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EFFECT OF IRRIGATION INTERVALS AND FOLIAR SPRAYING TREATMENTS ON GROWTH AND YIELD OF SOME RICE CULTIVARS

Badawi, M. A. ; S. A. El-Moursy ; S. E. Seadh and Y. M. A. Souror
Agronomy Dept., Fac. Agric., Mansoura University, Egypt.

ABSTRACT

The field experiments were carried out at a Farm in El-Abhar Village, El-Hamoul Center, Kafr El-Sheikh Governorate, during 2011 and 2012 seasons to determine the effect of irrigation intervals (irrigation every 2, 6 and 12 days) and foliar spraying treatments (without foliar spraying, foliar spraying with Flowering-Spring fertilizer, Tecamin-Max fertilizer, Potassium- Sulphate and Ascorbic-Acid) on growth, yield and its attributes of some rice cultivars (IET 1444, Giza 177 and Giza 178). Each irrigation intervals was performed in separate experiment. Every experiment of irrigation intervals was carried out in strip plot design with three replications.

The results showed that normal irrigation schedule every 2 days (control treatment) associated with significant increases in all studied characters and resulted in the highest values in both seasons.

IET 1444 cultivar significantly superior the two local cultivars Giza 177 and Giza 178 and resulted in the highest values of most studied characters.

Foliar spraying rice plants with Tecamin max fertilizer surpassed other studied foliar spraying treatments and resulted in the highest values of all studied characters in both seasons. This treatment followed by spraying with Flowering spring fertilizer without significant differences between them in most characters, then potassium sulphate and then ascorbic acid in both seasons.

It can be concluded that, irrigated IET 1444 rice cultivar every 6 days and foliar spayed with Tecamin max or Flowering spring fertilizers could be recommend to raise productivity and save irrigation water and irrigated Giza 178 and Giza 177 rice cultivars every 2 days and foliar spayed with Tecamin max or Flowering spring fertilizers to maximize productivity under the environmental conditions of El-Hamoul district, Kafr El-Sheikh Governorate.

Keywords: Rice, *Oryza sativa* L., irrigation intervals, irrigation treatment, water stress, foliar spraying treatments, cultivars, varieties, growth, yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple cereal foods consumed by about half of the world's population, supplies adequate energy in the form of calories and is a good source of thiamine, riboflavin, and niacin (Zhu *et al.*, 2010). Rice is one of the major field crops in Egypt. It is the most important summer cereal crop of traditional rice growing areas of Egypt and is among the major export commodities.

Rice is sensitive to moisture stress and in view of the water scarcity in the coming years, it is imperative to evaluate the performance of rice cultivar under moisture deficit (Majeed *et al.*, 2011). Water usage in agriculture accounts for about 70% of total water consumption in the world, and rice cultivation is in turn the largest water user, which accounts for about

50% of total water usage in agriculture. Therefore, it is quite important to improve water utilization efficiency to reduce water consumption in rice (Zhang *et al.*,2005). Water deficit stress is one of the most important environmental stresses that limit crop growth and agricultural products. In addition, drought and water deficit stress had several effects on agricultural and ecological systems (Rochefort and Woodward, 1992). However, the extent of inhibition or reduction varies greatly with the growth stages, duration and severity of stress, and plant genotypes. El-Ekhtyar (2004) concluded that water deficit at both panicle initiation and heading stages must be avoided to obtain considerable grain and straw yields. Furthermore, drought stress at tillering stage can be practiced without more considerable reduction in grain yield. Pirmoradina *et al.* (2004) found that intermittent flooding irrigation at 2-day intervals was as effective as continuous flooding for grain yield. Zhang *et al.* (2005) concluded that water stress causes severe inhibition of plant growth and development as well as yield reduction. However, the extent of inhibition or reduction varies greatly with the growth stages, duration and severity of stress and plant genotypes. Kishk (2006) reported that prolonging irrigation intervals up to 12 days significantly decreased number of days to 50 % heading, plant height number of panicles/m^2 and panicle length, number of grains/panicle and 1000-grain weight as well as grain and straw yields and grain quality characters. Dolatabadian *et al.* (2010) demonstrated that final yield was more affected when plants were stressed at reproductive phase than those were stressed at vegetative phase. In rice, drought resistance and water utilization efficiency might be improved by developing stress-resistant cultivars and foliar spraying treatments.

Chosen the high yielding ability cultivars undoubtedly is very important to raise rice productivity per unit area. Kishk (2006) concluded that Sakha 104 cultivar surpassed Giza 182 cultivar in all studied characters. Zayed *et al.* (2006) reported that Giza 178 and Sakha 104 varieties were comparable in their performance under such conditions (salt tolerant Egyptian varieties) considering grain yield. Dineshkumar *et al.* (2008) showed that Kh Rs-21 variety was under taken for farm trail due to good performance in genotype selection. It was significantly reported highest yield that tested varieties. Ahmadikhah *et al.* (2010) showed that the two studied varieties were significantly differed in their performance and all studied traits, except 1000-grain weight. The inbred variety Choaram showed superiority over local variety. Salama *et al.* (2011) pointed out that Egyptian hybrid rice 1 cultivar (H_1) significantly surpassed the local cultivar (Giza 178) in number of days from transplanting to 50 % heading, flag leaf area, plant height, number of panicles/m^2, panicle length, number of grains/panicle, weight of grains/panicle, 1000-grain weight, grain and straw yields/fed.

Foliar fertilization is now being tried to alleviate or neutralize growth inhibition due to water stress. Foliar fertilization with macronutrients (NPK) is considered as one of the most important factors which affect the productivity of rice, expressly under water stress, where its allows to maximize the utilization of the nutrients. Kavitha *et al.* (2008) studied the effect of foliar spraying with seaweed extract (phytozyme) on growth and yield of rice.

Spraying seaweed extract on the foliage of rice twice at 50 per cent flowering and at milk stages significantly influenced the growth, yield attributes and grain yield. Amino acids are a well known as bio-stimulant which has positive effects on plant growth, yield and significantly reduce the injuries caused by a biotic stresses. Foliar spraying with Aminototal rapidly correct nutrients deficiencies due to L-Amino Acids being readily absorbed and directly utilized to synthesis proteins. Yuan *et al.* (2013) recorded that foliar spraying with Fe amino acid (Fe-AA) and zinc (Zn) fertilizers are known to be an effective way to improve Fe and Zn concentrations in rice grains as well as grain yield. However, results can differ significantly among different rice cultivars and/or types of foliar fertilizer. Bhuyan *et al.* (2012) concluded that foliar nitrogen spray in bed planting method is a new approach to get fertilizer and water use efficiency as well as higher yield compared to existing agronomic practice. Potassium is vital for osmoregulation and protein synthesis, maintaining cell turgor and stimulating photosynthesis. Higher levels of potassium in young expanding tissue are associated with tolerance to abiotic stress in many plants (Khatun and Flowers, 1995). Ascorbic acid is regarded as one of the most effective growth regulators against abiotic stresses (Conklin, 2001). Ascorbic acid not only acts as an antioxidant but the cellular levels of ascorbic acid are correlated with the activation of complex biological defense mechanisms (Conklin and Barth, 2004). It has also been used to counteract the adverse effects of water stress in many crop plants (Khan *et al.*, 2010).

The aims of this study were to test the hypothesis that foliar spraying of some rice cultivars with fertilizer solutions containing NPK, amino acids, potassium sulphate or ascorbic acid could ameliorate the stress in rice plants caused by increasing irrigation intervals. As well as, determining the effects of water stress and foliar spraying treatments on growth, grain yield and its attributes and grains technological characters of some rice cultivars under the environmental conditions of Kafr El-Sheikh Governorate.

MATERIALS AND METHODS

The field experiments were carried out at a Farm in El-Abhar Village, El-Hamoul Center, Kafr El-Sheikh Governorate, during 2011 and 2012 seasons to determine the effect of irrigation intervals and foliar spraying treatments on growth, yield and its attributes of some rice cultivars.

Each irrigation intervals *i.e.* irrigation every 2 days (control treatment), irrigation every 6 and 12 days was performed in separate experiment. Every experiment of irrigation treatment was carried out in strip plot design with three replications. The vertical plots were assigned to the three rice cultivars (IET 1444, Giza 177 and Giza 178). Summary of the main details of the studied cultivars are shown in Table 1.

Table 1: The pedigree of the studied cultivars.

Cultivars	Origin	Cultivar group	Drought resistance	Parentage
IET 1444	IRRI	Indica	Tolerant	TN1/Co 29
Giza 177	Egypt	Japonica	Sensitive	Giza 171/Yomji No.1 // Pi No.4
Giza 178	Egypt	Indica/Jap.	Medium tolerant	Giza 175 / Milyang 49

The horizontal plots were occupied with the following five foliar spraying treatments:

1- Without foliar spraying (control).
2- Foliar spraying with Flowering-Spring fertilizer, which contains NPK, at the rate of 2.0 kg/100 liter water/fed.
3- Foliar spraying with Tecamin-Max fertilizer, which contains amino acids, at the rate of 1.25 liter/100 liter water/fed.
4- Foliar spraying with Potassium- Sulphate (48 % K2O) at the rate of 2 % (4.0 kg potassium sulphate/100 liter water/fed).
5- Foliar spraying with Ascorbic-Acid at the rate of 150 ppm (30 g Ascorbic acid/100 liter water/fed).

Foliar spraying treatments were carried out twice at the aforementioned rates after 25 and 55 days from transplanting using Knapsack Sprayer. The chemical composition of foliar fertilizer Flowering-Spring is N (20 %), P (20 %) and K (20 %). However, the chemical composition of foliar fertilizer Tecamin-Max is N (7 %), free amino acids "L-amino acids" (12 .0 %), total amino acids (14.4 %) and pH 6.6. Ascorbic-Acid is produced by El-Nasr Pharmaceutical Chemicals Co., Egypt, and obtained from El-Gomhouria Company for Trading Pharmaceutical Chemical & Medical.

The experimental plot area was 3.0 m width and 3.5 m length, resulted an area of 10.5 m^2 (1/400 fed). The preceding winter crop for the nursery and permanent field was Egyptian clover (*Trifolium alexandrinum* L.) in both seasons.

Soil samples were taken at random from the experimental field area at a depth of 0 - 15 and 15 - 30 cm from soil surface before soil preparation during the growing seasons and mixed to make homogeneous sample to measure the physical and chemical soil properties and the corresponding data are presented in Table 2.

The nursery seedbed preparation was well performed. The nursery land was fertilized with calcium superphosphate (15.5 % P_2O_5) at the rate of 4 kg/kirat (1 kirat = 175 m^2) on the dry soil before ploughing. Nitrogen in the form of urea (46.0 % N) was added at the rate of 3 kg/kirat after last ploughing before leveling and zinc sulphate (24 % Zn SO4) at the rate of one kg/kirat was also incorporated with soil after leveling and before sowing. Rice grains at the rate of 60 kg/fed were soaked in water for about 48 hours and incubated for 24 hours. Thereafter, they were broadcasted with 2-3 cm of standing water in the nursery at 1st may in the first and second seasons. Weeds were chemically controlled with Saturn 50 % at the rate of 2 liters dissolved in 100 liters of water/fed and sprayed using at seven days after sowing using Knapsack Sprayer.

Table 2: Mechanical and chemical soil characteristics at the experimental site during the two growing seasons of 2011 and 2012.

Soil analysis		First season 2011	Second season 2012
A: Mechanical properties:			
Sand (%)		28.61	28.60
Silt (%)		14.87	14.89
Clay (%)		56.52	56.51
Texture		Sandy clay	Sandy clay
B: Chemical analysis			
Soil reaction pH		7.89	7.76
EC (ds/m^2) in soil water extraction (1:5) at 25^{0}C		5.61	5.60
Organic matter (%)		2.76	2.70
Total carbonate (%)		2.75	2.74
Available N (ppm)		85.2	86.3
Soluble cations meq/L	Ca^{++}	16.75	15.73
	Mg^{++}	12.31	13.00
	Na^{+}	26.25	25.23
	K^{+}	0.78	0.80
Soluble anions meq/L	CO_3^{-}	-	-
	HCO_3^{-}	7.81	7.75
	Cl^{-}	23.50	23.45
	SO_4^{-}	24.79	24.90

The permanent land was prepared as recommended. Calcium superphosphate (15.5 % P_2O_5) was added at the rate of 100 kg/fed on the dry soil before ploughing. Twenty five days old seedlings were transplanting at a rate of 4-5 seedlings/hill adopting a spacing of 20 x 20 cm, which were sown regularly with the rate of 25 hills/m^2, with 2-3 cm of the standing water on the land surface. Nitrogen at the rate of 60 kg N/fed in the form urea (46 % N) was added in two equal portions. The first part was added after 6 days from transplanting and the second part was added after 24 days from the first one. Potassium in the form of potassium sulphate (48 % K_2O) was added to soil at the rate of 24 kg K_2O/fed with the first dose of nitrogen fertilizer. The weeds were chemically controlled with Saturn 50 % as mentioned after transplanting with four days. However, the common agricultural practices for growing rice according to the recommendations of Ministry of Agriculture were followed, except the factors under study.

Data recorded:

A. Growth characters:

1- Number of days from transplanting to 50 % heading.

2- Total chlorophyll content: Five SPAD-502 readings were measured on leaves of five plants by the portable chlorophyll meter (SPAD-502, Minolta, Japan).

3- Flag leaf area (cm^2): The leaf area of flag leaf was estimated at maximum tillering stage (90 DFS) following the formula reported by Yoshida *et al.*

(1976) as follows: Flag leaf area (cm^2) = 0.75 x Length (cm) x width (cm).

B. Yield and its attributes:

At harvest, the following data were recorded:

4- Plant height (cm).
5- Number of panicles/m^2.
6- Panicle length (cm).
7- Number of grains/panicle.
8- 1000- grain weight (g).
9- Grain yield (t/fed): The plants in the inner four square meter of each experimental unit were harvested, collected together, labeled and tied. Thereafter, plants were transported to the threshing floor for air drying for five days, threshed and the grains were separated. The grain yield was recorded in kg/4 m^2, and then it was converted to record grain yield in ton per feddan at 14 % moisture content.
10- Straw yield (t/fed): It was estimated using the same steps for grain yield estimation.

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the strip plot design to each experiment (irrigation intervals), then combined analysis was done between irrigation experiments as mentioned by Gomez and Gomez (1984). Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described Snedecor and Cochran (1980). All statistical analyses were performed using analysis of variance technique (ANOVA) by means of" MSTAT-C" computer software package.

RESULTS AND DISCUSSION

1- Effect of water stress:

Water stress treatments expressed as irrigation intervals (irrigation every 2, 6 and 12 days) exhibited significant effect on all studied growth characters (number of days from transplanting to 50 % heading, total chlorophyll content and fag leaf area) and yield and its attributes (plant height, number of panicles/m^2, panicle length, number of grains/panicle, 1000-grain weight, grain and straw yields per feddan) in both seasons as shown in Table 3 and 4. It can be observed that from obtained results normal irrigation schedule every 2 days (control treatment) associated with significant increases in all studied characters and resulted in the highest values of these characters in the two growing seasons of this research. However, irrigation rice plants every 6 days followed by this treatment with significant differences in both seasons. Increasing water stress by irrigation rice plants every 12 days gave the lowest values of all studied traits in both seasons. It can be concluded that the decreases in grain yield as a results of increasing irrigation interval to 6 days were 8.16 and 5.12 % as well as these decreases reached about 30.56 and 29.82 % due to increasing irrigation intervals to 12 days as compared with control treatment (irrigation every 2 days) in the first

and second seasons, respectively. This increase in growth and productivity of rice due to deceasing irrigation intervals by irrigation every 2 may be due to provide moisture for rice plants continuously which allows better growth, thereby enhancement vegetative growth attributes and resulting in increments in panicle length, number of panicles/m^2, number of grains/panicle and 1000-grain weight as well as grain yield. These findings are in good conformity with those reported by El-Ekhtyar (2004), Pirmoradina *et al.* (2004), Zhang *et al.* (2005) and Kishk (2006).

2- Cultivars performance:

The obtained results showed that the three studied cultivars *i.e.* IET 1444, Giza 177 and Giza 178 cultivars were significantly differed in all studied characters (number of days from transplanting to 50 % heading, total chlorophyll content, fag leaf area, plant height, number of panicles/m^2, panicle length, number of grains/panicle, 1000-grain weight, grain and straw yields per feddan in both seasons (Tables 3 and 4). It seem that IET 1444 cultivar significantly superior the two local cultivars Giza 177 and Giza 178 and resulted in the highest values of total chlorophyll content, fag leaf area, plant height, number of panicles/m^2, panicle length, number of grains/panicle, 1000-grain weight, grain and straw yields per feddan in both seasons. This means that IET 1444 cultivar had greater growth and yield stability than Giza 177 and Giza 178 cultivars in the first and second seasons of this study. It could be noticed that Giza 178 cultivar associated with delaying in heading date, which resulted in the highest number of days from transplanting to 50 % heading and shortest plants in the first and second seasons. Whereas, Giza 177 cultivar recorded the earliness in heading date, where registered the lowest number of days from transplanting to 50 % heading and lowest values of total chlorophyll content, fag leaf area, number of panicles/m^2, panicle length, number of grains/panicle, 1000-grain weight, grain and straw yields per feddan. The superiority of IET 1444 cultivar in growth and grain yield over than Giza 178 and Giza 177 cultivars might be related to genetic factors which resulted from genetic makeup relations for the varieties. The obtained results of this study are partially agreement with those noticed and discussed by Kishk (2006), Zayed *et al.* (2006), Dineshkumar *et al.* (2008) and Salama *et al.* (2011).

3- Effect of foliar spraying treatments:

From obtained results foliar spraying treatments (without spraying and spraying with NPK, amino acids, potassium sulphate and ascorbic acid) showed significant effect on all studied growth characters (number of days from transplanting to 50 % heading, total chlorophyll content and fag leaf area) and yield and its attributes (plant height, number of panicles/m^2, panicle length, number of grains/panicle, 1000-grain weight, grain and straw yields per feddan) in both growing seasons (Tables 3 and 4). From obtained results of this study it can be noticed that foliar spraying rice plants twice after 25 and 55 days from transplanting with Tecamin max fertilizer (source of amino acids) surpassed other studied foliar spraying treatments and resulted in the

highest values of all studied characters in the first and second seasons. This foliar spraying treatment followed by spraying with Flowering spring fertilizer (source of NPK) without significant differences between them in most characters, then foliar spraying with potassium sulphate and then foliar spraying with ascorbic acid in both seasons. On the contrary, the lowest means of all studied characters were produced from control treatment (without foliar spraying) in both seasons. Noteworthy, the increases in grain yield due to foliar spraying with Tecamin max, Flowering spring, potassium sulphate and ascorbic acid were 8.04, 7.63, 3.72 and 3.69 % as compared with control treatment over both seasons. The increase in rice growth and grain yield because of foliar spraying with fertilizers contains amino acids, NPK or ascorbic acid can be easily ascribed to its role in improvement early growth, more dry matter accumulation and stimulation the building of metabolic products. These results are in compatible with those found by Kavitha *et al.* (2008), Bhuyan *et al.* (2012), and Yuan *et al.* (2013).

Table 3: Number of days to 50 % heading, total chlorophyll, flag leaf area, plant height and Number of panicles/m^2 as affected by irrigation treatments and foliar spraying treatments of some rice cultivars as well as their interactions during 2011 and 2012 seasons.

Characters / Seasons / Treatments	Number of days to 50 % heading		Total chlorophyll (SPAD)		Flag leaf area (cm^2)		Plant height (cm)		Number of panicles/m^2	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Irrigation treatments:										
Irrigation every 2 days (control)	91.24	93.13	19.14	18.73	26.39	26.24	95.15	94.46	350.1	352.5
Irrigation every 6 days	88.33	90.37	17.92	18.14	23.15	22.27	84.25	82.38	314.8	315.3
Irrigation every 12 days	87.04	89.11	15.39	14.86	19.25	18.52	77.28	72.55	265.8	278.5
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.92	0.72	0.19	0.27	0.66	0.40	1.64	2.13	1.8	1.4
B- Cultivars:										
IET 1444	89.55	91.53	19.71	19.30	26.28	25.78	94.66	94.26	347.3	346.7
Giza 177	86.82	88.88	16.24	15.46	19.43	18.64	82.41	78.46	277.0	280.6
Giza 178	90.24	92.20	16.50	16.96	23.07	22.60	79.61	76.67	306.4	318.9
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.60	0.53	0.17	0.22	0.42	0.37	1.20	0.98	1.7	1.6
C- Foliar spraying treatments:										
Without spraying (control)	87.77	89.59	16.50	16.24	21.58	21.02	81.58	76.89	293.1	300.8
Flowering spring (NPK)	89.40	91.11	18.03	17.64	23.63	22.97	87.29	84.77	315.6	321.3
Tecamin max (amino acids)	90.48	93.25	18.20	18.02	23.65	23.20	88.47	85.53	319.8	324.9
Potassium sulphate (PS)	88.77	90.48	17.41	17.20	23.25	22.34	85.73	84.47	311.8	316.7
Ascorbic acid (AA)	87.92	89.92	17.29	17.10	22.54	22.18	84.74	84.00	310.9	313.3
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.79	0.44	0.12	0.19	0.53	0.41	1.43	0.73	1.3	1.7
D- Interactions:										
A × B	*	*	*	*	*	*	*	*	*	*
A × C	NS	NS	*	*	*	NS	*	NS	*	*
B × C	NS	NS	*	*	*	NS	*	NS	*	*
A × B × C	NS	NS	*	*	*	NS	*	NS	*	*

Table 4: Panicle length, number of grains/panicle, 1000 - grain weight, grain and straw yields per feddan as affected by irrigation treatments and foliar spraying treatments of some rice cultivars as well as their interactions during 2011 and 2012 seasons.

Characters / Seasons / Treatments	Panicle length (cm)		Number of grains/panicle		1000 - grain weight (g)		Grain yield (t/fed)		Straw yield (t/fed)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
A- Irrigation treatments:										
Irrigation every 2 days (control)	22.88	23.09	122.3	123.6	24.48	23.05	4.277	4.138	3.500	3.558
Irrigation every 6 days	20.80	20.84	103.5	103.8	21.67	19.22	3.928	3.926	3.225	3.232
Irrigation every 12 days	16.93	17.18	77.6	74.6	19.64	17.38	2.970	2.904	2.942	2.709
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.10	0.15	1.6	1.7	0.31	0.29	0.031	0.014	0.020	0.012
B- Cultivars:										
IET 1444	22.86	21.06	126.3	125.0	22.96	21.28	4.507	4.343	3.499	3.591
Giza 177	16.95	19.25	75.3	75.5	21.12	19.07	3.015	2.961	3.031	2.807
Giza 178	20.80	20.80	101.8	101.5	21.71	19.29	3.654	3.663	3.137	3.100
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.18	0.20	1.5	1.1	0.19	0.16	0.018	0.005	0.017	0.009
C- Foliar spraying treatments:										
Without spraying (control)	19.43	19.31	96.3	94.3	20.78	18.95	3.490	3.497	2.928	3.003
Flowering spring (NPK)	20.45	20.74	102.1	102.4	22.38	20.32	3.806	3.714	3.188	3.235
Tecamin max (amino acids)	20.65	20.90	105.7	105.0	22.74	20.57	3.828	3.721	3.725	3.243
Potassium sulphate (PS)	20.31	20.48	102.0	101.0	21.92	19.91	3.775	3.679	3.106	3.186
Ascorbic acid (AA)	20.18	20.42	99.5	100.6	21.83	19.65	3.726	3.668	3.163	3.164
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.12	0.18	1.3	1.0	0.17	0.14	0.017	0.008	0.026	0.014
D- Interactions:										
A × B	*	*	*	*	*	*	*	*	*	*
A × C	*	*	NS	*	*	*	*	*	*	*
B × C	NS	NS	*	*	*	*	*	*	*	*
A × B × C	NS	NS	*	*	*	NS	*	*	*	*

4- Interactions effect:

Regarding the effect of interactions, there are many significant effect of the interactions among studied factors on studied characters. We reported enough the significant interactions on grain yield only.

The interaction between irrigation treatments and rice cultivars cleared significant effect on grain yield/fed in the first and second seasons of this study. As seems to appear from data in Table 5, increasing irrigation intervals of IET 144 cultivar from 2 to 6 and 12 days associated with little deceases in grain yield/fed, whereas Giza 178 and Giza 177 cultivars

accompanied with huge reduction in both seasons. This means that IET 1444 cultivar was more tolerant to water stress than Giza 178 and Giza 177 cultivars. The maximum values of grain yield/fed (4.609 and 4.361 t/fed) were obtained as a result of normal irrigation schedule (irrigation every 2 days) of IET 1444 cultivar in the first and second seasons, respectively. On the other hand, the lowest values of grain yield/fed were resulted from subjected Giza 177 cultivar to high water stress (irrigation every 12 days), which were 2.208 and 2.120 t/fed in the first and second seasons, respectively.

The interaction between irrigation treatments and foliar spraying treatments had a significant effect on grain yield/fed in both seasons. Data presented in Table 6 show that, the highest values of grain yield/fed (4.384 and 4.203 t/fed) were obtained when irrigated rice planting every 2 days (control treatment) and foliar sprayed with Tecamin max fertilizer (source of amino acids) in the first and second seasons, respectively. Irrigation rice plants every 2 days and foliar sprayed with Flowering spring fertilizer (source of NPK) came in the second rank without significant differences in the second season. On the other hand, the lowest values of grain yield/fed were resulted from increasing irrigation intervals up to 12 days without foliar spraying (control treatment), which were 2.710 and 2.720 t/fed in the first and second seasons, respectively.

Table 5: Grain yield (t/fed) of rice as affected by the interaction between irrigation treatments and cultivars during 2011 and 2012 seasons.

Cultivars / Irrigation	2011 season			2012 season		
	IET 1444	Giza 177	Giza 178	IET 1444	Giza 177	Giza 178
Irrigation every 2 days (control)	4.609	3.799	4.424	4.361	3.572	4.490
Irrigation every 6 days	4.563	3.038	4.184	4.352	3.193	4.224
Irrigation every 12 days	4.349	2.208	2.354	4.317	2.120	2.274
F. test	*			*		
LSD at 5%	0.031			0.019		

Table 6: Grain yield (t/fed) of rice as affected by the interaction between irrigation treatments and foliar spraying treatments during 2011 and 2012 seasons.

Foliar spraying / Irrigation	2011 season					2012 season				
	Control	NPK	Amino acids	PS	AA	Control	NPK	Amino acids	PS	AA
Irrigation every 2 days (control)	4.046	4.350	4.384	4.330	4.277	4.008	4.195	4.203	4.154	4.131
Irrigation every 6 days	3.714	4.000	4.013	3.982	3.931	3.762	3.982	3.988	3.950	3.948
Irrigation every 12 days	2.710	3.068	3.088	3.015	2.970	2.720	2.966	2.973	2.935	2.924
F. test	*					*				
LSD at 5%	0.029					0.015				

Paddy rice yield/fed was significantly affected by the interaction between cultivars and foliar spraying treatments in both seasons. From data listed in Table 7 indicate that, the highest values of grain yield/fed (4.620 and 4.401 t/fed) were obtained as a result of foliar sprayed IET 1444 cultivar with Tecamin max fertilizer as a source of amino acids in the first and second seasons, respectively. Followed by foliar spayed the same cultivar with Flowering spring fertilizer as a source of NPK fertilizer without significant differences in both seasons. On the other hand, the lowest values of grain yield/fed were resulted from planting Giza 177 cultivar without foliar spraying, which were 2.804 and 2.817 t/fed in the first and second seasons, respectively.

The interaction among irrigation treatments, cultivars and foliar spraying treatments excreted significant effect on grain yield/fed in both seasons. The highest values of grain yield/fed (4.709 and 4.418 t/fed) were obtained when irrigated IET 1444 cultivar every 2 days and foliar sprayed with Tecamin max fertilizer as a source of amino acids in the first and second seasons, respectively (Table 8). Followed by irrigated IET 1444 cultivar every 2 days and foliar spayed with Flowering spring fertilizer as a source of NPK, then irrigated IET 1444 cultivar every 6 days and foliar spayed with Tecamin max fertilizer and then irrigated IET 1444 cultivar every 6 days and foliar spayed with Flowering spring fertilizer without significant differences among them in both seasons. On the other hand, the lowest values of grain yield/fed were resulted from irrigated Giza 177 cultivar every 12 days without foliar spraying, which were 1.990 and 1.957 t/fed in the first and second seasons, respectively.

Table 7: Grain yield (t/fed) of rice as affected by the interaction between cultivars and foliar spraying treatments during 2011 and 2012 seasons.

Foliar spraying / Cultivars	2011 season					2012 season				
	Control	NPK	Amino acids	PS	AA	Control	NPK	Amino acids	PS	AA
IET 1444	4.252	4.609	4.620	4.549	4.504	4.219	4.394	4.401	4.353	4.350
Giza 177	2.804	3.074	3.102	3.023	3.072	2.817	3.013	3.023	2.981	2.973
Giza 178	3.415	3.738	3.763	3.651	3.703	3.453	3.736	3.740	3.703	3.682
F. test	*					*				
LSD at 5%	0.031					0.015				

Table 8: Grain yield (t/fed) of rice as affected by the interaction among irrigation treatments, cultivars and foliar spraying treatments during 2011 and 2012 seasons.

Foliar spraying / Irrigation	Cultivars	2011 season					2012 season				
		Control	NPK	Amino acids	PS	AA	Control	NPK	Amino acids	PS	AA
Irrigation every 2 days (control)	IET 1444	4.363	4.697	4.709	4.652	4.622	4.273	4.409	4.418	4.376	4.384
	Giza 177	3.498	3.872	3.922	3.884	3.822	3.478	3.608	3.621	3.596	3.556
	Giza 178	4.278	4.481	4.522	4.453	4.386	4.339	4.569	4.570	4.491	4.484
Irrigation every 6 days	IET 1444	4.254	4.672	4.687	4.630	4.570	4.206	4.391	4.397	4.359	4.354
	Giza 177	2.924	3.081	3.098	3.075	3.009	3.017	3.264	3.267	3.200	3.217
	Giza 178	3.963	4.247	4.255	4.240	4.215	3.995	4.290	4.299	4.286	4.250
Irrigation every 12 days	IET 1444	4.138	4.458	4.464	4.366	4.322	4.178	4.382	4.387	4.325	4.313
	Giza 177	1.990	2.262	2.286	2.263	2.238	1.957	2.168	2.180	2.148	2.146
	Giza 178	2.004	2.485	2.513	2.416	2.351	2.026	2.349	2.352	2.332	2.312
F. test		*					*				
LSD at 5%		0.051					0.046				

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تأثير فترات الرى ومعاملات الرش الورقى على نمو وإنتاجية بعض أصناف الأرز

محسن عبد العزيز بدوى ، سعد أحمد المرسى ، صالح السيد سعده و ياسر ماهر عبد العزيز سرور
قسم المحاصيل – كلية الزراعة– جامعة المنصورة.

أجريت تجربتان حقليتان بمزرعة بقرية الأبحر – مركز الحامول – محافظة كفر الشيخ خلال موسمى ٢٠١١ و ٢٠١٢ م لدراسة سلوك بعض أصناف الأرز (IET 1444 ، جيزة ١٧٧ وجيزة ١٧٨) تحت ظروف الإجهاد المائى (إطالة فترات الرى وهى الرى كل ٢ ، ٦ و١٢ يوم) والرش الورقى ببعض الأسمدة والمركبات التى تساعد النبات على مقاومة الإجهاد المائى وتزيد من الإنتاجية والجودة وهى: بدون رش ورقى (معاملة المقارنة) ، الرش الورقى بسماد "فلاورنج سبيرنج" ، سماد "تيكامين ماكس" ، سلفات البوتاسيوم وحمض الأسكوربيك. أجريت كل معاملة من معاملات الرى فى تجربة مستقلة. ثم نفذت كل تجربة فى تصميم الشرائح المتعامدة فى أربع مكررات. حيث إحتوت الشرائح الرأسية على أصناف الأرز. بينما إحتوت الشرائح الأفقية على معاملات للرش الورقى.

أدى الري العادي كل يومان (معاملة المقارنة) إلى زيادات كبيرة في جميع الصفات المدروسة حيث أعطى أعلى القيم لتلك الصفات فى كلا الموسمين. فى حين أن رى الأرز الري كل ٦ أيام تلي معالة المقارنة مع وجود اختلافات كبيرة في كلا الموسمين. أما زيادة الإجهاد المائي عن طريق رى نباتات الأرز كل ١٢ يوما أنتج أقل القيم لجميع الصفات المدروسة في كلا الموسمين.

تفوق صنف الأرز IET 1444 بشكل كبير على كلا الصنفين المحليين جيزة ١٧٧ وجيزة ١٧٨ حيث أنتج أعلى القيم لمعظم الصفات المدروسة فى كلا المومسين.

أظهر رش نباتات الأرز بسماد تيكامين ماكس (مصدر للأحماض الأمينية) تفوقا على معاملات الرش الورقى الأخرى وأنتج أعلى القيم لجميع الصفات المدروسة في الموسمين الأول والثاني. تلى تلك المعاملة الرش الورقى بسماد فلاورنج سبيرنج (مصدر NPK) بدون فروق معنوية بينهما فى معظم الصفات ، ثم الرش الورقى بكبريتات البوتاسيوم ثم الرش الورقى بحمض الاسكوربيك في كلا الموسمين.

من النتائج المتحصل عليها فى هذه الدراسة فإنه يمكن التوصية برى الأرز صنف IET 1444 كل ٦ أيام مع الرش الورقى بسماد فلاورنج سبيرنج أو سماد تيكامين ماكس وذلك لزيادة الإنتاجية وتوفير مياه الرى ورى الأرز صنف جيزة ١٧٨ أو جيزة ١٧٧ كل يومان مع الرش الورقى أيضا بسماد فلاورنج سبيرنج أو سماد تيكامين ماكس وذلك للحصول على أعلى إنتاجية وجودة من محصول الأرز تحت ظروف منطقة الحامول – محافظة كفر الشيخ.

قام بتحكيم البحث

أ.د / احمد نادر السيد عطيه	**كلية الزراعة – جامعة المنصورة**
أ.د / بدوى حسانين	**كلية الزراعة – جامعة الازهر**