Egypt. J. Agric. Res. , 78 (2), 2000

PRODUCTIVITY OF GIZA 177 RICE VARIETY GROWN AFTER DIFFERENT WINTER CROPS AND FERTILIZED WITH DIFFERENT NITROGEN LEVELS

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(Manuscript received 22 August, 1999)

Abstract

Two field experiments were conducted at the Rice Research and Training Center (Etai El-Baroud Agricultural Research Station Farm) to study the effect of different preceding crops and different nitrogen fertilizer levels on the productivity of Giza 177 rice cultivar in two consecutive seasons (1996 and 1997). Rice was grown after clover, broad bean, red radish and wheat. Nitrogen fertilizer was applied to the rice crop at the rate of 0, 96 and 144 kg N/ha in the urea form. The main results indicted that increasing nitrogen levels up to 144 kg/ha significantly increased plant height, panice length, plant biomass, grain yield and yield and yield components as well as harvest index in the two growing seasons regardless of the previous crop. Highest values of yield and yield components were obtained when rice was grown after legume crops followed by red radish, while the lowest values of these traits were obtained when rice was grown after wheat in both seasons. Data showed also that nitrogen controgen content and uptake increased significantly by increasing the nitrogen fertilizer level to 144-kg N/ha. Higher agronomic efficiency (kg rice/kg nitrogen applied) was found when rice was grown after legume crops and fertilized with 96 kg N/ha. The study concluded that 96 kg N/ha was the optimum and economical dose for reasonable productivity of Giza 177 when grown after legume crops and 144 kg N/ha if grown after non legume crops.

INTRODUCTION

Rice (*Oryza sativa*, L.) is one of the major cereal crops in Egypt. Its importance lies not only in being a basic food for the majority of the population, but also in its role as an export crop. In North Delta of Egypt, rice is grown as a summer crop alternately with corn or cotton in a three year crop rotation after either legume (clover and broad bean) or non-legume crops (flax, barley, wheat, sugar beet and red radish) as winter crops. These preceding crops play a dominant role in the production of rice. Inclusion of legumes in the cropping pattern with rice would improves soil fertility by supplying organic material to the soil (Tisdall and Oades, 1982), and through the activity of their living roots (Reid and Coss, 1981). The importance of legumes attributed to the deposition of the atmospheric nitrogen in the soil through biological nitrogen fixation which enhances soil fertility (Gorge et al, 1992).

Rice grain yield and its components responded to nitrogen up to 96 kg/ha or 144 kg/ha when preceded by clover or barley, respectively (Abd El-Wahab et al 1993).

Nitrogen fertilizer is the most important nutrient for rice and its deficiency shows almost everywhere unless nitrogen is applied as fertilizer. Low land rice is more dependable on soil fertility than on fertilizer. A Significant increase in rice grain was obtained by raising nitrogen levels up to 30 kg N/fed (Badawi, 1977), 40 kg N/fed (Mahrous and Badawi, 1986).

This study aimed to investigate the effect of previous crops on yield and their impact on rice under different nitrogen levels.

MATERIALS AND METHODS

This investigation was carried out at the Experimental Farm of Etai El-Baroud Agricultural Research Station (Agricultural Research Center) during 1996 and 1997 rice seasons to study the effect of different previous crops and nitrogen levels on productivity of Giza 177 rice cultivar. Clover, broad bean, red radish and wheat were the previous crops to rice. Three nitrogen levels were used namely, 0, 96 and 144 kg N/ha in the urea form (46.5% N) as recommended in two splits (2/3 basal and incorporated into the dry soil and 1/3, 7 days before panicle initiation).

Three seedlings, 25 days old were transplanted in hills spaced 15 cm and 20 cm between rows in 3 x 5 m plots. All culture practices were applied as recommended for the variety.

A representative soil sample was taken at the depth of 0-30 from soil surface then subjected to chemical analysis according to the standard methods.

Split plot design with four replications was used, previous crops were allocated in the main plots, and nitrogen levels in the sub plots.

At harvest, plant height and number of productive tillers/hill were estimated. Ten main panicles were randomly collected from each plot for estimating panicle length, panicle weight, number of grains/panicle and 1000 grain weight. Ten guarded

Table 1. Some chemical properties of the experimental sites

Preceding Crops	EC	pH	N%	O.M%
Clover	1.6	8.05	0.05	1.30
Broad bean	1.3	8.00	0.08	1.20
Red radish	1.8	8.00	0.08	1.05
Wheat	1.4	8.16	0.03	0.98

Table 2. Effect of previous crop and nitrogen levels on rice plant height, panicle length and number of panicles.

Main effect	plant height		plant length(cm)		Number of panicles / m2	
	1996	1997	1996	1997	1996	1997
Previous crop						
Clover	90.0 a	91.7 a	19.4 a	19.9 a	979.2 a	475.0 a
Broad bean	89.8 a	92.3 a	19.0ab	19.3 b	474.6 a	471.1 a
Red radish	86.1 b	86.5 b	18.7 b	18.4 c	445.0 b	442.9 b
Wheat	83.9 b	85.7c	18.4 b	17.8 d	411.0 c	407.1 c
N level Kg/ha						
0	82.9c	83.7 c	17.8 c	18.0 b	412.5 c	411.4 c
96	85.8b	87.3 b	18.8 b	18.8 b	457.0 b	444.5 b
144	93.6a	96.3 a	20.0 a	19.6 a	487.8 a	491.2 a
Interaction F test	NS	NS	NS	NS	**	**

Means of followed by the same letter in each colamn are not significantly different at the 5% level according to Duncan's multiple range test.

Fig.1: Number of rice panicles as affectd by the interaction between previous crops and N-levels (1996).

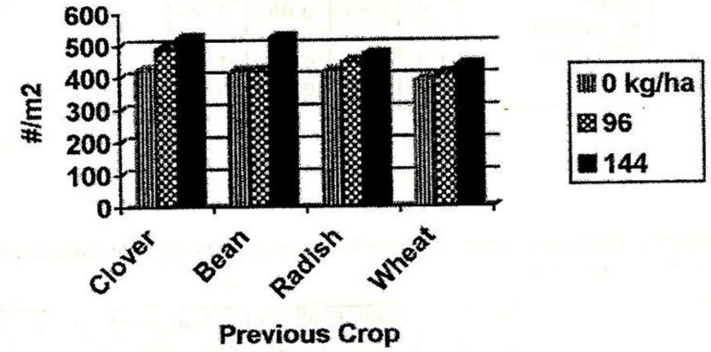
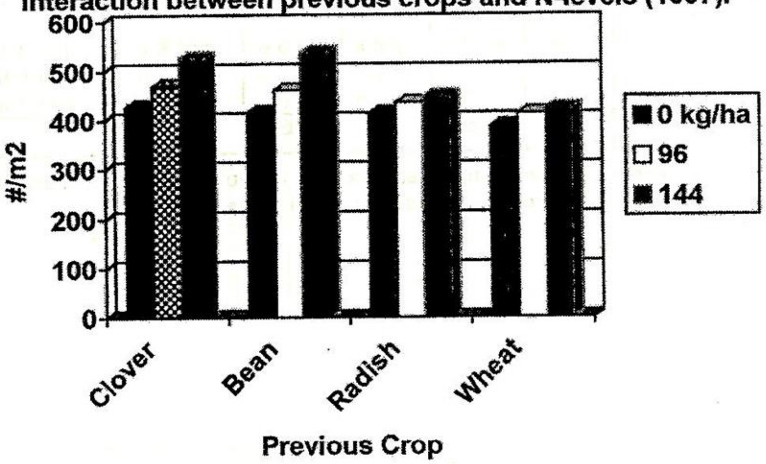


Fig.2: Number of rice panicles/m2 as affected by the interaction between previous crops and N-levels (1997).



square meters were harvested and threshed for grain and straw yields estimation. Grain yield was adjusted to 14% moisture cotent. Grain and straw samples were collected dried, ground and nitrogen content determined by the standard micro-Kjeldahl method. Nitrogen uptake was computed on the dry weight basis. Agronomic efficiency was computed according to the following equation

Agronomic efficiency = Grain yield of fertilized rice -grain yield of unfertilized plots/ amount of nitrogen applied (kg).

All data collected were statisically analyzed according to Gomez and Gomez, (1984) and presented in tables and illustratedi in figures.

RESULTS AND DISCUSSION

Plant height, panicle length and number of panicles per unitm area as affected by different preceding crops and nitrogen levels are presented in Table 2. Data indicated that tallest plants were observed when rice was grown after either clover or broad bean (legume crops). On the other hand plants grown after either red radish or wheat were short with short panicles and less panicles per unit area. This could be attributed to nitrogen contributed from residual soil nitrogen and greater uptake of soil nitrogen by the rice crop, after legume crops than after non-legume crops. Data also showed that increasing nitrogen fertilizer up to 144 kg/ha, significantly increased plant height, panicle length and number of panicles in both seasons. Highest values of these traits obtained when 144 kg N/ha was applied. similar findings were reported by Sernaratne and Hardarsn (1988), George et al (1994) Ladha et al (1996) and El-Wehishy (1998).

The interaction between nitrogen nitrogen levels and previous crop had no significant effect on pl) ant height and panicle lenth but number of productive tillers was significantly affected as shown in Table 2. Data showed that higher number of panicles were obtained when higher nitrogen rate. (144 kg N/ha) was combined with legume crops either clover or broad bean in both seasons. This is due to the higher residual nitrogen after legume crops than after non-legume crops. So higher amounts of nitrogen were available to the rice plant particularly when the available soil nitrogen is low as shown from the soil chemical analysis (Table1).

Interaction between nitrogen levels and different previous crops has a significant effect on number of panicles/m2 at the two growing seasons (Fig.1 and 2). Date

Table 3. Effect of previous crop and nitrogen levels on some yield components.

Main effect	Panicle weight (g)		Number of grain/ panicle		1000-grain weight (g)	
	1996	1997	1996	1997	1996	1997
Previous crop						
Clover	3.03 a	2.98 a	105.2 a	103.8 a	24.3 a	24.0 a
broad bean	2.93 b	2.97a	99.8 b	99.8 b	23.8 a	23.6 a
Red radish	2.87 b	2.85 a	99.9 b	98.3 b	22.8 b	22.3 b
Wheat	2.56 c	2.53 c	94.3 c	94.4 c	22.6 b	21.8 b
N level Kg/ha						
0	2.66 c	2.58 c	96.4 c	92.9 c	21.8 b	21.6 c
96	2.85 b	2.86 b	99.4 b	99.2 b	23.8 a	22.8b
144	3.04 a	3.05 a	103.6a	102.9a	24.4 a	24.4 a
Interaction F test	NS	NS	*	NS	NS	NS

Means followed by the same letter in each colamn are not significantly different at the 5% level according to Duncan's multiple range test.

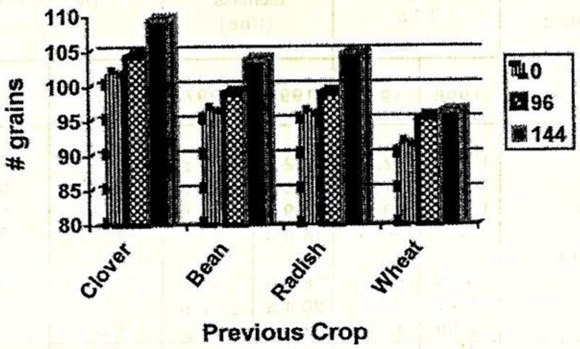


Fig. 3. Number of grains per rice panicle as affected by the interaction between previous crops and N-levels (1996).

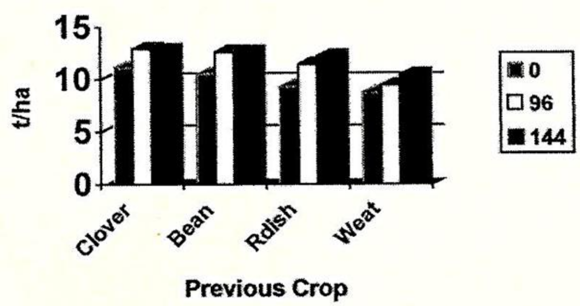


Fig. 4. Grain yield of rice as affected by the interaction between previous crops and N-levels (1997).

Table 4. Effect of previous crop and nitrogen levels on rice grain yield, biomass and harvest index.

Main effect	Grain yield T/ha		Biomass (t/ha)		Harvest index %	
	1996	1997	1996	1997	1996	1997
Previous crop						
Clover	12.3 a	12.3 a	22.2 b	22.3 a	55.0 a	55.0 a
broad bean	11.8 a	11.9 a	29.8 a	22.3 b	56.0a	56.0 a
Red radish	11.1 b	10.9 a	19.9 c	20.0 b	55.0a	55.0 a
Wheat	9.2 c	9.5 c	18.0 d	18.3 c	51.0 b	52.0 b
N level Kg/ha						
0	9.8 b	9.9 b	18.4 b	18.9 c	53.0 b	52.0 b
96	11.4 b	11.6 a	20.4 a	20.8 b	55.0 a	56.0 a
144	12.0a	11.9 a	21.8 a	21.8 a	55.0 a	55.0 a
Interaction	NS	*	NS	NS	NS	NS

Means followed by the same letter in each column are not significantly different at the 5% level according to Duncan's multiple range test.

Table 5. Nitrogen cotent and nitrogen yield of rice as affected by different nitrogen levels and different previous crops.

Year	Main effect	N content%		N-yield kg/ha		Total N Kg/ha
		Grain	Stra w	Grain	Straw	
1996	Previous crop					
	Clover	1.13 a	0.21 b	138.99a	20.79c	159.78 b
	Broad bean	1.15a	0.62a	135.70b	28.60a	164.30 a
	Red radish	0.92 a	0.29 b	102.12c	25.52b	127.64 c
	Wheat	0.88 a	0.21 b	80.96d	18.48c	99.44 d
	Nitrogen Kg N/ha					
	0	0.82 c	0.18 c	80.36c	14.45c	94.81 c
	96	1.02 b	0.25 b	116.28b	23.13b	139.41 b
	144	1.22 a	0.31 a	146.40a	34.79a	181.19 a
	Interaction F test	NS	NS	NS	NS	NS
1997	Previous crop					
	Clover	1.81 a	0.24a	143.66a	24.00b	161.30b
	Broad bean	1.64 a	0.29a	139.07b	30.16a	165.63a
	Red radish	1.00 b	0.21 b	109.00c	18.90c	127.90c
	Wheat	0.97 b	0.20 b	92.15 d	17.60c	109.67d
	Nitrogen Kg N/ha					
	0	0.89c	0.19 c	87.57c	17.10c	104.67c
	96	1.09 b	0.24 b	126.44b	24.96b	151.40 b
	144	1.25 a	0.29 a	148.75a	28.71a	177.46 a
	Interaction F test	NS	NS	NS	NS	NS

Means followed by the same letter in each column are not significantly different at the 5% level according to Duncan's multiple range test.

Table 6. Agronomic efficiency as affecteed by previous crop nitrogen levels

Previous crop	Nitrogen	
	69	144
Clover	18.75	11.81
Broad bean	21.88	14.58
Red radish	21.88	20.14
Wheat	7.29	11.81

showed that highest number of panicles/m2 was obtained when rice plants were grown after clover and broad bean and fertilized with 144 kg N/ha. While, the lowest number of panicles/m2 was found when rice was grown after wheat with nitrogen fertilizer application. It could to attributed to the reduction in organic metter and N% after wheat compared with legume crops. Wheat also removes more nutrients from the soil legumes. These finding are true mainly because lower quantities of soil nitrogen removed by legume crops relative to non-legume crops. These findings are in agreement with of Papastylianou, (1990) and El-Wehishy, (1998). Panicle weight, number of grains/ Panicle, and 1000-grain weight as affected by preceding crops and nitrogen levels are presented in Table3. Data indicated that rice grown after broad bean or clover produced heavy panicles, higher number of grains per panicle and higher 1000-grain values that after red radish or wheat in both seasons. This might be attributed to that nitrogen daposited in the soil was higher after legume crops than that after non-legume crops. Besides, legume residues contain more nutrients than-legume residues, consequently increases nutrient availability which promotes productivity. Data also showed that values of these components were significantly increased as nitrogen level increased up to 144kg N/ha both season. This could be attribbuted to the fact that nitrogen fertilizer promotes and enhances tiller formation in rice and increases yield attributes, consequently the productivity of the rice plants. Similar results were reported by Leilah and Fayed (1992) and Ebaid, (1995).

Number of grains per panicle as affected by the interaction between previous crops and nitrogen levels is presented in Fig. 3. Data showed that higher number of grains per panicle was obtained when the previous crop was clover combined with 144kg N/ha. Under the same level of nitrogen, no sigificant difference was found in number of grains per panicle when previous crops was broad bean or red radish. Significant reduction in number of grains was found when rice was grown after wheat relative to other previous crops. Generally, higher number of grains per panicle was found when rice was grown after legume crops.

Data in Table (4) present grain yield, biomass weight and harvest index as affected by previous crops and nitrogen levels. Data showed that higher grain yield was obtained whean rice was grown after clover or broad or bean in 1996, while in 1997 higher grain yield was obtained when rice was grown after clover, followed by broad bean. On the other hand, lower grain yield was obtained when rice was grown after wheat. Data in Table 4 showed also that higher biomass weight and higher harvest index were found when rice grown after legume crops. Data showed also that rice responded to higher rates of nitrogen regardless of the previous crops. Higher yield, higher biomass weight and higher harvest index were obtained when the rate of 144kg N/ha was applied. Similar data were obtained El-Sirafy et al (1986) and Khalil at al (1997).

Generally, rice grown after legume crops produced more yield and higher yield components that non legume crops. This ismainly because non legume crops remove higher amounts of soil nutrients than legume crops. These results could also be attributed to the fact that nitrgoen contributed from the residual soil nitrogen conservation these results are in harmony with that reported by George et al (1994), Ladha et al, (1996) and El-Weheshy, (1997). Also legumes decrease soil pH through release of large amount of H from their roots because of their high uptake of cations in comparison with anions (Reid and Goss, 1981; Schaler and Ficher, 1985; and Mengel and Kirkby, 1987). On the other hand, the residual effect of legumes, compared with non-legumes, to subsequent crops is partly due to lower quantities of soil nitrogen removed from soil and fertilizer Papastylianou (1990), also, nitrogen fixed by legumes is available to the subsequent crop (Elwaraky and Haunold, 1990).

The interaction between previous crops and added nitrogen levels, had no significant effect on grain yield, biomass weight and harvest index except on grain yield in 1997 season. Higher grain yield was obtained when rice was grown after legume crops and fertilized with 96 kg N/ha and there was no significant difference between 96 and 144 kg N/ha (Fig 4). Data also showed that under both rates of nitrogen, productivity of rice grown after wheat was significantly less than that after other crops. Nitrogen content and nitrogen yield are presented in Table 5. Data indicated that nitrogen content and nitrogen yield values were high when rice was grown after legume crops in both seasons. On the other hand, lower values were found when rice was grown after wheat crop. This could be attributed to the fact that legume crops fix atmospheric nitrogen and increase its content in the soil. In addition soil pH after wheat was highr and soil organic matter and total soil nitrogen were lower than after the other crops (Table 1). So that nitrogen content and nitrogen yield increased significantly when nitrogen fertilization rate increased up to 144 kg N/ha after non-legume crops.

Agronomic efficiency (kg rice/kg nitrogen applied) as affected by previous crops and nitrogen levels is presented in Table 6. Data indicated that higher agronomic efficiency values were found when rice was grown after either bean or red radish followed by clover. While, the lowest value was found when rice was grown after wheat. Data also showed that higher agronomic efficiency values were found when rice was fertilized with 96 kg N/ha. These results indicated also that rice grown after either legume crops or red radish produced higher amount of rice per kilogram of nitrogen at the 96 kg N/ha rate. On the other hand, rice grown aftr wheat produced higher grains per kilogram of nitrogen when fertilized with 144 kg N/ha. That means the 96 kg N/ha is the economical rate of fertilizer nitrogen if the previous crop is legume or red radish.

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إنتاجية صنف الأرز جيزه ١٧٧ المنزرع بعد محاصيل شتوية مختلفة ومسمد بمعدلات آزوتية مختلفة

رجب عبد الغنى عبيد ، صبحى عبد الحليم غانم

مركز البحوث والتدريب فى الآرز - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية سخا-كفر الشيخ

أقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بإيتاى البارود (مركز البحوث الزراعية) بهدف دراسة إنتاجية الصنف جيزة ١٧٧ الذى زرع بعد محاصيل شتوية مختلفة وسمد بمعدلات مختلفة من السماد النيتروجينى خلال موسمى ١٩٩٦، ١٩٩٧ وكانت المحاصيل الشتوية السابقة للأرز البرسيم المصرى والفول البلدى، ومحاصيل غير بقوليه هى الفجل الأحمر والقمح، وكانت معدلات التسميد الآزوتى المستخدمة فى الآرز صفر، ٩٦، ١٤٤ وحدة نتروجين / هكتار أضيفت على دفعتيين الأولى ٣/٢ الكمية عند تجهيز الأرض المستديمة على الشراقى قبل الغمر مباشرة أما الدفعة الثانية ٣/١ الكمية فقد أضيفت قبل طرد السنابل بحوالى ٧ أيام . ثم شتل الأرز على مسافات ١٥ x ٢٠سم حسب التوصيات الخاصة بمسافة الشتل لهذا الصنف، بمعدل ٣ - ٤ بادرات بالجورة الواحدة وكان مصدر السماد هو اليوريا ٤٦٪ فى كلا الموسمين. استخدام تصميم القطع المنشقة مرة واحدة فى أربع مكررات ، حيث كانت المحاصيل السابقة فى القطع الرئيسية بينما كان السماد النيتروجينى فى القطع المتشقة. وقد أظهرت النتائج أن أعلى محصول وأعلى قيم لمكونات المحصول وجدت عند زراعة الأرز بعد محصول بقولى مثل البرسيم أو الفول البلدى فى حين أعطى الأرز المنزرع بعد محاصيل غير بقوليه مثل الفجل الأحمر والقمح قيما أقل .وأظهرت النتائج أيضا أن ذيادة معدل التسميد الآزوتى حتى ١٤٤ كجم/هكتار أدى إلى زيادة طول النبات وطول السنبلة والوزن الجاف ومحصول الحبوب ومكوناته وكذلك دليل الحصاد فى كلا الموسمين زيادة معنوية بغض النظر عن نوع المحصول السابق. كما بينت النتائج أيضا أن نسبة وكمية النتروجين الممتص سواء فى الحبوب أو القش زاد زيادة معنوية بزيادة التسميد الآزوتى وأن أعلى قيم للنتروجين الممتص كانت قد وجدت عندما تمت زراعة الأرز بعد محصول بقولى وتم تسميده إما ١٤٤ أو ٩٦ كجم آزوت/هكتار، حيث كانت الفروق بين هذين المعدلين غير معنوية. وقد استخلصت الدراسة أنه في حالة زراعة الأرز بعد محصول بقولي. فإنه يجب إضافة ٩٦ كجم /هكتار أما فى حالة زراعة الأرز بعد محصول غير بقولى فإنه يجب ذيادة السماد الآزوتى المضاف إلى ١٤٤ وحدة أزوت للهكتار.