J. Agric. Sci. Mansoura Univ., 34 (7): 8081 - 8092, 2009

EFFECT OF IRRIGATION WATER DEFICIT AND POTASSIUM FERTILIZATION ON SOME RICE VARIETIES

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ABSTRACT

Two field experiments were cared out in El-Sirw Agricultural Research station ,at Damitta Governorate in 2005 and 2006 seasons , to study the effect of four irrigation treatments i.e. continuous flooding , irrigation withholding for 10 days at 25 day after transplanting (DAT),irrigation withholding for 10 day at 25 and 45 DAT and irrigation withholding for 10 day at 25,45 and 65 DAT and potassium as a foliar application i.e. one spray (at 25 DAT),tow sprays (one at 25 and one at 45 DAT) and three sprays (one at 25 ,one at 45 and one at 65 DAT) on growth ,yield, yield components of three rice varieties i.e. Giza 178 , Sakha101 and Sakha103. Spilt-split plot design with four replications was used . The optianed results showed that increasing water deficit (irrigation withholding at 25,45 and 65 DAT) decreased number of panicle /m^2, panicle grain weight, 1000-grain weight, grain yield per feddan, straw yield per feddan, increased compared to all other irrigation treatments in both seasons. Data recorded indicated that rice varieties significantly differed in all studied characters in both seasons . Variety Giza 178 exceeded Sakha 101and Sakha 103 in number of panicle /m^2, and grain yield per feddan in seasons. Results exhibited that increasing number of potassium spraying increased values of all previously mentioned studied traits. The high at grain yield was recorded with plants received three potassium spraying in both seasons. At the highest water deficit (irrigation withholding for 10 day at 25, 45 and 65 DAT),verity Giza 178 supposed in grain yield per Fadden compared to other used variety in both seasons. At the highest water deficit application potassium with three sprayings increased values of all studied characters. The highest grain yield was obtained when variety Giza 178 received three potassium sprayings compared to other variety under study in both seasons. Fertilized variety Giza 178 by potassium at the three sprayings under the highest water deficit increased grain yield per Feddan in both seasons .

INTRODUCTION

Rice *(Oryza Sativa,L*)is considered one of the most important food and exportable cereal crops in Egypt and world. Nowadays, Egypt face problem in amounts of irrigation water, thus the first important step of Egyptian strategy is increasing rice productivity from unit area with the lowest irrigation water and decreased rice areas to saving the irrigation water. Irrigation water withholding at certain times of the growth stages of rice can save some irrigation water. According the shortage of irrigation water the end of channel suffered from the irrigation water deficit at different growth periods during growing season. Exposing rice plant to the interdict of irrigation water at any growth stage decreased growth, yield and its components of rice. Wade *et al.* (2000), found that plant growth rate was more affected by drought at tillering stage than those of panicle initiation of rice. Rahman *et al*. (2002), reported that the lowest values of number of tillers/hill, number of panicle/ hill

and grain yield/ hill were obtained when exposed to water stress at booting, but the lowest values of 1000-grain weight was obtained when stress was at flowering. Zayed (2002), ratified that water withholding for 12 days at a diversity time 15,25 and 35 days after transplanting decreased number of panicles/m2, panicle weight, 1000 grain weight, grain yield and straw yield of rice. Sorvestain *et al.* (2008), found that water stress at flowering stage had a greater reduction in grain yield than stress at vegetative and filling stage. Water deficit during vegetative, flowering and grain filling reduced grain yield of rice by 21,50 and 21% respectively. Water stress at grain filling reduced 1000 grain weight by 17% compared to control.

Attempts have been made to overcome the deleterious effect of water stress upon plant growth of rice crop, one of which is the foliar application with potassium fertilizer and planting drought tolerant rice cultivars.

With respect to rice cultivars El-Hawary (2000), Ebaid and El-Eewainy, (2005), and El–Refaee (2007), in Egypt reported that rice varieties significantly differed in number of panicle/m^2, panicle grain weight, 1000 grain weight, grain yield and strew yield.

Potassium increased the leaf relative water content, water potential, chlorophyll content and photosynthetic rate, on the other hand decreased the dark respiration rate and carotenoid content in controlled. Potassium is not apart of any plant constituent but it is stored in large quantities in vacuoles. It serves primarily as an enzyme activator or co-factor for some enzymes. Potassium also aids in the maintenance of osmotic potential, turger pressure of cells and water uptake. potassium serves to balance the anions charge and influences their up take and transport. Potassium was found to be serves as vital role in photosynthesis through k helps in CO_2 assimilation and increasing the upward translocation of photosynthate and raising proline content. Ramana *et al*. (2002), Omer (2002), in Egypt, reported that a foliar application of potassium at 1 % increased total number of panicles/hill, panicle length , panicle grains weight, 1000-grain weight , straw yield and grain yield. El-Refaee (2007), reported that increasing K level up to 86 kg K_2O/ha significantly increased grain yield and attributes under prolonging irrigation intervals. Zayed *et al* (2007), stated that the triple splitting of potassium at a rate of 57kg K_2O/ha into 1/3 basally + 1/3 at maximum tilliring stage + 1/3 at panicle initiation gave the highest values of number of panicle/hill, 1000 grain weight and grain yield. However, effect of potassium as foliar application on rice varieties grown under water stress at different growth stage in Egypt had rare investigated therefore, this investigation was carried out to study the effect of irrigation water withholding and the effect of potassium foliar application on growth, yield and its components of some rice varieties grown under irrigation water deficit at North Delta condition of Egypt.

MATERIALS AND METHODS

Two field experiments were laid out at El-Sirw Agricultural Research Station, (ARC), Damietta Governorate, Egypt during two rice successive seasons of 2005 and 2006, to study the effect of some irrigation, potassium

fertilization treatments and their interaction on yield and its components of some rice varieties .

A – Irrigation treatments

Four irrigation treatments were studied as follows :

1 – Continuous flooding throughout the season (control).

2– Irrigation water withholding for 10 days at 25 days after transplanting (DAT).

3– Irrigation water withholding for 10 days at 25 and at 45 (DAT).

4– Irrigation water withholding for 10 days at 25 , at 45, and at 65(DAT).

B – Rice varieties:

Three rice studied were Giza 178, Sakha 101, and Sakha103 .

Rice seeds of the studied varieties were obtained from Rice Res. and Training center (RRTC) Sakha, Kafr el-Sheikh, Egypt.

C- Potassium treatments

Four potassium treatments used were as follows :

1- Spraying water without potassium application (Control) .

2- Spraying of potassium solution 2% at 25 (DAT).

3- Spraying of potassium solution at 25 and at 45 days (DAT).

4- Spraying of potassium solution at 25, at 45 and at 65 (DAT).

Rice plants sprayed with the previously mentioned treatments at the rate of 2kg potassium sulphate 48% K_2O in 100 liters/ feddan.

The experiments were laid out in split-split plot design with three replication. The main plots were devoted to the irrigation treatments, sub plots were allocated to the rice cultivars and sub-sub plots were devoted to the potassium treatments . The sub-sub plot area was 10 m^2 (10 rows x 5 m long x 0.2 m wide). The permanent land was prepared as usually for rice crop . Thirty days old seedlings were transplanted. Nitrogen in the form of urea (46.5 %N) was applied in this study at the rate of (69 kg N/fed). Soil samples at experiments site were taken before land preparation in two depths from the soil surface i.e. 0-15 cm and 15-30 cm to determined chemical and physical properties according to Piper (1950), and Black *et al.*(1965), respectively in 2004 and 2005 seasons as presented in Table (1).

Data recorded:

The outer rows of each sub-sub plot side were left as border, where the second and ninth rows were used for sampling. Yield was determined from the central 10 rows. The studied characters were grouped into three main topics as follows:

1- Number of panicles/m^2.

2- Panicle grain weight (g).

3- 1000- grain weight (g**)**.

4- Grain yield per feddan (ton)

5- Straw yield per feddan (ton).

Data recorded were statistically analyzed as the technique of analysis of variance (ANOVA) of the Split-split Plot design as mentioned by Gomez and Gomez (1984) The treatment means were compared using the New least significant differences (N-L.S.D) .

Table (1): The chemical and physical properties at the experimental site in 2005 and 2006 seasons

Characters	2005 season	2006 season
Physical Properties:		
Sand %	11.5	12.7
Silt %	32.9	35.0
Clay %	55.6	52.3
Texture class	Clay	Clay
Soluble Anions, meq/lit.:		
CO_3^-	-	-
HCO_3^-	2.60	2.20
Cl-	13.00	14.00
SO_4^{--}	1.35	1.30
pH	7.80	7.97
EC ds/m	1.80	2.00
O.M.%	1.10	1.20
N (ppm) available	9.00	8.00
P (ppm) available	28.00	30.00
Soluble cations,meq/lit.:		
Na^+	11.0	12.00
K^+	0.36	0.30
Ca^{++} Mg^{++}	6.20	7.20

RESULTS AND DISCUSSION

Average number of panicle /m^2, panicle grain weight, 1000 grain weight, grain yield per feddan, straw yield per feddan, of three rice varieties as affected by irrigation and potassium treatments as well as their interaction during 2005 and 2006 seasons are shown in Tables 2-6

The obtained results indicted that irrigation treatments had a significant effect on all studied traits in both seasons. Rice plants exposed to irrigation withholding 10 days at 25,at 25 and at 45 as well as at 25, at 45 and at 65 days after transplanting (DAT) reduced values of all studied characters compared to continuous flooding in both seasons. Irrigation water withholding for 10 days at 25, at 45 and at 65 days after transplanting reduced of number of panicle/m2, by 18.79% and 19.07%, panicle grain weight by 23.65% and 26.24% , 1000-grain weight by 14.38% and 16.82%, and 20.77% grain yield per feddan by 13.55% and 15-51%, straw yield per feddan by 12.58 % and 9.10%, as compared with continuous flooding in 2005 and 2006 seasons, respectively.

These results are in agreement with those of Park *et al*., (1999) in Koran, EL- Hawary (2000), in Egypt, Rahman *et al* , (2002) in Bangladesh, Kumar (2002) in India, Castillo *et al*.(2006) in Japan, El – Refaee (2007) in Egypt,

The reduction in grain yield caused by irrigation withholding may be attributed to the deleterious effect of water deficit on number of panicle/m^2, panicle grain weight and 1000 grain weight which led to decreased grain yield,

Data presented in Tables 2 to 6 show clearly that rice varieties significantly differed in all studied traits in both seasons. Rice variety Giza 178 gave the highest values of number of panicle/ m^2 and grain yield per

feddan while rice variety Sakha 101 exceeded the other varieties in panicle grain weight, 1000 grain weight, but rice variety Sakha 103 surpassed Gize 178 and Sakha 101 in straw yield per feddan. The superiority of Giza 178 in grain yield may be attributed to it gave the highest values of number of panicle/m^2 which led greatest grain yield per feddan.These results are in harmony with those of El-Hawary (2000), Ebaid and El-Eewainy, (2005), and El–Refaee (2007), in Egypt.

Table (2) :Average number of panicles/m^2 of three rice varieties as affected by irrigation treatments, and potassium rates as well as their interaction in 2005 and 2006 seasons.

Irrigation Treatments	Varieties	2005 Season					2006 Season				
		Potassium rates				Mean	Potassium rates				Mean
		K_0	K_1	K_2	K_3		K_0	K_1	K_2	K_3	
I_1	**Giza 178**	400	454	502	516	**468**	373	416	460	460	**427**
	Sakha101	398	436	469	481	**446**	346	393	443	453	**408**
	Sakha103	363	418	461	468	**427**	328	376	428	434	**391**
	Mean	**387**	**436**	**477**	**488**	**447**	**349**	**395**	**443**	**449**	**409**
I_2	**Giza 178**	383	436	463	473	**438**	346	399	438	441	**405**
	Sakha101	365	410	446	449	**417**	324	375	414	424	**384**
	Sakha103	335	386	425	430	**494**	311	354	390	395	**363**
	Mean	**361**	**411**	**444**	**450**	**416**	**327**	**376**	**414**	**420**	**384**
I_3	**Giza 178**	361	415	448	449	**418**	330	371	399	410	**378**
	Sakha101	343	380	416	425	**391**	303	339	386	395	**355**
	Sakha103	303	353	388	391	**358**	283	328	364	369	**336**
	Mean	**335**	**382**	**417**	**422**	**389**	**305**	**346**	**383**	**391**	**356**
I_4	**Giza 178**	335	383	421	426	**391**	305	343	384	393	**356**
	Sakha101	318	353	388	398	**364**	281	328	361	365	**334**
	Sakha103	279	328	363	365	**333**	253	299	328	333	**303**
	Mean	**310**	**355**	**390**	**396**	**363**	**280**	**323**	**357**	**363**	**331**
varieties	**Giza 178**	370	422	458	466	**429**	338	382	420	426	**392**
	Sakha101	356	395	430	438	**405**	313	359	401	409	**370**
	Sakha103	320	371	409	413	**378**	293	339	377	383	**348**
General mean		348	396	432	439		**315**	**360**	**399**	**406**	

L.S.D at 5% for:				
Irrigation:	**(I)**	2	3
Varieties:	**(V)**	2	3
Potassium:	**(K)**	2	3
Interaction:	**(I x V)**	5	6
	(I x K)	5	6
	(V x K)	4	6
	(I x V x K)	8	10

***I_1 : Continuous flooding.**
I_2 : Irrigation withholding for 10 days at 25 day after transplanting ((DAT)).
I_3 : Irrigation withholding for 10 days at 25 and 45 (DAT).
I_4 : Irrigation withholding for 10 days at 25 , 45 and 65 (DAT).

Data recorded in Tables 2-6 indicate that spraying rice plants with potassium had as significant effect on all studied characters in both seasons. Increasing number of potassium spraying increased values of all studied traits compared to control in both seasons. Rice plants received three potassium spraying (one spray having 2kg potassium sulphate 48%k_2O in 100 Liter water) gave the highest number of panicle/m^2(439 and 406), panicle grain weight (2.76 and 2.65g), 1000 grain weight (23.72 and 23.05g), grain

yield per feddan (2.907 and 2.803 ton), strew yield per feddan (3.772 and 3.748 ton). as compared with all other potassium treatments in 2005 and 2006 seasons, respectively.

These results are in harmony with those of Fageria *et al.* (1990) in brazil, Ramana *et al*. (2002), El – Refaee (2007) in Egypt, Slaton *et al*. (2004) in Arkansas, Bahmaniar *et al*. (2007) in Iran, Increasing grain yield per feddan caused by potassium foliar spraying may be due to its enhance effect on dry matter accumulated and translocation into grain during grain filling period. Moreover Potassium increased chlorophyll content and carotenoid as well as photosynthetic rate. On the other hand decreased the dark respiration rate. The obtained results showed that the interaction effect among irrigation treatments and rice varieties was significant on all studied characters in both seasons. At all irrigation treatments, variety Giza 178 exceeded Sakha 101 and Sakha 103 variety in number of panicle/m^2, grain yield per feddan, and straw yield per feddan in both seasons.

Table (3) : Average panicles grain weight(g) of three rice varieties as affected by irrigation treatments, and potassium rates as well as their interaction in 2005 and 2006 seasons.

Irrigation treatments	Varieties	2005 Season					2006 Season				
		Potassium rates				Mean	Potassium rates				Mean
		K_0	K_1	K_2	K_3		K_0	K_1	K_2	K_3	
I_1	**Giza 178**	2.70	2.93	3.11	3.16	**2.98**	2.54	2.72	2.90	2.96	**2.78**
	Sakha101	2.82	3.05	3.33	3.37	**3.14**	2.61	2.80	3.27	3.32	**3.00**
	Sakha103	2.53	2.73	2.90	2.94	**2.78**	2.36	2.58	2.83	2.89	**2.66**
	Mean	**2.68**	**2.91**	**3.11**	**3.16**	**2.96**	**2.50**	**2.70**	**3.00**	**3.05**	**2.82**
I_2	**Giza 178**	2.49	2.69	2.85	2.90	**2.73**	2.26	2.46	2.67	2.75	**2.53**
	Sakha101	2.59	2.77	2.90	2.96	**2.81**	2.36	2.55	2.79	2.84	**2.63**
	Sakha103	2.24	2.39	2.59	2.61	**2.46**	2.09	2.35	2.61	2.65	**2.42**
	Mean	**2.44**	**2.62**	**2.78**	**2.82**	**2.66**	**2.24**	**2.45**	**2.69**	**2.75**	**2.53**
I_3	**Giza178**	2.28	2.50	2.71	2.69	**2.54**	2.07	2.28	2.53	2.53	**2.35**
	Sakha101	2.38	2.58	2.73	2.78	**2.61**	2.19	2.38	2.58	2.61	**2.44**
	Sakha103	2.00	2.20	2.39	2.40	**2.25**	1.85	2.03	2.36	2.40	**2.16**
	Mean	**2.22**	**2.43**	**2.61**	**2.62**	**2.47**	**2.04**	**2.23**	**2.49**	**2.51**	**2.32**
I_4	**Giza 178**	2.10	2.29	2.50	2.56	**2.36**	1.92	2.10	2.26	2.29	**2.14**
	Sakha101	2.14	2.33	2.53	2.59	**2.40**	1.91	2.13	2.35	2.40	**2.20**
	Sakha103	1.78	1.95	2.15	2.20	**2.02**	1.55	1.86	2.11	2.13	**1.91**
	Mean	**2.01**	**2.19**	**2.39**	**2.45**	**2.26**	**1.79**	**2.03**	**2.24**	**2.27**	**2.08**
varieties	**Giza 178**	2.39	2.60	2.79	2.83	**2.65**	2.20	2.39	2.59	2.63	**2.45**
	Sakha101	2.48	2.68	2.87	2.92	**2.74**	2.27	2.46	2.75	2.79	**2.57**
	Sakha103	2.14	2.32	2.51	2.54	**2.38**	1.96	2.20	2.47	2.51	**2.29**
General mean		**2.34**	**2.53**	**2.72**	**2.76**		**2.14**	**2.35**	**2.60**	**2.65**	

L.S.D at 5% for:	**Irrigation:**	**(I)**	0.02	0.02
	Varieties:	**(V)**	0.01	0.01
	Potassium:	**(K)**	0.02	0.01
	Interaction:	**(I x V)**	0.03	0.02
		(I x K)	0.03	0.03
		(V x K)	0.03	0.02
		(I x V x K)	0.06	0.05

*** I1 : Continuous flooding.**
I2 : Irrigation withholding for 10 days at 25 day after transplanting ((DAT)).
I3 : Irrigation withholding for 10 days at 25 and 45 (DAT).
I4 : Irrigation withholding for 10 days at 25 , 45 and 65 (DAT).

Table (4) : Average 1000 grain weight/g of some rice varieties as affected by irrigation treatments, and potassium rates as well as their interaction in 2005 and 2006 seasons.

Irrigation Treatments	varieties	2005 Season					2006 Season				
		Potassium rates				Mean	Potassium rates				Mean
		K0	K1	K2	K3		K0	K1	K2	K3	
I1	Giza 178	19.80	20.92	21.89	22.02	**21.15**	19.32	20.53	21.66	21.80	**20.83**
	Sakha101	26.77	27.85	28.85	28.99	**28.11**	25.58	26.76	27.90	27.89	**27.03**
	Sakha103	23.68	24.50	25.39	25.49	**24.76**	22.87	24.09	25.22	25.34	**24.38**
	Mean	**23.41**	**24.42**	**25.37**	**25.50**	**24.68**	**22.59**	**23.79**	**24.92**	**25.01**	**24.08**
I_2	Giza 178	17.97	19.23	20.10	20.26	**19.39**	17.69	18.75	19.93	20.13	**19.12**
	Sakha101	25.72	26.75	27.51	27.71	**26.92**	24.11	25.60	26.53	26.70	**25.73**
	Sakha103	22.54	23.60	24.63	24.62	**23.85**	21.38	24.20	24.04	24.11	**23.43**
	Mean	**22.08**	**23.19**	**24.08**	**24.20**	**23.39**	**21.06**	**22.85**	**23.50**	**23.65**	**22.76**
I_3	Giza178	16.87	18.10	18.77	19.18	**18.23**	16.37	17.71	18.86	19.04	**17.99**
	Sakha101	24.54	25.54	26.54	26.55	**25.79**	22.97	24.06	25.07	25.19	**24.32**
	Sakha103	21.52	22.60	23.51	23.53	**22.79**	21.63	21.63	22.62	22.82	**21.84**
	Mean	**20.97**	**22.08**	**22.94**	**23.09**	**22.27**	**19.88**	**21.13**	**22.18**	**22.35**	**21.39**
I_4	Giza 178	14.41	17.10	18.00	18.10	**16.89**	15.33	16.50	17.65	17.78	**16.81**
	Sakha101	23.47	24.53	25.47	25.54	**24.75**	19.66	22.68	23.88	24.01	**22.56**
	Sakha103	20.25	21.55	22.59	22.65	**21.76**	19.05	20.40	21.68	21.77	**20.72**
	Mean	**19.38**	**21.06**	**22.02**	**22.09**	**21.13**	**18.01**	**19.86**	**21.07**	**21.19**	**20.03**
Varieties	Giza 178	17.26	18.84	19.69	19.88	**18.92**	17.18	18.37	19.52	19.68	**18.69**
	Sakha101	25.12	26.17	27.09	27.20	**26.39**	23.08	24.77	25.84	25.95	**24.91**
	Sakha103	22.00	23.06	24.03	24.07	**23.29**	20.90	22.58	23.39	23.51	**22.56**
General mean		**21.46**	**22.69**	**23.60**	**23.72**		20.39	21.91	22.92	23.05	

L.S.D at 5% for:	**Irrigation:**	**(I)**	0.06	0.21
	Varieties:	**(V)**	0.06	0.16
	Potassium:	**(K)**	0.11	0.33
	Interaction:	**(I x V)**	0.05	0.18
		(I x K)	0.11	0.37
		(V x K)	0.10	0.42
		(I x V x K)	0.19	0.63

*** I1 : Continuous flooding.**
I2 : Irrigation withholding for 10 days at 25 day after transplanting ((DAT)).
I3 : Irrigation withholding for 10 days at 25 and 45 (DAT).
I4 : Irrigation withholding for 10 days at 25 , 45 and 65 (DAT).

Table (5) : Average grain yield as affected by irrigation treatments, rice varieties and potassium rates as well as their interaction in 2005 and 2006 seasons.

Irrigation Treatments	Varieties	2005 Season					2006 Season				
		Potassium rate				Mean	Potassium rates				Mean
		K_0	K_1	K_2	K_3		K_0	K_1	K_2	K_3	
I_1	Giza 178	3.007	3.095	3.200	3.210	**3.128**	2.895	3.013	3.148	3.155	**3.053**
	Sakha101	2.961	3.025	3.127	3.135	**3.062**	2.854	2.933	3.087	3.089	**2.991**
	Sakha103	2.886	2.928	2.993	3.002	**2.952**	2.756	2.845	2.941	2.963	**2.876**
	Mean	**2.952**	**3.016**	**3.107**	**3.116**	**3.047**	**2.835**	**2.930**	**3.059**	**3.069**	**2.973**
I_2	Giza 178	2.808	2.869	2.014	3.038	**2.932**	2.771	2.839	2.889	2.904	**2.850**
	Sakha101	2.750	2.845	2.934	2.935	**2.866**	2.688	2.793	2.865	2.891	**2.809**
	Sakha103	2.685	2.723	2.850	2.832	**2.773**	2.615	2.659	2.729	2.745	**2.687**
	Mean	**2.748**	**2.812**	**2.933**	**2.935**	**2.857**	**2.691**	**2.764**	**2.826**	**2.847**	**2.782**
I_3	Giza178	2.692	2.802	2.909	2.914	**2.829**	2.566	2.696	2.772	2.779	**2.703**
	Sakha101	2.586	2.754	2.868	2.874	**2.770**	2.503	2.603	2.698	2.701	**2.629**
	Sakha103	2.459	2.600	2.745	2.750	**2.639**	2.491	2.558	2.628	2.640	**2.579**
	Mean	**2.579**	**2.719**	**2.840**	**2.846**	**2.746**	**2.523**	**2.619**	**2.700**	**2.707**	**2.637**
I_4	Giza 178	2.576	2.683	2.815	2.831	**2.726**	2.491	2.575	2.651	2.667	**2.596**
	Sakha101	2.458	2.646	2.741	2.762	**2.652**	2.394	2.501	2.594	2.604	**2.524**
	Sakha103	2.428	2.498	2.570	2.605	**2.525**	2.291	2.393	2.480	2.501	**2.417**
	Mean	**2.487**	**2.609**	**2.709**	**2.733**	**2.634**	**2.392**	**2.490**	**2.576**	**2.591**	**2.512**
varieties	Giza 178	2.771	2.862	2.984	2.998	**2.904**	2.681	2.781	2.864	2.876	**2.800**
	Sakha101	2.689	2.817	2.918	2.927	**2.838**	2.612	2.708	2.811	2.821	**2.738**
	Sakha103	2.615	2.687	2.789	2.797	**2.722**	2.538	2.614	2.695	2.712	**2.640**
General mean		2.691	2.789	2.897	2.907		2.610	2.701	2.790	2.803	

L.S.D at 5% for:			2005 Season	2006 Season
	Irrigation:	(I)	0.018	0.010
	Varieties:	(V)	0.015	0.009
	Potassium:	(K)	0.013	0.011
	Interaction:	(I x V)	0.016	0.018
		(I x K)	0.025	0.022
		(V x K)	0.022	0.019
		(I x V x K)	0.044	0.039

***I.1 : Continuous flooding.**
I.2 : Irrigation withholding for 10 days at 25 day after transplanting ((DAT)).
I.3 : Irrigation withholding for 10 days at 25 and 45 (DAT).
I.4 : Irrigation withholding for 10 days at 25 , 45 and 65 (DAT).

Table (6) :Average straw yield as affected by irrigation treatments, rice varieties and potassium rates as well as their interaction in 2005 and 2006 seasons.

Irrigation Treatments	Varieties	2005 Season					2006 Season				
		Potassium rates				Mean	Potassium rates				Mean
		K_0	K_1	K_2	K_3		K_0	K_1	K_2	K_3	
I_1	**Giza 178**	3.705	3.815	3.940	3.970	**3.857**	3.688	3.807	3.929	3.957	**3.845**
	Sakha101	3.638	3.776	3.858	3.877	**3.787**	3.597	3.754	3.864	3.875	**3.772**
	Sakha103	3.772	3.885	4.151	4.173	**3.995**	3.666	3.845	3.956	3.968	**3.859**
	Mean	**3.705**	**3.825**	**3.983**	**4.006**	**3.880**	**3.651**	**3.802**	**3.916**	**3.933**	**3.825**
I_2	**Giza 178**	3.483	3.704	3.834	3.856	**3.718**	3.538	3.692	3.827	3.863	**3.730**
	Sakha101	3.405	3.640	3.754	3.768	**3.641**	3.515	3.645	3.751	3.761	**3.668**
	Sakha103	3.537	3.766	3.899	3.903	**3.776**	3.522	3.641	3.792	3.832	**3.698**
	Mean	**3.474**	**3.703**	**3.829**	**3.843**	**3.717**	**3.525**	**3.660**	**3.791**	**3.819**	**3.699**
I_3	**Giza 178**	3.325	3.597	3.721	3.727	**3.593**	3.471	3.590	3.733	3.752	**3.637**
	Sakha101	3.311	3.528	3.646	3.668	**3.538**	3.431	3.520	3.639	3.644	**3.558**
	Sakha103	3.448	3.640	3.786	3.798	**3.668**	3.514	3.546	3.666	3.681	**3.602**
	Mean	**3.361**	**3.588**	**3.718**	**3.731**	**3.600**	**3.472**	**3.552**	**3.678**	**3.693**	**3.599**
I_4	**Giza 178**	3.127	3.379	3.489	3.470	**3.367**	3.376	3.501	3.632	3.525	**3.509**
	Sakha101	3.167	3.351	3.459	3.483	**3.365**	3.247	3.439	3.538	3.551	**3.444**
	Sakha103	3.214	3.450	3.549	3.569	**3.445**	3.346	3.448	3.552	3.571	**3.480**
	Mean	**3.170**	**3.393**	**3.499**	**3.507**	**3.392**	**3.323**	**3.463**	**3.575**	**3.549**	**3.477**
varieties	**Giza 178**	3.410	3.623	3.746	3.756	**3.634**	3.518	3.647	3.780	3.774	**3.680**
	Sakha101	3.379	3.574	3.679	3.699	**3.583**	3.448	3.589	3.697	3.708	**3.611**
	Sakha103	3.493	3.685	3.846	3.861	**3.721**	3.512	3.620	3.742	3.763	**3.659**
General mean		**3.427**	**3.628**	**3.757**	**3.772**		**3.748**	**3.740**	**3.619**	**3.493**	

L.S.D at 5% for:	**Irrigation:**	**(I)**	0.016	0.023
	Varieties:	**(V)**	0.017	0.011
	Potassium:	**(K)**	0.033	0.017
	Interaction:	**(I x V)**	0.015	0.022
		(I x K)	0.030	0.034
		(V x K)	0.025	0.030
		(I x V x K)	0.051	0.059

***I1 : Continuous flooding.**
I2 : Irrigation withholding for 10 days at 25 day after transplanting ((DAT)).
I3 : Irrigation withholding for 10 days at 25 and 45 (DAT).
I4 : Irrigation withholding for 10 days at 25 , 45 and 65 (DAT).

In addition, at the highest water deficit (irrigation water withholding for 10 days at 25, at 45 and at 65 days after transplanting) variety Giza 178 gave the highest relative values of number of panicle/ m^2 (83.54 and 83.37%) compared to those of the control (continuous flooding) in 2005 and 2006 seasons, respectively. These results suggested that variety Giza 178 was more tolerant than the other studied varieties, therefore it gave the highest absolute and relative grain yield per feddan under water stress.

The interaction effect among irrigation treatments and potassium treatments was significant on all measured traits in both seasons. However, at all irrigation treatments, rice plants sprayed with potassium increased values of all studied characters. At the highest water taboo (irrigation water withholding for 10 days at 25,45 and 65 (DAT), plants received three potassium sprayings at the previously days of water interdicted gave the highest values of all studied traits, compared to the other treatment under this

interaction in both seasons. These results indicted that potassium alleviated the injurious effect of irrigation water withholding on growth and yield components, therefore, grain yield increased as number of potassium spraying increased also my be due to Potassium increased the leaf relative water content, water potential. Potassium also aids in the maintenance of osmotic potential, turger pressure of cells and water uptake. potassium serves to balance the anions charge and influences their up take and transport. Potassium was found to be serves as vital role in photosynthesis through k helps in CO_2 assimilation and increasing the upward translocation of photosynthate and raising proline content.

The interaction effect between rice varieties and potassium treatment was significant on all studied characters in both seasons. Treated Giza 178 with three potassium spraying gave the highest values of number of panicle/m^2, grain yield per feddan and straw yield per feddan compared to the other this interaction treatments in both seasons.

The interaction effect between irrigation treatments ,varieties and potassium treatments was significant on all studied traits in both seasons. At the highest water deficit (irrigation withholding for 10 days at 25,45 and 65 DAT, sprayed variety Giza 178 by three potassium sprayings gave the highest values of number of panicle/m^2, and grain yield per feddan compared to all other treatments in this interaction in both seasons.

Generally, it could be recommended that when the irrigation water was shortage at any growth period of rice plants, it could applied potassium as a foliar fertilization for variety Giza 178 to obtain greatest grain yield per feddan at Nourth Delta condition of Egypt.

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***معهد بحوث الأرز والتدريب – مركز البحوث الزراعية – وزارة الزراعة – مصر .**

أجريت تجربتان حقليتان في محطة البحوث الزراعية بالسرو بمحافظة دمياط في موسمي ٢٠٠٦،٢٠٠٥ م لدراسة تأثيرات أربعة فترات للري وهى الغمر المستمر – والري مع الحرمان لمدة ١٠ أيام عند ٢٥ يوم من الشتل - والري مع الحرمان لمدة عشرة أيام عند ٢٥ يوم و٤٥ يوم من الشتل - والري مع الحرمان لمدة عشرة أيام عند ٢٥،٤٥،٦٥ يوم من الشتل وأربعة مستويات من البوتاسيوم وهى بدون رش وإضافة رشة بوتاسيوم عند ٢٥ يوم من الشتل وإضافة رشتان بوتاسيوم الأولى عند ٢٥ يوم والثانية عند ٤٥ يوم من الشتل وإضافة ثلاثة رشات من البوتاسيوم الأولى عند ٢٥ يوم والثانية عند ٤٥ يوم والثالثة عند ٦٥ يوم الشتل على النمو والمحصول ومكوناته وجودته في ثلاثة أصناف من الأرز جيزة ١٧٨ وسخا ١٠١ وسخا ١٠٣ . وقد استخدم تصميم القطع المنشقة مرتين في أربعة مكررات .

وتتلخص أهم النتائج فيما يلي :

أظهرت النتائج أن زيادة نقص ماء الري (منع الري لمدة عشرة أيام عند ٢٥ ،٤٥ ، ٦٥ يوم من الشتل) أدت إلى نقص عدد الداليات /م ووزن حبوب السنبلة ووزن الألف حبه وعدد الحبوب المملؤة بالدالية ومحصول الحبوب للفدان ومحصول القش للفدان مقارنة مع الري المستمر في كلا موسمي الزراعة .

أوضحت النتائج أن زيادة عدد مرات الرش بالبوتاسيوم أدت إلى زيادة قيم كل الصفات المدروسة سالفة الذكر مقارنة مع معاملة الكنترول في كلا موسمي الزراعة .

سجلت النتائج اختلافات معنوية بين الأصناف الثلاثة تحت الدراسة في كل الصفات المدروسة في كلا الموسمين . فقد تفوق الصنف جيزة١٧٨ على صنف سخا ١٠١ وسخا ١٠٣ في عدد الداليات / م ومحصول الحبوب للفدان في كلا موسمي الدراسة .

تحت ظروف نقص الماء عند مراحل النمو الثلاثة تفوق الصنف جيزة ١٧٨ على سخا ١٠١ وسخا ١٠٣ في محصول الحبوب للفدان في كلا الموسمين . أعطى التسميد بالبوتاسيوم رشا ثلاثة مرات تحت ظروف نقص ماء الري عند ٢٥، ٤٥، ٦٥ يوم من الشتل زيادة معنوية في كل الصفات المدروسة في كلا الموسمين . أعطى الصنف جيزة ١٧٨ اعلى محصول للحبوب / فدان عندما استقبل ثلاثة رشات من بالبوتاسيوم مقارنة بالأصناف الأخرى في كلا الموسمين .

عموما: تحت ظروف نقص ماء الري عند مراحل النمو المختلفة أعطى تسميد الصنف جيزة ١٧٨ بالبوتاسيوم بثلاثة رشات أعلى محصول حبوب للفدان مقارنة بالأصناف الأخرى في كلا موسمي الدراسة .