WATER BALANCE AND ECONOMIC EVALUATION OF SOME EGYPTIAN RICE CULTIVARS

El-Refaee, I. S., E. E. Gewaily, E. S. Naeem and B. A. Zayed
Rice Research & Training Center, 33717 Sakha - Kafr El-Sheikh, Field Crops Research Institute, Agricultural Research Center, Egypt.

ABSTRACT

Considerable national breeding effort has been exerted to develop suitable and acceptable rice cultivars for the different production environments of Egypt. Increasing rice productivity through improved varieties continues to remain a challenge, especially with limiting areas and irrigation water. Therefore, this study was conducted in order to evaluate some Egyptian inbred and hybrid rice cultivars economically and to determine their efficiencies in saving irrigation water comparing with long duration rice cultivar during 2009 and 2010 seasons at the Experimental Farm of Rice Research Section (RRTC), Sakha, Kafr El-Sheikh, Egypt. The experiments were laid out in a randomized complete block design (RCB), with four replications, using nine inbred cultivars namely Giza 171 (long duration cultivar), Giza 177, Giza 182, Sakha 102, Sakha 103, Sakha 105 (short duration cultivars), Sakha 101 Sakha 104, Giza 178 as well as two hybrid cultivars namely Egyptian hybrid 1(EH1) and SK2058H (medium duration cultivars).

The results showed that hybrid cultivars (Egyptian hybrid 1 and SK2058H) achieved the highest grain yield production, the highest values of water use and utilization efficiency. Giza 171 (long duration cultivar) achieved the highest amount of water input, the lowest values of water use, water utilization and water application efficiencies and the highest percentage of water loss. However, short duration cultivars (Giza 177, Giza 182, Sakha 102, Sakha 103 and Sakha 105) recorded the lowest values of total water input and water loss as well as gave the highest value of water use efficiency and water application efficiency. The economic evaluation showed that short duration cultivars (especially Sakha 105) and medium duration cultivars (especially hybrid cultivars) enhanced irrigation efficiency and rice productivity. If hybrid cultivar rice (Egyptian hybrid 1) was used on the national wide, it may contribute adding about 7381.2 and 7928.9 million L.E. However, the contribution was about 6473.6 and 5987.8 million L.E in case of the averages of short duration cultivars as a compared to Giza 171 (long duration cultivar) in both seasons, respectively. So, it is important to enhance farmer's acceptance of short duration and hybrid rice cultivars by improving their yields and its grain quality.

INTRODUCTION

Rice (*Oryza sativa* L.) is the important primary cereal crop in the world. It is the staple food for more than two third of the world's population (Dowling *et al*, 1998). Although rice ranks second to wheat as the most extensively grown crop in the world, it is the most important food crop and largest irrigated crop in the world (Roel *et al.*, 1999). A growing world population decreases water availability for agriculture while the demand for rice, the major staple crop for a large part of the world's population, increases at the same time. Growing rice with less water while maintaining its high yields is one of the major objectives in rice research to date. Because of the flooded nature of rice, its water balance and water productivity are different from those of other cereals such as wheat and maize. Water inputs to rice fields are needed to match the outflows by seepage, percolation, evaporation, and transpiration. In Asia, rice is a heavy consumer of freshwater, and approximately 50 % of the freshwater used in Asian agriculture is used for rice production (Guerra *et al.* 1998). In Egypt, considerable national breeding effort has been exerted to develop suitable and acceptable rice cultivars for the different production environments. Increasing rice productivity through improved varieties continues to remain a challenge, especially with limiting areas and irrigation water. However, irrigation water is relatively limited and insufficient for both reclamation and irrigation purposes for Egyptian soil. So, it is important to identify rice production systems that require less irrigation water with minimum yield reduction. Total seasonal water input to rice fields varies among cultivars according to plant duration and canopy. However, the growth of rice cultivars is likely to differ under continuous flooding conditions and it may also differ with the amounts of water needed. Cultivars that could maintain water uptake under lower soil water content may produce larger amounts of yield and these cultivars would become important as the water supply decreases. Now, water is becoming scarce in many countries. Individuals, agencies and international declarations advise that water should be treated as an "economic good" (ICWE, 1992).

The objective of this study was to evaluate some new Egyptian inbred and hybrid rice cultivars economically and to determine their efficiencies in saving irrigation water comparing with old rice cultivar.

MATERIALS AND METHODS

The field experiments were conducted at the Experimental Farm of Rice Research Section (RRTC), Sakha, Kafr El-Sheikh (31° 07 'N and 30° 57 'E), Egypt, during 2009 and 2010 seasons to evaluate some new Egyptian rice cultivars economically and to determine their efficiencies in saving irrigation water comparing with old rice cultivar. The meteorological data for the two seasons are presented in Table (1).

Table (1): means of monthly temperature, relative humidity (RH) and pan evaporation (E) at the study area during the experimental period.

Month	2009					2010				
	Air temperature (^oC)		RH %		E (mm/ day)	Air temperature (^oC)		RH %		E (mm/ day)
	Max.	Man.	7:30	13:30		Max.	Man.	7:30	13:30	
May	29.0	10.0	70.5	42.5	6.91	28.7	12.6	72.5	45.0	6.37
June	33.0	15.0	82.5	50.0	7.33	33.6	19.0	82.0	43.0	8.13
July	32.0	15.7	80.0	55.7	6.79	33.0	20.2	80.0	50.6	7.26
August	33.0	16.3	83.2	56.0	6.53	32.4	19.0	81.5	51.0	6.81
September	33.5	15.0	77.3	47.7	6.08	32.5	19.0	77.0	46.0	6.35
Mean	32.1	14.4	78.7	52.4	6.73	32.0	18.0	78.6	47.1	6.98

The experiments were laid out in a randomized complete block design (RCB) with four replications using nine inbred cultivars i.e. Giza 171 (long duration cultivar), Giza 177, Giza 182, Sakha 102, Sakha 103, Sakha 105 (short duration cultivars), Sakha 101 Sakha 104, Giza 178 beside two hybrid cultivars i.e. Egyptian hybrid 1 (EH1) and SK2058H (medium duration cultivars). The rice cultivars characters are shown in Table (2). The experiments were preceded by Egyptian clover in both seasons. The soil was clayey with pH 8.2, organic matter content of 1.6 %, EC 2.30 dS/m (soil paste), total N 0.065 %, available P 18.8 ppm, and field capacity of 46.3 %. Nitrogen (in form of urea, 46.5% N), phosphorus (P_2O_5) and zinc ($Zn\ SO_4$) as well as all other cultural practices for each cultivar were undertaken as recommended. Cultivars were sown on 5 and 3 of May in 2009 and 2010 seasons, respectively.

Table (2): Some characteristics of rice cultivars used in the study (RRTC, 2008)

Cultivar	Duration (days)	Type	Grain type	Blast
L D:				
Giza 171	165	Japonica	Short	S
SD:				
Giza 177	125	Japonica	Short	R
Giza 182	125	Indica	Long	R
Sakha 102	125	Japonica	Short	R
Sakha 103	120	Japonica	Short	R
Sakha 105	125	Japonica	Short	R
MD:				
Giza 178	135	Indica-Japonica	Short	R
Sakha 101	140	Japonica	Short	S
Sakha 104	135	Japonica	Short	S
EH 1	135	Indica-Japonica	Short	R
SK2058H	135	Indica-Japonica	Short	R

LD = long duration, SD = short duration, MD = medium duration, S = sensitive and R= resistant

Pre-germinated grains were broadcasted in presence of water after puddling the nursery at the rate of 40 and 10 kg seed/fed for inbred and hybrid cultivars, respectively. One to two (for hybrid) or three to four (for inbred) seedlings, thirty days old, were transplanted at 20 x 20 cm distance between hills and rows, except Giza 177 was transplanted at 15 x 15 cm as recommended. Plot size was 40 m^2 (8 x 5 m) each. Irrigation water head was kept at 3-5 cm for 7 days after transplanting, then, irrigation was stopped for 2-3 days for well established and adapted rice plants in the soil. The irrigation water (in permanent field) was applied every four days with 4 -5 cm water head at the time of water addition. To avoid the lateral movement of water and to achieve more water control, each block was separated by two meter-wide ditches. Water pump provided with a calibrated water meter was used for all water measurements. The actual consumptive use of rice was determined in the field using tanks technique according to Abd El-Hafez (1982). At harvest, total number of panicles/m^2 was counted. Ten random panicles were collected from each plot to estimate, panicle length, total spikelets/panicle, unfilled grain percentage, panicle weight and 1000-grain weight. Grain yield was assessed from 12 m^2 (3 x 4 m) at the center of each plot and adjusted to 14 % moisture content. Data collected were statistically analyzed according to Gomez and Gomez (1984) using GENSTAT 5th Edition Computer Program.

RESULTS AND DISSCUTIONS

1- Grain yield and its attributes:

Cultivars differed significantly in their grain yield and its attributes in both seasons (Table 3). Egyptian hybrid 1 surpassed the other

Table (3): Grain yield and its attributes of some rice cultivars during 2009 and 2010 seasons.

Cultivar	No. of Panicles/m^2		Panicle length (cm)		No. of spikelets /panicle		Unfilled grain (%)	
	2009	2010	2009	2010	2009	2010	2009	2010
L D:								
Giza 171	528.7	518.7	19.57	19.00	109.5	104.3	9.00	10.37
SD:								
Giza 177	530.0	508.1	20.71	20.09	126.7	122.8	6.46	7.70
Giza 182	578.7	558.1	22.68	23.28	128.3	131.7	7.25	8.00
Sakha 102	518.7	496.9	20.74	21.58	105.7	113.0	7.40	4.60
Sakha 103	508.7	485.6	21.72	19.53	101.1	104.3	8.03	5.77
Sakha 105	542.5	568.7	22.62	22.60	128.8	129.5	5.63	5.92
MD:								
Giza 178	588 7	583.1	22 25	21.00	142 2	138 3	6.85	4.70
Sakha 101	605.0	591.2	20.74	22.18	119.1	114.7	10.30	9.80
Sakha 104	556.2	557.5	20.87	21.51	118.8	110.2	10.10	9.83
EH1	612.5	603.6	22.96	22.25	161.4	151.3	6.23	6.44
SK2058H	593.7	595.0	21.59	22.60	157.8	143.2	6.48	7.05
L.S.D 5 %	53.7	68.2	1.49	3.07	19.0	13.1	2.04	1.89

Table (3) : Continued

Cultivar	Panicle weight (g)		1000-grain weight (g)		Grain yield (t/fed)	
	2009	2010	2009	2010	2009	2010
L D:						
Giza 171	2.51	2.49	23.83	23.91	3.21	3.19
SD:						
Giza 177	3.10	3.03	28.59	26.87	4.22	4.31
Giza 182	3.37	3.27	27.89	26.90	4.36	4.34
Sakha 102	3.07	3.19	28.36	28.27	4.15	4.10
Sakha 103	2.98	2.87	27.06	27.66	4.20	4.08
Sakha 105	3.42	3.18	28.15	29.52	4.53	4.52
MD:						
Giza 178	3.13	3.33	23.66	24.08	4.93	4.49
Sakha 101	3.07	3.16	27.66	27.54	4.17	4.22
Sakha 104	2.86	2.76	29.16	28.63	4.28	3.95
EH 1	4.19	4.01	24.71	23.76	5.24	5.42
SK2058H	3.91	3.91	23.81	23.23	5.09	5.18
L.S.D 5 %	0.56	0.42	2.65	3.59	0.38	0.30

LD = long duration, SD = short duration and MD = medium duratio

hybrid and inbred cultivars, where, it recorded the highest grain yield of 5.24 and 5.42 t/fed in first and second seasons, respectively, accompanied with maximum values of panicles number/m^2, total spikelets/panicle and panicle weight.

The long duration cultivar (Giza 171) gave the lowest values of grain yield, panicle weight and 1000-grain weight. For inbred cultivars, the highest grain yield obtained from Giza 178 and Sakha105 in the first and second season, respectively, without significant difference between them in the second season. Comparing medium duration cultivars Giza 178 followed by Sakha 101 in first season and Sakha 104 in second season gave the highest grain yield. However, among short duration cultivars Sakha 105 followed by Sakha 102 in first season and Sakha 103 in second season recorded the maximum grain yield. Generally, panicle length was the highest in Egyptian hybrid 1 followed by SK2058H, Giza 182 and Sakha 105 in first season. However, Giza 182 and Sakha 105 (inbred) followed by SK2058H (hybrid) recorded the maximum length of panicle in second season. Unfilled grain percentage was the lowest in Sakha 105 in both seasons. One thousand grain weight was the maximum in Sakha 104 and Sakha 105 in both seasons, respectively. However, the minimum 1000-grain weight was recorded by Giza 178, SK2058H and Giza 171 in first season and by SK2058H, Egyptian hybrid 1 and Giza 171 in second season. These findings are closely related to the findings of Sedeek (2001), El-Refaee et al. (2005) Amiri et al. (2009), and Abbasi and Sepaskhah. (2011). They found differences among rice cultivars in grain yield and its attributes.

2- Water relations

Data in Tables (4 and 5) showed that the rice cultivars were differed in grain yield and water balance in both seasons. Medium duration cultivars resulted in the highest grain yield (4.741 and 4.651 t/fed) followed by short duration ones (4.289 and 4.268 t/fed), however long duration cultivar recorded the lowest values (3.210 and 3.190 t/fed) in both seasons, respectively. Giza 171 (long duration) required the highest quantity of total water input in both seasons compared to other cultivation methods. While, short duration rice had the lowest amount of water requirement and medium duration comes in between. Such differences in total water input could be attributed to difference in growth duration among rice cultivars (Table 2), which lead to different numbers of irrigation and consequently affect the total water applied. On the other hand, the crop growth period in the main field of short and medium duration's cultivars is shorter than that of Giza

Table (4): Water balance and the productivity of some inbred and hybrid rice cultivars in 2009 season.

Rice cultivar	Total water input (m^3/fed)	WUTE (kg/m^3)	CU (m^3/fed)	WUE (kg/m^3)	Loss (m^3/fed)	WAE (%)	Loss (%)
L D:							
Giza 171	6980	0.46	4055	0.79	2925	58.09	41.91
SD:							
Giza 177	5270	0.80	3240	1.30	2030	61.48	38.52
Giza 182	5010	0.87	3300	1.32	1710	65.87	34.13
Sakha 102	5120	0.81	3240	1.28	1880	63.28	36.72
Sakha 103	5120	0.82	3110	1.35	2010	60.74	39.26
Sakha 105	5260	0.86	3280	1.38	1980	62.36	37.64
SD main	5156	0.83	3234	1.33	1922	62.72	37.28
MD:							
Giza 178	5940	0.83	3510	1.40	2430	59.09	40.91
Sakha 101	5710	0.73	3655	1.14	2055	64.01	35.99
Sakha 104	5940	0.72	3510	1.22	2430	59.09	40.91
EH1	5630	0.93	3400	1.54	2230	60.39	39.61
SK2058H	5630	0.90	3400	1.50	2230	60.39	39.61
MD main	5770	0.82	3495	1.36	2275	60.57	39.43
SD and MD main	5463	0.83	3365	1.34	2098	61.60	38.40

LD = long duration, **SD** = short duration and **MD** = medium duration
WUTE (water utilization efficiency) = Yield (kg/fed) / total water input (m^3/fed).
CU = water consumptive use.
WUE (water use efficiency) = Yield (kg/fed) / water consumptive use (m^3/fed).
Loss = total water input (m^3/fed) - water consumptive use (m^3/fed).
WAE (water application efficiency) = water consumptive use (m^3/fed) / total water input (m^3/fed).

Table (5): Water balance and the productivity of some inbred and hybrid rice cultivars in 2010 season.

Rice cultivar	Total water Input (m^3/fed)	WUTE (kg/m^3)	CU (m^3/fed)	WUE (kg/m^3)	Loss (m^3/fed)	WAE (%)	Loss (%)
LD:							
Giza 171	6645	0.48	4120	0.81	2705	59.29	40.71
SD:							
Giza 177	5315	0.81	3110	1.30	2005	62.28	37.72
Giza 182	5100	0.85	3340	1.30	1760	65.49	34.51
Sakha 102	5130	0.80	3110	1.29	1940	62.18	37.82
Sakha 103	5100	0.80	3110	1.28	1910	62.55	37.45
Sakha 105	5380	0.84	3195	1.36	2060	61.71	38.29
SD main	5205	0.82	3234	1.31	1935	62.82	37.18
MD:							
Giza 178	5610	0.80	3420	1.31	2190	60.96	39.04
Sakha 101	5630	0.75	3500	1.21	21.30	62.17	37.83
Sakha 104	5610	0.70	3450	1.14	21.60	61.50	38.50
EH1	5700	0.95	3370	1.56	2220	61.05	38.95
SK2058H	5700	0.91	3370	1 49	2220	61 05	38.95
MD main	5650	0.82	3495	1.34	2184	61.35	38.65
SD and MD main	5428	0.82	3365	1.32	2060	62.05	37.95

LD = long duration, **SD** = short duration and **MD** = medium duration
WUTE (water utilization efficiency) = Yield (kg/fed) / total water input (m^3/fed).
CU = water consumptive use.
WUE (water use efficiency) = Yield (kg/fed) / water consumptive use (m^3/fed).
Loss = total water input (m^3/fed) - water consumptive use (m^3/fed).
WAE (water application efficiency) = water consumptive use (m^3/fed) / total water input (m^3/fed).

171, resulting in lower evapotranspiration (ET) and seepage and percolation. Consequently, irrigation and total water input during this period is higher in long duration than in short and medium durations. Varietals difference in total water input was recorded by El-Refaee (2002). The mean water utilization efficiency (WUTE) were 0.460, 0.830 and 0.820 kg rice/ m^3 water in 2008 and between 0.480, 0820 and 0.823 kg rice /m^3 water in 2009 for long, short and medium rice cultivars, respectively (Tables 4 and 5). It varied among the rice cultivars where Egyptian hybrid 1 had the highest values compared to SK2058H and all other cultivars. However, Giza 182 followed by Sakha 105 recorded the highest values compared to other inbred cultivars. Generally, higher values of WUTE in hybrid cultivar came from their high grain yield. However, higher values of WUTE in medium rice cultivars came from their high grain yield and low water input. The differences in WUTE among the medium rice cultivars were considered negligible. In both season, water consumptive use (CU) values were high in Giza 171 compared to other cultivars. Such differences could be attributed to difference in growth duration among rice cultivars. The highest value of water use efficiency (WUE) was accompanied with the highest values of grain yield. Therefore, hybrid cultivars followed by Sakha 105 gave the maximum value as compared to the other cultivars (Tables 4 and 5). The losses of the irrigation water (m^3/fed) were estimated, and it was observed that long growth duration with Giza 171 led to lose the highest quantity of water comparing to short and medium duration ones in both seasons Therefore, short duration reduced the amount of water added and so far, it saved the irrigation water and increased the water application efficiency (WAE). It was clear that short duration achieved the highest value of WAE (62.72 and 62.82 %) followed by medium duration (60.57 and 61.35 %). however, long duration cultivar recorded the lowest values (58.09 and 59.29 %) of the water application efficiency in first and second seasons, respectively. The low marketing of hybrid cultivars makes it less attractive to most farmers, who interested in raising the yields regardless of water consumption. This is because farmers get the irrigation water free. To make full use of the potential of hybrid as well as short duration cultivars in saving water and increasing water productivity, it is important to enhance farmer's acceptance of hybrid and new cultivars by improving their yields and grain quality. Similar conclusions were reported by Tuong (1999), Abou El-Hassan et al. (2005) and El-Refaee et al. (2007).

2- Economic evaluation:

The contribution of used cultivation methods was measured relatively concerning saving irrigation water as following:

A- Relative contribution of water in rice production:

Data in Table (6) indicated that the lowest contribution of water in producing rice was for Giza 171 (0.460 and 0.480 kg/m^3), however the efficient practice was for Egyptian hybrid 1 (0.93 and 0.951 kg/m^3) and Giza 182 as inbred rice (0.87 and 0.851 kg/m^3) in both seasons, respectively.

Considering Giza 171 (long duration) equal to one hundred percent, consequently Sakha 104 gave the lowest values (157 and 147 %) close with Sakha 101 (159 and 156 %) of relative utility. However, Egyptian hybrid 1 gave the highest values (202 and 198 %) in 2004 and 2005 seasons, respectively. While, Giza 182 followed by Sakha 105 recorded the maximum values for inbred cultivars. In other ways, short and medium duration cultivars including hybrid ones achieved an increase in water utility (water contribution). For example, Egyptian hybrid 1 increased contribution of 100 m^3 water by 102 and 98 kg comparing to 57 and 47 kg in case of using Sakha 104 in 2009 and 2010, respectively.

B- Economic return of water:

The quantity of water used in producing one kg of grain yield decreased for all rice cultivars relative to long duration cultivar Giza 171 (Tables 7 and 8). Over both seasons, one kg of grain yield of Egyptian hybrid 1 needs 1.06 m^3 of water (49.9 % of Giza 171 requirement) followed by about 1.11 m^3 of water for SK2025H (51.8 % of Giza 171). However, one kg of grain yield needs about 1.17 and 1.18 m^3 of water (54.6 and 55.4 % of Giza 171 requirement) for the

Table (6): Relative contribution of water in producing rice by cultivation methods.

Season	Rice cultivar	Water utility		Increasing utility	
		kg/m^3	Trad %	kg/m^3	kg/100 m^3
2009	**<u>L D</u>:**				
	Giza 171	0.46	100	-	-
	<u>SD</u>:				
	Giza 177	0.80	174	0.34	34
	Giza 182	0.87	189	0.41	41
	Sakha 102	0.81	176	0.35	35
	Sakha 103	0.82	178	0.36	36
	Sakha 105	0.86	187	0.40	40
	<u>MD</u>:				
	Giza 178	0.83	180	0.37	37
	Sakha 101	0.73	159	0.27	27
	Sakha 104	0.72	157	0.26	26
	EH 1	0.93	202	0.47	47
	SK2058H	0.90	196	0.44	44
2010	**<u>L D</u>:**				
	Giza 171	0.48	100	-	-
	<u>SD</u>:				
	Giza 177	0.81	169	0.33	33
	Giza 182	0.85	177	0.37	37
	Sakha 102	0.80	167	0.32	32
	Sakha 103	0.80	166	0.32	32
	Sakha 105	0.84	175	0.36	36
	<u>MD</u>:				
	Giza 178	0.80	167	0.32	32
	Sakha 101	0.75	156	0.27	27
	Sakha 104	0.70	147	0.22	22
	EH1	0.95	198	0.47	47
	SK2058H	0.91	189	0.43	43

LD = long duration, **SD** = short duration and **MD** = medium duration

inbred cultivars Giza 182 and Sakha 105, respectively. Over mains of short and medium cultivars, one kg of grain yield needs about 1.22 m^3 of water (57.0 % of Giza 171 requirement). In other words, the quantity of water saves for producing 100 kg of rice grain were 110.0

and 103.1 m^3 for Egyptian hybrid 1 as compared to 97.2 and 86.4 m^3 for short duration cultivars. While, it were 95.7 and 86.8 m^3 for medium duration cultivars in both seasons, respectively. Data in Tables (7 and 8) showed also that short duration cultivars saved 5368.4 and 4104.0 million m^3, however medium duration cultivars saved 5285.5 and 4123.0 million m^3 in 2009 and 2010 seasons. respectively. This quantity of irrigation water is inverted into increment quantities of rice that can be added to the national agricultural

Table (7): Average water requirement and increment quantities of rice cultivars in 2009 season.

Rice cultivar	Average requirements*		Quantity increased (m^3/kg)	Total national production (million kg)**	Total quantity of water available (million m^3)	Yield added (million kg)	Farm price (L.E /kg)***	Total values of rice added (million L.E.)
	m^3/kg	Trad =100						
	1	2	3	4	5 (3 x 4)	6 (5/1)	7	8 (6 x 7)
L D:								
Giza 171	2.17	100.0	0.000		0.0	0.0	1.40	0.0
SD:								
Giza 177	1.25	57.5	0.924		5103.3	4082.6	1.40	5715.6
Giza 182	1.15	52.8	1.025		5661.1	4922.7	1.30	6399.5
Sakha 102	1.24	56.8	0.939		5186.1	4182.3	1.40	5855.3
Sakha 103	1.22	56.1	0.955		5274.5	4323.3	1.40	6052.7
Sakha 105	1.16	53.5	1.012		5589.3	4818.3	1.40	6745.7
SD main	1.20	55.3	0.972	5523	5368.4	4473.6	1.38	6173.6
MD:								
Giza 178	1.21	55.4	0.969		5351.8	4423.0	1.30	5749.9
Sakha 101	1.37	63.0	0.805		4446.0	3245.3	1.40	4543.4
Sakha 104	1.39	63.9	0.786		4341.1	3123.1	1.40	4372.3
EH 1	1.07	49.4	1.100		6075.3	5677.9	1.30	7381.2
SK2058H	1.11	50.8	1.069		5904.1	5319.0	1.30	6914.7
MD main	1.22	56.0	0.957		5285.5	4332.4	1.34	5805.4
SD and MD main	1.21	55.6	0.965		5329.7	4404.7	1.36	5990.4

LD = long duration, **SD** = short duration and **MD** = medium duration
* Average requirements = Grain yield (kg/fed) ÷ Total water input (m^3/fed)
** Source: Yearly bulletin of statistics crop areas and plant production, Central Agency for Public Mobilization and Statistics
*** Rice Research & Training Center (RRTC), Field Crops Research Institute, Agricultural Research Center, Ministry of Agricultural and Land Reclamation

Table (8): Average water requirement and increment quantities of rice cultivars in 2010 season.

Rice cultivar	Average requirements*		Quantity increased (m^3/kg)	Total national production (million kg)**	Total quantity of water available (million m^3)	Yield added (million kg)	Farm price (L.E /kg)***	Total values of rice added (million L.E.)
	m^3/kg	Trad =100						
	1	2	3	4	5 (3 x 4)	6 (5/1)	7	8 (6 x 7)
L.D:								
Giza 171	2.08	100.0	0.000		0.0	0.0	1.80	0.0
SD:								
Giza 177	1.23	59.3	0.848		4028.0	3274.8	1.80	5894.6
Giza 182	1.18	56.4	0.908		4313.0	3655.1	1.70	6213.6
Sakha 102	1.25	60.0	0.833		3956.8	3165.4	1.80	5697.7
Sakha 103	1.25	60.1	0.832		3952.0	3161.6	1.80	5690.9
Sakha 105	1.19	57.2	0.892		4237.0	3560.5	1.80	6408.9
SD main	1.22	58.5	0.864	4750	4104.0	3363.9	1.78	5987.8
MD:								
Giza 178	1.25	60.0	0.832		3952.0	3161.6	1.70	5374.7
Sakha 101	1.33	54.0	0.750		3565.5	2678.6	1.80	4821.4
Sakha 104	1.42	68.2	0.663		3149.3	2217.8	1.80	3992 0
EH 1	1.05	50.5	1.031		4897.3	4664.0	1.70	7928.9
SK2058H	1.10	52.8	0.983		4669.3	4244.8	1.70	7216.1
MD main	1.21	58.3	0.868		4123.0	3407.4	1.74	5928.9
SD and MD main	1.22	58.4	0.866		4113.5	3371.7	1.76	5934.2

LD = long duration, **SD** = short duration and **MD** = medium duration

* Average requirements = Grain yield (kg/fed) ÷ Total water input (m^3/fed)

* Source Yearly bulletin of statistics crop areas and plant production, Central Agency for Public Mobilization and Statistics

** Rice Research & Training Center (RRTC), Field Crops Research Institute, Agricultural Research Center, Ministry of Agricultural and Land Reclamation

production. Short duration cultivars contributed in adding 6173.6 and 5987.8 million L.E, while medium duration cultivars contributed in adding 5805.4 and 5928.9 million L.E in both seasons, respectively comparing to long duration cultivar. Egyptian hybrid 1 contributed in adding the highest values (7381.2 and 7928.9 million L.E) and Sakha 104 recorded the minimum values (4372.3 and 39992.0 million L.E) compared to all other cultivars. While, Sakha 105 contributed in adding the highest values (6745.7 and 6408.4 million L.E) compared to inbred cultivars in 2009 and 2010 seasons. respectively.

REFERANCES

Abbasi, M.R. and A.R. Sepaskhah. (2011) Response of different rice cultivars (oryza sativa L.) to water-saving irrigation in greenhouse conditions. International Journal of Plant Production, 5(1): 37-48.

Abd El-Hafez, S. A. (1982). Effect of irrigation and fertilization on rice yield and soil properties. Ph.D. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

Abou El-Hassan W.H., Y. Kitamura, A. El-Serafy, S. Gomaa and M. Irshad (2005). Effect of irrigation schedules and tillage systems on rice productivity and soil physical characteristics – a case study in the north Nile delta, Egypt. International Commission on Irrigation and Drainage Nineteenth Congress, Beijing, q.52 – p.1.19

Amiri, E., M. Khandan, H. R. Bozorgi, S. M. Sadeghi and M. Rezaei. (2009 Response of Rice Varieties to Water Limit Conditions in North Iran. World Appl. Sci. J., 6 (9): 1190-1192.

Dowling N.G., S.M. Greenfield and K.S. Fisher. (1998). Sustainability of Rice in the Global Food System. 1st Edn. International Rice Reseach Institute. Los Banos, Philippines,:404.

El-Refaee, I. S. (2002). Studies on irrigation systems for some rice cultivars. Ph.D. Thesis, Fac. of Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

El-Refaee, I. S., A.E. Abd El-Wahab, F. N. Mahrous and S.A Ghanem (2007). Irrigation management and splitting of nitrogen application as affecting on grain yield and water productivity of hybrid and inbred rice. African crop science conference, El-Minia Univ., October, 27-31, (8):45-52.

El-Refaee, I. S.; I. M. El-Rewainy, B. A. Zayed and M. M. El-Malky (2005). Physiological aspects of grain yield variation in short and medium duration cultivars of rice grown under submergence conditions. Alex. J. Agric. Res., 50 (2B): 33-38.

Gomez, K.A. and A.A. Gomez. (1984). Statistical Procedures for Agricultural Uses. 2nd Ed., John Wiley & Sons, New York, USA.

Guerra, L.C., Bhuiyan S.I., Tuong T.P. and Barker R. (1998). Producing more rice with less water from irrigated systems. SWIM Paper 5. IWMI/IRRI, Colombo, Sri Lanka, 24 p.

ICWE. (International Conference on Water and the Environment) (1992). The Dublin Statement and Report of the Conference. WMO, Geneva, Switzerland.

Roel, A., J. L. Heilman, and G.N. McCauley. (1999). Water use and plant response in two rice irrigation methods. Agricultural Water Management, 39: 35-46.

RRTC (2008). Rice Research & Training Center, Annual Report for 2008. Sakha, Kafr El-Sheikh, Egypt.

Sedeek, S.E.M. (2001). Studies of morphological and agronomical characteristics of some early varieties and lines of rice. M. Sc. Thesis, Fac. of Agric. Kafr El-Sheikh, Tanta Univ., Egypt.

Tuong, T.P. (1999). Productive water use in rice production: opportunities and limitations. J. Crop Prod. 2, pp. 241–264.

الملحص العربى

التوازن المائي و التقييم الاقتصادي لبعض أصناف الأرز المصرية

إسماعيل سعد الرفاعي ،– السيد السيد جويلي – السيد سعد نعيم ـ بسيوني عبد الرازق زايد

مركز البحوث و التدريب في الأرز- سخا– كفر الشيخ- معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

تبذل جهود كبيرة لتحسين أصناف الأرز لتناسب ظروف الإنتاج المصرية خاصاً مع محدودية الأرض و المياه و لذلك أقيمت تجربتان حقليتان في المزرعة البحثية لمركز البحوث و التدريب في الأرز – سخا – كفر الشيخ- جمهورية مصر العربية خلال موسمي ٢٠٠٩ و ٢٠١٠ م بهدف التقييم الاقتصادي لبعض أصناف الأرز المصرية و كذلك تقدير كفاءتها في توفير مياه الري. إستخدم تصميم القطاعات كاملة العشوائية في أربعة مكررات مع تسعة أصناف للأرز و هى جيزة ١٧١ (صنف طويل العمر) و جيزة ١٧٧ و جيزة ١٧٨ و جيزة ١٨٢ و سخا ١٠١ و سخا ١٠٢ و سخا ١٠٣ و سخا ١٠٤ و سخا ١٠٥ بالإضافة الى صنفى الأرز الهجين و هما هجين مصرى واحد و SK2058H.

أوضحت النتائج أن الأرز الهجين (هجين مصرى ١ و SK2058H) قد حقق أعلى إنتاج لمحصول الحبوب وبعض مكوناته و أعلى كفاءة استخدام مياه الري و قد استهلك الصنف طويل العمر جيزة ١٧١ أكبر كمية من مياه الري و أعطى أقل قيمة لكفاءة استخدام و توصيل المياه بالإضافة إلى تحقيق أعلى نسبة لفقد مياه الري. على الجانب الأخر، استهلكت الأصناف قصيرة العمر (جيزة ١٧٧ و جيزة ١٨٢ و سخا ١٠٢ و سخا ١٠٣ و سخا ١٠٥) أقل كمية من مياه الري و سجلت أقل نسبة فقد لمياه الري و أعطت أعلى كفاءة لاستخدام مياه الري.

و قد أظهر التقييم الاقتصادي أن زراعة الاصناف قصيرة العمر (خاصا الصنف سخا ١٠٥) و كذلك الاصناف متوسطة العمر (خاصا أصناف الأرز الهجين) أدت إلى زيادة كفاءة استخدام مياه الري و تحسين إنتاجية الأرز و أنه إذا استخدمت أصناف الأرز الهجين على مستوى قومي فإنه يمكن أن تساهم في إضافة حوالي ٧٣٨١,٢ - ٧٩٢٨,٩ مليون جنيه إلى الدخل القومي بينما تسهم الاصناف قصيرة العمر بحوالى 5987.8 - 6173.6 مليون جنيه و ذلك بالمقارنة بالصنف طويل العمر جيزة ١٧١.

و يستنتج من ذلك انه من الأهمية بمكان زيادة المساحة المنزرعة بأصناف الأرز قصيرة العمر و الأصناف الهجين مع إعطاء أهميه لتحسين صفات الجودة و الإنتاجية لزيادة إقبال المزارعين عليهما.