Minufiya J. Agric. Res. *Vol.39 No. 3(1): 957 - 973 (2014)* "http://www.mujar.net"

RESPONSE OF EGYPTIAN HYBRID RICE 1 TO DIFFERENT COMBINATIONS OF NITROGEN AND COMPOST LEVELS UNDER SOME IRRIGATION INTERVALS

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(Received : Nov. 6 , 2013)

ABSTRACT: *Two field experiments were carried out at the Experimental Farm, Rice Research & Training Centre, Sakha, Kafr Elsheikh Governorate, Egypt. The experiments were conducted to evaluate the effect of mineral nitrogen and compost on growth, grain yield and yield components of Egyptian hybrid rice one (EHR1) under different irrigation intervals as well as to determine water productivity.*

Irrigation treatments namely, Continuous flooding (CF), Irrigation every 6 days (6- days), and Irrigation every 12 days (12- days) Mineral nitrogen and compost rates were used as follows: T1- Control (without fertilizer) , T2- 165 kg N/ha (Recommended dose of nitrogen N), T3- 110 kg N/ha + (2.5 t/ha) compost, T4- 110 kg N/ha + (5.0 t/ha) compost, T 5- 110 kg N/ha + (7.0 t/ha) compost. The important results could be summarized as follows:

The irrigation every 6 days recorded the highest values of number of days to 50% heading, leaf area index (LAI), dry matter production (DM), plant height, panicle length, number of tillers/ m^2, number of panicle /m^2, number of total grains/plant, number of filled grains/panicle, panicle weight, 100-grain weight as well as grain and straw yields/ha. On the other hand, the maximum values of all growth and yield characters were noted in plants treated with 100% N (165 kg N/ha alone), followed by adding 110 kg N/ha + 7.0 t/ha compost (T_5) compared with the other treatments.

In respect to irrigation intervals, It was observed that continuous flooding received the highest amount of water throughout the seasons (15324 and 14656 m^3/ha) while the lowest amounts were received by irrigation every 12 days (11137 and 10292 m^3/ha) in both seasons, respectively. There were no large variation in the amounts of irrigation water input water to the stable condition, namely temperature, relative humidity and evaporation rates in both seasons. Water saved due to increasing the intervals, compared to CF, ranged from 7.44 to 27.32% in the first season, and from 8.05 to 29.78%, in the second season for 6 days and 12 days, respectively. Irrigation every 12 days considerably reduced irrigation water input, compared with continuous flooding, but, at the same time, grain yield was significantly decreased.

The results showed that the interaction between 110kg N/hat + 7.0 t/ha compost under continuous flooding recorded the highest values of Plant height, panicle length, No. of tillers/m^2, number of total grains/panicle, number of filled grains as well as grain and straw yields/ha.

From the results it could be concluded that the application of 110kg N/hat + 7.0 t/ha compost under continuous flooding produced the highest grain and straw yields/ha. Also, application 165 kg N/fed or 110kg N/hat + 7.0 t/ha under irrigation every 6 days found to be the recommended for increasing grain yield of Egyptian hybrid rice one (EHR1) cultivar under the conditions of this study .

Key words: *Egyptian hybrid rice one (EHR1) cultivar, Mineral Nitrogen, Compost, Irrigation intervals, yields, water productivity.*

INTRODUCTION

Rice is the stable food for nearly half of the world's population, most of whom live in developing countries, the crop occupies one – third of the worlds total area and consumed by 2.7 billion people (Guerra *et al.* 1998). In Egypt rice is an important cereal crop. It occupies about 600 thousand hectares, which represent about 22% of the cultivated area during summer season.

Egyptian rice production must be increase by about 20% to maintain current levels of consumption. Increasing rice production has been problem due to limited land available and water shortage (Naeem *et al.* 2010). Introduction of hybrid rice is an important step towards augmentation of rice yield. Hybrid rice yields about 15-20 % more than the promising high – yielding Commercial varieties (Chaturvedi, 2005).

The availability of water for agriculture, in particular for rice production, is threatened in many regions of the world, not only by limitations to water resources , but also by increasing in urban and industrial demand (Wopereis *et al.* 1994).

In Egypt, increase the intervals between irrigations, wherever allowed the rice fields to dry for a few days in between irrigations for six to eight days. Awad (2001) found that the grain yield was not affected by irrigation intervals, ranging from four to eight days. Belder *et al* (2005) reported that water productivity was higher, in the alternatively submerged and non submerged regimes, than in the continuous submerged regime.

Nitrogen fertilizer is one of the most important agronomic inputs and limiting factors realizing the potential rice grain production in the world. Increasing rice production can be achieved also through improving over all management system of crop culture, especially the nutrient management of the crop, as well as the proper utilization of different sources of nutrients, i.e. the natural nutrient reserve of soil, chemical, organic and bio- fertilizer. The nutrient management aims. to reduce agrochemical use and enhance soil fertility through using different sources of nitrogen fertilizer (EL-R-Rewainy *et al.* 2010).

In recent years although chemical fertilizers have widely spread throughout the world, fertilizer cost and concern for sustainable soil productivity and ecological stability, in relation to chemical fertilizer use, has emerged as an important issue (Aulakh and Singh, 1997). However, it is now realized that, in fields under intensive monoculture, which receive heavy applications of chemical fertilizers alone, there is a slow decline in productivity. This decline occurs even in irrigated paddy fields. On the other hand, over a longer period of time, applications of organic materials such as livestock manure and crop residues have been found to bring about a gradual improvement in soil productivity and crop performance.
Sustainability in crop yield and soil health could be achieved by the application of mineral fertilizers, along with organic fertilizers.

The application of organic materials, like farmyard manure, poultry manure and residual crops compost are fundamentally important in that they supply various kinds of plant nutrients, including micronutrients, improve soil physical and chemical properties and hence, nutrient holding and buffering capacity as well as consequently enhance microbial activities (Raikar, 2007). In addition organic matter continuously, releases N as plant needs it. N is the most limiting nutrient in irrigated rice systems, but, P and K deficiencies are, also, the constraints increasing grain yield for consecutive planting of rice. Prasd and Sinha (2000) found that the farmyard manure (FYM) or FYM + crop residues could substitute 50 % NPK for wheat production and their residual effect was equivalent to 50 % of the recommended dose of NPK, as a chemical fertilizer on grain yield of succeeding rice crop. To meet the current shortage of chemical fertilizers, caused by energy crisis and socioeconomic constraints it has become desirable to conserve crop residues and organic manure and recycles them into the soil to increase the efficiency of soil nutrients.

Substantial yield and water productivity gains are possible with the application of appropriate nutrients in combination with optimum water management adapted to the target environments.

Thus, the objective of the present study was to evaluate the effect of mineral nitrogen rates and compost rates on growth, grain yield and yield components of Egyptian hybrid rice one (EHR1) cultivar under different irrigation intervals as well as to determine water productivity.

MATERIALS AND METHODS

Two field experiments were conducted during 2011 and 2012 summer seasons at the Experimental Farm of Rice Research and Training Center (RRTC), Sakha, Kafr EL-Sheikh, Egypt. The average of metrological data (from May to September) of the experimental sites were 31.7 and 32.8 C° for maximum temperature;17.3 and 23.5 C° for minimum temperature; 82.14 and 81.40 % for relative humidity and 6.78 and 6.53 mm/day for pan evaporation in the two successive seasons, respectively.

A split plot design with four replicates was used in the two experiments. The main plots were devoted to the three irrigation intervals: Continuous flooding (CF), Irrigation every 6 days (6- days), and Irrigation every 12 days (12- days). The sub-plots were occupied by five fertilizer treatments as follows:

(T1) Control (without fertilizer).
(T2) 165 kg N/ha (Recommended dose of nitrogen).
(T3) 110 kg N/ha + 2.5 t/ha compost.
(T4) 110 kg N/ha + 5.0 t/ha compost.
(T5) 110 kg N/ha + 7.0 t/ha compost.

The dose of N fertilizer (in the form of urea 46.5%) was applied in three equal splits (as basal, top dressing at panicle initiation and late booting).

The two experiments were preceded by wheat. The experimental soil was clay in texture and chemical analysis is shown in Table (1). Compost fertilizer was prepared at the Gemmiza Agriculture Research Station using organic materials and subsequently applied and incorporated into dry soil of the experimental plots according to treatments. The chemical composition of compost is presented in Table (1). Seed of Egyptian hybrid rice one (EHR1) cultivar at the rate of 24 kg/ha was soaked in sufficient water for 24 hours and incubated for 48 hours to enhance germination. Pre-germinated seed were broadcasted in the presence of water after puddling the nursery. The experiments were sown on 13 th and 15 th of May in the two successive seasons. Zinc ($ZnSo_4$) as well as all other culture practices were applied as recommended for the nursery.

To avoid the lateral irrigation water movement and more water control, each main plot was separated by two meter wide ditches. Water pump provided with a calibrated water meter was used for all water measurements. Water productivity (WP) was calculated as the weight of grains per unit of water used (kg grains / m^3 water).

Five hills were randomly collected, from all treatments at booting and heading stages (75 and 90 days after sowing) to estimate dry matter production and leaf area index (LAI). Number of days from sowing to 50 % heading was recorded in each sub-plot.

At harvest (20th and 22th of September), plant height and number of panicles/ m^2 were estimated. Ten randomly panicles were collected from each sub-plot to estimate panicle length (cm), number of total grains/panicle, number of filled grains / panicle, panicle weight (g), 1000-grain weight (g).

Grain and straw yields/ha. were measured from area of 10.5 m^2 (3x3.5) and grain yield was adjusted to 14 % moisture content.

Table (1): Chemical properties of the experimental sites before planting and chemical composition of compost in 2011 and 2012 seasons.

Soil				Compost			
Properties	2011	2012	Average	Properties	2011	2012	Average
pH	7.8	8.0	7.90	C %	28.8	30.0	29.4
Organic matter %	1.70	1.60	1.65	N %	1.70	1.35	1.53
Total N ppm	460	467	463.5	C/N ratio	16.94	14.85	15.90
Available p ppm	14	15	14.5	P %	0.37	0.50	0.44
Available K ppm	469	467	468	K %	0.60	0.49	0.55
				Zn (ppm)	51	34	42.5

The analysis of variance was carried out according to Gomez and Gomez (1984). Treatment means were compared by Duncan's Multiple Rang Test (Duncan, 1955). All statistical analysis of variance were performed by means of (MSTATC) computer software package.

RESULTS AND DISCUSSION

1. Growth attributes:

The results in Table (2) revealed that the growth attributes; viz., number of days to 50% heading, leaf area index (LAI), dry matter production (DM), plant height, panicle length and number of tillers /m^2 were significantly influenced by irrigation intervals. Number of days to 50% heading was less at continuous flooding (99.18 and 99.76 days) as compared to irrigation every 6 days (100.34 and 100.66 days) and irrigation every 12 days (102.10 and 102.40 days) in both seasons, respectively. Sikuku *et al.,* (2010) found that rice plants, which watered daily, took the least days to attain 50% flowering, while, plants watered after every six days which were the most stressed plants, took the shortest duration to attain 50% flowering. Leaf area index (6.94 and 6.79), dry matter production (1823 and 1899 g/m^2), plant height (97.9 and 95.6cm) and panicle length (23.8 and 23.6 cm), showed the highest values at continuous flooding, flowed by irrigation every 6 days in the two successive seasons, however the lowest values were observed at irrigation every 12 days. Meanwhile, the differences in dry matter production between continuous flooding and 6 days intervals were statistically insignificant in 2011 season.

The reduction in dry matter accumulation and LAI might be attributed to the reduction in plant height, number of tillers/m^2, total leaf, area death of the lower leaves and plant growth, which in general affected by less available water. However, the increasing in plant height might be attributed to the significant effect of water in encouraging the cell division and elongation. Also, it might be due to favorable root growth and higher mobility of N in soil solution and its absorption by plant roots, consequently resulting in higher vegetative growth. Kato *et al.,* (2006), reported that total dry matter was increased with increasing water supply Chandrasekaran (1996), Jayakumar and Krishhasamy (2005) and El-Refaee (2012) cam to the same results.

The reduction in the number of tillers/m^2 with increasing irrigation intervals up to 12 days could be attributed to the fact that under water stress, plants had to adapt and direct most of their energy to overcome the shortage in water, so that, plants reduced their tillers to avoid the water stress. Similar results were obtained by De Datta (1981) and Gazy (2010).

Date in Table (2), revealed that growth attributes were significantly affected by fertilizer treatments (Combination between mineral fertilizer (N) and organic fertilizer (Compost)). The highest values of all studied traits were noted in plants treated with 100% N (165 kg N/ha alone) T_2, followed by adding 66% N + 7.0 t/ha compost (T_5), with significant differences among each other. While the minimum values of such traits were obtained by the control treatment (T_1). The increase in plant height, in response to application of organic compost with mineral N fertilizers, was probably due to enhancing availability of major nutrients. The available nutrients might be enhancing leaf area index, which thereby resulted in higher photo-assimilates and more dry matter production. These results are supported by the findings of Swarup and Yaduvanshi (2000) Yadana *et al.,* (2009), siavoshi *et al* (2011) and El-Refaee (2012). Also, the favorable effect of organic and mineral fertilizer application on number of tillers/m^2 and panicle length was reported by Abd El-Wahab (1998) and Abou-Khadrah (1999).

The effect of the interaction between irrigation intervals and fertilizer treatment for plant height was significant in 2012 season only, Table (3). Data showed that the tallest plants were produced with 110kg N/ha + 7.0 t/ha compost (T_5) under continuous flooding.

Panicle length was significantly affected by the interaction between irrigation intervals and fertilizer treatments in 2011 season (Table 4). The longest panicles (25.0cm) were obtained from continuous flooding (CF) with 165 kg N/ha which didn't significantly differed with the combination of continuous flooding (CF) with 110 kg N/ha + 7 t/ha organic compost.

Table 2

Table (3): Plant height (cm) of EHRI rice cultivar as influenced by the interaction between irrigation intervals and fertilizer treatments in 2012 season.

Irrigation intervals	Fertilizer treatment				
	T_1	T_2	T_3	T_4	T_5
Continuous flooding (CF)	89.6fg	96.3bc	95.5bc	97.4ab	99.3a
Irrigation every 6 days	87.6gh	92.6de	91.6ef	94.4cd	96.6bc
Irrigation every 12 days	77.7j	86.4h	80.6i	82.6i	85.8h

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT (1955).

Table (4): Panicle length (cm) of EHR1 rice cultivar as influenced by the interaction between irrigation intervals and fertilizer treatments during 2011season.

Irrigation intervals	Fertilizer treatment				
	T_1	T_2	T_3	T_4	T_5
Continuous flooding (CF)	22.7 cf	25.0 a	23.2 be	23.2 be	24.7 ab
Irrigation every 6 days	21.5 ef	24.2 abc	22.5 deF	23.5 ad	19.5 g
Irrigation every 12 days	21.7 def	21.0 fg	21.2 F	21.2 f	22.5 def

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT (1955).

Data given in Table (5) indicated that the interaction between irrigation intervals and fertilizer treatments had a significant effect on number of tillers/m^2 in both seasons. The highest number of tillers /m^2 was resulted from continuous flooding (CF) with 165 kg N/ha which didn't significantly differed with the combination of 110 kg N/ha + 7 t/ha organic compost (640 and 631.3 for T_2 & 636.3 and 631.3 for T_5) in both season, respectively, in the same trend the combination of Irrigation every 6 days with both 165 kg N/ha and 110 kg N/ha + 7 t/ha organic compost didn't significantly differed with the combination of continuous flooding (CF) with both 165 kg N/ha and 110 kg N/ha + 7 t/ha organic compost in number of tillers/m^2 character in both seasons.

2. Grain yield and its related characters:

Grain yield and its related characters (number of panicle /m^2, number of total grains/plant, number of filled grains/panicle, panicle weight, 100-grain weight and straw yield/ha) were significantly higher under continuous flooding over the irrigation every 12 days (Table 6 and 7). Grain yield and most of its attributes with irrigation every 6 days was at the second ranking compared with continuous flooding(CF). On the other hand, number of unfilled grains/panicle was increased with increasing irrigation intervals up to 12 days. These results are in accordance with those reported by Primoradian *et al.,* (2004) who indicated that water stress caused an increase in percentage of unfilled grains the highest values of grain yield were recorded by continuous flooding (CF) (12.19 and 11.78 t/ha) followed by irrigation every 6 days (11.57 and 11.05 t/ha). However, the lowest values (8.11 and 8.05 t/ha) were obtained by irrigation every 12 days. The increase in grain yield with continuous flooding (CF) could be ascribed to increasing in grain yield attributes (Tables 6 and 7). Also, such results might be interpreted by the act that available water enhanced the production and transportation of the dry matter contents to panicles, resulting in more grain filling and weight as well as higher grain yield. However increasing in grain yield with irrigation every 6 days might be due to better aeration and root system associated with higher mobility and absorption of inorganic N

Table 5

Table 6

Table 7

in soil solution, which increased the uptake of nutrients and contributed to favorable growth characters, which in turn had resulted in higher grain yield. These holds true since all grain yield attributes were affected by such condition. These results are in agreement with those obtained by Masian and Vijayjumar (1993), Peng *et al*. (1994), El-Refaee (2002), Jayajumar and Krish hassamy (2005) and El-Refaee (2012).

Application of N fertilizer and organic compost significantly affected grain yield and its attributes of EHR1 rice cultivar in seasons, (Tables 6 and 7). The highest values of number of panicles/m^2, total number of grains/panicle, number of filled and unfilled grains/panicle, panicle weight, 100-grain weight and straw yield/ha were showed in rice plants treated with 110 kg N/ha+ 7 t/ha compost (T_5), followed by that treated with 165 kg N/ha. alone (100% of recommended dose, T_2), without significant differences between them in grain yield and most of its related traits.

The maximum grain yield was observed in T_5 (110 kg N/ha + 7 t/ha compost) was 11.84 and 10.80 t/ha in both season, respectively. Such results supported the finding, in long term experiment, by Man *et al.,* (2003), who found that rice grain yield in treatment of rice straw after decomposition (6 t/ha) combined with 50% of recommended rate of mineral fertilizer was not significantly different from treatment of 100% of recommended rate of mineral fertilizer application.

Data in Table (7) showed that the grain yield/ha in both treatment of 110 kg N + 7 t/ha compost (T_5) and 165 kg N/ha did not significantly differed in both seasons indicating that organic compost could substitutes 34% of recommended dose from N in rice production. It could be attributed to enhancing the availability of plant nutrients and improving in soil physical properties by organic compost incorporation. The beneficial effect of organic fertilizer also could be attributed to continuous mineralization and release of nutrients from the organic manure compared to the application of N alone. These results are in line with the findings of Mandal *et al.,* (1991), Usmn *et al*., (2003) and El-Refaee (2012).

The effect of the interaction between irrigation intervals and fertilizer treatments was significant with respect to the number of total grains/plant and number of unfilled grains/panicle only in 2012 season (Table 8) and for grain yields/ha in both seasons (Table 8 to 10)

The combination of continuous flooding with T_5 (110 kg N/ha + 7 t/ha compost) recorded the highest values of total number of grains/panicle in second season only, while grain and straw yields/ha in both seasons followed by The combination of continuous flooding with T_2 (165 kg N/ha). In this trend, the combination of irrigation every 6 days with T_5 (110 kg N/ha + 7 t/ha compost) or T_2 (165 kg N/ha) did not significantly differed with The combination of continuous flooding with T_5 or T_2 for grain yield /ha. character in both seasons.

On the other hand, the lowest values of total number of grains/panicle and grain yield/ha were obtained by irrigation every 12 days with unfertilized plants (T_1).

Also, results in Table (8) indicated that the application of 110 kg N/ha + 7 t/ha compost (T_5) with irrigation every 12 days produced the highest number of unfilled grains/plant only in the second seasons.

3. water relations:

Data in Table (11) showed that the amount of water in put before secarting treatments, for land preparation of both nursery and permanent field, raising nursery for thirty days and through ten days after treating and before treatments application were 4170 and 3860 m3/ha in 2011 and 2012 seasons, respectively. The previous period (forty days) was considered a blank for all treatments.

Comparing the different treatments of irrigation (Table 12) it was observed that continuous flooding received the highest amount of water throughout the seasons (15324 and 14656 m3/ha) as expected while the lowest amounts were received by irrigation were 12 days (11137 and 10292 m3/ha) in both seasons, respectively. There were no large variation in the amounts of irrigation water input water to the stable condition, namely temperature, relative humidity and evaporation rates in both seasons.

Table (8): Number of total grains/panicle and number of filled grains of EHRI cultivar as affected by the interaction between irrigation intervals and fertilizer treatments in 2012 season.

Fertilizer treatments	Number of total grains/panicle			Number of unfilled grains/panicle		
	Irrigation intervals					
	CF	6-day	12-day	CF	6-day	12-day
T_1	174.1cd	154.5f	146.0f	9.0i	12.8ef	13.1def
T_2	200.1a	198.5b	153.6f	12.5fg	14.1abc	14.5abc
T_3	174.8cd	167.0de	146.8f	11.0h	13.9bcd	14.7abc
T_4	180.2bc	172.6cd	147.9f	11.2h	13.7cde	14.7abc
T_5	201.4a	188.8b	157.2ef	11.7gh	14.8abc	15.1a

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT.

Table (9): Grain yield (t/ha) of EHR1 rice cultivar as influenced by the interaction between irrigation intervals and fertilizer treatments during 2011 and 2012 seasons.

Irrigation intervals (I):	Fertilizer treatment (T)									
	(2011)					(2012)				
	T_1	T_2	T_3	T_4	T_5	T_1	T_2	T_3	T_4	T_5
Continuous flooding (CF)	8.9 de	13.5 a	12.4 b	12.6 ab	13.8 a	8.6 d	12.7 ab	11.7 bc	12.3 bc	13.5 a
Irrigation every 6 days	8.5 e	12.7 ab	11.5 c	12.2 bc	12.9 ab	8.0 d	11.7 c	11.4 c	11.8 bc	12.2 bc
Irrigation every 12 days	5.8 F	9.4 d	8.2 e	8.7 de	8.4 e	6.5 e	8.6 d	8.0 d	8.2 d	8.9 d

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT.

Table (10): Straw yield (t/ha) of HER1 rice cultivar as influenced by the interaction between irrigation interval and fertilizer treatment during 2011 and 2012 seasons.

Irrigation intervals (I):	Fertilizer treatment (T)									
	(2011)					(2012)				
	T_1	T_2	T_3	T_4	T_5	T_1	T_2	T_3	T_4	T_5
Continuous flooding (CF)	12.9g	17.6 a	16.8 abc	16.7 bc	17.4 ab	12.1fg	16.9 a	16.3 ab	16.4 a	17.2 a
Irrigation every 6 days	12.2gh	16.3 c	14.6 e	15.4 de	16.2 cd	11.7g	15.00cd	14.1cde	13.9 de	15.2bc
Irrigation every 12 days	11.5 h	14.00 F	14.1f	14.4 F	14.8eF	11.3g	14.3cde	13.8 de	13.1eF	13.4e

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT.

Table (11): Amount of applied water (m^3/ha) in rice field before starting irrigation treatments during 2011 and 2012 seasons.

Period	2011	2012
Land preparation of the nursery	250	210
Seedling raising 30 days	350	290
Preparation of permanent field	2300	2110
Ten days before starting treatments	1270	1250
Total	4170	3890

Table (12): Total water used (m^3/ha) water saved (%) and grain yield reduction as affected by irrigation intervals during 2011 and 2012 seasons.

characters	Grain yield (t/ha)		Total water used (m3/ha)		Water saved %		Grain yield reduction %	
Irrigation intervals	2011	2012	2011	2012	2011	201	2011	2012
Continuous flooding	12.19	11.78	15324	14656	-	-	-	-
Irrigation every 6 days	11.56	11.05	14185	13476	7.44	8.05	6.71	6.22
Irrigation every 12 days	8.11	8.05	11137	10292	27.32	29.78	33.83	31.18
Average	10.62	10.29	13549	12808	17.38	18.92	20.27	18.70

Water saved due to increasing the intervals, compared to cf, ranged from 7.44 to 27.32% in the first season, and from 8.05 to 29.78%, in the second season, for 6 days and 12 days respectively. Table (12). Irrigation at 12 days weight considerably reduces irrigation water input, compared with continuous flooding. But, at the same time, grain yield was significantly decreased. Noar *et al* (1994) found that continuous saturation recorded the highest water saved followed by irrigation every eight days as compare to the continuous submergence. Ebaid and El-Reface 2007, showed that rice water saved due to increasing irrigation interval compared to continuous flooding was 11.2 and 20.5% with corresponding grain yield reduction of 110 and 24.9% for irrigation every 8 days and 12 days respectively.

Among different irrigation schedules, the application of irrigation every 6 days was considered the best water productivity (WP) averaged 0.815 and 0.819 kg/m3 in the two seasons, respectively (Table 13). The high values of WP in 6 days were counted by the extremely high grain yield which statistically was the same as that obtained from continuous flooding and low water in puts in this treatment (Table 13). Masian and Vijaykumar (1993) found that maintaining 5 cm of water yielded the most rice grain in the experiment but required the highest amount of water. Other treatments consumed less water than continuous flooding but significantly yielded less. Wardana *et al.,* (2010) found that intermittent irrigation technique saved water up to 55% without affecting yields. Resulting in a 2-3 times higher water productivity, Similar results were reported by Cao et al (2002) with savings up to 36% and Bindraban *et al* (2006) with water saving up to 50% for a range of experimental condition.

Regarding the effect of fertilizer treatments on WP, the observed data showed that, over irrigation intervals recorded values ranged from 0.567 to 0.605 kg/m3 with (T_1) and from 0.855 to 0.878 kg/m3 with T_5 in both seasons, respectively (Table 13). Under all irrigation treatments, application of N fertilizers alone either with organic compost, recorded higher WP than the control treatment (T_1). High WP with N application was associated with high grain yield. The mean WP could be increased to reach its maximum values under irrigation every 6 days with T_5 (0.909 and 0.907 kg/m3) followed by T_2 (0.895 and 0.884 kg/m3) and T_4 0.860 and 0.881 kg/m3 However, the maximum values, under 12 days interval were recorded by T_2 (0.844 and 0.864) kg/m3.

Table (13): Water productivity (kg/m^3) as influenced by irrigation intervals and fertilizer treatments during 2011 and 2012 seasons.

Fertilizer treatment	Irrigation intervals							
	2011				2012			
	CF	6days	12 days	Average	CF	6days	12 days	Average
T_1	0.581	0..599	0.521	0.567	0.588	0.596	0.632	0.605
T_2	0.881	0.895	0.844	0.873	0.862	0.884	0.864	0.859
T_3	0.809	0.8110	0.736	0.785	0.802	0.845	0.779	0.809
T_4	0.822	0.860	0.781	0.821	0.839	0.881	0.799	0.839
T_5	0.901	0.909	0.754	0.855	0.872	0.907	0.838	0.878
Average	0.799	0.815	0.727	0.780	0.793	0.819	0.782	0.798

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost.

On the other hand under CF, the maximum values were recorded when T_5 0.901 and 0.872 kg/m^3 and T_2 0.881 and 0.862 kg/m^3 were used in the two successive seasons Table (13)

CONCLUSION

From the obtained results it could be concluded that the application of 110kg N/hat + 7.0 t/ha compost under continuous flooding recorded the highest grain and straw yields. Also, the application of 165 kg N/fed or 110kg N/hat + 7.0 t/ha under irrigation every 6 days found to be the recommended for increasing grain yield of Egyptian hybrid rice one (EHR1) cultivar under the condition of this study.

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استجابة هجين الأرز مصر ١ للتواليف المختلفة لمستويات النيتروجين والكمبوست تحت فترات الرى المختلفة

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الملخص العربى

أجريت تجربتان حقليتان بالمزرعة البحثية لمركز البحوث والتدريب فى الأرز بسخا – محافظة كفر الشيخ خلال موسمى ٢٠١١ و٢٠١٢ وذلك لتقييم تأثير معدلات السماد النيتروجينى وإضافة الكمبوست والتواليف المختلفة بينهما تحت فترات الرى المختلفة على النمو والمحصول ومكوناته لصنف الأرز هجين مصر ١ وكذلك تقييم انتاجية المياه.

وقد استخدم تصميم القطع المنشقة فى أربعة مكررات لتنفيذ التجربة بحيث شكلت معاملات الرى القطع الرئيسية ومعاملات التسميد المختلفة القطع المنشقة وكانت مستويات العوامل تحت الدراسة كما يلى :

أولاً : فترات الرى

١- الرى بالغمر المستمر طوال الموسم.

٢- الرى كل ٦ أيام طوال الموسم.

٣- الرى كل ١٢ يوم طوال الموسم.

ثانياً : معاملات التسميد

بدون تسميد.

١) ١٦٥ كجم نتروجين/ هكتار (فى صورة يوريا ٤٦%).

٢) ١١٠ كجم نتروجين/ هكتار + ٢.٥ طن/ هكتار كمبوست.

٣) ١١٠ كجم نتروجين/ هكتار + ٥.٠ طن/ هكتار كمبوست.

٤) ١١٠ كجم نتروجين/ هكتار + ٧.٠ طن/ هكتار كمبوست.

٥) وقد تم استخدام طريقة الشتل اليدوى فى الزراعة على مسافات ٢٠x٢٠ سم .

وتتلخص أهم النتائج المتحصل عليها فيما يلى

١- اعطى الرى كل ستة أيام اعلى القيم لصفات عدد الأيام حتى الطرد، دليل مساحة الأوراق ، إنتاجية المادة الجافة ،ارتفاع النبات ،طول الدالية ، عدد الفروع/ م٢ ، عدد الداليات / م٢ ، عدد الحبوب الكلى/ نبات ، عدد الحبوب الممتلئة / دالية، عدد الأشطاء/م^{٢} وعدد الداليات /نبات ، وزن الألف حبة ، ومحصول الحبوب ، ومحصول القش .

٢- سجلت اقصى قيم لمعظم الصفات الخضرية وصفات المحصول من النباتات المعاملة بمعدل ١٦٥ كجم نيتروجين منفردا تليها معاملة١١٠ كجم نتروجين/ هكتار(٦٦ % من النيتروجين) + ٧ طن كمبوست وذلك بالمقارنة بباقى المعاملات هذا وقد سجلت معاملة الكنترول اقل القيم لهذه الصفات.

٣- أدى إضافة النيتروجين بمعدل ١٦٥ كجم نيتروجين أو بمعدل ١١٠كجم ن / هكتار + ٧ طن كمبوست تحت نظام الغمر المستديم أعلى القيم لصفات ارتفاع النبات ، وطول السنبلة ، عدد الفروع/ م٢ ، عدد الحبوب الكلى/ دالية ، عدد الحبوب الممتلئة ، محصول القش ومحصول الحبوب بالمقارنة مع باقى المعاملات.

٤- أظهرت نتائج التفاعل ان اضافة بين ١١٠ كجم ن / هكتار + ٧ طن كمبوست تحت ظروف الرى كل ستة ايام لم تختلف معنويا فى صفة محصول الحبوب عن نفس المعاملة تحت ظروف الغمر المستديم .

٥- تشير النتائج أن معاملة رى الغمر المستديم قد استهلكت أعلى كمية من المياه خلال موسم النمو (١٥٣٢٤ و ١٤٦٥٦ م٣/ هكتار) بينما استهلك نظام الرى كل ١٢ يوم اقل كمية مياه رى (١١١٣٧ و ١٠٢٩٢ م٣/هكتار) فى كلا الموسمين على التوالى.

٦- يتضح من نتائج كلا الموسمين انه لا توجد اختلافات كبيرة فى كميات الرى تحت الظروف الثابتة من الحرارة والرطوبة النسبية ومعدل البخر .

٧- أظهرت الدراسة أن زيادة فترات الرى قد ادت الى توفير كمية مياه تتراوح بين ٧.٤٤ الى ٢٧.٣٢ % فى الموسم الاول و من ٨.٠٥ الى ٢٩.٧٨ % فى الموسم الثانى عند الرى كل ٦ و ١٢ يوم على التوالى بالمقارنه بالرى بالغمر هذا وقد ادى الرى كل ١٢ يوم الى خفض المدخل من مياه الرى معنويا بالمقارنة مع ظروفالرى بالغمر مع ملاحظة انه فى نفس الوقت قد تناقص محصول الحبوب تناقصا معنويا مقارنة بالرى بالغمر.

٨- من نتائج هذه الدراسة يمكن التوصية بإضافة النيتروجين بمعدل ١١٠ كجم ن/ هكتار + ٧ طن كمبوست / هكتار تحت ظروف الغمر المستديم والتى أعطت اعلى القيم لمحصول الحبوب ومحصول القش وأيضا يوصى باضافة ١٦٥ كجم ن/ هكتار أو ١١٠ كجم ن هكتار + ٧ طن كمبوست / هكتار تحت ظروف الرى كل ٦ أيام لزيادة محصول الحبوب من صنف الأرز هجين مصر ١.

Table (2): Number of days to 50% heading, LAI dry matter production, plant height, length and Number of tillers of EHRI rice cultivar as affected by irrigation intervals and fertilizer treatments during 2011 and 2012 seasons.

Treatments	Number of days to 50% heading		Leaf area index LAI		Dry matter production g/m^2		Plant height cm		Panicle length cm		Number of tillers/m^2	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Irrigation interval (I):												
Continuous flooding (CF)	99.18b	99.76c	6.94a	6.79a	1823a	1899a	97.9a	95.6a	23.8a	23.6a	566.5a	556.5a
Irrigation every 6 days	100.34b	100.66b	6.06b	6.48b	1722a	1766b	91.6b	92.5b	22.2b	23.1a	555.5a	541.2a
Irrigation every 12 days	102.10a	102.40a	6.38c	5.82c	1546b	1556c	81.0c	82.6c	21.5b	22.2b	532.0b	469.0b
F. test	**	**	**	**	**	**	**	**	**	**	**	**
Fertilizer treatment (T):												
(T1) No fertilizer added	97.62c	98.10c	5.53c	5.03c	1184d	1258d	84.4d	85.0d	22.0b	21.7c	472.5d	456.7c
(T_2)165 kg n/ka urea	102.24a	102.74a	7.33a	6.97a	1976a	1974a	91.9ab	91.7b	23.4a	23.5ab	603.3a	572.1a
(T_3) 110 kg n/ha + 2.5 t/ha compost	99.53b	99.86b	6.52b	6.23b	1581c	1653c	89.1c	89.2c	22.3b	22.8b	511.7c	491.7b
(T_4) 110 kg n/ha + 50 t/ha compost	100.23b	100.32b	6.86b	6.26b	1800b	1831b	91.3bc	91.5b	22.6b	23.3ab	548.3b	510.8b
(T_5) 110 kg N/ha + 7 t/ha compost	102.93a	100.14a	7.13a	7.28a	1943a	1961a	94.0a	93.9a	23.8a	23.6a	620.8a	580.0a
F. Test	**	**	**	**	**	**	**	**	**	**	**	**
Interaction I x T	NS	NS	NS	NS	NS	NS	NS	**	**	NS	**	**

**,* highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Rang Test.

Table (5): No. of tillers/m^2 of EHR1 rice cultivar as influenced by the interaction between irrigation interval and fertilizer treatments during 2011 and 2012 seasons.

	Fertilizer treatments									
	(2011)					(2012)				
	T_1	T_2	T_3	T_4	T_5	T_1	T_2	T_3	T_4	T_5
Irrigation intervals (I)										
Continuous flooding (CF)	485.0 ef	640.0 a	512.5 de	558.7 c	636.3 a	468.7 efg	631.3 a	512.5 bc	538.7 b	631.3 a
Irrigation every 6 days	470.0 f	618.7 ab	512.5 de	550 c	626.3ab	462.5 fg	607.5 a	508.7bcd	521.3 b	606.3 a
Irrigation every 12 days	462.5 f	551.3 c	510.0 de	536.3 cd	600.0 b	438.7 g	477.5 cf	453.7 fg	472.5 dg	502.5 be

T_1 = control (no fertilizer added), T_2 = 165 kg/ha, T_3= 110kg n/ha+ 2-5 t/ha compost, T_4 = 110kg/ha + + 5.0 t/ha compost and T_5 = 110kg N/ha + 7.0 t/ha compost. Means followed by the same letters are not significantly different according to DMRT(1955).

Table (6): Number of panicles/m^2, No. of total grains/ panicle, No. unfilled grains and No. of filled grains/ panicle of EHR1 rice cultivar as influenced by irrigation intervals and fertilizer treatments in 2011 and 2012 seasons.

Treatments	No. of panicles/m^2		No. of total grains/ panicle		Number of Unfilled grains		No. of filled grains/ panicle	
	2011	2012	2011	2012	2011	2012	2011	2012
Irrigation intervals (I)								
Continuous flooding (CF)	538 a	524 a	191 a	186 a	10.0 c	11.1 c	181 a	175.5 a
Irrigation every 6 days	516 b	503 a	180 b	174 b	13.9 b	13.8 b	165 b	168 b
Irrigation every 12 days	440 c	426 b	152 c	150 c	14.5 a	15.4 a	137 c	139 c
F. test	* *	* *	* *	* *	* *	* *	* *	* *
Fertilizer treatments (T)								
Control (zero fertilizer) (T_1)	422 c	410 d	162 b	158 c	11.5 c	11.6 b	150 b	154 b
165 kg N/ha (T_2)	558 a	543 a	186 a	182 a	13.2 ab	13.7 a	173 a	166 a
110 kg N/ha + 2.5 t/ha compost (T_3)	458 b	443 c	166 b	163 bc	12.7 b	13.2 a	153 b	154 b
110 kg N/ha + 5.0 t/ha compost (T_4)	485 b	473 b	170 b	167 b	13.1 ab	13.2 a	156 b	156 b
110 kg N/ha + 7.0 t/ha compost (T_5)	565 a	554 a	187 a	182 a	13.6 a	13.9 a	183 a	169 a
F. test	* *	* *	* *	* *	* *	* *	* *	* *
Interaction (I×T)	N.S	N.S	N.S	*	N.S	*	N.S	N.S

**,* highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant. Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Rang Test.

Table (7): Panicle weight (g), 1000 grain weight (g), grain yield (t/ha) and straw yield (t/ha) of EHR1 rice cultivar as influenced by irrigation interval and fertilizer treatment in 2011 and 2012 seasons.

Treatments	Panicle weight (g)		1000 grain weight (g)		Grain yield (t/ha)		Straw yield (t/ha)	
	2011	2012	2011	2012	2011	2012	2011	2012
Irrigation intervals (I):								
Continuous flooding (CF)	4.2 a	3.9 a	25.1 a	24.9 a	12.19 a	11.78 a	16.30 a	15.80 a
Irrigation every 6 days	3.6 b	3.5 b	24.5 a	24.3 b	11.57 b	11.05 b	14.93 b	14.01 b
Irrigation every 12 days	3.3 b	3.2 b	23.1 b	22.6 c	8.11 c	8.05 c	13.77 c	13.19 c
F. test	**	**	**	**	**	**	**	**
Fertilizer treatments (T)								
Control (zero fertilizer) (T_1)	3.2 c	3.2 b	23.2 c	22.8 d	7.74 d	7.71 d	12.23 c	11.72 b
165 kg N/ha (T_2)	4.0 a	3.8 a	24.8 ab	24.6 ab	11.64 ab	11.03 ab	15.99 a	15.41 a
110 kg N/ha + 2.5 t/ha compost (T_3)	3.5bc	3.4 b	23.7 bc	23.6 cd	10.73 c	10.39 c	15.16 b	14.76 a
110 kg N/ha + 5.0 t/ha compost (T_4)	3.8ab	3.5 ab	24.1abc	23.9 bc	11.19 b	10.80 bc	15.48 ab	14.50 a
110 kg N/ha + 7.0 t/ha compost (T_5)	4.1 a	3.9 a	25.3 a	25.0 a	11.82 a	11.53 a	16.13 a	15.86 a
F. test	**	**	**	**	**	**	**	**
Interaction (I×T)	N.S	N.S	N.S	N.S	**	**	**	**

**,* highly significant and significant at 0.01 and 0.05 levels, respectively. NS= Not Significant.
Means of each factor designated by the same latter are not significantly different at 5% level using Duncan's Multiple Rang Test.