Response of Rice Crop to Convenential and Mechanical Cultivation Methods under N- fertilization Levels

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ABSTRACT: Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture (Saba Basha), Alexandria University, at Abees region, Alexandria. Egypt during the two successive seasons of 2012 and 2013 to study the response of rice crop to convenential and mechanical cultivation methods under N- fertilization levels on the yield, its components and technological characters of sakha 101 variety.

The experiment design was a split plot with three replicates. The main plots were occupied by nitrogen levels (40, 60 and 80 kg N/fed), while the subplots were consisted of two planting methods (manual transplanting and mechanical transplanting).The main results could be summarized as follows: Increasing nitrogen levels up to 80kg N/fed, significantly decreased plant height and significantly increased yield and its components and rice grain quality characters in the two planting methods while, these increases were higher in manual transplanting than mechanical transplanting in the two seasons. on the other hand, the rice production in manual transplanting per fed, increased by 41.80% comparing with mechanical transplanting.

Key words: Manual transplanting, Mechamcal transplanting, nitrogen level rice crop.

INTRODUCTION

Rice (*Oryza sativa,* L.) is one of the most important and leading food crops of the world and now is the major stable food of over half of the world population. More important, it is the stable food in area of high population density and fast population growth. The green revolution has enabled rice production to meet the demand of the growing population and most of the increased demand will be in developing countries.

The demand for food grains in Egypt had been increased and will continue to increase with the increase in population and the rice in the standed of living. Rice cultivated are ranges from 0.50 to 0.60 million hectare (1.2 to 1.5 million fed). The average of rice productivity in 2007 season was 10.0 t/ha (4.2 t/fed) and total rice production was 6.0 million through increasing yield per unit area has been accomplished by some combined effects such as nitrogen fertilization and transplanting methods.

Increasing nitrogen efficiency through the most important factors that limit productivity of rice (Salem *et al*., 2005). Also, rice cultivars may differ in their requirements of nitrogen levels to produce the maximum grain yield and the highest technological properties of rice grains (Ebaid and Ghanem, 2000).

Planting methods play an important role in rice production. Transplanting rice manually is a higher demanding operation equaling intensive labour for few days in a season (El- Kasaby *et at.,* 2002). Also, Abdou (1995) reported that the manual transplanting gave a rice production more than the mechanical transplanting. Also, Aref (1990) carried out comparative studies of different mechanization methods on rice production. This investigation aimed to study the effect on productivity of rice convenential and mechanical cultivation methods under N- fertilization levels.

MATERIALS AND METHODS

To achieve the aim of the present work, two field experiments were carried out at the Experimental Farm, Faculty of Agriculture (Saba- Basha), Alexandria University, Egypt, during 2012 and 2013 seasons. The experiments were carried out to study the effect on the productivity of rice variety sakha 101 convenential and mechanical cultivation methods under N- fertilization levels.

A split plot design with three replications was used, the main plots were occupied by nitrogen levels (40, 60 and 80 kg N/fed), while the subplots were consisted of two planting methods (manual transplanting and mechanical transplanting).

1- Manual transplanting

The nursery area was well prepared and rice seeds at a rate of 40 kg/feddan were socked for 24 hours and incubated for 24 hours, then the seeds were handily broadcasted. Twenty five days old seedlings were transplanted at the rate of 4 seedling/hill adopting a spaces of 15 × 15 cm.

2- Mechnaical transplanting

For transplanting rice, it is necessary to prepare the seedling, the paddy field and then transplanted the paddy field with rice seedling.

Preparation of seedling

To use the rice transplanting, it is necessary to get a health seedling through the nursery box.

Nursery box

It is fabricated from plastic, the inside dimensions of the nursery box are 58 cm length, 28cm width and 3cm depth.

Seedling the nursery box

For seedling the nursery box, the same stage as recommended by (rice Mechanization Center, Meet El- Deba, Agric. Research. Institute) and a Japanese textbook of farm machinery on the application of rice mechanical transplanting.

Paddy field preparetion

The field was plowed by using Behira Rau 7 Shares chisel plow, the plowing depth was 12 cm according to the recommendation of Abdel- Maksoud *et al*. (1994). The water was floated to an average depth of 3 cm, and the soil was compact about 24 hours after careful padding of its surface.

Seedling

For using the rice transplanting, the following conditions have been taken in this experiment. The height around 25cm length of root within 50mm, tiller within 2 as recommended by Ebaid *et al*. (2001).

Transplanting mechanism for mat seedling

The machine plants seedlings one by one by using separating time. Transferring the fixed quantity of the seedling on the platform traversely to right and left. When one cycle in finished and the mat seedling reaches the edge of the platform the seedling is sent out below by a longitudinal transferring mechanism and the plant form begins to save again.

The seedling- scparting and planting mechanism makes an approximate elliptic motion at the extremity vis crank action by four links as shown in Fig (1).

The stubbles are divided by times in order to plant the seedling. The tines press the seedling into the soil, by Yammer diesel engine instruction book, Agricultural machinery.

3- Nitrogen fertilization

Three nitrogen levels (40, 60 and 80kg N/fed) as urea form (46% N) were applied 2/3 basal and corporate in to the dry soil before flooding and 1/3 at panicle initiation.

Soil analysis

Soil samples were collected from 0- 30cm depth from the experimental sites and the analysis is shown in Table (1) according to the method reported by Page *et al*. (1982). Other cultural practices were deas recommended in rice fields.

Table (1): Some physical and chemical properties of the experimental soil in 2012 and 2013 seasons

Soil properties	Values	
	2012	2013
A- Particle size distribution %		
Sand	14.30	14.20
Silt	42.00	42.70
Clay	43.40	43.10
Soil texture	Clay loam	Clay loam
B- Chemical properties		
pH (1:1)	7.80	7.70
EC (1:1),	3.40	3.50
1- Soluble cations (1:2) (cmol/kg soil)		
K^+	1.37	1.41
Ca^{++}	14.20	15.30
Mg^{++}	11.40	11.30
Na^+	13.20	13.50
2- Soluble anions (1:2) (cmol/kg soil)		
CO^-_3+ HCO^-_3	2.80	2.90
CL	19.60	20.10
SO^-_4	12.30	12.50
Calcium carbonate %	6.70	6.90
Total nitrogen %	0.85	0.87
Available P (mg/kg)	3.80	3.70
Organic matter %	1.50	1.45

Data recorded:

At harvest, plants of one square meter were taken from each plot and the following characters were recorded: Plant height, Panicle length, number of tillers/m^2,number of panicles/m^2, number of grains/panicle, number of filled grains/panicle, 1000- grain weight, grain and straw yield/fed and biological yield Guraded cm square meter of plants were the harvested manually and left three

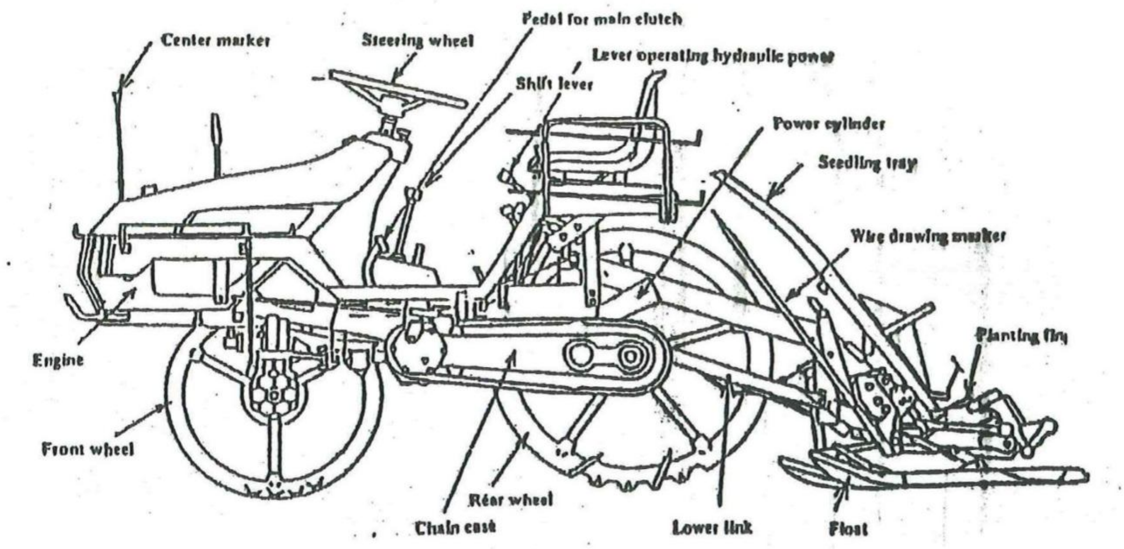

Fig. (1) : Rice transplanter

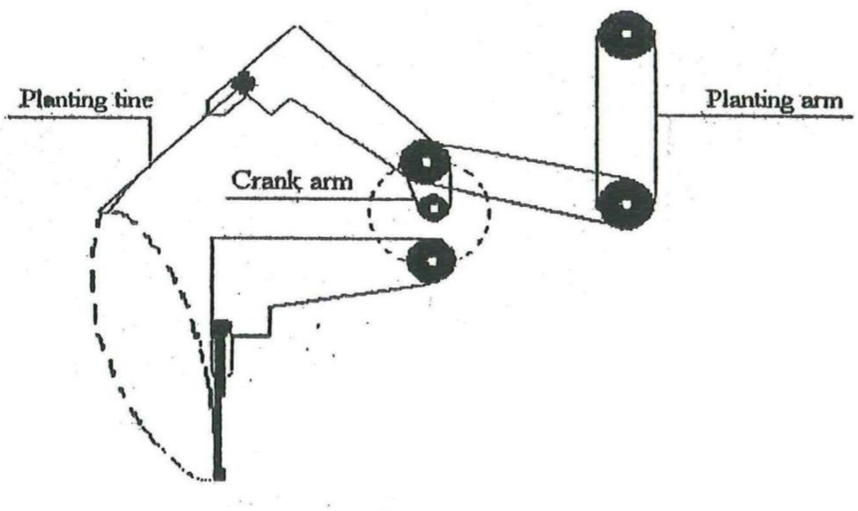

Fig. (2): Transplanting mechanism

days for drying and biomass weight was taken, then mechanically threshed and grain yield was estimated and adjusted to 14% moisture content.

Technological characters of grains

Grains samples (250 gm) from each sub- plot was taken to determine some technological characters (Hullig %, Milling% and broken rice %). These technology tests were carried out at Rice Technology Trainining Center (RTTC), Alexandria.

All data collected were subjected to statistical analysis of variance according to Gomez and Gomez (1984). The treatments average were compared using L.S.D test at 0.05 level of significant.

RESULTS AND DISCUSSION

A- Yield and its components:

Data in Tables (2 &3) showed that increasing nitrogen levels up to 80 kg N/fed, significantly increased all yield and its components except plant height was decreased by increasing nitrogen levels, this decrease due to nitrogen application delay leaves aging and increased root activity during grain filling and increase grain fertility which greatly increase grain yield. These results are in similar with Abdel- Rahman *et al*. (1990), Hassan *et al*. (1990) and Ebaid *et al*. (2001). This increase may be due to that increasing nitrogen supply minimized the inter and intra- specific competing, then increased the amounts of metabolites synthesized by rice plants.

The evaluated planting methods exerted highly significant effects on all yield and its components except 1000- grain weight in both seasons Tables (2 &3). Manual transplanting produced the highest plant height (89.96 & 93.00 cm), panicle length (21.22 & 22.12 cm), number of tillers/m^2 (519.67 & 633.78), number of panicles/m^2 (513.89 & 627.22), No. of grains/panicle (1352.56), No. of filled grains/panicle (130.45), grain yield (3.92 & 5.24 t/fed), straw yield (7.12 & 10.25 t/fed) and biological yield (10.82 & 15.27 t/fed) than mechanical transplanting. These data are in agreement with those reported by Abdou (1995), Ebaid *et al*. (2001).

The interaction between nitrogen fertilizer and planting methods were significant for yield and its components in both seasons.

B- Technological characters:

Data in Table (4) indicated the effect of nitrogen levels and planting methods on hulling %, milling% and broken rice %. Increasing nitrogen level up to 80 kg N/fed, significantly increased the technological grain characters (hulling % and milling %) in both seasons, as well as up to 60 kg N/fed, significant increase for broken rice % in both seasons. These results are in agreement with (Ebaid, 1995 and Ebaid *et al*., 2001). They reported that increasing nitrogen fertilizer significantly increased the technological characters in rice plants grains.

Manual transplant significantly increased these technological characters (hulling%, milling% and broken rice%) compared with the mechanical transplanting in both seasons.

Table 2: Effect of nitrogen levels and planting methods on rice yield and some yield components during 2012 and 2013 seasons

Treatments	Plant height (cm)		Panicle length (cm)		No. of tiller/m^2		No. of spikes/m^2		No. of grain /panicle	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
A)Nitrogen levels(kg/fed)										
40	93.84a	88.67a	20.17c	21.84a	466.67c	468.67c	429.67b	468.34c	141.67b	121.67
60	87.50b	87.67b	20.67b	20.83b	477.00b	522.00b	430.00c	516.50b	150.67a	123.67
80	84.43c	87.83b	20.84a	21.84a	596.67a	653.67a	588.67a	648.34a	148.84a	122.67
L.S.D. 0.05	**1.20**	**0.60**	**0.15**	**0.18**	**8.30**	**9.30**	**11.45**	**20.11**	**2.90**	**ns**
C)Planting methods										
Manual transplanting	89.56a	93.00a	21.22a	22.12a	519.67a	633.78a	513.89a	627.22a	147.45	135.56a
Mech trantplanting	87.56b	83.11b	19.89b	20.78b	412.22b	462.45b	405.33b	461.56b	146.34	109.78b
L.S.D. 0.05	**1.35**	**1.20**	**0.94**	**1.10**	**21.50**	**16.29**	**16.29**	**22.6**	**ns**	**14.15**
Interactions										
A× B	*	*	*	*	*	*	*	*	*	*

Table 3: Effect of nitrogen fertilization and planting methods on rice yield and some of its components during 2012 and 2013 seasons

Treatments	No. of filled Grains/panicle		1000- grain weight (g)		Grain yield/fed (tons)		Straw yield/fed (tons)		Biological yield/fed (tons)	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
A)Nitrogen levels										
40	132.34b	118.00	31.00b	31.67b	3.26b	4.02b	5.00b	6.60b	8.62b	10.62b
60	142.50a	119.67	32.00a	32.33a	3.25b	4.09b	4.39b	6.74b	7.42c	10.52b
80	141.00a	118.00	31.83a	32.50a	3.62a	5.20a	7.05a	11.19a	10.32a	16.39a
L.S.D. 0.05	**5.10**	**ns**	**0.48**	**0.47**	**0.30**	**0.46**	**0.70**	**1.20**	**0.70**	**1.10**
C)Planting methods										
Manual transplanting	138.11	130.45a	29.78b	30.33b	3.92a	5.24a	7.12a	10.25a	10.82a	15.27a
Mech trantplanting	139.11	106.67b	33.44a	33.33a	2.83b	3.62b	3.83b	6.12b	6.75b	9.74b
L.S.D. 0.05	**ns**	**6.20**	**0.56**	**0.70**	**0.66**	**0.72**	**1.05**	**1.30**	**1.20**	**1.25**
Interactions										
A× B	*	*	*	*	*	*	*	*	*	*

***, ** an Ns indicated P<0.05 and not significant, respectively**
Mean of each factor followed by acommon letter and not significant different at 5% level using L.S. D test.

Table 4: Effect of nitrogen levels and planting methods on some technological characters of rice grains during 2012 and 2013 seasons

Treatments	Hulling %		Milling %		Broken rice %	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**
A)Nitrogen levels						
40	80.72c	81.00c	70.80c	71.00c	12.68b	11.90b
60	81.10b	82.40b	72.50b	73.20b	15.30a	13.80a
80	82.17a	83.70a	73.84a	74.70a	12.75b	11.50b
L.S.D. 0.05	**0.20**	**0.40**	**0.32**	**0.42**	**0.50**	**0.40**
C)Planting methods						
Manual transplanting	81.97a	82.40a	73.11a	73.90a	16.45a	15.70a
Mech trantplanting	80.67b	80.90b	71.73b	71.80b	10.66b	10.80b
L.S.D. 0.05	**0.40**	**0.50**	**0.60**	**0.56**	**0.60**	**0.80**
Interactions						
A× B	ns	ns	ns	ns	ns	ns

The interactions between nitrogen levels and planting methods were significant for technological characters (hulling % milling% and broken rice %) in both seasons (Table 4).

C- Economic study

Table (5) indicates the components of mechanical and manual transplanting cost. The rice production cost per feddan in manual transplanting increases by 47.5% comparing with the mechanical transplanting (Ebaid *et al*., 2001).

Table 5: Economic study on mechanical and manual rice transplanting methods

Variables	Cost of mechanical transplanting L E/feddan	Cost of manual transplanting L E/feddan
grains nursery preparation and transplanting	800	1050
Permanent field preparation	120	120
Nitrogen fertilizer	594	594
Herbicides	60	60
Hand hoeing	250	250
Harvesting	340	1120
Total	**2164**	**3194**

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الملخص العربي

استجابة محصول الأرز لطرق الزراعة التقليدية والآلية تحت معدلات مختلفة من التسميد النتروجيني

فتحي إبراهيم رضوان، محمود عبد العزيز جمعة، إبراهيم فتح الله رحاب و هالة محمد شوقي حسن محمود

قسم الإنتاج النباتي . كلية الزراعة سابا باشا . جامعة الإسكندرية . مصر

أقيمت تجربتان حقليتان في مزرعة كلية الزراعة سابا باشا . جامعة الإسكندرية . بمنطقة أبيس – إسكندرية (مصر) أثناء موسمي الزراعة ٢٠١٢، ٢٠١٣. بهدف دراسة استجابة محصول الأرز لطرق الزراعة التقليدية والآلية تحت معدلات مختلفة من التسميد النتروجيني حيث صممت التجربة بتصميم القطع المنشقة مرة واحدة مع استخدام ثلاث مكررات.

<u>وكانت التوصية كما يلي:</u>

- قد أوضحت النتائج أن زيادة التسميد النتروجيني حتى ٨٠كجم نتروجين/فدان أدى إلى نقص معنوي في طول النبات وا إلى زيادة معنوية في المحصول ومكوناته وكذلك الصفات التكنولوجية للحبوب وذلك في كلا طريقتي الزراعة التقليدية والزراعة الآلية.
- من ناحية أخرى أدى استخدام الزراعة التقليدية إلى زيادة صفات المحصول ومكوناته والصفات التكنولوجية مقارنة بالزراعة الآلية وقد وجد أن الشتل اليدوي أدى إلى زيادة قدرها ٤١.٨% في محصول الحبوب مقارنة بالشتل الميكانيكي.