THE INFLUENCE OF SOME IRRIGATION WATER SOURCES AND NITROGEN LEVELS ON GROWTH AND PRODUCTIVITY OF RICE UNDER NEWLY RECLAIMED SOIL CONDITIONS

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Abstract

Two water sources i.e. normal irrigation water and recycled irrigation water (drained from fish culture units) besides four nitrogen levels i.e. control, 40 , 80 and 120 kg N/fed. were utilized to determine their effect on growth and yield and its components of the rice variety Giza 178 under newly reclaimed soil conditions during 2001 and 2002 seasons.

It could be concluded that plant height and no. of days to heading were not significantly affected by different irrigation water forms. Meanwhile, recycled irrigation water caused a significant increase in the means of no. of tillers/m^2, in both seasons. Furthermore, different nitrogen levels affect significantly the means of all studied characters. The highest increase was detected at 120 kg N/fed. From another point of view, the interaction between the two factors (water sources and nitrogen levels) was not significant in general except in 2001 season for no of tillers/m^2.

In addition most of yield and yield component characters were significantly affected by using the recycled water in irrigation. Increasing nitrogen levels resulted in a gradual increase in the yield component characters that significantly influenced grain yield as a final result. On the other hand, the interaction between irrigation water sources and nitrogen levels was significant for all number of panicles/m^2 and 1000 grain weight in 2002 season only. This could lead to the conclusion that both studied factors had indepentally affect on most of yield and its attributes.

INTRODUCTION

In recent years, due to the limitation of irrigation water and the increasing demand of water for the new national agricultural projects, the agricultural policy in Egypt turn towards decreasing the rice area to overcome the water shortage and to save water for other needs since rice is a high water consuming crop.

Many research areas were opened to solve this problem and they recommended the following steps. First, breeding for earliness, and second, improving agronomic practices which save water and increase water use efficiency. On the other hand, because of the limitation of irrigation water from the River Nile, utilization of some other sources of water must be studied. In the same direction, the utilization of the aforeused water such as drainage water and aquaculture water needs to be studied as recycling irrigation water.

Abd-Allah (1995) reported that the use of drainage water in irrigation caused high increase in EC of the saturated soil extracts. The increase of EC with applying the mixed water was lower than that of drainage water alone. El- Mardi et al. (1995) reported that the effect of waste water on the vegetative and reproductive growth stages of some crops were assessed. Moreover, Amira (1997) found that using drainage water in irrigation showed a reduction in yield,

From another point of view, nitrogen levels influence grain yield through its effect on the vegetative and reproductive stages. The amounts of nitrogen fertilizer applied have gradually increased with the spread of newly improved cultivars. However, the heavy dose of nitrogen fertilizers applied to rice field lead to a high risk of contaminating the surface and ground water by nitrates and may also lead to salinization of the soil.

Badawi and Mahrous (1985) indicated that the nitrogen level had a highly significant effect on all components of grain yield of rice. Salam and Subramanian (1989) found that grain yield, no.of filled grains / panicle, number of panicles/ m^2, and 1000 grain weight increased with increasing nitrogen levels from zero up to 120 kg N/ha. Bassal *et al* (1996) stated that raising nitrogen fertilizer rate up to 60 Kg N/fed significantly increased grain yield of rice and its attributes. Ke-Fuyuan *et al* (1997) indicated that N is the yield limiting factor of rice compared to the control (no fertilizer). Badawi (2002) reported that increasing nitrogen level from zero to 96 kg nitrogen per hectare resulted in significant progressive increase in grain yield /ha.

Keeping in view the importance of these factors, the present investigation aimed to study the effect of different sources of irrigation water together with different nitrogen levels on rice growth and productivity under newly reclaimed soil conditions.

MATERIALS AND METHODS

This investigation was carried out at the experimental farm of the Faculty of Agriculture (Saba Basha), Alexandria University during 2001 and 2002 seasons to determine the effect of two sources of irrigation water and four levels of nitrogen fertilization on some growth , yield and its component characters of the rice variety Giza 178. This farm is allocated in the newly reclaimed soil at South of Alexandria Governorate (Ebis).

Two sources of irrigation water were used i.e., normal irrigation water (NW) , and recycled irrigation water drained from fish culture units (RUW). The chemical analysis of the two forms of irrigation water are presented in Table (1). In addition, 4 nitrogen levels (control , 40, 80 and120 kg N/fed) in the form of urea (46.5% N) were utilized.

Split plot design with four replicates was used in both seasons. The water irrigation sources were assigned as the main plots and the nitrogen levels were randomized within each sub-plot. The size of each sub-plot (experimental unit) was 3x3.5 m . Nitrogen was added in two doses, the first dose was added and incorporated in the dry soil before puddling, while the second dose was added at 25 days after transplanting.

Pre-germinated seeds of the rice variety Giza 178 were broadcasted in the nursery. Thirty days old seedlings were transplanted (3 seedlings / hill) in the permanent field and hills were spaced at 20x20 cm (25 hills /m2). The ordinary rice water règime management (4 days on and 6 days off) was allowed for the two irrigation water treatments. The field was kept free of weeds, and the other agronomic practices for rice cultivation were followed as recommended.

Table 1. The chemical analysis of the two sources of irrigation water

Parameter	Normal water	Recycled water
Ph (acidity)	8.3	9.0
E.C.(Salinity)	4.5	4.9
T.H. (Ca+Mg) Degree of water hardness	850.8	705.7
Ca ++ (Calcium)	240.2	100.1
NH3 (Amonia)	0.99	0.6
NO3 (Nitrate)	0.42	0.42
NO2 (Nitrite)	1.12	0.35
T.P.	2.25	1.49
O.P.	0.63	0.14
SO2	180	230 mg/l.
H2S Hydrogen Sulphate	2.8	3.5 g/l
Pb (Lead)	0.03	0.23 p.p.m.
Zn (Zinc)	0.23	1.03 p.p.m.
O2 (Oxygen)	6.5	3.5 mg/l
PO 4 Phoshate)	0.41	2.1
Fe (Iron)	1.57	1.9 p.p.m.
Cu (Cupper)	0.04	0.12 p.p.m

Studied characters:

A . Growth characters:

1- Number of days to heading.

2- Plant height (cm)

3- Number of tillers/ m^2

B. Yield and yield components

1- Number of panicles/m^2

2- Number of filled grains/panicle

3- One thousand grain weight (g)

4- Grain yield (t/fed)

All data collected were subjected to statistical analysis as described by Gomez and Gomez (1984). The mean values were compared by Duncan Multiple Range Test (Duncan 1955).

RESULTS AND DISCUSSION

A. Growth characters

1. Number of days to heading (days):

It is obviously seen that this character was not affected significantly by the different treatments of irrigation water in 2001 and 2002 growing season. The data indicated that heading was delayed when the recycling irrigation water was used in the two seasons, however, this delay was not significant (Table 2).

Concerning the effect of different nitrogen levels on no. of days to heading, data in table (2) showed that highly significant differences were estimated between different nitrogen levels. The heading was delayed by 9 to 10 days when nitrogen level increased from zero to 120 kg N/fed.

These findings could be attributed to the fact that increasing nitrogen levels enhances the rice plant to produce more green canopy and this in turn causes a delay in heading. Similar results were obtained previously by Mukhi and Shukoi (1991) and Peng and Li (1991).

Furthermore, data in table (2) demonstrated that the interaction between different water treatments and nitrogen levels on no. of days to heading was not significant in the two seasons. This result indicated that these factors affected the aforementioned traits independently.

2. Plant height (cm)

Data cited in Table (2) reveal insignificant differences in plant height as affected by the two irrigation water treatments. This result shows the possibility of using any of these two irrigation water sources in rice cultivation with no significant effect on plant height.

Furthermore, data in Table (2) indicate that the successive increase in nitrogen levels from zero to 120 kg /fed. resulted in a progressive increase in plant height in both seasons.

This increase in plant height could be attributed to the more cell elongation of the internodes resulted from adequate supply of nitrogen fertilization. This promoting effect of nitrogen on plant height was reported also by Thakur (1993), Abd el-Rahman (1997), Abd-el-Wahab (1998) and Badawi (2002).

Table 2. The effect of water sources and nitrogen levels on some growth characters.

Main effect & interaction	No. of days to heading		Plant height (cm)		No. of tillers/m^2	
	2001	2002	2001	2002	2001	2002
Water sources (W)						
Normal water	90.82	89.54	94.37	96.76	233	242
Recycled water	91.74	91.12	95.32	97.49	242	252
F- test	n.s	n.s	n.s	n.s	*	*
Nitrogen levels(N)						
Zero	87.65	86.59	91.7	93,84	215.5	222.5
40	90.43	90.28	93.39	96.16	229.0	245.0
80	94.71	95.06	96.63	98.39	248.5	254.0
120	96.88	97.13	97.66	100.19	257.0	265.0
F- test	**	**	**	**	**	**
Interaction W x N	n.s	n.s	n.s	n.s	*	n.s

* & ** : Significant and highly significant at 0.05 and 0.01, respectively

The interaction between different irrigation water sources and nitrogen levels on plant height was not significant in the two seasons of study.

3. Number of tillers /m^2:

Data in table (2) indicate that the number of tilles/m^2 was affected significantly by irrigation water sources in the two seasons. The highest values of the mentioned traits were recorded when recycled irrigation water was used. These results are in agreement with that obtained by Kogano et al (1991).

Further, data in Table (2) showed highly significant effects of the different nitrogen levels on number of tiller/m2 in both seasons. Number of tillers/m2 was significantly higher at the rate of 120 kg N/fed., than those of zero, 40 and 80 kg N/fed. in the two seasons. The favorable effect of nitrogen levels on number of tillers/m2 was reported also by Reddy (1986), Andrade and Neto (1996) and Abd El-Wahab (1998).

The interaction between irrigation water sources and nitrogen levels on number of tillers/m2 was significant in 2001 season only, (Table 3).

Table 3. The interaction between irrigation water sources and nitrogen levels on number of tillers/m^2 character during 2001 season.

Nitrogen level	Number tillers /m^2	
	Normal water	Recycled water
Zero	213	218
40	225	233
80	240	251
120	254	260
L.S.D.0.05 (W) (N)	3.808 6.302	

B. Yield and yield components :

1- Number of panicles/m²

Number of panicles/m^2 as affected by different sources of irrigation water are presented in Ttable (4). The results indicated that the irrigation by recycled water gave the highest number of panicles/m^2 compared with irrigation by normal water in the two seasons of study. This could be attributed to the differences in the chemical composition of both types of irrigation water. These results are in a partial agreement with those obtained by Kogano *et al* (1991) and Nour *et al.* (1997).

In addition, data in table (4) show that the successive increase in nitrogen level from zero to 120 kg/fed, resulted in a progressive increase in number of panicles/m2 in the two seasons. Such result indicated that with higher level of nitrogen, more tillers develop a panicle. The promoting effect of nitrogen on number of panicles/m2 was reported by Salam and Subramanian (1989) and Abou – Khadrah *et al.* (1999).

The interaction between water forms and nitrogen levels on number of panicles/m^2 was significant in 2002 season only. As a conclusion, using 120 kg N/fed. together with recycled water produced a significantly higher number of panicles/m^2 in this season only (table 5).

2. Number of filled grains/ panicle :

Data in Table (4) revealed that number of filled grain/panicle was not affected in 2001 season by different irrigation sources. Meanwhile, it was significantly effected in the second season. While the recycled irrigation water resulted in an increase in number of filled grain/panicle.

Table 4. The effect of irrigation water sources and nitrogen levels fertilization on yield and its components characters.

Main effect & interaction	No. of Panicle /m^2		No.of filled grains panicle		1000grains weight (gm)		Grain yield (t/f)	
	2001	2002	2001	2002	2001	2002	2001	2002
Water sources (W)								
Normal water	188.25	192.25	105.83	103.91	21.80	20.20	1.515	1.593
Recycling Water	194.50	198.50	119.83	126.41	23.28	24.21	2.588	2.703
F.Test	**	**	*	*	**	**	**	**
Nitrogen levels (N)								
Zero	178.50	181.00	99.83	102.16	17.25	16.55	1.350	1.475
40	184.50	191.00	109.49	112.99	19.94	20.04	1.805	1.910
80	198.50	202.50	125.00	126.49	22.37	23.710	2.820	2.320
120	204.00	207.00	135.99	138.99	24.68	24.54	2.930	2.885
F.Test	**	**	**	**	**	**	**	**
Interaction WxN	n.s	*	n.s	n.s	n.s	n.s	n.s	n.s

* and ** Significant and highly significant at 0.05 and 0.01, respectively.

Furthermore, data given in Table (4) indicate that highly significant effect of nitrogen fertilization on number of field grains/panicle was found in 2002 season. In both seasons, the increase in nitrogen fertilizer level resulted in a progressive increase in this trait, although this increase was not significant in the first season. Thus, nitrogen appears to increase the number of fertile spikelets of the panicle which set a grain. Under shortage of nitrogen, the setting of seeds was impaired. The favorable nitrogen effect on number of grains/panicle was reported by Badawi and Mahrous (1985) and Andrade and Neto (1996) and Badawi (2002)

Table 5. The interaction between irrigation water sources and nitrogen levels on number of panicles/m^2, and 1000 grain weight (g).

Year	Nitrogen level	No.of Panicle/m^2		1000grain weight (gr)	
		Normal Water	Recycled Water	Normal Water	Recycle Water
2002	Zero	177	185	17.50	16.59a
	40	187	195	19.88	20.20
	80	199	206	22.32	23.60
	120	206	208	24.61	24.60
L.S.D.0.05	W	1.89		0.112	
	N	2.188		0.036	

3- One thousand grain weight (g)

The mean values of 1000 grain weight in both 2001 and 2002 seasons are given in Table (4). The analyzed data indicated that there were significant differences for the effect of the studied factors on the mentioned character during 2001 and 2002 seasons. There was a significant effect for irrigation water sources effect on 1000 grain weight. The results indicated that this character tend to increase when recycled water was used..

Table (4) further shows that the 1000-grain weight was affected significantly by nitrogen rates in the two seasons. At 120 kg N/fed, 1000 grain weight increased significantly as compared with the control treatment during both seasons.

Nitrogen effect on 1000-grain weight was reported by Abd El Rahman (1997). Meanwhile , Badawi et al (1990) found that 1000-grain weight decreased as nitrogen level was increased. The interaction between nitrogen levels and the water sources on this character was not significant in 2001 season. Meanwhile, it was highly significant in the second season. Using recycled irrigation water accompanied by 120 kg N/fed gave the highest 1000-grain weight (Table 5).

4- Grain yield (T/fed):

It is clear from Table (4) that the highest grain yield per fed was obtained by recycled irrigation water, while the lowest value was resulted from normal irrigation water in both seasons. Grain yield was increased from 1.515 to 2.568 ton/fed and from1.593 to 2.703 tons/fed when recycled irrigation water was used compared with the normal irrigation water in the two seasons, respectively.

Furthermore, data in Table (4) show that grain yield was high significantly influenced by nitrogen levels in both seasons. Increasing nitrogen level from zero to 120 kg/fed. resulted in a progressive increase in grain yield. The highest numerical grain/yield fed. produced in both seasons of study could be attributed to the highest number of panicles/m^2 and to the highest number of filled grain/panicle. Similar increase in grain yield due to nitrogen fertilization was reported by Badawi et al (1990), Singh *et al.* (1991), Singh and Pillai (1994), EL-Kady and Abd El-Wahab (1999) and Badawi (2002)

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دراسة تأثير بعض مصادر مياه الرى ومستويات التسميد النيتروجينى على صفات النمو والمحصول ومكوناته فى الأرز تحت ظروف الأراضى حديثة الإستصلاح

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أجريت هذه الدراسة لدراسة تأثير بعض مصادر الرى وبعض مستويات التسميد النيتروجينى على صفات النمو والمحصول ومكوناته لصنف الأرز جيزة ١٧٨ وذلك تحت ظروف الأراضى حديثة الإستصلاح لمزرعة كلية الزراعة – سابا باشا – جامعة الإسكندرية خلال موسمى ٢٠٠١ ، ٢٠٠٢ . استخدم فى هذه الدراسة نوعان من مياه الرى وهى مياه رى عادية ومياه رى معاد استخدامها ناتجة من صرف مزرعة سمكية كما استخدمت أيضا أربعة مستويات تسميد هى صفر ، ٤٠ ، ٨٠ ، ١٢٠ كجم نيتروجين / فدان)

عند دراسة بعض صفات النمو أوضحت النتائج أنه لا يوجد تأثير معنوى لنوعى مياه الرى على صفتى عدد الأيام للتزهير وطـــول النبات بينما زاد عدد الأفرع / م٢ زيادة معنوية فى موسمى الدراسة وذلك عند الرى بواسطة المياه المعاد تدويرها ومن ناحية أخرى أدت الزيادة فى مستويات التسميد النيتروجينى إلى زيادة معنوية فى هذه الصفات حيث زادت عدد أيام التزهير بمقدار ٩ – ١٠ أيام وزاد طول النبات بحوالى ٥,٩٦ – ٦,٢٥ سم وزادت أيضـــا عـــدد الأفرع / م٢ تدريجيا حتى مستوى ١٢٠ كم / للفدان

مـــن ناحية أخـــرى – أوضحت النتائج أيضا أن التفاعل بين نوعى مياه الرى ومستويات التسميد لم يكن معنويا فى صفتـــى عدد أيام التزهير وطول النبات بينما كان معنويا فى حالة صفة عدد الأفرع/ م٢ فى موسم ٢٠٠١ فقط

وأما بالنسبة لصفات المحصول ومكوناته فقد أوضحت النتائج أن عدد النورات/ م٢ ووزن ١٠٠٠ حبة وكذلك المحصول/ فدان زادت معنويا عند استخدام المياه المعاد تدويرها بينما لم تتأثر صفة عدد الحبوب الممتلئة / سنبلة.

كما ازدادت متوسطات جميع هذه الصفات بزيادة معدل التسميد النيتروجينى حتى ١٢٠ كم نيتروجين / فدان وذلك فى كل من موسمى الزراعة وقد أوضحت النتائج أيضا أن التفاعل بين عاملى الدراسة كان معنويا بالنسبة لصفتى عدد النورات / م٢ ووزن ١٠٠٠ حبة وذلك فى موسم ٢٠٠٢ فقط.