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RESPONSE OF TWO RICE CULTIVARS TO SCHEDULING IRRIGATION BASED ON CLASS A PAN EVAPORATION

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ABSTRACT

With decreasing water availability for agriculture, and increasing demand for rice, water apply in rice production systems has to be well managed to increase its productivity. This investigation aimed to study the effect of scheduling irrigation based on Class A Pan Evaporation on grain yield and water use of two rice cultivars. Two field experiments were carried out at the Experimental Farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh governorate, Egypt during 2003 and 2004 summer seasons. The two experiments were laid out in a split plot design, with four replications, where the main plots were occupied by irrigation every six days with applied water equal 1.0 , 1.5 and 2.0 times of accumulative pan evaporation (APE) as well as continuous flooding as a traditional irrigation (check treatment). However, the sub plots were assigned to rice cultivars i.e. Sakha 101 and Sakha 102.

The main results revealed no significant differences in grain yield among irrigation treatments having continuous flooding and irrigation every six days interval with applied water equal 1.5 and 2.0 times of APE . At the same time, they significantly produced higher grain yield and most of its components than irrigation every six days interval with applied water equal 1.0 of APE.

Rice cv. Sakha 101 produced higher dry matter, number of tillers/m^2, number of panicls/m^2, panicle length, total grains/panicle, sink capacity, panicle weight, and grain yield. However, cv. Sakha 102 surpassed Sakha 101 in plant height and 1000-grain weight. Over both seasons, irrigation water amounts applied were 10495, 13769, 17044, and 15878 m^3/ha for irrigation every six days interval with applied water equal 1.0, 1.5 and 2.0 times of APE as well as continuous flooding treatments, respectively. Water requirements for rice cvs. Sakha 101 and Sakha 102 were 14868 and 13725 m^3/ha, respectively. Irrigation water applied equal 1.0 of APE had the highest value of water utilization efficiency (WUtE) compared to other irrigation schedules using Class A Pan and the continuous flooding as well. Mean WUtE ranged from 0.659 to 0.704 kg rice/m^3 water for Sakha 101, while it was between 0.681 and 0.721 kg rice/m^3 water for Sakha 102 in 2003 and 2004 seasons, respectively. The quantity of water used in producing one kg of rice was higher in irrigation every six days with water applied equal 2.0 times of APE, followed by contentious flooding, however, irrigation water every six days with applied equal 1.5 and 1.0 of APE came in between.

Therefore, watering every six days interval with applied water equal 1.5 times of APE using Sakha 101 and Sakha 102 could be applied under shortage of irrigation water.

INTERODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop after wheat in Egypt. It is a heavy consumer of freshwater, and approximately 25.15 % of water requirements used in Egyptian agriculture goes to rice production (Ainer *et al.*, 1999). The efficiency of water use in rice culture is low in case of poor management, and inadequate irrigation designs are the main causes of high water losses resulting in low yields, reduced irrigated areas and environmental problems. Soil water evaporation (E) constitutes the major proportion of the annual water loss during establishment and senescence periods of the cropping cycles and intervening bare periods. Evaporation from an open water surface provides an index of the integrated effect of radiation, air temperature, air humidity and wind on evapotranspiration (ET). However, differences in the water and cropped surface produce significant differences in the water loss from an open water surface and the crop. Mahrous *et al.* (1984) found that total rice water requirements were 199, 165 and 141 cm when irrigation intervals were 4, 6 and 8 days, respectively. El-Refaee (1997) revealed that total water used by rice were 14390.9, 1337.9, 11967.7 and 10769.3 m^3/ha for continuous flooding, 6, 9 and 12 days intervals, respectively. El-Refaee *et al.* (2006) revealed that, as compared to continuous flooding, grain yield was reduced by 3.9 % when soil was kept at saturation, whereas, the reductions were 6.9 and 18.8 % with six and eight days irrigation intervals, respectively. Continuous flooding resulted in a higher rice yield than that of intermittent flooding, while intermittent flooding raised the water use efficiency by 22 – 40 % over that of the continuous flooding (Genaidy *et al.* (1989). Nour (1989) reported that water use efficiency was increased by 0.438, 0.566 and 0.649 kg grains/m^3 of water applied as the irrigation interval increased from 4 to 8 and 12 days, respectively. Nour and Mahrous (1994) found that continuous saturation recorded the highest water use efficiency and water save compared to irrigation every 8 days.

Irrigation scheduling is the technique to timely and accurately dose of water to the crop and is the key to conserving water, improving irrigation performance and sustainability of irrigated agriculture. A range of irrigation scheduling methods has been developed to assist farmers and irrigators to apply water more efficiently taking into account crop evaporation (Raes *et al.* 2002). Kulandaivelu (1990) found that when applying irrigation water at 0.5, 1.0 or 1.5 times, the cumulative water loss by evapotranspiration (ET) + percolation for a week gave rice paddy yields of 5.08, 4.95 and 4.10 t/ha, respectively, compared with 5.02 and 4.76 t/ha for weekly irrigation with 7 and 5 cm water, respectively. Water use efficiencies in the previous five irrigation treatments were 4.0, 3.2, 6.2, 5.1 and 6.1 kg paddy/ha per mm water, respectively. Shah *et al.* (1986) reported that daily seasonal average of pan evaporation was 7.42 mm, whereas the evaporation rate estimated by Penman's method was 6.11 mm over a period of 12 h. Batchelor and Roberts (1983) found that the total evaporation from rice transplanting up to harvest was 646 mm.

Varietal difference in growth, grain yield and its components under both irrigation and drought conditions were recorded by Abou El-Darag (2000) and El-Refaee et al. (2005).

This paper deals with the effect of scheduling irrigation on grain yield and some water relations of Sakha 101 and Sakha 102 rice cultivars. This schedule was based on evaporation from Class A pan during the growing season as recorded by evaporation pan.

MATERIALS AND METHODS

Two field experiments were carried out during the summer seasons of 2003 and 2004 at the Experimental Farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh governorate (31° 07 'N and 30° 57 'E), Egypt. The meteorological data for the two seasons are presented in Table (1).

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

Month	2003					2004				
	Air temperature (°C)		RH %		E (mm/ day)	Air temperature (°C)		RH %		E (mm/ day)
	Max.	Man.	7:30	13:30		Max.	Man.	7:30	13:30	
May	32.2	15.0	84.7	54.2	791	28.5	13.0	76.0	40.0	665
June	33.5	18.7	86.2	43.7	750	32.3	16.2	84.0	46.6	765
July	32.6	19.7	84.4	52.6	758	33.1	18.5	86.0	48.0	755
August	33.7	19.9	91.3	55.0	659	32.5	21.0	87.7	47.7	701
September	33.0	18.0	88.3	48.9	611	32.2	18.0	87.4	48.2	621
Mean	33.0	18.3	87.0	50.9	714	31.7	17.3	84.2	46.1	701

The two experiments were laid out in a split plot design, with four replications, where the main plots were occupied by irrigation every six days with applied water equal 1.0, 1.5 and 2.0 times of accumulative pan evaporation (APE) as well as continuous flooding as a traditional irrigation (check treatment). However, the sub plots were assigned to rice cultivars i.e. Sakha 101 (japonica, high tillering ability with 140 days duration) and Sakha 102 (japonica, low tillering ability with 125 days duration). To avoid the lateral movement of water and ensure more water control, two meters wide ditches separated the sub plots among each other. Egyptian clover preceded rice in both seasons. Soil texture at the experimental site was clayey, with 46.5 % clay, 29.8 % silt and 23.7 % sand. The average electrical conductivity of irrigation water was 0.48 dSm^{-1}. The electrical conductivity of soil saturation extract, over 0-60 cm depth, was 1.80 dSm^{-1} and pH of the soil was 8.1. Recommended package of nitrogen (Urea, 46 %N), phosphorus (Supper phosphate 15.5 % P_2O_5) and zinc ($Zn\ So_4$, 28 % Zn) as well as all other cultural practices were followed.

Three to four seedlings, 25 days old, were transplanted, at 20 x 20 cm distance among hills and rows, on 5th June in both seasons. Plant samples were randomly collected from all treatments at booting to determine the dry matter weight. At harvest, plant height was measured in cm and the total number of tillers and panicles were counted from ten random hills and, then, conformed to numbers/m^2. Ten random main panicles were collected from each sub-plot to estimate panicle length, number of total grains/panicle, unfilled grains (%), panicle grain weight, 1000-grain weight and sink capacity (number of spikelets per field unit area). Panicle density was estimated as the number of spikelets per panicle divided by panicle length according to the method described by Futuhara *et al.* (1979). Grain yield was measured from an area of 12 m^2 (3 x 4 m) in the center of each sub-plot and adjusted to 14% moisture content.

Irrigation water applied (IWA): The amount of water applied at each irrigation was determined based on irrigation every six days interval with applied water equal 1.0, 1.5 and 2.0 times of AEP. As for continuous flooding treatment, standing water ranged from 5 to 7 cm water head at the time of water addition. Water pump, provided with a calibrated water meter, was used for all water measurements. Field water use efficiency was calculated according to Jensen (1983) as follows:

$$\text{WUtE} = \frac{\text{Grain yield in kg}}{\text{Amount of applied water in m}^3} \text{ kg/m}^3$$

All obtained data were subjected to analysis of variance (ANOVA) according to methods described by Snedecor and Cochran (1980). The mean values were compared by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Dry matter and grain yield and its attributes:

Rice dry matter and grain yield and its attributes of Sakha 101 and Sakha 102 as responded to variable irrigation schedule in both seasons are given in Tables (2 and 3). In both seasons, continuous flooding produced the highest values of dry matter, plant height and number of tillers/m^2 as well as grain yield and its components except panicle density which was not significantly affected by irrigation schedule and unfilled grain percentage which recorded its maximum values with irrigation every 6 days with water applied equal 1.0 of accumulative pan evaporation (AEP). In general, irrigation every 6 days with water applied equal 2.0 of AEP produced higher grain yield and the most of its components than other irrigation schedules except continuous flooding which produced the highest values. In addition, there was no significant difference among continuous flooding and irrigation every 6 days with water applied equal 1.5 or 2.0 times of AEP in grain yield and most of its components. Kulandaivelu (1990) found that grain yield of rice did not differ significantly between application of 1.0 and 1.5 times of the accumulative water loss by evapotranspiration (ET) plus percolation for a week. This finding agrees with that of Kumer and Singh (1978) who reported that there were no differences in grain yield by allowing soil moisture to the saturation point and hair crack appearance.

Data presented in Tables (2 and 3) further revealed existence of significant differences between the two rice cultivars for all studied characters. In both seasons, Sakha 101 surpassed Sakha 102 in dry matter, grain yield and the most of its attributes (no. of tillers/m^2, no. of panicles/m^2, panicle length, total grains/panicle, sink capacity and panicle weight). The inverse was true in plant height and 1000-grain weight. However, the two cultivars did not differ significantly in the unfilled grain percentage and panicle density.

Table (2): Dry matter, plant height, number of tillers/m², number of panicles/m², panicle length and total grains/panicle of Sakha 101and Sakha 102 rice cultivars as affected by irrigation schedules.

Treatment	Dry matter (g/m²)		Plant height (cm)		No. of tillers/m²		No. of panicles/m²		Panicle length (cm)		Total grains / panicle	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Irrigation treatments (I):												
Continuous flooding	885.5 a	861.9 a	102.0a	104.3a	555.4 a	574.1 a	521.8 a	531.9 a	22.4 a	21.4 a	119.1 a	123.1a
1.0 APE	686.5 c	672.9 c	89.6 c	92.6 c	450.4 c	455.6 c	356.3 b	393.9 b	20.9 b	19.3 b	102.6 b	108.1 b
1.5 APE	846.0 b	804.5 b	96.3 b	97.2 b	522.9 b	517.6 b	502.8 a	493.8 a	21.4ab	20.4ab	112.2ab	118.9 a
2.0 APE	876.5ab	842.5 a	100.1a	99.1 b	530.7 b	569.5ab	509.4 a	503.8 a	21.6ab	21.7 a	116.7 a	119.7 a
F test	**	**	**	**	**	**	**	**	**	*	*	**
Cultivars (C):												
Sakha 101	866.4	843.8	90.8	91.3	558.3	566.1	515.8	522.6	22.5	21.6	120.5	127.1
Sakha 102	780.8	747.0	103.4	105.3	471.4	487.3	429.3	439.1	20.6	19.6	104.8	107.7
F test	**	**	**	**	**	**	**	**	**	**	**	**
Interaction I x C	*	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS

APE = accumulation pan evaporation. 1.0, 1.5 and 2.0 APE= Irrigation every six days with accumulative pan evaporation equal 1.0, 1.5 and 2.0 times, respectively.

NS = not significant, * and ** significant at 0.05 and 0.01 levels, respectively.

Table (3): Unfilled grains (%), sink capacity, panicle density, panicle weight, 1000-grain weight and grain yield of Sakha 101and Sakha 102 rice cultivars as affected by irrigation schedules.

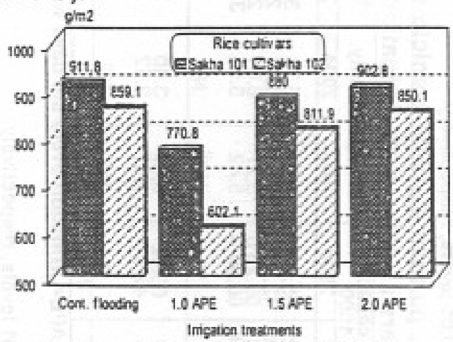
Treatment	Unfilled grains (%)		Sink capacity x 1000		Panicle density		Panicle weight (g)		1000-grain weight (g)		Grain yield (t/ha)	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Irrigation treatments (I):												
Continuous flooding	3.31d	4.77 c	62.43 a	65.81 a	5.27	5.76	3.09 a	3.24 a	27.16 a	27.91 a	9.85 a	10.34 a
1.0 APE	9.12 a	11.13a	36.99 c	42.90 c	4.92	5.67	2.58 c	2.46 b	25.97c	26.68 c	8.58 b	8.86 c
1.5 APE	7.41 b	8.67 b	56.70 b	59.25 b	5.27	6.01	2.94 b	2.93 a	26.61 b	27.27 b	9.59 a	9.89 a
2.0 APE	5.74 c	9.56 ab	60.16ab	60.56 b	5.42	5.53	3.03ab	3.00 a	26.68ab	27.45ab	9.82 a	10.16 a
F test	**	**	**	**	NS	NS	**	**	*	**	**	**
Cultivars (C):												
Sakha 101	6.30	8.20	62.49	66.62	5.37	3.40	3.40	3.41	25.62	26.40	9.67	10.07
Sakha 102	6.49	8.86	45.65	47.64	5.07	2.42	2.42	2.43	27.59	28.25	9.25	9.53
F test	NS	NS	**	**	NS	NS	**	**	**	**	*	*
Interaction I x C	NS	NS	NS	NS	NS	NS	**	NS	**	NS	NS	NS

APE = accumulation pan evaporation. 1.0, 1.5 and 2.0 APE= Irrigation every six days with accumulative pan evaporation equal 1.0, 1.5 and 2.0 times, respectively.

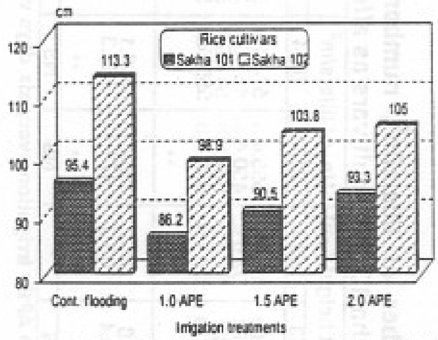
NS = not significant, * and ** significant at 0.05 and 0.01 levels, respectively.

Generally, the superiority of Sakha 101 in grain yield and the most of its components might be attributed to the improved plant type characters; namely, dry matter production, number of panicles/m^2 and number of grains/panicle. These results are in harmony with data obtained by El-Kady and Abd El-Wahab (1999), Abou El-Darag (2000) and El-Refaee *et al.* (2005).

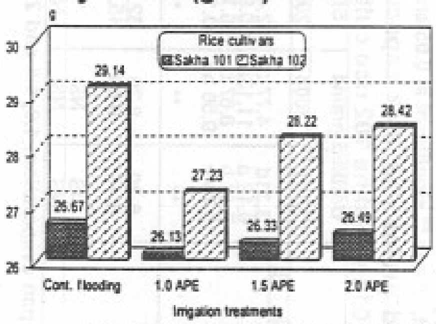
The interaction between irrigation and rice cultivars had a significant effect on dry matter and 1000-grain weight (g) in 2003 season as well as plant height in 2004 season, (Fig 1). Under continuous flooding, Sakha 101 produced the highest dry matter (911.8 g), while, Sakha 102 produced the lowest one (602.1 g) under irrigation every six days with 1.0 of accumulative pan evaporation (Fig. 1 A). The tallest plants (113.3 cm) and heaviest 1000-grain weight (29.14 g) were obtained from Sakha 102 under continuous flooding, while, the shortest plants (86.2 cm) and lightest 1000-garin weight (26.13 g) were obtained from Sakha 101 cultivar under irrigation every six days with 1.0 time of APE. Plant height and 1000-garin weight of Sakha 101 were, generally, less affected by irrigation regimes than Sakha 102 (Figs. 1, B and C).



A- Dry matter (g/m2) in 2003



B- Plant height (cm) in 2004



C- 1000-grain weight (g) in 2003

Fig. (1): A- Dry matter (g/m^2)), B- plant height (cm) and C- 1000-grain weight (g) as affected by the interaction between irrigation treatments and rice cultivars. (1.0, 1.5 and 2.0 Pan = Irrigation every six days with irrigation water equal 1.0, 1.5 and 2.0 times

Irrigation Water Applied (IWA):

Data in Table (4) showed that the amounts of water applied, before starting irrigation treatments, for land preparation of both nursery and permanent field, raising nursery for twenty five days and through ten days after transplanting and before treatments application were 4063.0 and 3829.5 m^3/ha in 2003 and 2004 seasons, respectively.

Over both seasons, the amounts of water used through irrigation treatments, which started 10 days after transplanting, were 12533.0, 6923.5, 10385.3 and 13846.9 m^3/ha for Sakha 101 and11331.1, 6173.8, 9260.8 and 12347.6 m^3/ha for Sakha 102 under continuous flooding, 1.0, 1.5 and 2.0 APE, respectively (Table 5). There was variation between the two seasons in the amounts of irrigation water input to continuous flooding treatment due to difference in tile drainage system in the experimental sites. However, stable conditions i.e. evaporation rates as previously showed in Table (1) resulted in low variation between the two seasons in the amounts of irrigation water input based on Class A pan evaporation treatments. Data, also, showed that the amount of water input increased from June to reach maximum values in August for all irrigation treatments in both seasons.

Table (4): Amounts of water applied (m^3/ha) in rice field before starting irrigation treatments.

Practice	2003	2004
- Land preparation of the nursery	245.0	210.0
- Seedling raising (25 days)	335.4	278.2
- Preparation of permanent field	2310.0	2108.5
- 10 days before starting treatments	1272.6	1232.8
Total	4063.0	3829.5

Overall means, results in Table (5) showed that irrigation every six days with water applied equal 2.0 of AEP resulted in the highest water input throughout the season (17043.5 m^3/ha) followed by continuous flooding (15878.3 m^3/ha), while, the lowest amounts were obtained by irrigation event every six days with water applied equal 1.0 of AEP (10494.9 m^3/ha). Total water required for Sakha 101 and Sakha 102 were 14868.4 and 13724.6 m^3/ha, respectively. The amount of water input for Sakha 101 was higher than that of Sakha 102. Such differences could be attributed to difference in growth duration of the two rice cultivars, which leads to different numbers of irrigation and consequently affect the total water applied. Rice varietal differences in total water input were recorded by El-Refaee (2002).

In comparison with continuous flooding, grain yield reduction percent was higher as a result of lower irrigation applied (1.0 APE), while it slightly decreased with irrigation water applied equal 2.0 of APE in both seasons (Table 6). Mean reduction showed that reduction percent in grain yield of Sakha 102 was higher than that of Sakha 101 by 34.2 and 87.0 % in 2003 and 2004, respectively. It means that rice cv. Sakha 101 was more tolerant to water deficit than did cv. Sakha 102.

Water utilization efficiency (WUtE) varied among the irrigation schedules, where irrigation water applied equal 1.0 of APE had the highest value and was considered the best in WUtE compared to other irrigation schedules using Class A pan (Table 6). Mean water utilization efficiency ranged from 0.659 to 0.704 kg /m^3 for Sakha 101, while it ranged 0.681 - 0.721 kg /m^3 for Sakha 102 in both seasons, respectively.

Table (5): Water input (m^3/ha) through irrigation treatments as affected by irrigation schedules and rice cultivars

Season	Cultivar	Month	Continuous flooding	1.0 APE	1.5 APE	2.0 APE
2003	Sakha 101	June	2535.4	1435.9	2153.9	2871.8
		July	4250.5	2317.8	3476.7	4635.6
		August	4784.2	2403.3	3605.0	4806.6
		September	1408.3	771.0	1156.5	1542.0
		Total	12978.4	6928.0	10392.1	13856.0
	Sakha 102	June	2535.4	1435.9	2153.9	2871.8
		July	4250.5	2317.8	3476.7	4635.6
		August	4784.2	2403.3	3605.0	4806.6
		Total	11570.1	6157.0	9235.6	12314.0
2004	Sakha 101	June	2524.5	1382.4	2073.6	2764.8
		July	4106.0	2302.5	3453.8	4605.5
		August	4461.5	2505.7	3758.6	5011.4
		September	995.5	728.3	1092.5	1456.6
		Total	12087.5	6918.9	10378.4	13837.8
	Sakha 102	June	2524.5	1382.4	2073.6	2764.8
		July	4106.0	2302.5	3453.8	4605.5
		August	4461.5	2505.7	3758.6	5011.4
		Total	11092.0	6190.6	9285.9	12381.2
Over both seasons		Sakha 101	12533.0	6923.5	10385.3	13846.9
		Sakha 102	11331.1	6173.8	9260.8	12347.6
*Total water input throughout the season overall means		15878.3, 10494.9, 13769.3 and 17043.5 m^3/ha for continuous flooding, 1.0, 1.5 and 2.0 APE, respectively 13724.6 and 14868.4 m^3/ha for Sakha 101 and Sakha 102, respectively				

APE = accumulation pan evaporation. 1.0, 1.5 and 2.0 APE= Irrigation every six days with cumulative pan evaporation equal 1.0, 1.5 and 2.0 times, respectively.
*Included the amounts of water applied before starting irrigation treatments for land preparation and nursery.

The quantity of water used in producing one kg of rice grains was higher in irrigation water applied equal 2.0 APE treatment followed by contentious flooding, and irrigation water applied equal 1.5 and 1.0 of APE respectively, over both seasons (Table 6). In case of 1.0 of APE one kg of rice needs 1.23 and 1.17 m^3 of irrigation water applied (72.4 and 76.5 % of continuous flooding) for Sakha 101. However, one kg of Sakha 102 needs 1.24 and 1.18 m^3 of irrigation water applied (77.0 and 81.4 % of continuous flooding) in both seasons, respectively. Over both seasons, one kg of rice requires 1.44 and 1.40 m^3 of water applied of 1.5 of APE (89.0 and 91.4 % of continuous flooding), however, one kg of rice needs 1.76 and 1.66 m^3 of irrigation water applied of 2.0 of APE (108.9 and 108.4 % of continuous flooding requirement) for rice cvs. Sakha 101 and Sakha 102, respectively.

Generally, watering every six days interval with applied water equal 1.5 times of APE using Sakha 101 and Sakha 102 could be applied under shortage of irrigation water.

Table (6): Effect of irrigation schedules on water balance, productivity and average water requirement of Sakha 101 and Sakha 102 rice cultivars.

Treatment	2003						2004					
	Grain yield (t/ha)	Total water input (m^3/ha)	Yield reduction (%)	WUtE (kg/m^3)	Average requirements		Grain yield (t/ha)	Total water input (m^3/ha)	Yield reduction (%)	WUtE (kg/m^3)	Average requirements	
					m^3/kg	Trad =100					m^3/kg	Trad =100
Sakha 101												
Cont. flooding	10.013	17041.4	-	0.588	1.70	100.0	10.410	15917.0	-	0.654	1.53	100.0
1.0 APE	8.942	10991.0	10.70	0.814	1.23	72.4	9.220	10748.4	11.43	0.858	1.17	76.5
1.5 APE	9.788	14455.1	2.25	0.677	1.48	87.1	10.200	14207.9	2.02	0.718	1.39	90.8
2.0 APE	9.948	17919.0	0.65	0.555	1.80	105.9	10.340	17667.3	0.67	0.585	1.71	111.8
Mean	9.672	15101.6	4.53	0.659	1.55		10.043	14635.2	4.71	0.704	1.45	
Sakha 102												
Cont. flooding	9.688	15633.1	-	0.620	1.61	100.0	10.260	14921.5	-	0.688	1.45	100.0
1.0 APE	8.225	10220.0	15.10	0.805	1.24	77.0	8.503	10020.1	17.12	0.849	1.18	81.4
1.5 APE	9.387	13298.6	3.11	0.706	1.42	88.2	9.585	13115.4	6.58	0.731	1.37	94.5
2.0 APE	9.685	16377.0	0.03	0.591	1.69	105.0	9.980	16210.7	2.73	0.616	1.62	111.7
Mean	9.256	13882.2	6.08	0.681	1.49		9.582	13566.9	8.81	0.721	1.41	

APE = accumulation pan evaporation. 1.0, 1.5 and 2.0 APE= Irrigation every six days with accumulative pan evaporation equal 1.0, 1.5 and 2.0 times, respectively.

* WUtE (water utilization efficiency) = Yield (kg/ha) / total water input (m^3/ha).

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استجابة صنفين من الأرز لجدولة الري باستخدام وعاء البخر القياسى

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[1]مركز البحوث و التدريب في الأرز– معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية – سخا– كفر الشيخ

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نظرا لتناقص مياه الري المتاحة للزراعة و زيادة الطلب على الأرز يجب تنظيم مياه الري لنظم إنتاج الأرز و زيادة إنتاجيتها. و قد أجريت تجربتان حقليتان في المزرعة البحثية لمركز البحوث و التدريب في الأرز– سخا– كفر الشيخ– جمهورية مصر العربية عامي ٢٠٠٣ و ٢٠٠٤ باستخدام وعاء البخر القياسي بهدف جدولة الري لصنفين من الأرز وأثر ذلك على المحصول ومكوناته وبعض العلاقات المائية. استخدم تصميم القطع المنشقة في أربع مكررات حيث وزعت معاملات الري بالقطع الرئيسية . وكان الري يتم كل ٦ أيام وبكمية مياه تعادل ١,٠ ، ١,٥ ، ٢,٠ من إجمالي البخر اليومي للوعاء بالإضافة الى معاملة المقارنة التي تروى كما هو متبع في المنطقة (كل ٣ أيام طوال الموسم وبعمق مياه ٥–٧ سم). في حين وزع صنفي الأرز (سخا ١٠١ ، سخا ١٠٢) على القطع الشقية.

توضح النتائج أنه لا توجد فروق معنوية في محصول الحبوب بين معاملات الغمر المستمر و جدولة الري كل ستة أيام بكمية مياه تعادل ١,٥ و ٢,٠ مرة من إجمالي قيمة البخر اليومي لوعاء البخر، و في نفس الوقت سجلت معاملات الري السابقة زيادة معنوية في محصول الحبوب و معظم مكوناته بالمقارنة مع معاملة الري كل ستة أيام بكمية مياه تعادل ١,٠ مرة من إجمالي قيمة البخر اليومي. تفوق صنف الأرز سخا ١٠١ على الصنف سخا ١٠٢ معنويا في إنتاج المادة الجافة و عدد الأشطاء/م^2 و عدد الداليات/م^2 و طول الدالية و عدد السنيبلات/دالية و السعة المحصولية و وزن الدالية و محصول الحبوب بينما تفوق الصنف سخا ١٠٢ في قيم ارتفاع النباتات و وزن ١٠٠٠ حبة.

كمتوسط للموسمين، كانت كميات الري المضافة حوالي ١٠٤٩٥ و ١٣٧٦٩ و ١٧٠٤٤ و ١٥٨٧٨ م^3/هكتار لمعاملات الري كل ستة أيام مع التعويض بكمية مياه تعادل ١,٠ و ١,٥ و ٢,٠ مرة من إجمالي قيمة البخر اليومي و كذلك معاملة الغمر المستمر، على التوالي. و كان متوسط الاحتياجات المائية للصنف سخا ١٠١ و سخا ١٠٢ تساوى ١٤٨٦٨ و ١٣٧٢٥ م^3/هكتار ،على التوالي. سجلت جدولة الري كل ستة أيام مع التعويض بمرة واحدة من إجمالي قيمة البخر اليومي أعلى القيم لكفاءة استخدام مياه الري بالمقارنة بباقي معاملات جدولة الري باستخدام وعاء البخر القياسي و كذلك معاملة الغمر المستمر. وبلغت قيمة كفاءة استخدام مياه الري ٠,٦٥٩ و ٠,٧٠٤ كجم/م^3 للصنف سخا ١٠١ بينما كانت القيم ٠,٦٨١ و ٠,٧٢١ كجم/م^3 للصنف سخا ١٠٢ لموسمي ٢٠٠٣ و ٢٠٠٤ ،على التوالي. كانت كمية مياة الري اللازمة لإنتاج كيلو جرام واحد من حبوب الأرز مرتفعة لمعاملة الري كل ستة أيام مع التعويض بـ ٢,٠ مرة من قيمة البخر اليومي يليها معاملة الغمر المستمر ، بينما سجلت معاملتا الري كل ستة أيام مع التعويض بكمية مياه تعادل ١,٠ و ١,٥ مرة من إجمالي قيمة البخر اليومي قيما متوسطة.

و بالتالي يمكن جدولة الري كل ستة أيام بكمية مياه تعادل ١,٥ مرة من جمالي قيمة البخر اليومي لصنفي الأرز سخا ١٠١ و سخا ١٠٢ تحت ظروف النقص في مياه الري.