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EFFECT OF HILL SPACINGS AND NITROGEN LEVELS ON YIELD AND ITS COMPONENTS OF TWO RICE CULTIVARS

BY

Abd El-Raouf, M.S.*; El-Metwally, El.M.A.*; Ghanem, S.A. and Abd El-Salam, R.M.***

* Agronomy Department, Faculty of Agric., Cairo University, Egypt.

** Rice Research and Training Center. Sakha, Kafr El-Sheikh, Egypt.

ABSTRACT

Two field experiments were carried out at Rice Research Training Center, Sakha, Kafr-El-Sheikh Governorate during 2000 and 2001 seasons. The effects of nitrogen levels (0, 23, 46, 69, and 92 kg N/fad) and three hill spacing (15x10, 15x15, and15x20 cm) on growth, yield and yield components of two rice cultivars (Giza 182 and Sakha 103) were studied. Results showed that:

Giza182 cultivar exceeded Sakha103 in plant dry weight, chlorophyll content, panicle length, panicle weight, number of filled grains\panicle, 1000-grain weight and grain yield. On the contrary, Sakha 103 cultivar exceeded Giza 182 in harvest index as well as hulling, milling and head rice percentage.

Number of tillers\hill, dry weight of plant\hill, panicle length, number of filled grains\panicle and grain yield significantly increased with increasing space between hills from 10 to 20 cm.

Plant height, number of tillers\hill, plant dry weight, panicle length, number of grains\panicle, panicle grain weight and 1000-grain weight significantly increased as nitrogen level increased up to 92 kg N\fad. However grain yield\fad, hulling, milling and head rice percentage significantly responded only up to 69 Kg N\fad and further N increase could not show any significant increase in yield.

Key words: Rice, Cultivar, Hill spacing, Nitrogen, Growth, Quality, Hulling, Milling.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the major crops in Egypt today, Nitrogen fertilizer is considered a key element in the growth and yielding capacities of rice because applied inorganic N is rapidly lost from the soil-flood water system by nitrification, denitrificaton, ammonia volatilization, runoff, and leaching. The amount of nitrogen application required for maximum yield differs among rice varieties. Rice yield is influenced considerably by plant population per unit area. Badawi *et al.* (1990) found that Giza 181 gave the highest grain yield followed by IR 28 while, Giza 171 gave the lowest grain yield. On the other hand, grain yield of Giza 182 significantly increased as nitrogen level increased up to 72 kg N\ha. Further more, IR28 and Giza 181 responded to higher nitrogen levels (108 kg N/ha.). El-Kalla *et al.*(1990) recorded significant differences among some rice varieties (Giza 175, Giza 181 and IR 28) in grain yield and most of its components. Also, rice varieties significantly differed in their requirements to nitrogen levels for producing the highest grain yield. Assey *et al.*(1992a) reported that plant height, number of grains/ panicle, panicle grain weight, 1000-grain weight and grain yield of IR28 variety were larger than those of Giza 175 under different hill spacings. Assey *et al.*(1992 b) mentioned that IR28 rice variety under different levels of nitrogen gave higher plant height, number of grains/panicle, panicle grain weight and 1000-grain weight than Giza 175. Abd El-Wahab (1998) concluded that medium duration varieties (Giza 175, 178 and 181) gave higher number of tillers/m^2, dry matter content and grain yield than both short duration variety (Giza 177) and long duration variety (Giza 171).Timothy *et al.*(2008) found that XL723 rice hybrid produced more filled grain\panicle and head rice yield than Cocodrie rice variety under different nitrogen rates.

Hegazy *et al.*(1995) reported that changing hill spacing from 15x15 to 20x20cm caused insignificant increase in grain yield compared with 25x25cm hill spacing. The regular transplanting at the spacing of 20 x 20 cm was the optimum density for obtaining the highest yield. Sorour *et al.*(1998) found that dry weight\m^2 and plant height were significantly higher with 15x15 cm spacing than with 20x20cm hill spacing. Unfilled grain (%), 1000-grain weight, grain yield, hulling (%), milling (%) and head rice (%) were not affected by spacings.

Assey *et al.* (1992b) indicated that increasing nitrogen level from 50 to 60 and 70 kg N\fad.significantly increased each of number of panicles\m^2, number of grains/ panicle, panicle grain weight, 1000-grain weight and grain yield. Abd El-Wahab (1998) stated that plant height and dry matter content were significantly increased as nitrogen levels increased up to 200 kg N\ha., while number of tillers\m^2 and leaf area index showed significant response up to 150 kg N\ha. Grain yield of all the tested cultivars were gradually increased as nitrogen levels increased up to 200 kg N\ha. however, there was no significant difference between 200 and 150 kg N/ha. In this aspect. Meena *et al.* (2002) reported that panicle length, panicle grain weight, number of grains\panicle, 1000-grain weight and grain yield significantly increased up to 200 kg N\ha. Jason *et al.* (2008) reported that 1000-grain weight, filled grain\panicle and head rice yield significantly increased as nitrogen levels increased up to 202 kg\ha. The objective of the current study was to determine the response of two rice cultivars to different nitrogen levels, hill spacing and their interactions.

MATERIALS AND METHODS

Two field experiments were carried out at Rice Research and Training Center (RRTC), Kafr-El-Sheikh Governorate, Egypt during 2000 and 2001 seasons. Each experiment included 15 treatments, which were the combinations of three spacings and five nitrogen levels. Each experiment included one of the following two short duration rice varieties: Sakha 103 (Japonica plant type with short grains) and Giza 182 (Indica plant type with long grains).

The three different hill spacings tested were 10, 15, and 20 cm. The hills were arranged in rows 15cm apart. Four seedlings were transplanted in each hill.

Five-nitrogen fertilization levels namely 0, 23, 46, 69 and 92 kg N\fed. In the form of urea (46 % N) were applied in two doses. The first dose (2/3 nitrogen rate) was incorporated in dry soil before flooding, while the second dose (1/3 nitrogen rate) was applied as a top-dressing at 30 days after transplanting.

A split- plot design with four replications was used. The hill spacing was randomly assigned to main plots and the sub-plots were allocated to nitrogen levels. The sub-plot area was 15 m^2 (3x5m).

At 50 days after transplanting; plant height (cm), number of shoots\hill and shoots dry weight (g) were estimated.

Plants of three hills were taken and dried in an oven at 70° c for 72 hrs, and then the total dry weight was determined.

At harvest, ten random panicles were taken from each sub-plot to measure panicle length, panicle weight, number of grains\ panicle and 1000- grain weight.

Rice plants were harvested at 80 percentage of panicles become yellow stage. Guarded ten square meters from the center of each sub-plot were manually harvested then gathered in bundles and left in the field one week to dry then mechanically threshed. The moisture content of rice grains was estimated using portable moisture meter. The weight of grains was adjusted to have 14% moisture content.

Harvest index was calculated as follow:

$$\text{Harvest index \%} = \frac{\text{Grain yield}}{\text{Grain yield} + \text{Straw yield}} X\ 100$$

Hulling recovery percentage was determined by dehulling of 100-grams of grains from each sub-sub plot by a dehulling machine. Dehulled grains was estimated as a percentage relative to 100-gram of paddy rice.

The milled rice percentage was determined by milling 100-gram of paddy rice by an experimental milling machine. The milled grains was computed as a percentage relative to 100 grains of paddy rice.

Milled rice was graded and grains up to 75% were considered as head rice and computed as percent from the total weight of the rough rice.

All collected data were subjected to the standard statistical analysis according to Gomez and Gomez (1984). Test for homogeneity of variance was used to compare between variances over two varieties and the two seasons before deciding the validity of combined analysis.

RESULTS AND DISCUSSION

Growth, yield and some agronomic traits of two rice cultivars as affected by three hill spacings and five nitrogen levels are presented and discussed as follow: -

Growth characters:

Effect of cultivars:

Results in Table (1) revealed that Giza 182 cultivars surpassed Sakha 103 cultivar in number of shoots/hill and plant dry weight. Such results may be attributed to the differences in genetic constitution where the two cultivars are belonging to two different types (Japonica and indica). These results are in harmony with those reported by Badawi *et al.* (1990), El-Kalla *et al.*(1990), Assey *et al.*(1992a and b) and Abd El-Wahab (1998).

2.1. Effect of hill spacing.

Results in Table (1) revealed that plant height, number of shoots\hill and plant dry weight\hill were increased as hill spacing increased. This increment may be attributed to the fact that increasing space between hills encouraged most of growth characters such as, tillering of plant and dry matter accumulation as a result to higher conversion of light energy to chemical energy in different plant parts under low plant population.

Effect of nitrogen levels:

Results in Table (1) indicated that plant height, number of shoots\hill and plant dry weight significantly increased as nitrogen level increased up to 92 kg N\fad. Generally, these results might be due to the role of nitrogen as an essential element which plays a prominent role in building new meristemic cells, cell elongation and increasing photosynthetic activity of rice plants. These results are in agreement with those obtained by Abd El-Wahab (1998) and Ebaid and Ghanem (2000).

Effect of interaction:

Results in Table (2) indicated that only, cultivars x nitrogen levels interaction had a significant effect on most of characters under study. The tallest plants resulted from sowing Sakha 103 cultivar and application of 92 kg N\fad. While, the shortest plants were obtained with the combination between Sakha 103 cultivar and unfertilized check. Giza 182 cultivar with 92 kg N level treatment produced the highest number of shoots\hill and dry matter. While, the lowest values resulted with the combination between Sakha 103 cultivar and check treatment for nitrogen fertilizer.

Table (1): Some growth and agronomic characters of two rice cultivars as affected by hill spacing and nitrogen levels (combined data over 2000 and 2001seasons).

Characters	Plant height (cm)	No. of shoots/ hill	Plant dry weight(g)	Panicle length (cm)	No. grains/ panicle	Panicle grain wt. (g)	1000-grain wt. (g)	Grain yield (t/fad)	Harvest index
Cultivars									
Sakha 103	103.7	13.7	30.3	18.7	111.0	2.91	24.6	3.92	44.4
Giza 182	103.5	14.1	31.9	22.7	135.1	3.44	25.6	4.13	40.8
Significance	ns	*	*	*	*	*	*	*	*
Hill spacing									
10	103.4	12.9	30.6	20.4	121.9	3.14	25.0	3.96	42.7
15	103.4	13.6	31.3	20.6	122.9	3.19	25.1	4.04	42.4
20	104.0	15.0	31.6	20.7	124.3	3.20	25.1	4.08	42.8
L.S.D at 5%	0.35	0.12	0.19	0.12	1.1	ns	ns	0.07	ns
N. Levels									
0	92.7	10.1	26.2	19.2	106.5	2.70	24.1	2.82	44.2
23	99.1	11.8	28.4	20.1	115.4	2.96	24.7	3.55	43.2
46	104.2	13.5	31.2	20.8	124.8	3.21	25.1	4.04	41.9
69	108.8	16.4	34.6	21.3	134.0	3.48	25.8	4.79	42.5
92	113.2	17.4	35.4	21.5	135.0	3.53	25.9	4.93	41.1
L.S.D at 5%	0.63	0.16	0.23	0.18	1.6	0.08	0.8	0.21	1.5

Table (2): Some growth and agronomic characters of two rice cultivars as affected by the interaction between cultivars and nitrogen levels (Kg N\fad) (combined data over 2000 and 2001 seasons).

Characters		Plant height (cm)	No.of shoots/ hill	Plant dry weight(g)	Panicle length (cm)	No. grains/ panicle	Panicle grain wt. (g)	1000-grain wt. (g)	Grain yield (t/fad)	Harvest index
Cultivars	**N**									
Sakha103	0	92.2	9.9	25.0	17.4	100.2	2.6	23.5	2.70	44.8
	23	99.3	11.2	27.7	17.8	105.4	2.7	24.0	3.53	45.9
	46	103.9	13.2	30.6	18.6	110.6	2.8	24.5	3.94	44.1
	69	109.6	16.6	33.9	19.0	119.2	3.1	25.2	4.70	44.5
	92	113.5	17.3	34.6	19.1	119.4	3.1	25.4	4.73	43.3
Giza 182	0	93.2	10.3	27.3	20.9	112.7	2.7	24.5	2.93	43.8
	23	98.9	12.3	29.1	22.2	125.5	3.1	25.2	3.57	40.8
	46	104.5	13.9	31.7	23.0	139.0	3.5	25.5	4.14	39.9
	69	107.9	16.1	35.3	23.7	148.7	3.8	26.2	4.89	40.6
	92	112.9	17.4	36.2	23.8	149.5	3.9	26.4	5.13	38.9
L.S.D at 5%		0.90	0.23	0.30	0.25	2.3	0.11	ns	0.23	1.8

Yield and yield component

Effect of cultivars

The results in Table (1) revealed that Giza 182 cultivars surpassed Sakha 103 cultivars regarding panicle length, number of grains/panicle, panicle grain weight, thousand grain weight, grain yield. These results are in harmony with those reported by Badawi *et al.* (1990), El-Kalla *et al.*(1990), Assey *et al.* (1992a and b), Abd El-Wahab (1998) and Jason *et al.*(2008).

Effect of hill spacing

Results in Table (1) revealed that panicle length, number of filled grains\panicle and grain yield significantly increased with increasing space between hills from 10 to 20cm. On the other hand, panicle grain weight, 1000-grain weight, harvest index were not signifantly affected by hill spacing.

2.3. Effect of nitrogen levels

Results in Table (1) indicated that panicle length, number of grains\panicle, panicle grain weight and 1000-grain weight significantly increased as nitrogen level increased up to 92 kg N\fad. Grain yield significantly responded only up to 69 Kg N\fad and further increase could not show any significant increase. On the other hand harvest index significantly decreased with increasing nitrogen levels. Generally, these results might be due to the favorable effect of nitrogen fertilizer on yield component. These results are in agreement with those obtained by Abd El-Wahab (1998), Ebaid and Ghanem (2000) as well as Timothy *et al* (2008).

Effect of interaction

Results in Table (2) indicated that panicles of Giza 182 cultivar fertilized by 92 kg N/fad. were the tallest while, the shortest ones resulted from Sakha 103 cultivar with the unfertilized control. The highest number of filled grains/panicle was that of Giza 182 cultivar fertilized by 69 kg N\fad. while, the lowest number of filled grains/panicle resulted from the unfertilized Sakha 103 cultivar. The heaviest panicles were obtained when plants of Giza 182 cultivar were fertilized by 92 or 69 kg N levels without significant difference among them, while the lightest grains per panicle resulted from Sakha 103 cultivar and unfertilized check. The highest grain yield was obtained with Giza 182 cultivar and 92 kg N level. In addition, the unfertilized check of Sakha 103 produced the lowest grain yield. The highest value of harvest index was obtained by using Sakha 103 cultivar combined with 23 kg N\fad. while, the lowest value of harvest index resulted from the combination between Giza 182 cultivar and unfertilized check of nitrogen.

Technological characters

Effect of cultivars

The results in Table (3) revealed that there was a significant difference between both cultivars in hulling recovery, milling recovery and head rice percentage. Sakha 103 was superior than Giza 182 in hulling recovery, milling recovery and head rice percentage. Such results may be attributed to the differences in genetic constitution and genetical-environmental interaction. Moreover, as mentioned before the two cultivars are belonging to different type (Japonica and indica). These results are in harmony with those reported by Badawi *et al.* (1990), Assey *et al.* (1992a and b) and Abd El-Wahab (1998)

Effect of hill spacing

Results in Table (3) revealed that hulling percentage, milling percentage and head rice percentage were not significantly affected by hill spacing.

Effect of nitrogen levels

Results in Table (3) indicated that hulling percentage, milling percentage and head rice percentage significantly responded only up to 69 Kg N\fad and further increase could not show any significant increase.

Effect of interaction

Results in Table (4) indicated that the interaction between cultivars and nitrogen levels had a significant effect on hulling recovery %, milling recovery % and head rice %. Whereas, Sakha 103 cultivar with the application of 69 kg N/fad. recorded the highest percentage of hulling, milling and head rice. While, Giza 182 cultivar combined with zero nitrogen check recorded the lowest value for these traits.

From the above results it could be concluded that 69 kg N level combined with 15 cm hill spacing are the most favorable either for Giza 182 or Sakha 103 cultivar to maximize rice yield.

Table (3): Some technological characters of two rice cultivars as affected by hill spacing and nitrogen levels (combined data over 2000 and 2001seasons).

Characters	Hulling recovery percentage	Milling recovery percentage	Head rice percentage
Cultivars			
Sakha 103	81.56	70.40	61.90
Giza 182	78.65	67.37	58.25
Significance	*	*	*
Hill spacing			
10	79.94	68.56	59.93
15	80.25	69.09	60.06
20	80.11	69.02	60.23
L.S.D at 5%	0.24	ns	ns
N. Levels			
0	79.13	67.62	58.52
23	79.87	68.39	59.80
46	80.35	69.12	60.33
69	80.67	69.97	61.10
92	80.51	69.34	60.63
L.S.D at 5%	0.28	0.43	0.40

Table (4): Some technological characters of two rice cultivars as affected by the interaction between cultivars and nitrogen levels (Kg N\fad) (combined data over 2000 and 2001 seasons).

Characters		Hulling recovery percentage	Milling recovery percentage	Head rice percentage
Cultivars	N			
Sakha 103	0	80.79	69.38	59.14
	23	81.42	70.08	61.50
	46	81.87	70.81	62.41
	69	81.92	71.43	63.54
	92	81.81	70.31	62.88
Giza 182	0	77.46	65.86	57.91
	23	78.31	66.69	58.09
	46	78.83	67.43	58.25
	69	79.43	68.51	58.66
	92	79.21	68.38	58.37
L.S.D at 5%		0.39	0.61	0.56

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تاثير مسافات الزراعة ومستويات التسميد النيتروجينى علي المحصول ومكوناته في صنفين من أصناف الأرز

محمد صبري عبد الرؤوف*، المتولي عبد الله المتولي*، صبحي عبد الحليم غالم**، ربيع محمد عبد السلام

* قسم المحاصيل-كلية الزراعة-جامعة القاهرة
** معهد البحوث والتدريب في الأرز بسخا- كفر الشيخ- مركز البحوث الزراعية.

أجريت تجربتان حقليتان بمزرعة مركز البحوث والتدريب في الأرز بسخا-محافظة كفر الشيخ-خلال موسمي ٢٠٠٠، ٢٠٠١ لهدف دراسة تأثير ثلاث مسافات بين الجور (١٠، ١٥، ٢٠ سم) مع مسافة ثابتة بين السطور (١٥ سم) وخمس مستويات للتسميد النيتروجيني (صفر، ٢٣، ٤٦، ٦٩، ٩٢ كجم نيتروجين للفدان) على صفات النمو،المحصول ومكوناته وبعض الصفات التكنولوجية للحبوب لصنفين من أصناف الأرز (سخا ١٠٣، جيزة ١٨٢).

وتشير لنتائج الدراسة الى:

تفوق الصنف جيزة ١٨٢ معنويا علي الصنف سخا ١٠٣ في الوزن الجاف للنبات، عدد الداليات/م٢، طول الدالية (سم)، وزن حبوب الدالية (جم)، عدد الحبوب الممتلئة/دالية، وزن الألف حبة ومحصول الحبوب (طن/ فدان).وعلى العكس تفوق الصنف سخا ١٠٣ على الصنف جيزة ١٨٢ في دليل الحصاد، تصافي التقشير، تصافي التبيض والنسبة المئوية للأرز السليم.

أدت زيادة مسافات الشتل بين الجور من ١٠ إلي ٢٠ سم إلي زيادة معنوية في طول الدالية وعدد الحبوب الممتلئة/دالية ومحصول الحبوب. وبصفة عامة لم يتاثر كل من وزن حبوب الدالية، وزن الألف حبة، دليل الحصاد،تصافي التقشير، تصافي التبيض والنسبة المئوية للأرز السليم بتغير المسافة بين الجور.

أدت زيادة معدلات التسميد حتى ٩٢ كجم نيتروجين/فدان إلى زيادة معنوية في عدد الأفرع/جوره، الوزن الجاف للنبات، طول الدالية،وزن حبوب الدالية، عدد الحبوب الممتلئة/دالية، وزن الألف حبة . بينما استجابت محصول الحبوب وكذلك تصافي التقشير، تصافي التبيض والنسبة المئوية للأرز معنويا بزيادة التسميد حتى ٦٩كجم نيتروجين/فدان.