

CW = Canal water, DW= Drainage water and MW= Mixed water

Interaction between water qualities and rice cultivars greatly affected unfilled grain during 2011 season only (Table 8). The highest values of unfilled grain were produced with Sakha 101 under poor water quality (DW). On the other hand, Sakha 102 gave the lowest values unfilled grain percentage (Table 9).

4- Panicle dry weight (g)

Data in Table 8 reveals that water qualities had obviously significant effect on panicle weight (g), where poor water quality sharply reduced the panicle weight. The heaviest panicle was given when rice plants were watered with canal water (CW). The lightest panicle were recorded when rice plants were watered with drainage water in both seasons. All previous results and the present discussion confirm that drainage water (DW) is more effective on rice growth and yield attributes. These results are in harmony with those that reported by Cabrera *et al.* (1988),Wang and Yan (1990),Sarkunan *et al.*(1991), Maria (1992) and El Sayed(1998).

High significant differences in panicle weight were calculated among the rice cultivars in both seasons of study (Table 8). Giza 178 produced the heaviest panicle weight in both seasons, respectively. It is worth to mention that Sakha 102 recorded the lightest panicle weight in the two seasons, respectively.

With respect to the interaction between water qualities and rice cultivars, Table8 showed that the interaction between water qualities and rice cultivars had markedly significant effect on panicle weight in first season only. Giza 178 produced the heaviest panicle when it watered by drainage water (DW). The same trend was obtained under ICW: 2DW and MW. Sakha 102 produced the lightest panicle under the same water. The poor quality water as compared with other varieties under study does not affect Giza 178(Table 9).

Table9. Unfilled filled grain, Panicle weight and 1000-grain weight as affected by the interaction between water qualities and some rice cultivars

Cultivars	Water qualities	Unfilled grain %	Panicle weight (g)	1000-grain weight (g)	
		2011	2010	2010	2011
Giza 182	CW	4.11	6.13	25.50	25.60
	DW	2.89	8.18	22.70	23.02
	MW	2.65	7.60	24.14	24.55
	1CW:1DW	3.93	7.00	25.00	25.10
	2CW,1DW	4.01	7.25	25.50	52.62
	1CW:2DW	3.12	8.68	24.00	24.34
Giza 178	CW	3.83	5.93	20.50	25.62
	DW	3.19	7.55	19.13	20.12
	MW	3.54	7.93	19.38	20.32
	1CW:1DW	3.44	6.88	21.00	21.20
	2CW:1DW	3.58	5.00	20.25	20.29
	1CW:2DW	3.27	8.28	19.25	20.00
Sakha 102	CW	3.03	4.88	26.75	26.78
	DW	2.15	7.23	22.12	22.21
	MW	2.35	7.25	24.38	24.45
	1CW:1DW	2.66	6.45	26.45	26.50
	2CW:1DW	2.86	4.58	26.50	26.55
	1CW:2DW	2.23	4.70	22.40	22.44
Sakha 101	CW	4.15	7.30	25.75	25.79
	DW	3.11	1I.60	24.00	24.11
	MW	3.69	8.50	24.54	24.60
	1CW:1DW	3.98	7.82	25.38	25.43
	2CW:1DW	4.05	6.15	25.75	25.78
	1CW:2DW	3.23	10.93	24.07	24.12
F.test		*	*	*	*
LSD at 5%		0.58	2.45	2.09	2.11

CW = Canal water, DW= Drainage water and MW= Mixed water

5-1000-grain weight (g)

Data in Table 8 showed that water qualities had significant effect on 1000-grain weight in both seasons. Where, the poor water quality stress sharply decreased the 1000-grain weight on the other hand, there was no significant difference between canal water (CW), 2CW: 1DW or 1CW: 1DW.

The heaviest 1000-grain weight in both seasons, respectively was given when rice plants were well watered by canal water (CW). The lightest 1000-grain weight (g) was recorded when rice plants were watered with drainage water (DW) treatment in the two seasons, respectively. The reduction in 1000-grain weight (g) under drainage water treatment might be due to high osmotic potential and decreasing assimilates supply to sink and increasing spikelet competition resulting in lighter grains and partly filled grains. The unfavorable effect of poor water quality at identified growth stages has been notified by several workers such as, Cabrera *e1 al.* (1988), Wang and Yan 1990), Sarkunan *et. a1.* (1991) and Maria (1992).

In addition, data in Table 8 showed significant differences among the rice cultivars for 1000-grain weight in both seasons. Sakha 101 produced the heaviest 1000grain weight (g), in the first and second seasons, respectively. It is worth to mention that Giza 178 recorded the lightest 1000-grain weight in both seasons, respectively. Generally, the varietal differences might be mainly due to genetic and partially to the environment.

Data in Table 9 showed that the interaction between water qualities and rice cultivars had markedly significant effect on 1000-grain weight in both seasons. Sakha 101 produced the heaviest 1000-grain weight in both seasons respectively under poor quality water but, Giza 178 produced the lightest1000-grain weight in both seasons respectively under the other water qualities used (Table 9).

6- Grain yield (t/ha)

Data in table 10 showed that water qualities had a significant effect on grain yield in both seasons. The highest values of grain yield were obtained when plants received canal water (CW). The lowest values were obtained when plants received drainage water (DW) only overall season in both seasons, respectively. The reduction in yield is due to using different water qualities in both seasons, respectively (I CW: 1 DW, 2 CW: 1 DW, 1 CW: 2 DW, MW and DW). It was observed that the reductions with using I CW: 2 DW, MW and DW were higher than that of 1CW, 1CW: 1 DW and 2 CW: 1 DW treatments. That might be due to poor quality water, which contained different slat forms and high sodium level, which reduce growth dry matter production, and assimilates translocation to the sink. In addition, the drainage water (DW) contained high concentrations of heavy metals, oils and some other chemicals, which effect on growth development. Study indicated that 2CW: I DW treatment is reasonable and save to irrigate rice plants for fields particularly soils at the end of canal. These findings are in agreed with those reported by Cabrera *et al.* (1988), Wang and Yan (1990),Sarkunan *et al.* (1991) and Maria (1992).

The data of grain yield per hectare (Table 10) showed that there were significant differences among the four rice cultivars under study in 2010 and 2011 seasons. Giza 178 produced the highest grain yield in both seasons respectively with no significant differences with Sakha 101. Sakha 102 recorded the lowest grain yield in both seasons respectively. These results are in agreement with those reported by Shehata (1995).

Interaction between water qualities and rice cultivars in Table 10 showed that the interaction between water qualities and rice cultivars had markedly significant effect on grain yield in both seasons. Giza 178 produced the highest grain yield in both seasons, respectively under poor quality water (DW) and Sakha 102 produced the lowest grain yield under (DW) in this study (Table11).

7- Straw yield (t/ha)

Data in Table 10 indicated that water qualities had significant effect on straw yield (t/ha) in 2011 season. Data indicated also that no significant differences in straw yield between canal water and 2CW: IDW in both seasons. The highest values of straw yield (t/ha) in the first season was obtained when plants were irrigated with canal water (CW), but in the second season it was obtained when plants were irrigated with 2CW: IDW. While the lowest values were obtained when plants were irrigated with drainage water (DW) in both seasons, respectively. Moreover, the straw yield (t/ha) in the two seasons followed the same trend as grain yield t/ha. The effect of poor quality water on straw yield has been testified by Wang and Yan (1990), El Saady (1991), Sarkunan *et. al*. (1991) and Maria (1992).

The data of straw yield (t/ha) (Table 10) showed that there were significant differences among the four rice varieties under study in the second seasons only. The highest values of straw yield were produced by Giza 182 but Sakha 102 produced the lowest straw yield in both seasons. Also, the results revealed that there was no significant difference between 178 and Giza 182 varieties in the two seasons. The low straw yield of Sakha 102 is due to its inferiority under this condition.

Table10.Grain yield, Straw yield and Harvest index of some rice cultivars as affected by irrigation water qualities during2010 and 2011summer seasons.

Characters / Treatments	Grain yield (t/ha)				Straw yield(t/h)		Harvest index	
Water qualities(I)	2010	Reduction %	2011	Reduction %	2010	2011	2010	2011
CW	10.04	-	11.7	-	12.75	12.83	0.44	0.46
DW	8.37	16.7	8.69	23.8	11.02	11.33	0.33	0.43
MW	9.01	10.3	9.7	13.7	12.15	12.66	0.43	0.43
1CW: DW	9.57	4.7	10.38	6.9	12.46	13.13	0.43	0.44
2CW:1DW	9.96	0.8	10.67	4.0	12.64	12.98	0.44	0.45
1CW:2DW	8.69	13.5	9.35	17.2	11.86	11.96	0.43	0.43
F.test	*	-	*	-	NS	*	NS	NS
LSD at 5%	0.46	-	0.60	-	-	1.22	-	-
Rice cultivars(V)								
Giza182	9.24	15.6	10.18	6.2	12.34	12.94	0.43	0.44
Giza178	9.98	10.9	10.87	2.7	12.07	12.08	0.45	0.47
Sakha102	8.02	20.8	8.29	18.0	11.16	10.91	0.42	0.43
Sakha101	9.84	13.6	10.56	6.4	11.92	12.03	0.45	0.48
F.test	*	-	*	-	NS	*	*	*
LSD at 5%	0.32	-	0.54	-	-	-	0.02	0.01
Interaction IxV	**	-	**	-	NS	NS	*	*

CW = Canal water, DW= Drainage water and MW= Mixed water

The interaction between water qualities and rice cultivars had no significant effect on straw yield in both seasons the local conditions of the present investigation.

8- Harvest index (HI)

Harvest index of the four rice cultivars as influenced by water qualities is shown in Table10 .Water qualities had no significant effect on harvest index in both seasons. These data are in a good harmony with those reported by Wang and Yan (1990), Sarkunan *et al.* (1991), Maria (1992) and El Sayed (1998).

Significant varietals differences were observed regarding the harvest index, in both seasons, (Table 10). Sakha 101 recorded the highest values of harvest index, while Sakha 102 gave the lowest values of harvest index in 2010 and 2011 seasons, respectively. Whereas no significant difference between Sakha 101 and Giza 178 in both seasons.

Interaction between water qualities and rice cultivars greatly affected harvest index in 2010 and 2011 seasons (Table 11). The highest values of harvest index in both seasons were produced by Giza 178 drainage water (DW). On the other hand, Sakha101 gave the lowest harvest index in both seasons when it received drainage water (DW). These results confirm that Giza 178 is more stable under poor quality water than the other cultivars under study.

Table 11. Grain yield and Harvest index as affected by the interaction between water qualities and some rice cultivars

Cultivars	Water qualities	Grain yield (t/ha)		Harvest index	
		2010	2011	2010	2011
Giza 182	CW	10.43	11.80	0.44	0.45
	DW	7.80	8.00	0.42	0.43
	MW	8.60	9.88	0.43	0.44
	1CW:1DW	10.00	10.83	0.43	0.44
	2CW:1DW	10.33	11.20	0.43	0.44
	1CW:2DW	8.28	9.38	0.42	0.44
Giza 178	CW	10.53	11.75	0.45	0.46
	DW	9.27	10.17	0.44	0.45
	MW	9.87	10.67	0.44	0.45
	1CW:1DW	10.16	11.04	0.44	0.45
	2CW:1DW	10.35	11.20	0.45	0.46
	1CW:2DW	9.68	10.40	0.44	0.45
Sakha 102	CW	8.86	9.13	0.39	0.42
	DW	7.23	6.85	0.42	0.44
	MW	7.78	8.08	0.40	0.42
	1CW:1DW	8.11	7.85	0.40	0.41
	2CW:1DW	8.57	9.10	0.42	0.43
	1CW:2DW	7.58	7.73	0.41	0.42
Sakha 101	CW	10.35	11.58	0.47	0.48
	DW	9.13	9.77	0.39	0.41
	MW	9.78	10.18	0.43	0.44
	1CW:1DW	10.00	10.80	0.45	0.46
	2CW:1DW	10.57	11.17	0.46	0.46
	1CW:2DW	9.20	9.88	0.43	0.45
L S D at 5%		1.13	1.34	0.04	0.02

CW = Canal water, DW= Drainage water and MW= Mixed water

III- Mineral composition of rice plants in relation to water Qualities

1- Potassium % in straw and grain:

Data in Table12 showed that water qualities had significant effect on K % in both seasons. The lowest % of potassium in straw and grain in both seasons, respectively were obtained with applying drainage water treatment(DW) while, the highest % of K in straw and in grain in both seasons, respectively were found with applying canal water treatment(CW) . Potassium which is a monovalent essential plant nutrient, plays special roles in membrane transport processes alone with establishing the cell ionic and osmotic equilibrium particularly under saline conditions. Increasing both osmotic pressure and salinity level of water lead to clear reductions in K % (El Gayer *et al.*,1986 and Atwa, 1999). The results above attributed to the antagonistic phenomenon between K^+ and Na^+ either in soil solution of in side plant tissues. The % of K in straw and grain of rice differed widely according to composition and type of applied water (Atwa, 1999 and Zayed, 2001).

Sakha 101 had the highest % of K in straw and grain in both seasons. However, the results showed also that the lowest values of K % in straw and in grain in both seasons, respectively were gotten by Sakha 102 that explained the inferiority of this cultivar under poor water quality stress (Table12).

None of the interactions had a significant effect on potassium % in any of the two seasons under the local conditions of the present investigation.

2-Sodium % in straw and grain:

As shown in Table 12 the water qualities had significant effect on Na% in straw and in grain in both seasons. The highest percentages of sodium in straw and grain in both seasons, respectively resulted from applying drainage water (DW), while the lowest values of sodium % in straw and grain in both seasons, respectively were obtained with applying canal water (CW) throughout the growing season. Also data showed that no significance different between canal water (CW) and 2CW: I DW treatments in Na % in both seasons. The previous results indicated that, under drainage water (DW) (poor quality water) increase Na % in straw and grain of rice. Applying canal water(CW) overall growing season leave up Na^+ leaching from root zone and reduced Na^+ content in either straw or grain.Sobh et al.(1997)and Armstrong David *et al.* (2001) reported that poor quality of water increase sodium % in straw and grain.

There were significant varietal differences regarding to sodium % in straw in both seasons and no significant differences were found among varieties in case of the %of Na+ in grain in both seasons. The highest Na^+ content in straw and grain in both seasons were found with Sakha 102 followed by Giza 182, while the lowest values of Na^+ % in straw and grain in both seasons, respectively were contained in Giza 178. That might be explain why Giza 178 is more tolerant to inadequate conditions than Sakha 102 which is more sensitive to inappropriate conditions. Sobh *et al*. (1997) and Armstrong David *et al.* (2001) in harmony with those report these data.

The interaction between water qualities and rice cultivars had no significant effect on either sodium % in straw or grain in both seasons of the present investigation(Table12).

Table12. K^+ % and Na^+% concentrations in straw and grain and Na^+/K^+ ratio as affected by irrigation water qualities during2010 and 2011 seasons.

Characters / Treatments	K				Na				Na/K ratio Grain	
	Straw		Grain		Straw		Grain			
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Water qualities(I)										
CW	2.07	1.93	0.49	0.49	2.39	2.62	0.12	0.13	0.24	0.26
OW	2.0	1.9	0.46	0.46	2.57	2.68	0.13	0.14	0.28	0.3
MW	1.68	1.5	0.42	0.43	2.57	2.86	0.12	0.14	0.29	0.33
1CW:IDW	1.5	1.38	0.38	0.38	2.67	2.85	0,13	0.14	0.34	0.37
2CW:1DW	1.41	1.36	0.34	0.34	2.77	2.91	0.14	0.18	0.41	0.53
ICW:2DW	1.41	1.36	0.28	0.29	3.04	3.18	0.15	0.18	0.53	0.64
F.test	*	*	*	*	*	*	*	*	*	*
L S D at 5%	0.09	0.11	0.04	0.05	0.18	0.01	0.01	0.01	0.05	0.08
Rice cultivars (V)										
Giza 182	1.5	1.85	0.38	0.38	2.8	3,06	0.14	0.15	0.37	0.39
Giza 178	1.83	2.02	0.41	0.41	2.51	2.63	0.13	0.15	0.32	0.37
Sakha 102	1.49	1.7	0.35	0.35	2.82	3.05	0.14	0.16	0.4	0.43
8akha 101	1.8	1.91	0.45	0.45	2.53	2.66	0.13	0.15	0.29	0.33
F.test	*	*	*	*	*	*	NS	NS	*	*
L S D at 5%	0.08	0.12	0.04	0.07	0.26	0.29	-	-	0.08	0.05
Interaction (IXV)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

CW = Canal water, DW= Drainage water and MW= Mixed water

3- Na^+/K^+ ratio

Results in Table 12 showed that irrigation treatments had significant effect on N^+ /K^+ ratio in both seasons. Using drainage water (DW) increased the Na^+/K^+ ratio and gave the highest ratio Na^+/K^+ in both seasons, while the lowest ratio found under canal water treatment (CW). The same explanation is correct in case of K^+ and Na^+%. Also, this results attributed to high percentage of Na^+ in soil solution under drainage water treatment which is consider as a one of the important factors effect on Na^+/K^+ ratio inside the plant Abou-Seeda *et al.*,(1997).

Regarding the performance of rice cultivars in this trait, Table 12 show that there is a significant difference in Na^+/K^+ ratio in the two seasons among varieties. The highest ratio of Na^+/K^+ in both seasons, respectively was found in Sakha 102 that confirmed its inferiority under inadequate conditions, while the lowest ratio in both seasons respectively was found by Giza 178 because its superiority under the stress conditions. Shehata (1995),Liu *et al.* (1998) stated that the potentiality of tolerance of any cultivars rely on its Na^+/K^+ ratio .

Regarding to the effect of interactions among the two factors under study it could be noticed that Na^+/K^+ ratio was not significant influenced by various ways of interaction during the seasons.

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السلوك الفسيولوجي لبعض أصناف الأرز المتأثرة بأنواع مختلفة من جودة مياه الري

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أقيمت تجربتان حقليتان خلال موسمي صيف ٢٠١٠ و٢٠١١ فى مزرعة مركز البحوث والتدريب في الأرز بسخا كفر الشيخ مصر لدراسة سلوك بعض أصناف الأرز وتقييم إنتاجيتها تحت ظروف استخدام أنواع مختلفة من جودة مياه الري وخاصة مياه الصرف الزراعي كأحد الحلول الملحة لحل مشكلة المياه فى مصر واستخدم فى هذه التجربة تصميم الشرائح المتعامدة ذو أربع مكررات ووزعت أنواع مياه الري فى القطع الأفقية كالتالي :-

١- ماء عذب طوال موسم الزراعة. ٢- ماء صرف زراعي طوال موسم الزراعة.

٣- ماء مخلوط(ماء عذب مع ماء صرف بنسبة١:١). ٤ - ريه واحدة ماء عذب: ريه واحدة صرف زراعي. ٥- ريتين ماء عذب :ريه واحدة ماء صرف . ٦- ريه واحدة ماء عذب : ريتين ماء صرف.

ووزعت الأصناف (جيزة ١٨٢،جيزة١٧٨،سخا١٠٢ ,سخا ١٠١) على الشرائح الرأسية

وكانت أهم النتائج المتحصل عليها من البحث كالتالي :-

١- صفات النمو:-

وجد أن معاملات جودة مياه الري ذات تأثير معنوي على كل من دليل مساحة الورقة، معدل النمو النسبي ، مساحة ورقة العلم،طول النبات،محتوى الكلوروفيل، اختراق الضوء،ميعاد طردالداليات، حيث وجد أن استخدام مياه الصرف فى الري طول موسم الزراعة يقلل كل الصفات السالفة الذكر وكانت أعلى القيم المتحصل عليها من تلك الصفات المذكورة تحت ظروف الغمر المستمر بمياه عذبة ، بينما أقلها كان تحت ظروف الغمر المستمر بمياه الصرف أوريه واحده بمياه عذبه :ريتين ماء صرف فيما عدا محتوى الكلوروفيل ،اختراق الضوء و ميعاد طردالداليات فقد زادت تحت ظروف الري بمياه الصرف فى كلا الموسمين (٢٠١٠،٢٠١١) .وكان الصنف جيزة١٧٨ هو أعلى الأصناف فى القيم المتحصل عليها .

٢- المحصول ومكوناته:-

وجد أن معاملات جودة مياه الري ذات تأثير معنوي على كل من عدد الأفرع ، عدد الداليات،وزن الدالية(جم) ،وزن الألف حبة (جم)، نسبة الحبوب الفارغة، محصول القش والحبوب(طن/ هكتار) ,دليل الحصاد حيث أعطى الغمر بمياه عذبه طول الموسم أعلى قيم للصفات المذكورة وكانت الزيادة على النحو التالي ماء عذب > مرتين ماء عذب : مره ماء صرف > مره ماء عذب : مره ماء صرف > مره واحده ماء عذب :مرتين ماء صرف> ماء مخلوط > ماء صرف بينما أعطى الغمر بمياه الصرف طوال الموسم أقل القيم للصفات المذكورة عدا نسبة الحبوب الفارغة .وكان الصنف جيزة١٧٨ هو أعلى الأصناف محصولا

٣- تركيز البوتاسيوم والصوديوم ونسبة الصوديوم إلى البوتاسيوم فى القش والحبوب:-

وجد أن معاملات جودة مياه الري لها تأثير على تركيز البوتاسيوم والصوديوم ونسبة الصوديوم إلى البوتاسيوم فى القش والحبوب حيث أعطى الري بمياه الصرف أقل القيم لنسبة البوتاسيوم بينما أعطى قيما أعلى لكل من الصوديوم، ونسبة الصوديوم إلى البوتاسيوم فى القش والحبوب فى كلا الموسمين. أما فى حالة استخدام المياه العذبة فقد أعطت أعلى قيم لنسبة البوتاسيوم فى القش والحبوب .ووجدت أقل نسبة للصوديوم وأعلى نسبة للبوتاسيوم لدى الصنف جيزة ١٧٨ .

** وبالنسبة لسلوك الأصناف فقد اختلفت فيما بينها فقد كان الصنف جيزة ١٧٨ أفضل الأصناف تحت الظروف الغير ملائمة وأكد مدى قدرته العالية على تحمل الظروف غير الملائمة بينما أظهر الصنف سخا ١٠٢ مدى عدم قدرته على تحمل الظروف غير الملائمة وجاء الصنف سخا ١٠١ فى المرتبة الثانية بعد جيزة ١٧٨ فى تحمل الظروف غير الملائمة .

** ولهذا يمكن أن نعطى ريه من ماء الصرف وريتين من الماء العذب دونما مخاطر وذلك فى بعض الأماكن التي تعانى مشكلة فى نقص المياه العذبة أو فى نهايات الترع وغيرها من المناطق التي تعانى مشاكل نقص المياه الجيدة للزراعة .

قام بتحكيم البحث

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