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GRAIN YIELD OF LOWLAND (*Oryza sativa*) AS INFLUENCED BY INTEGRATED USE OF UREA AND RICE STRAW FERTILIZER.

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ABSTRACT

A pot experiment was conducted during the rice seasons 2003 in the greenhouse of the Rice Research and Training Center Kafr El-Sheikh to study the effect of the application of rice straw combined with farm yard manure (FYM) as an activator as a complementary fertilizer with urea on soil organic matter and performance of Sakha 101 rice variety.

The main results of this study revealed that the application of rice straw plus nitrogen with or without farm yard manure (FYM) 3 weeks before transplanting caused a significant increase in grain and straw yields, yield attributes as well as organic matter content in the soil. Results indicated also the application of nitrogen alone caused a significant reduction in soil organic matter.

INTRODUCTION

Rice (*Oryza sativa*, L.) is one of the most important cereal crops in the world as well as in Egypt. It ranks the second after cotton regarding to exportation. It contributes more than 20 percent of the cereal consumption. Increasing productivity per unit land area is a native goal to meet the consistent demands from this crop. Increasing rice production can be achieved through optimizing cultural practices.

Crop residue management and its impact on soil organic matter and nutrient recycling are increasing in importance with the current renewed interest on sustainable soil fertility and crop productivity. Among forms of organic residues, incorporated rice straw which plays an important role in maintaining soil fertility and crop productivity if it returned to the soil either as a raw material or compost. Under the Egyptian condition more than 6 million tons of rice straw produced annually but only a small fraction is presently reincorporated into the soil, while the rest is subjected to burning in which is a big loss and contaminate the environment. A number of field studies have been done on the use of rice straw as a part of integrated nutrient management strategies in many parts of the world.

Therefore, the present study aimed to investigate the integration of rice straw plus nitrogen fertilizer on soil organic matter and the productivity of Sakha 101 rice cultivar.

MATERIALS AND METHODS

A pot experiment was conducted using transplanted rice plant (*Oryza sativa* L.), Sakha 101 rice variety during 2003 rice season in the greenhouse of the Rice Research and Training Center Kafr El-Sheikh to fulfill the objectives of the present study. Plastic pots (25 cm in diameter and 28 cm in height) were filled with 20 kg of air dried soil collected from Sakha Agriculture

Research Station Farm. Representative soil sample was taken and subjected to chemical analysis followed the standard procedures by Cottenie et al., (1982) and Page et al., (1982), and the results showed that this soil was clayey in texture with 1.4% organic matter, pH 8.3, EC 2ds/m , 31.8 ppm available N, 13 ppm P 305 ppm K.

All pots were fertilized with super phosphate (6.4% P) at the rate of 100 kg.fed^{-1} (2 g.pot^{-1} based on the weight of one fed. up to 15 cm is 1000,000 Kg) on the dry soil before flooding. The randomized complete block design with five replications was used, involving 20 treatments derived from 4 N- fertilizer (0, 0.989, 1.978 and 2.967 g urea. pot^{-1}) combined with rice straw at the rate of 40 g pot^{-1} either with or without 10 g pot $^{-1}$ FYM. Straw and FYM were added at two different times, first three weeks before transplanting, second just before transplanting. Urea was added in two splits, 2/3 before transplanting and the other 1/3 one month after transplanting. At harvest, grain and straw yields were estimated, yield components as well as agronomic efficiency which computed according to the equation cited from :Hammad *et al.*,(1994) equation as follows :

$$\text{Agronomic efficiency} = \frac{\text{Grain yield (kg) (fertilized) - Grain yield (kg) (unfertilized)}}{\text{N applied (Kg)}}$$

All data collected were subjected to the statistical analysis, according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Grain and straw yields:

Grain and straw yields of Sakha 101 rice cultivar as affected by the application of rice straw and nitrogen fertilizer treatments are presented in Table 1. Data revealed that the application of rice straw with or without FYM as an activator 3 weeks before transplanting plus nitrogen fertilizer produced higher grain yield (61.42 and 52.93 % yield increase over the control, respectively) than the application of rice straw plus nitrogen with or without activator just before transplanting (50.72 and 42.89 % yield increase over the control, respectively) . It is important to notice that the application of rice straw plus nitrogen with FYM gave higher grain yield (61.42 and 50.93 % yield increase over the control, respectively) than the application of rice straw plus nitrogen without FYM at the same time of fertilizer addition (52.93 and 42.89 % yield increase over the control, respectively). This is mainly due to that the application of N fertilizer plus FYM 3 weeks before transplanting to rice straw stimulated its decomposition thereby increasing the mineralization of straw beside its own supply of nitrogen and subsequent recovery by rice plants which due to increase the grain yield. These results are in harmony with those obtained by Sharma and Mittra (1991).

Data indicated also that, grain yield obtained from plots that received higher amount of nitrogen (2.967 g urea.pot^{-1}) was higher (74.18 % yield increase over the control) than obtained (41.58 % yield increase over the control) from lower amount (0.989 g urea.pot^{-1}). This may be due to nitrogen addition resulted in increase the number of microorganism which resulted in good decomposition of rice straw which added more nutrients.. These

findings are in agreement with those reported by Lakpale *et al*, (1999) and Pathak and Sarkar (1997) who found that a very high dose of nitrogen with rice straw was necessary to get a good yield. The same trend was almost found with rice straw yield.

Table 1: Grain and straw yields (g.pot^{-1}) as affected by the application of rice straw and different rates of nitrogen fertilizer in 2003 season

Time of application	Treatments			Yield (g.pot^{-1})			
	Rice straw g.pot^{-1}	FYM g.pot^{-1}	Urea g.pot^{-1}	Grain	% relative to control	Straw	% relative to control
Three weeks before transplanting	40	10	0	73.41 l	22.41	103.45 i	16.32
	40	10	0.989	92.73 hi	54.62	122.93 g	38.12
	40	10	1.978	101.10 ef	68.58	136.28 d	53.12
	40	10	2.967	119.99 a	99.93	150.30 a	68.87
	Mean			**96.80**	-	**128.24**	-
	40	0	0	66.17 m	10.33	96.67 j	8.95
	40	0	0.989	89.72 ij	49.60	122.24gh	37.34
	40	0	1.978	97.21 fg	62.09	135.62 d	52.38
	40	0	2.967	113.76 b	89.69	146.40 b	64.49
	Mean			**91.71**	-	**125.23**	-
Before transplanting	0	0	0	**59.97 n**	-	**89.00 k**	-
	0	0	0.989	84.91 k	41.58	119.29 h	34.03
	0	0	1.978	93.39 ghi	55.72	131.11 f	47.31
	0	0	2.967	104.46 de	74.18	141.16 c	58.60
	Mean			**85.68**	-	**120.14**	-
	40	10	0	66.67 m	11.17	97.00 i	8.98
	40	10	0.989	89.74 ij	49.64	122.26gh	37.37
	40	10	1.978	95.15 gh	58.72	135.00 de	51.68
	40	10	2.967	110.01 bc	83.44	144.11 bc	61.92
	Mean			**90.39**	-	**124.59**	-
	40	0	0	59.50 n	-0.78	89.33 k	0.37
	40	0	0.989	85.11 jk	41.92	120.38 h	35.25
	40	0	1.978	93.51 gh	55.92	132.50 ef	48.87
	40	0	2.967	104.65 cd	74.50	143.00 c	60.67
	Mean			**85.69**	-	**121.30**	-

In a column values having a common letter are not statistically different at the 5% level according to DMRT.

Yield attributes:

Yield attributes of rice were influenced significantly by the combination of rice straw and nitrogen fertilizer (Table 2). Rice straw applied @ 40 g. pot^{-1} with FYM 3 weeks before transplanting plus 2.967 g urea.pot^{-1} directly before transplanting resulted in significantly higher values with respect of number of panicle.pot^{-1}, panicle length and filled grains percentage while 1000 grains weight were of lower level compared with control. Number of panicle.pot^{-1}, panicle length and filled grains percentage increased significantly with the increasing nitrogen doses. The increase in number of panicle.pot^{-1}, panicle length and filled grains percentage mainly due to the increase of the available N, P, K and other nutrient elements which may be

due to increase panicle excursion and stimulation effect of branches initiation but the decrease in 1000 grains weight may due to the increase of seeds.panicle^{-1}. These results are in quite agreement with those reported by Barnes, (1985) , Kalita and Sarmah (1992), Abd El-Rahman (1999) and Hemalatha *et al, (* 2000).

Table 2: Some yield attributes as affected by the application of rice straw and different rates of nitrogen fertilizer treatments in 2003 season

Time of application	Treatments			1000 grains weight (g)	No. of panicle pot^{-1}	Filled grains (%)	Panicle length (cm)
	Rice straw g.pot^{-1}	FYM g.pot^{-1}	Urea g.pot^{-1}				
Three weeks transplanting	40	10	0	20.90 a	26.00 f	91.00 ef	18.91 b
	40	10	0.989	20.79 a	38.00 d	93.00 cd	19.73 b
	40	10	1.978	20.63 a	47.00 c	93.00 cd	21.23 ab
	40	10	2.967	20.59 a	60.00 a	96.00 a	24.19 a
	40	0	0	20.92 a	23.00 fg	91.00 ef	18.89 b
	40	0	0.989	20.79 a	35.00 e	92.00 de	19.65 b
	40	0	1.978	20.67 a	44.00 c	93.00 cd	19.92 b
	40	0	2.967	20.65 a	53.00 b	95.00 ab	22.00 ab
Before transplanting	0	0	0	20.94 a	21.00 g	90.00 f	18.84 b
	0	0	0.989	20.88 a	31.00 e	92.00 de	19.70 b
	0	0	1.978	20.82 a	40.00 d	93.00 cd	20.55 b
	0	0	2.967	20.78 a	45.00 c	94.00 bc	21.21 ab
	40	10	0	20.91 a	24.00 fg	91.00 ef	18.89 b
	40	10	0.989	20.79 a	35.00 e	92.00 de	19.68 b
	40	10	1.978	20.73 a	4100 d	93.00 cd	19.89 b
	40	10	2.967	20.72 a	51.00 b	95.00 ab	21.50 ab
	40	0	0	20.93 a	22.00g	90.00 f	18.85 b
	40	0	0.989	20.87 a	33.00 e	92.00 de	19.74 b
	40	0	1.978	20.83 a	40.00d	93.00 cd	20.61 b
	40	0	2.967	20.76 a	47.00 c	94.00 bc	21.27 ab

In a column values having a common letter are not statistically different at the 5% level according to DMRT.

Agronomic efficiency:

The general trend of agronomic efficiency as shown in Table 3 tended to decrease with increasing nitrogen fertilizer levels with or without the application of rice straw plus FYM. This is mainly because the yield produced from the application of 1.978 g urea.pot^{-1} is not twice as much as yield obtained from the application of 0.989 kg N.fed^{-1}, so that the difference in the numerator in less than the difference in denominator. It is obvious that the application of rice straw with or without FYM either 3 weeks before transplanting or just before transplanting increased agronomic efficiency. The application of 40 g straw.pot^{-1} with FYM added 3 weeks before transplanting plus 0.989 g urea.pot^{-1} showed higher agronomic efficiency (71.21) compared to the other treatments. These results are in agreement with those obtained by Hammad *et al.*, (1994) and Sirisena *et al,* (2003).

Table 3: Agronomic efficiency of rice plant as effected by the application of rice straw and different rates of nitrogen fertilizer in 2003 season

N levels g/pot	Agronomic efficiency				
	Urea Urea + FYM + Straw	(3 WBT**) Urea + FYM + Straw	(BT) Urea + Straw	(3 WBT) Urea + Straw	(BT)
0	0.00	0.00	0.00	0.00	0.00
0.459	54.21	71.21	64.71	64.67	54.65
0918	36.32	44.70	38.23	40.97	36.45
1.377	32.23	43.49	36.26	38.77	32.37

** WBT = weeks before transplanting

Organic matter content:

Organic matter content (O.M%) of the soil as affected by the application of rice straw as a raw material and nitrogen treatments at harvest presented in Table 4. Data showed that the percentage of organic matter reduced with nitrogen alone at all application rate (1.36,1.37 and 1.36 % at 0.989.1.978 and 2.967 g urea.pot^{-1} respectively) compared to the percentage of OM before planting (1.4%) but the complementary use of rice straw plus different rates of nitrogen with or without FYM which applied either 3 weeks or directly before transplanting increased the percentage of O.M compared to the percentage of O.M before planting. These findings are in agreement with those obtained by Powlson and Brookes,(1986) and Ryser and pittet,(1999) who found that soil organic matter content was slightly decreased under exclusively mineral fertilization, slightly increased under green manure, and clearly increased under straw and soil manure.

Table 4: Organic matter content of the soil as affected by the application of different fertilizer treatments at harvest in 2003 season

Time of application	Treatments			Organic matter %
	Rice straw g.pot^{-1}	Urea g.pot^{-1}	FYM g.pot^{-1}	
Three weeks before transplanting	40	0	10	1.47
	40	0.989	10	1.45
	40	1.978	10	1.44
	40	2.967	10	1.44
	40	0	0	1.47
	40	0.989	0	1.45
	40	1.978	0	1.45
	40	2.967	0	1.45
Before transplanting	0	0	0	1.31
	0	0.989	0	1.36
	0	1.978	0	1.37
	0	2.967	0	1.36
	40	0	10	1.47
	40	0.989	10	1.46
	40	1.978	10	1.46
	40	2.967	10	1.45
	40	0	0	1.50
	40	0.989	0	1.50
	40	1.978	0	1.48
	40	2.967	0	1.46

The study concluded that the integration between rice straw and nitrogen fertilizer improved grain yield and yield attributes of Sakha 101 rice cultivar, agronomic efficiency and better build up of soil organic matter

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تأثير إضافة سماد اليوريا مع قش الأرز علي محتوي التربة من المادة العضـــوية وإنتاجية صنف الأرز سخا ١٠١.

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** مركز البحوث والتدريب فى الأرز- سخا-كفر الشيخ

أجريت تجربة في الصوبة السلكية خلال موسم ٢٠٠٣ بمركز البحوث والتدريب في الأرز – سخا – كفر الشيخ مستخدماً صنف الأرز سخا ١٠١ وذلك بهدف دراسة تأثير إضافة قش الأرز والسماد الآزوتي (اليوريا) على محصول الأرز ومكوناته وكفاءة استخدام السماد النيتروجينـــي والمادة العضوية بالتربة.

وقد أظهرت النتائج أن أعلى محصول للحبوب والقش ظهر عندما تم استخدام قش الأرز المطحون والسماد البلدي كمشط عند ٣أسابيع قبل الشتل مع اليوريا قبل الشتل مباشرة. التســميد بقش الأرز المضاف قبل ثلاث أسابيع من الشتل في وجود السماد البلدي مع إضافة اليوريا قبـــل الشتل مباشرة أدى إلى زيادة معنوية في عدد السنابل لكل . أصيص؛ نسبة الحبوب الممتلئة وطول السنبلة بينما وزن ١٠٠٠ حبة نقص . أعلى كفاءة لاستخدام السماد النيتروجيني وجدت مع إضافة قش الأرز + اليوريا في وجود أو عدم وجود السماد البلدي. كما أوضحت النتائج أن المعاملات التي استخدم فيها قش الأرز مع السماد النيتروجيني أدت إلى زيـــادة المـــادة العضـــوية مقارنـــة بالمعاملات الأخرى