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COMPARISON STUDY BETWEEN MECHANICAL AND MANUAL RICE TRANSPLANTING METHODS UNDER DIFFERENT NITROGEN FERTILIZATION LEVELS AND WEED CONTROL

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ABSTRACT

Two field experiments were carried out in Etai El-Baroud Agric. Res. St., Behaira Governorate Egypt) in the two growing seasons of 2000 and 2001 to study the effect of different nitrogen fertilization levels and weed control treatments under two planting methods, mechanical and manual transplanting, on Giza 177 rice cultivar. Four nitrogen rates were used i.e. 0, 46, 92 and 138 Kg N/ha (0, 19.2, 38.4 and 57.6 kg N/feddan) as Urea form (46.5%N), on 2 doses (2/3 basal in the dry soil before flooding and 1/3, 7 days before panicle initiation). Three evaluated chemical weed control treatments were applied (Saturn 50% Ec. 4 liter /ha (1.7 liter/feddan), Machete 60% Ec 2 Liter /ha (0.85 liter/feddan) and Saturn 50% Ec 2 Liter /ha (0.85 liter/feddan) + Machete 60%Ec 2Liter /ha (0.85 liter/feddan)) four days after transplanting, as well as hand weeding 2 times (30 and 60 days after transplanting). Mechanical transplanting was done using Japanese Yanmar transplanter. A split plot design with four replications was used, whereas, nitrogen fertilization levels were allocated in the main plots while weed control treatments were allocated in the sub plots. Main results indicated that, increasing nitrogen levels up to 138 Kg N /ha (57.6 kg N/feddan) significantly decreased weed dry weight and significantly increased plant height, 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, data indicated that, using herbicides in rice transplanting decreased the weed dry weight in both seasons and increased yield and its components on contrast no significant effect due to herbicides on rice grain technology characters.

INTRODUCTION

It is well known that rice is one of the major cereal crops in Egypt as well as in the world. Rice yield per unit area has been accomplished by some combined effects such as seed bed preparation, weed control, nitrogen fertilization, rice variety and transplanting methods. The increase in nitrogen supply caused increases in rice yield and in weed infestation (Balasubramiyan 1983). Similar response of rice yield and its components to nitrogen fertilization were reported by Aidy et al (1988), Abd El –Rahman et al (1990) and Hassan et al (1990). Weeds arise very serious problems in rice fields. When they were not controlled, grain yield of rice reduced by 36-68% in Peru (Fletcher and Kirkwood 1982). Thus, controlling rice weeds consider the important factor to increase rice production. Hand weeding by pulling weeds is one of the weed control methods, but it's expensive, more time consuming and there is a stages of growth. Consequently, the use of chemical weed control is necessary.

Hassan et al (1990) indicated that nitrogen level had a strong influence on the competition relationship of grass weeds to rice.

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Abd El Maksoud et al (1994) studied the effect of some technical factors on rice transplanting and seeding characteristics. They concluded that, the transplanter can be operated with high performance at transplanting speed of 1.4 km/h, plowing depth range (10 - 15 cm) and seedling block size of 10 × 14 mm. Morsey (1990), stated that, the field efficiency of 96% recorded by speed of 1.8 km/h., and other speeds 1.2, 1.4 and 1.6 gave 72.5, 81.0 and 88.75% respectively. The optimum value of the missing hill rate was 4.0% at transplanting speed of 1.2 km/h, and the higher production yield was 3.028 ton/feddan at transplanting speed 1.2 km/h. Abdou (1995) reported that, the manual transplanting gave a rice crop production more than the mechanical transplanting. El Kerdy (1982) mentioned that, the mechanical transplanting for rice gave a rice crop production more than the traditional transplanting method, that returns to the increase of number of hill per unit area. Aref (1990) carried out comparative studies of different mechanization methods on rice production. He conducted that, the mechanical transplanting gave a higher number of tiller than manual transplanting, but the manual transplanting gave a higher plant than the mechanical transplanting. He also mentioned that, the mechanical transplanting gave a higher whole grain percentage and lower empty grain and impurity than the manual transplanting. This investigation aimed to study the effect of nitrogen and different weed control methods (Chemical and mechanical) under mechanical and manual transplanting methods on rice crop production.

Materials &Methods

To achieve the aim of the present work, two field experiments were carried out at Rice Research &Training Center (Etai El-Baroud Agric. Res. St., Behaira Governorate Egypt) in the two growing seasons of 2000 and 2001 to study the effect of different nitrogen fertilization levels and weed control treatments under two planting methods, Mechanical and Manual transplanting, on Giza 177 rice cultivar. The experimental area was about 4 feddans.

A split plot design with four replications was used, the main plots were occupied by nitrogen levels, while, the sub plots were consisted of five weed control treatments in the two planting methods. The area of the main plot was about 3600 m^2 while the area of each sub plot was about 360 m^2.

1- Manual transplanting :-

The nursery area was well prepared and rice seeds at rate 96 Kg /ha (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 seedlings /hill adopting a spaces of 15X15 cm on June 20 and 18 in first and second year respectively. The normal practices of growing rice except the studied factors were applied.

2- Mechanical transplanting:

For transplanting rice, it is necessary to prepare the seedlings, the paddy field, and then transplanting the paddy field.

Preparation of seedlings:

To use the rice transplanter, 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, 28 cm width and 3 cm. depth.

Seeding the nursery box:

For seeding the nursery box the same steps 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 preparation:

The field was plowed by using Behira Rau 7 Shares chisel plow, the plowing depth was 12 cm according to the recommendation of Abd El Maksoud et al (1994) and Miura (1966). The water was floated to an average depth of 3 cm, and the soil was compact about 24 hours after careful paddling of its surface.

Seedlings:

For using the rice transplanter the following conditions have been taken in this experiment: The height around 25 cm, length of root within 50 mm, tiller within 2 and their body is hard as recommended by Miura (1966).

Transplanting rice:

The Japanese Yanmar transplanter Fig. (1) was used in this work. Its specifications as indicated in Table (1). The average transplanting speed was 1.6 km/h as used by Morsey (1990) to get a high efficiency.

Transplanting mechanism for mat seedlings:

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

The seedling-separating and planting mechanism makes an approximate elliptic motion at its extremity via crank action by four links as shown in Fig. (2), the stubbles are divided by tines in order to plant the seedlings. The tines press the seedlings into the soil, then released from the seedlings. While lifting they are shut again (Yanmar diesel engine instruction book, Agricultural machinery).

3-Nitrogen fertilization:

Four nitrogen levels (0, 46, 92 and 138 Kg N/ha (0, 19.2, 38.4 and 57.6 kg N/feddan)) as Urea form (46%N), were applied 2/3 basal and corporated in to the dry soil before flooding and 1/3 at panicle initiation.

4- Weed control:

Table (2) shows Common and chemical names of herbicides used in this work. For weed control treatments were studied:

1- Saturn 50% EC 4 L/ha (1.7 liter/feddan).
2- Machete 60% EC 4 L/ha (1.7 liter/feddan).
3- Saturn 50% 2 L/ha (0.85 liter/feddan) + Machete 60% 2 L/ha (0.85 liter/feddan).
4- Hand weed control.

Herbicides were sprayed by using Knapsack sprayer "CP3" (4 days) after transplanting in both planting methods.

Weeds were hand pulled at 50 and 75 days after transplanting, dry weight of weeds was recorded after drying the fresh weeds at 80 c for 24 hours.

5. Control treatment:

An area from the experimental field was used as a control without weeding control (without hand or chemical weed control.

The dominant weeds in the experimental situation were Echinochloa ssp (E Grussgalli and E. Colona) and Cyperus deforms.

Table (1): The specification of the ARP-8 -30 Yanmar rice transplanter.

Model	ARP-8 -30		
Type	Riding type		
Dimensions	Overall length, mm	3041	
	Overall width, mm	2791	
	Wheel base mm	1076	
	Overall height, mm	1568	
Weight (kg)	660		
Engine	Model	Yanmar GE-90 NRE	
	Type	Air cooled, 4-cycle, Gasoline engine	
	Rated power	10 hp/1650 rpm (7.35 kW)	
	Fuel	Gasoline	
	Fuel tank capacity (liter)	6.5	
Lifting system Steering system No. of geared wheel Type of brake	Hydraulic type Power steering 4-wheel geared Right / left independent, wet disc type		
Traveling device	Rear wheel type	Solid rubber wheel	
	Front wheel type	Air rubber wheel	
	Gear shifting	Forward (3 steps) / Rear (1 step)	
	Working speed	0.25 -0.75 m/s	
No. of rows	8		
Distance between rows	30		
Distance between hills, cm	14	16	18
No. of hills/3.3m^2	80	70	60
Planting system	Crank type		
Planting depth, mm	15 -45		
Seeding conditions	Nursery	Mat seeding of box or frame nursery	
	Seeding mat dimensions, cm	58 (longitudinal) × 28 (transverse × 3 (thick)	
	Planting rate, seedling paddy g/box	125 ~ 280	
	Stalk height (cm)	8 ~ 25	

Table (2): Common and chemical names of herbicides used .

Common name	Trade name	Chemical group	Formulation
1-Butachlor	Machete	Amides	60% EC
2-Thiobencarb	Saturn	Thiocarbamate	50% EC

Knapsack sprayer "CP3" (hand operated denoted by: K):

An English-made knapsack sprayer was used in this work. It is composed of a 20 L tank for pesticide and a cone nozzle. A hand pump is used to give an operational pressure. The pressure in the chamber is maintained by regular lever strokes (about 30 per minute). The spray angle is about 60°. During spraying, the pressure varies from 3 to 1 bar and the average flow rate is 0.78 L/min. Recommended application intensity is about 200 L per fed.

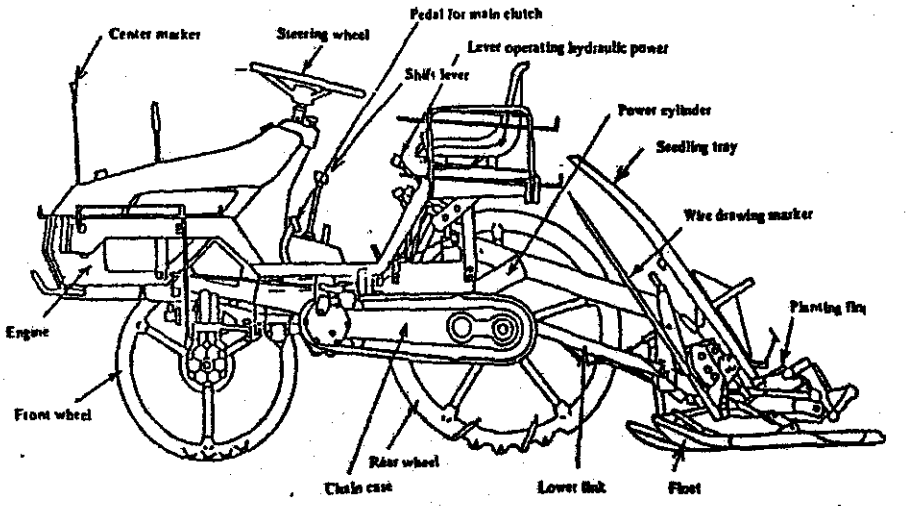

Fig. (1) : Rice transplanter

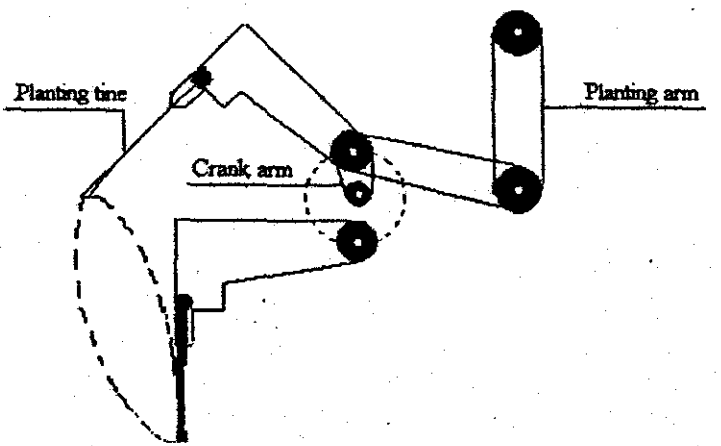

Fig. (2): Transplanting mechanism

6. Measurements:

At harvest, plants of one square meter were taken from each plot and the following characters were recorded. Plant height, number of panicles /m^2, panicle weight and number of grains/ panicle. Guarded ten square meter were harvested manually and left three days for air drying and biomass weight was taken, then mechanically threshed and grain yield was estimated and adjusted to 14% moisture content and harvest index was determined as follow:

$$\text{Harvest index} = \frac{\text{Grain yield (t / ha)}}{\text{Biomass yield (t / ha)}} \times 100$$

7- Technological characters of grain:

Grain samples (250 gm) from each sub plot was taken to determine some technological characters (Hulling %, Milling % and Head rice %). These technology tests were carried out at Rice Mechanization Center (Meet El-Deeba, Kafr El-Sheikh Governorate, Egypt. Combined analysis of the obtained data was carried out according to Sendecor and Cochran (1981) L.S.D. test at 5% level of significance was calculated to compare between means.

RESULTS AND DISCUSSION

1- Plant height, number of panicls/m^2 and panicle weight :-

Data in Table (3) showed that increasing nitrogen levels up to 138 Kg N/ha significantly increased plant height in both planting methods, these increases due to nitrogen application may be attributed to the role of nitrogen in the stimulation of cell division and internode elongation but in manual transplanting plant height was more than mechanical transplanting at all nitrogen levels, this might be due to seedling vigor. These results are in agreement with those reported by Shaalan et al; (1985) and Ebaid et al; (1995). The same trend was observed in number of panicles/m^2 and panicle weight. These increases might be attributed to the role of nitrogen in increasing carbohydrates accumulation in rice panicles one, two and three weeks after heading.

Table (3): Plant height, number of panicles /m^2 and panicle weight as affected by nitrogen levels and weed control treatments in two rice planting methods. (Average of two years).

Main effect	Plant height, cm		No of panicles/m^2		Panicle weight, gm	
A) -N levels Kg/ha#	Mech.*	Man.**	Mech.	Man.	Mech.	Man.
0	69.8	78.1	294.9	337.7	2.5	2.6
46	74.6	83.8	311.1	367.5	2.6	2.8
69	79.5	86.6	356.9	409.8	2.9	3.2
138	84.8	95.7	403.5	424.4	3.2	3.6
L.S.D 5%	3.45	3.01	15.00	11.85	0.15	0.20
B) -Weed control						
Saturn 50%	76.6	85.5	359.5	405.7	2.9	3.2
Machete 60%	76.2	85.2	311.7	345.1	2.4	2.8
Saturn+ Machete	77.6	86.6	345.3	393.7	2.9	3.2
Hand weeding	78.3	86.8	349.8	394.9	2.9	3.1
Control	58.2	62.4	218.7	250.2	1.8	2.0
L.S.D 5%	4.9	3.7	10.8	15.8	0.15	0.15
A x B F test	NS	NS	NS	NS	NS	NS

* = Mechanical transplanting.

**= Manual transplanting.

Data also showed that no significant differences among weed control treatments on plant height in both planting methods, while, in the other two characters Saturn 50% is the best one followed by hand weeding treatment and (saturn 50% + Machete 60%) while, Machete alone gave the lowest values on both planting methods. These data are in agreement with El-Bially and Attia (1991). Concerning the interaction between nitrogen levels and weed control treatments no significant effect on these characters in both planting methods.

2-Number of grains /panicle, grain yield and biomass yield

Data in Table (4) summarized the effect of nitrogen levels and weed control treatments on number of grains/panicle, grain yield and biomass yield ton/ha in both manual and mechanical planting methods. Increasing nitrogen levels up to 138 Kg /ha (57.6 kg N/feddan) significantly increased the previous characters compared with the control (no fertilizer). The increase in grain yield due to increasing nitrogen fertilizer was 74% and 36%in mechanical and manual transplanting methods respectively. While, the increase in biomass were 41% and 23% in the two planting methods.

These results are in agreement with Aidy et al (1988), Abd El –Rahman et al (1990) and Hassan et al (1990). These increases 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. Results showed that mixing Saturn 50% Ec with Machete 60% EC gave the highest number of grains/panicle. While, Saturn 50 EC treatment gave the highest grain yield and biomass yield in both planting methods. Data also showed that no significant difference between Saturn 50 % EC and hand weeding in these traits. These results may be due to the effective elimination of weeds obtained by Saturn 50% EC and hand weeding. These results are in agreement with EL –Bially and Attia (1991). No significant effect of the interaction between nitrogen fertilizers and weed control treatments on these characters in both planting methods .

Table (4): Number of grains/panicle, grain yield and biomass yield as affected by nitrogen levels and weed control in two planting methods (average two years).

Main effect	No of grain/panicle		Grain yield, t/ha		Biomass yield t/ha	
A)-N. levels, Kg/ha	Mech.	Man.	Mech.	Man.	Mech.	Man.
0	76.9	88.0	5.0	6.4	10.0	13.6
46	85.5	94.9	6.4	7.1	11.4	14.5
92	88.7	108.4	7.4	8.0	12.1	15.4
138	95.2	115.9	8.3	8.7	14.1	16.7
L.S.D 5%	**2.9**	**5.95**	**0.24**	**0.27**	**0.89**	**0.90**
B)- Weed control						
Saturn 50% EC	88.1	106.4	7.1	8.0	12.7	15.4
Machete 60%EC	80.0	91.9	5.9	6.9	10.9	13.8
Saturn +Machete	90.1	104.3	7.0	7.8	12.5	15.4
Hand weeding	88.2	104.6	7.0	7.7	12.5	15.3
Control	52.4	60.8	4.2	5.6	8.4	9.7
L.S.D. 5%	**3.00**	**5.20**	**0.23**	**0.21**	**0.82**	**0.81**
A X B F test	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**

* 1 ha =2.4 feddan

3- 1000 grain weight, harvest index and weed dry weight:

Data in Table (5) revealed that the effect of nitrogen levels and weed control treatments on 1000 grain weight, harvest index and weed dry weight. Increasing nitrogen levels up to 138 Kg N/ha significantly increased 1000-grain weight in both planting methods. This increase may be due to the role of nitrogen for enhancing the grain filling after heading (Ebaid et al 1995). Saturn 50 % EC treatment gave the highest value. While, there were no significant differences among the other weed control treatments in this character. Nitrogen application up to 96 Kg N/ha (40 kg N/feddan) gave the highest harvest index under mechanical transplanting. While in the manual transplanting, the treatment of 138 Kg N/ha (57.5 kg N/feddan) gave the highest value compared with the other nitrogen levels. Concerning weed control treatments, Machete 60% EC gave the lowest harvest index value. This may be due to the low efficiency of Machete 60% EC in weed control.

Also, data showed that increasing nitrogen fertilizer up to 46 Kg N /ha (19.2 kg/feddan) decreased weed dry weight. While, 92 and 138 Kg N/ha (38.4 and 57.6 kg N/feddan) increased weed dry weight. This refers to the high competitive ability of E. Spp. for nutrients, this findings are in agreement with Hassan et al (1990). They reported that increasing nitrogen supply from 15-45 Kg N/ha significantly increased the fresh weight of E.spp. Rao (1983) showed that E.Spp. are the most competitive weeds in rice fields, and it causes a considerable loss in soil nitrogen content amounted to 92 Kg N/ha. Also, data showed that the application of chemical and mechanical weed control treatments significantly depressed all estimated weed attributes compared with the untreated control. Effective weed control in rice fields was obtained by Butachlor (Singh and Sharma (1984) and Samar Singh et al (1986). Thiobencarb (Pandey 1984 and Youdeowei et al 1986). Among the applied herbicides, Saturn 50 % EC was the most effective one, 77.5 Kg and 61.5 Kg weed dry weight in mechanical and manual transplanting respectively compared with the control 203.1 Kg/ha and 190.8 Kg /ha in the two planting methods. Also, data showed that, there were no significant differences among the other weed control treatments as well as hand weeding compared with the control.

With regarding the interaction between different nitrogen levels and weed control treatments, data showed that there is no significant interaction on dry weed weight in both planting methods.

4- Technological characters:

Data in Table (6) indicated the effect of nitrogen levels and different weed control treatments on Hulling %, Milling % and Head rice %. Increasing nitrogen levels up to 138 kg N/ha (57.6 kg N/feddan) significantly increased the technological grain characters in both planting methods. These results are in agreement with (Ebaid et al. 1995). They reported that increasing nitrogen fertilizer significantly increased the technological characters in rice grain. While weed control treatments significantly increased these characters compared with the control (untreated plots).

On the other hand, there were no significant differences among chemical and hand weeding control treatments on the technological characters in both planting methods.

5. Economic study:

Table (7) indicates the component for the mechanical and manual transplanting costs.

Table (5): 1000 grain weight, harvest index and weed dry weight as affected by nitrogen levels and weed control in two planting methods (average two years).

Main effect	1000 grain weight		Harvest index		Weed dry weight	
A)-N. levels, Kg/ha	Mech.	Man.	Mech.	Man.	Mech.	Man.
0	25.2	25.4	0.45	0.47	146.5	142.0
46	25.5	25.8	0.56	0.49	135.5	124.0
92	26.0	26.4	0.61	0.50	140.0	121.0
138	26.6	27.2	0.59	0.52	145.0	125.0
L.S.D 5%	**0.35**	**0.26**	**0.24**	**0.01**	**17.55**	**23.3**
B)-Weed control						
Saturn 50 % EC	26.3	26.6	0.56	0.52	77.5	61.5
Machete 60% EC	25.4	25.8	0.54	0.50	110.0	11.0
Saturn +Machete	25.9	26.2	0.56	0.51	101.0	105.5
Hand weeding	25.6	26.2	0.56	0.50	108.5	102.0
Control	18.0	19.8	0.46	0.48	203	190.8
L.S.D 5%	**0.26**	**0.29**	**0.04**	**0.02**	**16.0**	**19.00**
A X B F test	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**

Table (6): Some technological characters as affected by nitrogen levels and weed control in two planting methods. (average two years).

Main effect	Hulling, %		Milling, %		Head rice, %	
A)-N. levels, Kg/ha*	Mech.	Man.	Mech.	Man.	Mech.	Man.
0	81.0	81.0	73.0	73.0	62.2	65.1
46	81.6	82.1	73.4	74.0	65.3	69.8
92	82.4	82.8	73.9	74.8	68.7	73.8
138	83.0	83.5	74.2	75.6	72.0	76.5
L.S.D 5%	**0.30**	**0.44**	**0.39**	**0.72**	**2.70**	**1.18**
B)-Weed control						
Saturn 50 % EC	82.3	82.1	73.9	73.4	67.2	70.8
Machete 60% EC	81.9	82.0	73.8	74.0	67.5	71.6
Saturn +Machete	81.8	81.9	73.6	73.7	68.6	71.1
Hand weeding	82.2	82.0	73.8	70.8	70.5	71.6
Control	80.0	79.0	70.2	1.18	65.4	65.7
L.S.D 5%	**0.54**	**0.64**	**0.76**	**1.18**	**1.04**	**1.29**
A X B F test	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**

Table (7): Economic study on mechanical and manual rice transplanting methods.

Variables	Mechanical		Manual	
	L.E /ha*	L.E/feddan	L.E /ha	L.E/feddan
Seeds, nursery preparation and transplanting	600	250.0	432.0	180.0
Permanent field preparation	95.2	39.7	95.2	39.7
Nitrogen fertilizer	59.5	24.8	59.5	24.8
Herbicides	47.6	19.8	47.6	19.8
Hand weeding	71.4	29.8	71.4	29.8
Harvesting	360.0	150.0	360.0	150.0
Total	1233.7	514.1	1065.7	444.1

* 1 ha ≈ 2.4 feddan

Conclusion

The present study revealed to the following main points.

The rice production cost per hectare in mechanical transplanting increases by 15.76% comparing with the manual transplanting. In the other hand the rice production in manual transplanting per hectare increases by 11.8% comparing with mechanical transplanting.

By increasing nitrogen levels up to 138 Kg N/ha (57.6 kg N/feddan) increased plant height in mechanic and manual transplanting methods, but in manual transplanting plant height was more than mechanical transplanting. And also increased the number of grains/panicle, grain yield and biomass yield ton/ha in both of the two transplanting methods compared with the control (no fertilizer). The increase in grain yield due to increasing nitrogen fertilizer was 74% and 36%in mechanical and manual transplanting methods respectively, while the increase in biomass were 41% and 23% in the two planting methods.

There were no significant differences among weed control treatments on plant height in mechanical and manual transplanting, while, in the other characters (number of grains/panicle, grain yield and biomass yield ton/ha) Saturn 50% is the best one followed by hand weeding treatment and (saturn 50% + Machete 60%) while, Machete alone gave the lowest values on both planting methods.

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الملخص العربى

مقارنة بين طريقتى شتل الأرز الميكانيكى واليدوى تحت معدلات مختلفة من التسميد النيتروجينى ومقاومة الحشائش

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بإيتاى البارود خلال موسمين زراعيين (٢٠٠٠ ، ٢٠٠١)، وذلك لدراسة تأثير معدلات مختلفة من التسميد النيتروجينى ومقاومة الحشائش تحت طريقتى زراعة (ميكانيكى، يدوى) على صنف أرز جيزة ١٧٧.

أستخدم أربعة معدلات من التسميد النيتروجينى هى (صفر، ٤٦، ٩٢، ١٣٨كجم نيتروجين/هكتار) فى صورة يوريا ٤٦% على دفعتين (ثلثى الكمية على الشراقى قبل الغمر مباشرة أما الثلث الأخير أضيف قبل طرد السنابل بسبعة أيام). كماأستخدم ثلاث مبيدات حشائش

(ساتيرن ٥٠% مستحلب ٤ لتر/هكتار ، ماشيت ٦٠ % مستحلب بمعدل ٤لتر/هكتار، ساتيرن ٥٠% مستحلب ٢ لتر/هكتار + ماشيت ٦٠% مستحلب بمعدل ٢ لتر/هكتار). أضيفت هذه المعدلات بعد أربعة أيام من الشتل فيكل من الشتل الميكانيكى واليدوى هذا بالاضافة إلى نقاوة الحشائش مرتين بعد 30، ٦٠ يوم من الشتل. تم الشتل الميكانيكى باستخدام الشتالة يانيمار اليابانية الصنع موديل ARP-8-30 .

أستخدم تصميم القطع المنشقة . عند الحصاد أخذت عينات من مساحة متر مربع من كل معاملة وذلك لتقدير الصفات الآتية (طول النبات، عدد السنابل/م^2 ، وزن السنبلة، عدد حبوب السنبلة) . كما تم تقدير محصول الحبوب والقش الناتج من مساحة ١٠ م^2 وذلك لتقدير محصول الحبوب والقش وكذلك دليل الحصاد. أخذت أيضا عينات حبوب من كل قطعة تجريبية وذلك لتقدير الصفات التكنولوجية للحبوب (نسبة التقشير، نسبة التبييض، نسبة الحبوب الكاملة).

وقد بينت النتائج أن زيادة التسميد النيتروجينى حتى ١٣٨ وحدة نيتروجين/هكتار أدى إلى نقص معنوى فى الوزن الجاف للحشائش وإلى زيادة معنوية فى طول النبات والمحصول ومكوناته وكذلك الصفات التكنولوجية للحبوب وذلك فى كلا طريقتى الزراعة الميكانيكية واليدوية.

من ناحية أخرى فقد أدى إستخدام مبيد الحشائش إلى زيادة الصفات الخضرية وصفات المحصول ومكوناته زيادة معنوية عند المقارنة (بدون نقاوة يدوية أو مبيد حشائش). كما لم تظهر النتائج تأثيرا معنويا" على الصفات التكنولوجية للحبوب نتيجة إستخدام مبيدات الحشائش.

وقد وجد أن الشتل اليدوى أدى إلى زيادة قدرها ١١,٨% فى محصول الحبوب مقارنة بالشتل الميكانيكى وأن تكاليف إنتاج الحبوب من وحدة المساحة (هكتار) قد زاد فى الشتل الميكانيكى بمقدار ١٥,٧٦% عن الشتل اليدوى.

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