Journal of Sustainable Agricultural and Environmental Sciences
https://jsaes.journals.ekb.eg/
JSAES, 2020,1(1): 105 - 118

ISSN-Print: 2735-4377
ISSN-Online: 2785-9878

Performance of Some Mutant Rice Varieties for Yield and its Components under Normal and Drought Conditions

Elgammaal, A.A.[1]*; Abo Yousef, M. I.[2]; O.; Abd EL Hameed[1] and Ahmed.A.I.Eliba[1]

[1] Agronomy Department, Faculty of Agriculture, Tanta University, Egypt.
[2] Rice Research Department, Field Crops Research Institute, Agric. Res. Center, Dokki, Giza, Egypt.

*Corresponding Author: Elgammaal, A.A. (amgad.elgamal@agr.tanta.edu.eg)

J.Sust.Agri.Env.Sci. (JSAES)

Keywords:
Rice; Mutant; Varieties; Drought; Yield.

ABSTRACT

Two field experiments were conducted at the experimental farm of the rice research and training center (RRTC), Sakha, Kafr El-Sheikh, Egypt during 2018 and 2019 seasons to investigate the effect of tow irrigation intervals on growth, yield and its components of some rice varieties.

The field experiments were laid out in strip-plot design with three replications. The horizontal plot was devoted to tow irrigation treatments, and rice varieties treated with gamma rays at Fn were in sub plot design, the date of sowing was in May1st during the two seasons.

Four rice varieties i.e., Sakha 101, Giza 178, Sakha 104 and Giza 177 treated with four different doses of radiation, 150, 200, 250 and 300 kilo Rontgen in privies study, these progenies at Fn.

The results of this study showed that, the interaction between irrigation treatments and varieties was significant every four days to heading (day), plant height (cm), number of tillers (hill), number of panicles/hills, sterility percentage (%), 1000-grain weight (g), panicle weight (g), grain yield (t/fed) and harvest index (%), in both seasons. The desirable growth characters with grain yield were obtained from the varieties Sakha 101 and Giza 178, implying that these varieties are considered as a new promising line tolerant to water stress.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important food crops in all over the world. Efforts are required to increase grain yield of rice per unit to meet food requirements of over growing populations. Water is the most important single components of sustainable rice production, especially in the traditional rice growing. Rice is grown in lowland areas under flooded conditions. More than 75% of the world's rice is produced under these conventional continuous flooding irrigation practices **(Van *et al.*, 2001)**.

Rice is the only cereal crops that can grow for long periods of time understanding water. Around 57% of rice cultivated area grown on irrigated land, 25% on rainfed lowland, 10% on the uplands, 6% in deep water and 2% in tidal wetlands **(IRRI-2002)**. Water requirements of rice are considered a

serious problem in Egypt because of limited irrigation water available from the river Nile. Due to shortage of irrigation water can't be expand rice cultivating area. Therefore, the success in develop some varieties which cultivate with less water or tolerate to water stress or some technologies for efficient management of water, it will be possible to expand the rice cultivated area.

So, the objectives of this study are: Evaluate some rice varieties under water stress conditions and estimate the effects of water stress on morphological characters and grain yield with its components.

2. MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm of the rice research and training center (RRTC), Sakha, Kafr El-Sheikh, Egypt during 2018 and 2019 seasons to investigate the effect of tow irrigation intervals on growth, yield and its components of some rice varieties. The field experiments were laid out in strip-plot design with three replications. The horizontal plot was devoted to tow irrigation treatments, i.e.; irrigation every 4 days, irrigation every 12 days, the progenies (Fn) from treated with doses of gamma rays 150, 200, 250 and300 of rice varieties results of privies study **(Draz *et al*., 2016)** to four rice varieties i.e. Sakha 101, Giza 178, Sakha 104, Giza 177 were in sub plot design, the date of sowing was in May1st during the two seasons and remain cultural practices were applied as recommended by **(RRTC, 2012)**.

2.1 Studied characters

the data were collected on days to heading (day), plant height (cm), number of tillers/hills, number of panicles/hills, sterility percentage (%), 1000-grains weight (g), panicle weight (g), grain yield (t/fed) and harvest index (%).

2.2 Statistical analysis

All data of this study were subjected to the statistical analyzed as the technique of analysis of variance for the strip plot design as mentioned by **Gomez and Gomez (1984)**, by using means of "MSTAT-C" computer software package. Least significant differences (LSD) method was used to test the differences between treatment means at 5% level of probability as described by **Snedecor and Cochran (1980)**.

3. RESULTS AND DISCUSSION

3.1. Days to heading

The effect of irrigation intervals on days to heading, plant height and number of tillers/hills were highly significant at both seasons. Earlier in heading was occurred by increasing the irrigation intervals, as well as number of days to heading was reduced dramatically in all the progenies with water stress. The highest mean values for plant height and number of tillers/hills were obtained from irrigation every 4 days and the lowest mean values were obtained from irrigation every 12 days, the desirable values were recorded with irrigated every four days. That meaning, the water deficit during the vegetative growth stage delay flowering and it is associated with grain yield. These findings were agreement with **Jin Kang and Futakuchi (2019)** showed that, flowering was delayed by 1.7 to 10.7 (4.5 on average) days under drought condition compared with that under the wet control condition.

In both seasons, the results indicated that, the progenies which produced from treated with gamma rays significantly differed in their number of days to heading, plant height and number of tillers/hills of all rice varieties. There were highly significant among the progenies produced from treated with different doses of gamma rays, where increasing doses of gamma rays delay heading as shown in Table 1. The highest mean values were obtained for dose 300 (103.56 and104.38 day) in both seasons and the lowest mean values were detected by doses 150 (100.00 – 100.19) in both seasons, respectively. From the results, these varieties are highly variable every four days to heading. The results were in agreement with those of **Gowthami *et al.* (2016)**. The character days to 50% flowering was variation over control and observed in terms of positive and negative direction in all the doses of gamma rays.

3.2. Number of tillers/hills

Regarding the effect of water stress on number of tillers/hill (Table 1), it was observed that water stress reduced tillers number/hill. Irrigation at 4 days produced the highest mean values (24.17 – 25.56) in both seasons, respectively. While the lowest mean values were obtained from irrigation every 12 days (18.98 – 20.92 tillers/hill) in both seasons, respectively. The obtained results agreed with **Islam and Moonmoon (2017)**.

The rice varieties produced with dose 150 recorded the lowest mean values of the number of tillers, the values ranged from 18.89 cm^2 to 19.90 cm^2 in both seasons. Data presented in Table 1 show that, the numbers of tillers/hill were significantly affected by the varieties studied. The rice variety Sakha 101 produced with treated by dose 300 recorded the highest mean values of number of tillers/hills in the first and second seasons, the values ranged from 24.13 – 24.83 tillers/hill. While, the rice variety, Giza 177 produced by treated with dose of 150 recorded the lowest mean values for this trait and ranged from 19.00 - 20.75 tillers/hill at the two seasons, respectively.

Plant height was significantly affected by water stress at different growth stages over the treatment (3) (irrigation every 4 days). In the severe water stress (irrigation at 12 days), plant height was significantly reduced to be 91.13 cm - 92.01 cm compared to 100.87 cm – 100.12 cm during 2018 and 2019 seasons, respectively. The decrease in plant height might be either due to inhibition of cell elongation or cell division by severe water stress as shown in Table 1. The results indicated that the doses 300 recorded the highest mean value of plant height, the values ranged from 97.99 – 99.05. While dose 150 recorded the lowest mean value and ranged from 92.24 – 93.58 cm. The most desirable mean values towards dwarfing were obtained from the varieties Sakha 101 and Giza 178. The varieties Giza 177 recorded the highest mean value of plant the two varieties belong to japonica type. The results were in agreement with those found by **Andrew *et al*. (2021)** Showed that significant reduction in days to flowering height, the values ranged from 106.70 - 107.30. While the varieties Sakha101 recorded the lowest mean value and ranged from 95.08 – 94.72 cm.

The results in Table 2 indicated that, the interaction between irrigation intervals and rice varieties had a significant effect on days to heading. The highest value of this trait (110.66 –111.50) was recorded when using Sakha101 treated with dose 300 under irrigation every 4 days in both seasons. While the lowest value of days to heading (85.50) and (87.22) was detected when using Giza177 treated with doses 150 under irrigation every 12 days in both seasons. It is important to mention that, if the water shortage applied at the beginning of the reproductive stage usually results in delay in heading, shortage of plants especially with sensitive varieties.

The results in Table 3 indicated that the interaction between irrigation intervals, doses of gamma rays and rice varieties had a significant effect on plant height. The highest values of this trait (114.00 – 113.00) was recorded when using Sakha177 with doses 300 under irrigation every 4 days in both seasons. While the lowest values of plant height (82.50) and (81.19) was detected when using sakha101 with doses 150 under irrigation every 12 days in both seasons.

Results in Table 4 indicated that the two rice varieties produced by treated with gamma ray 300 recorded the desirable mean values of number of tillers in both seasons (25.28 – 26.82cm^2), respectively.

There were highly significant among rice progenies every four days to heading, the highest mean value was obtained for Sakha101 (107.27 - 108.44) and the lowest mean value was detected by Giza 177 (94.95 – 96.23) in both seasons, respectively. This result indicating that, these two promising are highly variable every four days to heading, as well as plant height and number of tillers/hill although

(up to 11.81% reduction) and plant height (up to 40% reduction) combined with an increase in single plant yield (up to 45.73% increase) was observed in the mutant population.

The interaction between the doses of gamma rays and varieties had a significant effect on number of tiller/hills as shown in Table 4. The highest values of this trait (31.53 – 31.31) was recorded when using sakha101 with doses 300 under irrigation every 4 days in both seasons. While the lowest values of number of tiller/hill (14.63 – 14.12) was detected when using Giza 177with doses 150 under irrigation every 12 days in both seasons.

Table 1: Means of days to heading, plant height and panicle length as affected by irrigation intervals and doses of gamma rays of some rice varieties during 2018 and 2019 seasons

Irrigation intervals	Days to heading (day)		Plant height (cm)		Number of tillers/hills	
	2018	2019	2018	2019	2018	2019
Irrigation every 4 days	103.74	104.00	100.879	100.121	25.56	24.17
Irrigation every12 days	99.58	100.25	91.131	92.012	20.92	18.98
F. test	**	**	**	**	**	**
LSD at 0.05	0.636	0.641	1.118	1.120	1.053	1.052
Doses of Gamma Rays						
150	100.19	100.00	93.58	92.24	19.90	18.89
200	101.09	101.79	95.17	94.81	21.71	22.45
250	102.98	103.03	96.20	95.00	24.52	25.23
300	103.56	104.38	99.05	97.99	26.83	25.28
F. test	**	**	**	**	**	**
LSD at 0.05	0.213	0.217	0.253	0.244	0.270	0.271
Rice varieties						
Sakha101	107.27	108.44	95.08	94.72	24.83	24.13
Sakha104	104.03	103.12	105.60	104.54	23.57	22.43
Giza 177	94.95	96.23	107.305	106.701	20.75	19.00
Giza 178	101.59	102.66	100.39	99.17	23.80	23.54
F. test	**	**	**	**	**	**
LSD at 0.05	0.197	0.207	0.318	0.315	0.174	0.173
Interaction	**	**	**	**	**	**
I * D	**	**	**	**	**	**
I *G	**	**	**	**	**	**
D * G	**	**	**	**	**	**
I* D * G	**	**	**	**	**	**

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively NS=Not Significant

Table 2: Means of days to heading as affected by the interaction between irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation	Irrigation intervals x Doses of gamma rays x Rice varieties

intervals	Doses of gamma rays	Days to heading (day)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	102.51	100.00	95.29	96.65	102.00	99.12	94.42	97.44
	200	104.40	103.50	98.23	100.00	104.15	101.03	97.96	101.66
	250	108.83	105.50	100.50	104.21	107.22	104.97	101.00	103.20
	300	111.50	108.50	103.43	108.33	110.66	109.66	104.51	109.41
Irrigation every 12 days	150	98.83	94.81	85.50	93.52	96.86	95.17	87.22	90.00
	200	99.50	94.83	87.50	95.54	97.14	96.44	89.02	96.12
	250	103.53	99.50	94.43	98.52	103.00	97.41	94.45	97.23
	300	105.32	103.00	95.50	102.52	103.88	103.65	95.17	103.00
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.559				0.557			

**, *Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

Table 3: Means of plant height as affected by the interaction among irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Plant height (cm)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	87.00	96.76	97.50	95.00	86.22	95.33	97.11	96.16
	200	91.54	101.46	102.16	100.03	90.02	100.25	101.84	99.13
	250	96.50	107.02	108.08	106.56	95.45	106.69	108.00	105.62
	300	100.00	111.00	114.00	110.66	99.13	111.66	113.00	110.54
Irrigation every 12 days	150	82.50	89.66	83.83	85.00	81.19	88.43	82.54	84.54
	200	85.52	93.68	86.66	89.33	84.65	92.21	85.31	88.13
	250	89.06	97.55	90.00	93.00	90.32	96.17	98.00	92.11
	300	92.18	99.32	96.00	97.43	91.76	100.17	98.45	95.32
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		1.115				1.113			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

Table 4: Means of number of tillers/hills as affected by the interaction among irrigation intervals and doses of gamma rays during 2018 and 2019 seasons

	Irrigation intervals x Doses of gamma rays x Rice varieties

Irrigation intervals	Doses of gamma rays	Number of tiller/hills							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	26.00	20.90	18.50	23.56	25.76	19.24	16.00	22.36
	200	28.46	22.56	21.23	25.73	26.58	22.77	20.59	24.22
	250	29.00	24.60	21.83	27.54	29.07	25.65	23.44	26.00
	300	31.53	25.90	23.43	28.40	31.31	26.97	24.00	27.67
Irrigation every 12 days	150	17.50	18.00	14.63	19.11	16.77	17.55	14.12	19.00
	200	18.00	19.00	16.00	20.00	19.00	20.58	16.00	21.65
	250	21.83	21.70	18.65	22.00	21.00	21.84	19.45	23.36
	300	23.00	23.03	19.66	24.00	23.12	23.72	20.00	24.38
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.187				0.185			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

3.3. Number of panicles/hills

3.3.1. Effect of irrigation intervals

The results in Table 5 indicated that, number of panicles/hills was significantly affected by the irrigation intervals. The most effective interval was irrigation every 12 days for this trait, the values ranged from 18.02 - 19.25 panicles/hill. While irrigation every 4 days gave the highest number of panicles/hill (22.27 - 23.94) in the first and second seasons, respectively, indicated to shortage of water decreased the number of effective panicles/hills. The results indicated that the rice varieties produced by treated with dose 300 recorded the highest mean value of number of panicles/hills, the values ranged from 24.98 and 25.45 cm in both seasons, respectively. While rice varieties produced by treated with doses 150 recorded the lowest mean value and ranged from 17.66 – 18.89 cm in both seasons.

The results obtained showed that, the tested rice varieties differed significantly in number of panicles/hills. Sakha 101 rice variety produced with high doses of gamma rays recorded the highest mean values for number of panicles/hill (22.88 – 24.00) in the two seasons, respectively, while Giza 177 rice varieties recorded the lowest mean value (19.47 – 18.56) in the first and second seasons, respectively. The difference in the performance of these varieties may be attributed to the differences in the genetic background and constitution of the rice varieties.

The interaction among the irrigation intervals and varieties had a significant effect on number of panicles/hills as shown in Table 6. The highest number of panicles/hill (30.55 – 31.96) with deferent doses when using irrigation every 4 days with the Sakha101 produced with treated by highest dose of gamma ray in both seasons, respectively. On the other hand, the lowest values of number of panicles/hills (12.97 – 12.50) was recorded for rice variety Giza 177 produced by treated with dose 150 when using irrigation at 12 days.

Table 5: Means of number of panicles/hills, sterility percentage, 1000-grain weight as affected by irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Number of panicles/hills	Sterility percentage (%)	1000-grain weight (g)

	2018	2019	2018	2019	2018	2019
Irrigation every 4 days	23.94	22.27	8.02	9.14	26.79	27.19
Irrigation every12 days	19.25	18.02	11.57	10.00	21.27	21.33
F. test	**	**	**	**	**	**
LSD at 0.05	0.510	0.510	0.076	0.075	0.855	0.854
Doses of Gamma Rays						
150	17.66	18.89	13.08	14.00	21.63	21.81
200	20.35	21.77	11.13	10.77	22.66	22.00
250	22.98	23.55	9.08	9.19	23.11	23.97
300	25.45	24.98	5.90	7.15	25.70	25.32
F. test	**	**	**	**	**	**
LSD at 0.05	0.246	0.245	0.032	0.036	0.291	0.294
Rice varieties						
Sakha101	22.88	24.00	9.07	10.67	26.45	27.79
Sakha104	21.77	20.32	9.68	8.64	25.77	26.17
Giza 177	19.47	18.56	11.64	10.00	26.20	27.82
Giza 178	22.33	21.66	8.80	10.06	22.68	22.44
F. test	**	**	**	**	**	**
LSD at 0.05	0.279	0.267	0.043	0.045	0.224	0.224

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

Table 6: Means of number of panicles/hills as affected by the interaction between irrigation intervals and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Number of panicles/hills							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	24.54	20.50	15.58	21.50	23.44	19.00	14.78	20.81
	200	27.56	22.00	17.50	22.16	26.50	21.40	18.07	21.54
	250	28.51	23.23	18.57	23.83	28.56	23.00	19.67	24.00
	300	30.55	24.50	20.50	25.58	31.96	23.22	21.78	25.54
Irrigation every 12 days	150	13.00	14.76	12.97	15.55	13.19	15.22	12.50	16.56
	200	15.02	15.80	13.92	16.33	16.00	16.75	13.00	17.05
	250	18.00	18.68	15.00	19.50	18.20	19.08	15.23	20.45
	300	19.00	20.77	17.00	21.50	20.00	21.00	17.61	21.27
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.559				0.553			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

3.3.2.Sterility percentage

Sterility percentage was significantly affected by the irrigation intervals. The most desirable interval was irrigation every 4 days for this trait. The values ranged from (8.02 – 9.14%). The most effective interval was irrigation every 12 days. Irrigation every 12 days recorded the highest sterility percentage (11.57 – 10.00%) in the first and second seasons, respectively. Indicated that, the dose 300 k rad recoded different values of sterility percentage (%), the values ranged from 5.90– 7.15 cm in both seasons, respectively. While dose 150 k rad recorded the highest sterility percentage (13.08 – 14.00 %) in both seasons. The results showed that, the tested rice varieties differed significantly in sterility percentage. The variety Giza 177 and Sakha101 produced the

highest mean values of sterility percentage (11.64% - 10.67%). While Giza 178 and Sakha 104 produced the lowest sterility (8.80 %- 8.64 %) under 12 days as irrigation intervals in the first and second seasons, respectively.

The results in Table 7 indicated that the interaction among the irrigation intervals, doses of gamma rays and rice verities had a significant effect on sterility percentage. The highest values of sterility trait (15.73% – 16.00%) was recorded when using rice Giza178 produced with dose 150 gamma ray under irrigation every 12 days in both seasons. While the lowest values of sterility percentage % (2.21% – 3.18%) was detected when using Sakha101 produced with highest doses of gamma ray under irrigation every 4 in both seasons.

Table 7: Means of sterility percentage as affected by the among irrigation intervals, doses of gamma ray and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Sterility percentage (%)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	6.48	11.45	10.02	13.92	7.23	11.50	10.15	13.50
	200	5.63	9.93	9.80	12.50	5.09	10.40	8.44	12.33
	250	4.00	8.65	7.04	11.84	3.50	8.77	8.00	12.50
	300	2.21	7.57	6.04	9.14	3.18	7.91	6.78	10.48
Irrigation every 12 days	150	15.00	14.66	13.55	15.73	15.88	15.17	14.32	16.00
	200	12.94	12.31	11.23	15.49	14.21	13.51	12.96	15.43
	250	11.50	11.60	10.50	13.47	13.33	12.00	10.22	15.66
	300	11.00	10.14	8.97	11.87	11.62	11.36	9.00	13.00
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.123				0.127			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

3.4.1000-grain weight

The results indicated that 1000-grain weight was significantly affected by the irrigation intervals. The most effective interval was irrigation every 12 days for this trait. The values ranged from (21.33 g - 21.27 g). While irrigation every 4 days gave the highest values of 1000-grain weight (26.79 g – 27.19 g) in the first and second seasons, respectively. Indicated to the shortage of water affected on grain filling rate. The results indicated that the doses 300 gave the highest mean value of 1000-grain weight, the values ranged from 25.32- 25.70 g in both seasons, respectively. While doses 150 gave the lowest mean value and ranged from 21.63 – 21.81 g in both seasons.

The results in Table 5 also showed that the tested varieties differed significantly in 1000-grain weight. Sakha 101 rice variety produced the highest mean values of 1000-grain weight (26.45 - 27.79 g) in the two seasons, respectively. While Giza 178 recorded the lowest 1000-grain weight (22.68 – 22.44g) in the first and second seasons, respectively. The difference in the performance of these varieties may be attributed to the differences in the genetic background and constitution of the varieties as well as their level of water shortage-tolerance.

The results in Table 8 indicated that the interaction between irrigation intervals, doses of gamma rays and rice varieties had a significant effect on 1000-grain weight (g). The highest values of this trait (29.33 – 28.37) were recorded when using Sakha 101 with doses 300 under irrigation every 4 days in both seasons. While the lowest values of

1000-grain weight (19.50g) and (19.55g) were detected when using Giza 178 with doses 150 under irrigation every 12 days in both seasons. These results are in agreement with those reported by **Hossain *et al*. (2020)**.

Table 8: Means of 1000-grain weight as affected by the interaction between irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		1000-grain weight (g)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	25.50	24.00	25.50	20.00	24.00	24.31	25.00	21.56
	200	25.57	24.66	26.50	22.00	24.21	24.18	25.89	22.23
	250	27.66	25.66	27.08	23.16	26.11	23.44	26.13	23.78
	300	29.33	27.20	28.00	25.50	28.37	24.16	26.77	25.00
Irrigation every 12 days	150	22.60	21.27	21.66	19.50	22.21	21.80	22.31	19.55
	200	23.97	22.23	22.76	20.16	23.30	22.00	22.87	21.13
	250	24.00	23.40	23.60	21.66	24.08	23.26	23.41	22.00
	300	25.50	24.20	24.50	22.33	25.60	24.50	25.20	23.66
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.463				0. 65			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

3.5. Panicle weight

The results indicated that panicle weight was significantly affected by the irrigation intervals. The most effective intervals were irrigation every 12 days for this trait. The lowest values ranged from 3.14 g to 3.28 g. While irrigation every 4 days gave the highest values of panicle weight (4.03g – 4.57 g) in the first and second seasons, respectively.

The results in Table 9 show that, the tested varieties differed significantly in panicle weight. Sakha 101 rice varieties produced the highest mean values of panicle weight (3.77 – 3.87 g) in the two seasons, respectively. While Giza 177 recorded the lowest panicle weight (3.33 – 3.22 g) in the first and second seasons, respectively. The difference in the performance of these varieties may be attributed to the differences in the genetic background and constitution of the varieties as well as their level of water shortage tolerance.

The results in Table 10 indicated that the interaction between irrigation intervals, doses of gamma rays and rice varieties had a significant effect on panicle weight. The highest values of this trait (5.18 g – 5.00 g) were recorded when using Sakha 101 with dose 300 under irrigation every 4 days in both seasons. While the lowest values of panicle weight were 2.60 g and 2.64 g detected when using Giza 177 with dose 150 under irrigation every 12 days in both seasons.

Table 9: Means of panicle weight, grain yield and harvest index as affected by irrigation intervals, doses of gamma rays and varieties during 2018 and 2019 seasons

Irrigation intervals	Panicle weight (g)		Grain yield (t/fed)		Harvest index (%)	
	2018	2019	2018	2019	2018	2019
Irrigation every 4 days	4.03	4.57	4.860	4.793	44.21	43.15
Irrigation every12 days	3.14	3.28	3.371	3.307	32.64	32.06

F. test	**	**	**	**	**	**
LSD at 0.05	0.09	0.11	0. 028	0.021	0.285	0.284
Doses of Gamma Rays						
150	3.18	3.27	4.006	3.960	33.06	33.84
200	3.47	3.60	4.233	4.196	36.28	35.19
250	3.69	3.82	4.450	4.386	39.76	40.32
300	4.00	4.15	4.504	4.456	44.59	44.76
F. test	**	**	**	**	**	**
LSD at 0.05	0.044	0.047	0.013	0.009	0.150	0.144
Rice varieties						
Sakha 101	3.77	3.87	4.379	4.334	43.26	43.41
Sakha 104	3.53	3.57	4.048	3.987	39.54	40.89
Giza 177	3.33	3.22	3.890	3.816	36.82	35.34
Giza 178	3.71	3.78	4.144	4.113	41.08	42.00
F. test	**	**	**	**	**	**
LSD at 0.05	0.049	0.052	0.002	0.001	0.136	0.132
Interaction	**	**	**	**	**	**
I * D	**	**	**	**	**	**
I *G	**	**	**	**	**	**
D * G	**	**	**	**	**	**
I* D * G	**	**	**	**	**	**

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

Table 10: Means of panicle weight as affected by the interaction between irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 season

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Panicle weight (g)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	4.00	3.80	3.30	3.82	4.13	3.85	3.37	3.90
	200	4.20	3.88	3.50	4.00	4.15	3.77	3.53	3.96
	250	4.40	3.90	3.80	4.22	4.38	3.82	3.70	4.15
	300	5.00	4.26	3.89	4.85	5.18	4.29	3.93	4.82
Irrigation every 12 days	150	2.90	3.00	2.60	3.30	2.97	3.16	2.64	3.38
	200	3.00	3.11	2.63	3.60	2.85	2.99	2.69	3.08
	250	3.15	3.20	2.86	3.72	3.21	3.29	2.80	3.66
	300	3.22	3.40	3.00	3.80	3.39	3.64	2.92	3.74
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.070				0.068			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant

3.6. Grain yield

The results in Table 11 indicated that the interaction between irrigation intervals, doses of gamma rays and rice varieties had a significant effect on grain yield (t/fed). The highest values of this trait (5.295 – 5.121) was recorded when using Sakha 101 with dose 300 under irrigation every 4 days in both seasons. While the lowest values of grain yield (t/fed) (2.800 - 2.860) was detected when using Giza 177 with dose 150 under irrigation every 12 days in both seasons.

The results showed that, the highest mean values of this trait was produced by using irrigation every 4 days (4.860 t/fed - 4.793 t/fed) in both seasons, respectively. While the lowest mean values were obtained by using irrigation every 12 days (3.371 t/fed - 3.307 t/fed), respectively. In general, there were significant differences among the irrigation intervals studied for this trait. Indicated to the shortage of water at different growth stages had a greater grain yield reduction resulted from the reduction in fertile panicle and filled grain percentage. These results are in agreed with those found by **Abarshahr *et al*. (2011)**. The results indicated that the dose 300 gave highest mean value of grain yield (t/fed), the values ranged from (4.504 t/fed – 4.456 t/fed) in both seasons, respectively. While doses 150 gave the lowest mean value and ranged from (4.006 – 3.960 (t/fed) in both seasons.

The results indicated that the two tested varieties Sakha 101 (4.379 - 4.334 t/fed) and Giza 178 (4.144 - 4.113 t/fed) produced the desirable mean values of grain yield in the first and second seasons, respectively. On the other hand, Giza 177 produced the lowest mean values of the grain yield, and the values ranged from 3.816 - 3.890 t/fed in both seasons. Differences performance of the studied varieties may be attributed to differences in genetic background and their tolerance levels to water stress. These results are in agreed with those found by **Khanam and Hamid (2016)**. Grain yield reduced 44% and 9% by WS1 and WS2, respectively compared to well-watered condition.

Table 11: Means of grain yield as affected by the interaction among irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Grain yield (t/fed)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	4.875	4.570	3.950	4.604	4.715	4.500	3.840	4.590
	200	4.998	4.740	4.140	4.795	4.900	4.670	4.118	4.716
	250	5.026	4.800	4.370	4.839	5.113	4.830	4.310	4.904
	300	5.295	4.915	4.697	5.004	5.121	4.887	4.612	5.087
Irrigation every 12 days	150	3.308	3.470	2.860	3.712	3.316	3.390	2.800	3.897
	200	3.455	3.500	2.920	3.897	3.307	3.517	3.003	3.978
	250	3.668	3.780	3.255	4.050	3.660	3.705	3.300	4.212
	300	3.780	3.885	3.465	4.215	3.840	3.909	3.565	4.434
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.07				0.02			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively NS= Not Significant

3.7. Harvest index

The results in Table 12 indicated that, harvest index (%) was significantly affected by the irrigation intervals. Irrigation every 12 days recorded the lowest harvest index in both seasons, the values ranged from (32.64% - 32.06%). While, irrigation every 4 days recorded the highest harvest index (43.15% - 44.21%) in the first and second season, respectively. Indicated to the shortage of water reduced the capacity of plant in building up metabolites and this may account in turn to depression of

photosynthesis efficiency of the leaves with consequent reduction in harvest index.

The results indicated that the dose 300 recorded the highest mean value of harvest index, the values ranged from 44.59% – 44.76% in both seasons, respectively. While doses 150 gave the lowest mean value and ranged from 33.06% – 33.84% in both seasons. The results obtained showed that the tested varieties differed significantly in harvest index. Sakha101 rice genotype produced the highest mean values of harvest index (43.26% - 43.41%) in the two seasons, respectively, while Giza 177 recorded the lowest mean values (36.82% - 35.34%) in the first and second seasons, respectively. The difference in the performance of these varieties may be attributed to the differences in the genetic background and constitution of the varieties these findings are agreement with those reported by **Rungrat and Poothab (2019)**. The results showed that the average grain yield per pot and the harvest index decreased significantly by decreasing the soil moisture content.

The results in Table 12 indicate that, the interaction between irrigation intervals, doses of gamma rays and rice varieties had a significant effect on harvest index. The highest values of this trait (50.22% – 51.21%) were recorded when using sakha101 with doses 300 under irrigation every 4 days in both seasons. While the lowest values of harvest index (24.66%) and (25.00%) were detected when using Giza 177 with doses 150 under irrigation every 12 days in both seasons.

Table 12: Means of harvest index as affected by the interaction between irrigation intervals, doses of gamma rays and rice varieties during 2018 and 2019 seasons

Irrigation intervals	Doses of gamma rays	Irrigation intervals x Doses of gamma rays x Rice varieties							
		Harvest index (%)							
		2018				2019			
		Sakha101	Sakha104	Giza 177	Giza 178	Sakha101	Sakha104	Giza 177	Giza 178
Irrigation every 4 days	150	44.27	41.00	36.87	42.65	44.00	42.76	36.34	42.89
	200	45.32	42.77	38.35	43.54	45.39	43.54	38.12	44.17
	250	47.12	43.45	41.32	45.39	48.76	44.00	42.87	46.43
	300	50.22	46.54	44.64	47.31	51.21	47.69	44.39	48.65
Irrigation every 12 days	150	26.43	27.15	24.66	33.18	26.00	28.22	25.00	32.43
	200	28.43	29.67	25.54	34.00	28.77	29.96	26.18	35.68
	250	29.00	31.21	28.00	36.21	30.11	32.87	29.43	35.29
	300	34.00	35.44	32.44	39.45	35.54	36.00	33.77	41.76
F. test		**	**	**	**	**	**	**	**
LSD at 0.05		0.368				0.384			

**, * Highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant.

4. REFERENCES

Abarshahr, M.; B. Rabiei and H.S. Lahigi (2011). Assessing genetic diversity of rice varieties under drought stress conditions. Notulae Scientia Biologicae, 3(1):114-123.

Andrew-Peter-Leon M. T.; S. Ramchander; K.K. Kumar;M. M. Mehanathan and P. Arumugam (2021). Assessment of efficacy of mutagenesis of gamma-irradiation in plant height and days to

maturity through expression analysis in rice. J. Bios One., January 15, 2021.

Draz, A. E.; M.I. Abo Yousef; F. N. Mahrous; I. A. Talha; B.A. Zayed and A.A. EL-Gohary (2016). Improvement of some rice cultivars by using X- ray doses to induce new mutants tolerant to stress conditions. Egypt. J. Plant Breeding, pp.611-621.

Gomez, K. A and A. A. Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Edition. A Wiley-InterScience Publication. John Wiley and Sons, New York.

Gowthami, R.; C. V Anniarajan; J. Souframanien and M. Arumugam (2016). Effect of Gamma Rays and Electron Beam on Various Quantitative Traits of Rice (*Oryza sativa* L.) in M1 Generation. Advances in Life Sciences, 5(5):1876-1882.

Hossain, M. Z.; S. Sikder; A. Husna; S. Sultana; S. Akhter; A. Alim and J.C. Joardar (2020). Influence of water stress on morphology, physiology and yield contributing characteristics of rice. SAARC J. Agric., 18(1):61-71.

International Rice Research Institute (IRRI), (2002). Rice Almanac, 3rd Edition. (Gramena Reference ID 8379).

Islam, M. and S. Moonmoon (2017). Effect of drought stress at different growth stages on yield and yield components of six rice (*Oryza sativa* L.) varieties. J. Fundam. Appl. Agric., 2(3):285-289.

Jin Kang, D.; and K. Futakuchi (2019). Effect of Moderate Drought-Stress on Flowering Time of Interspecific Hybrid Progenies (*Oryza sativa* L. × *Oryzaglaberrima* Steud.). J. of Crop Science and Biotechnology, 22:75–81.

Khanam, M. and A. Hamid (2016). Effect of Water Deficit Stress on Grain Yield of Rice. The Journal of Agricultural Science, 49(1):13–18.

RRTC- Proceeding (2012). Proceeding of the 8th National program work shop (final results of 2011).

Rungrat and Poothab (2019). Short-term water deficit stress induces anthocyanin accumulation and changes in grain yield and yield components in colored rice grain. Agr. Nat. Resour., 53:292–297.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods. The Iowa State Univ. press, Iowa, USA.

Van der Hoek, W.; R. Sakthivadivel; M. Renshaw; J. B. Silver; M. H. Birley and F. Konradsen (2001). Alternate wet/dry irrigation in rice cultivation: A practical way to save water and control malaria and Japanese Encephalitis? Research Report, 47: International Water Management Institute, Colombo Sri Lanka.

Journal of Sustainable Agricultural and Environmental Sciences
https://jsaes.journals.ekb.eg/
JSAES, 2022, 1(1): 105 - 118

ISSN-Print: 2735-4377
ISSN-Online: 2785-9878

أداء بعض أصناف الأرز لصفات المحصول ومكوناته تحت الظروف العادية والجفاف

أمجد الجمال[١]، محمود أبو يوسف[٢]، أسامة عبد الحميد[١]، أحمد أبو الفتوح عليبه[١]

[١] قسم المحاصيل – كلية الزراعة – جامعة طنطا – مصر.
[٢] قسم بحوث الأرز – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – مصر.

مجلة العلوم الزراعية والبيئية المستدامة

الملخص العربي

أجريت هذه الدراسة في المزرعة البحثية بمحطة بحوث سخا – كفر الشيخ – مصر خلال موسمي زراعة الأرز ٢٠١٨ – ٢٠١٩ لدراسة تأثير الاجهاد المائي علي بعض الصفات الخضرية وصفات المحصول. تم إستخدام بذور أربعة أصناف هي سخا ١٠١، سخا ١٠٤، جيزة ١٧٧، جيزة ١٧٨ ومعاملتها بأشعة إكس حيث تم إستخدام أربع جرعات مختلفة من الأشعة وهي ١٥٠، ٢٠٠، ٢٥٠، ٣٠٠ كيلو رونتجن فى تصميم القطع المنشقة مرتين حيث تم وضع فترات الري في القطع الرئيسية بينما الأصناف والجرعات في القطع الشقية خلال موسمين ٢٠١٨ – ٢٠١٩.

أظهرت النتائج أن صفات النمو والمحصول للصنف جيزه ١٧٧ كان أعلي تأثرا تحت ظروف الإجهاد المائي والتفاعل بين معاملات الري، الأصناف والجرعات كان معنويا لكل من عدد الأيام حتي التزهير (يوم)، عدد الأفرع (جورة)، عدد السنابل (جورة)، نسبة العقم (%)، وزن ١٠٠٠حبة (جم)، وزن السنبلة (جم)، محصول الحبوب، دليل الحصاد (%)، في كلا الموسمين.

أظهر الصنف جيزة ١٧٨ المعامل بالجرعة العالية من الطفرات أفضل وأعلي في صفات النمو وصفات المحصول، مما يشير إلي أن هذا الصنف يعتبر مصدراً وراثياً لتحمل الإجهاد المائي في برامج تربية أصناف الأرز.