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PERFORMANCE OF TRANSPLANTED HYBRID RICE VARIETIES UNDER DIFFERENT SEED RATES AND N-LEVELS

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ABSTRACT

Two field experiments were conducted at Rice Research and Training Center (RRTC), Sakha Kafr El-Sheikh, Egypt, in 2010 and 2011 rice seasons to study the performance of SK2034H (H_1) and SK2046H (H_2) hybrid rice varieties under seeding rates i.e. 34, 46, 58 and 70 g/m^2 and N-levels (0, 50, 100, 150 and 200 kg/ha).

The obtained results revealed that, in nursery studies SK2034H surpassed SK2046H in both seedling length and shoot length. On contrast the opposite results was observed with both number of leaves/seedling and root : shoot ratio. Seed rate of 34 and 46 g/m^2 gave the greatest seedling characters in nursery (greatest seedling vigor) compared with the other seed rates. SK2034H gave the highest number of leaves/seedling under 34 g/m^2, while SK2046H produced the greatest value in this aspect under both 34 and 46 g/m^2. The first three seed rates (34, 46 and 58 g/m^2) improved root/shoot ratio of SK2034H, while the second hybrid responded to only 34 g/m^2.

In the permanent field, SK2046H (H_2) hybrid had higher dry matter content (DM), leaf area index (LAI), flag leaf area (FLA) and root dry weight than SK2034H (H_1). Seed rate of 34 g/m^2 gave the highest previous growth characters than the other rates under study. The application of 200 kg N/ha gave the greatest values in the same growth parameters. Seed rate of 34 g/m^2 combined with 200 kg N/ha produced the greatest dry matter content and flag leaf area of SK2046H.

In both seasons, H_2 surpassed H_1 in no. of panicles/m^2, 1000-grain weight, harvest index (HI) and grain yield. While, H_1 surpassed H_2 in both panicle weight and no. of filled grains/panicle. Seed rates of 34 g/m^2 was the best for number of panicles/m^2, yield components, while grain yield and HI was the highest under both seed rate of 34 and 46 g/m^2. Adding 200 kg N/ha produced the greatest grain yield and its components. Number of panicles/m^2 and 1000-grain weight of SK2046H (H_2) reached to maximum value under seed rate of 34 g/m^2 with 200 kg N/ha. Filled grains/panicle reached to the highest value when SK2034H (H_1) variety under the seed rate of 34 g/m^2 and fertilized by 200 kg N/ha. Grain yield of both hybrids (H_1 and H_2) was the best under the seed rates of 34 and 46 g/m^2 combined with 200 kg N/ha. The same trend was obtained with harvest index (HI).

INTRODUCTION

Rice 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. Introduction of hybrid rice with suitable production techniques is suggested as viable and appropriate strategies.

Rice hybrids produce about 14-28% higher grain yield than inbred cultivars (Siddiq, 1993). Yan (1988) observed that agronomic management of hybrid rice differs considerably than the conventional varieties. Therefore, to

exploit this advantage, it is necessary to adopt appropriate crop management practices. Therefore, the objective of the study was to identify the suitable seed rate for rice hybrid developed locally and effect of these seeding densities on yield under different N-levels in permanent field.

Tiller number per seedling is one of the most important characters in high quality seedlings (Long Ping Yuan and Xi-Qin Fu, 1995). Use of high quality seedlings with many tillers is important in hybrid rice than inbred rice to reduce the seed requirement and also to increase the grain yield. Hybrid rice has an ability to produce more tillers than that of inbred rice. Initial tillering in the nursery seedlings is highly influenced by nursery seed rate (Jayawardena *et al.* (2004). Singh *et al.* (1997) investigated rice seedlings grown in a nursery using seeding rate of 20, 40, 60 and 80 g seeds/m^2 were transplanted in permanent field using 1-3 seedlings/hill. They found that increasing seeding rates decreased no. of panicles/hill and no. of grains/panicle and decreased paddy yields. Kurmi and Sarmah (1993) studied the effect of seeding rates on different characters of three rice cultivars. These seeding rates were 40, 52, 64, 76, 88 and 100 g seeds/m^2. They found that at transplanting, dry weight of seedlings was the highest with 40 g seeds and the lowest with 100 g seeds. Lal and Roy (1996) investigated the effect of three seeding densities of nursery and their effects on yield and yield parameters. The seedling vigor was expressed in terms of root length, height and leaf area of seedling at the time of transplanting. They revealed that low seeding in nursery recorded significantly higher plant height. They clarified that rice plant grown from seedlings raised in the low seed density of nursery performed better productive tillers, grains/panicle and grain and straw yields than plant grown from seedlings raised in higher density nurseries. Hari *et al.* (1997) studied the effect of seedling density in the nursery on leaf area index and dry matter production after transplanting. Data obtained demonstrated that there was a significant decrease in leaf area index and dry matter production with the increase in seedling density from the sowing rate of 20, 40 and 60 g/m^2 in the nursery. Also, grain yield was the highest in plots transplanted with seedlings from nursery sown with 20 g seeds/m^2. Dong *et al.* (1999) studied the effect of sowing rates in nursery (10, 15, 20, 25 or 30 g/m^2). They found that grain yield was the highest in plots transplanted with seedlings from nursery sown with 20 g seed/m^2.

Nitrogen fertilizer is the most important agronomic factor. It has been proved that the N-application can be effected some traits such as dry matter (DM), panicles number/m^2 which are correlated with grain yield (Bansal *et al.*, 1993). Hari *et al.* (1997) studied the effect of seedling density in the nursery and N-levels after transplanting on LAI and DM production and observed that LAI, DM and grain yield increased with the increase in N application from 0 to 200 kg/ha. Meena *et al.* (2002) reported that panicle grain weight, no. of filled grains/panicle, 1000-grain weight and grain yield significantly increased up to 200 kg N/ha. There are positive correlations between some yield components like shoot dry matter, N harvest index and efficiency of N application with grain yield (Fageria and Borbosa Filho, 2001a, b; Shen *et al.*, 2003). Bahmaniar and Ranjbar (2007) and Gorgy (2010) reported that N-application

increased flag leaf length and width, LAI, DM, 1000 grain weight, no. of grains/panicles, grain yield and harvest index.

The purposes of the current study are:

- The effect of seed rates in the seedling vigor in nursery.
- The performance of the two hybrids (SK2034H and SK2046H) under different seed rates and N-levels.
- Identify the optimum seed rate and N-level for the two hybrids.

MATERIALS AND METHODS

Two field experiments were conducted at Rice Research and Training Center (RRTC), Farm, Sakha, Kafr El-Sheikh, Egypt, in 2010 and 2011 growing seasons to study the performance of SK2034H (H_1) and SK2046H (H_2) hybrid rice varieties under different seed rates and N-levels.

Seedbed preparation:

Seedbed was prepared by ploughed two times, then well dry leveled. Both phosphorus (super phosphate 15.5% P_2O_5) at the rate of 36 kg P_2O_5/ha and potassium (potassium sulphate 48% K_2O) at the rate of 50 kg K_2O/ha were applied during land preparation. Seed bed area was divided into eight equal parts, the first four parts were received the four seed rates of SK2034H (H_1) namely 34, 46, 58 and 70 g/m^2 which equal 14, 19, 24 and 29 kg/414 m^2 (nursery area/ha), the second four parts were received the same rates withy SK2046H (H_2). Nitrogen fertilizer was applied at the rate of 171 kg N/ha as form of urea (46.5%) which incorporated in dry soil immediately before flooding. All nurseries fertilized by zinc sulphate at the rate of 57 kg/ha.

The seeds with the different areas for the two hybrids were soaked in fresh water 24 hr. and incubated 48 hr. then exposed to atmosphere few minutes and broadcasted in the nurseries which had 2-3 cm water depth. Weeds were chemically controlled as recommended.

Nursery studies

In nursery, some seedling characters in the two hybrids (H_1 and H_2) were estimated under different seed rates to study the vigour growth of seedling. Twenty five days after sowing (DAS), 20 seedlings were collected four times from each nursery to determine: seedling length (shoot plus root length), shoot length, number of leaves/seedling and root : shoot ratio (R/S ratio) was estimated the following equation: R/S ratio = $\frac{\text{Root dry weight (g)}}{\text{Shoot dry weight (g)}}$

Permanent field preparation:

The same preparation as previously mentioned in nursery except the nitrogen which applied according to the following levels (control) 0, 50, 100, 150 and 200 kg N/ha applied as recommended of hybrid rice at three equal splits. The experiment design was split-split plot design with four replications. The main plots were occupied by the two hybrids, the seed rates were allocated in sub-plots and five N-levels were arranged in the sub-sub plots. Twenty eight days old seedling were transplanted at 20 x 20 cm distance

between hills and rows. Number of seedlings/hill were transplanted according to the seed rates. The size of sub-sub plot was 15 m^2. All cultural practices were done as recommended up to harvest.

Studied characters (permanent field):

- **Growth characters:**

At late booting, five hills from sub-sub plots were taken to determine dry matter content (DM), leaf area index (LAI), flag leaf area (FLA), root dry weight [metal sampler having dimensions at 20 x 20 x 50 cm was used to take the root sample (Craswell and Castillo, 1979)].

- **Grain yield and its attributes:**

At harvest, ten random hills from sub-sub plots were collected to determine the number of panicles/m^2, panicle weight, number of filled grains per panicle and 1000-grain weight. Nine square meter of each sub-sub plot was harvested, dried and threshed to estimate the grain yield. The grain yield was adjusted to 14% moisture content and converted into ton/ha. Harvest index (HI) was estimated according to the following equation:

HI = Economic yield (t/ha)/biological yield (t/ha)

Where: Economic yield is the actual grain yield and biological yield is the total yield of grain plus straw yield .

All the collected data was conducted with IRRISTAT and the difference among the treatments mean were computerized by M-state (Duncan, 1955 multiple range test at 5% level) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Nursery studies:

The results in Table (1) indicated that SK2034H surpassed SK2046H in seedling length and shoot length in both seasons. In the same time, hybrid rice SK2046H surpassed SK2034H in number of leaves/seedling and root:shoot ratio. These results could be attributed mainly to the genetic background. These results are in conformity with that reported by Clavijo and Baker (1986).

Data in Table (1) also, indicated that, low seeding rate 34 and 46 g/m^2 in nursery produced the tallest seedling length (cm) and shoot length (cm) than medium and high seeding density (58 and 70 g/m^2) in nursery in both seasons of study. These findings could be attributed to the fact that, the competition is less under low seeding rate in nursery. So that, the seedlings have the adequate condition to grow well. These data are in harmony with Hussain (1992). Also, data showed that, the lowest seeding rate (34 g/m^2) produced significantly the highest no. of leaves/seeding compared with other seeding rates. As a result to overcrowded of the nursery caused a significant reduction in leaves formation. So that, the seedling delayed to be consistent for transplanting from the physiological and morphological point of view (Hoshikawa, 1989).

The results in Table (1) showed that significant differences were observed among seed rates in nursery in root:shoot ratio. When seed density in nursery increased root:shoot ratio decreased. So, reduction in seeding

density in nursery could lead to obtain high root:shoot ratio as indicator for the seedling ability to constitute stout and sturdy vigorous root system. These results are in agreement with those reported by Lal and Roy (1996). Also, Jayawardena *et al.* (2004) who reported that low inter-plant competition among the seedlings at 20 and 30 g/m^2 densities could be the reason for producing multi-tillered seedling at low seeding densities.

Table (1): Seedling length, shoot length, number of leaves/seedling and root:shoot ratio of two hybrid rice varieties under different seed rates in nursery (seedling vigor) in 2010 and 2011 seasons.

Treatments	Seedling length (cm)		Shoot length (cm)		Number of leaves/seedling		Root:shoot ratio	
	2010	2011	2010	2011	2010	2011	2010	2011
Varieties								
SK2034H	30.84 a	29.78 a	22.15 a	22.28 a	5.53 b	5.64 b	0.3998 b	0.3900 b
SK2046H	29.41 b	28.02 b	21.16 b	20.92 b	6.25 a	6.13 a	0.4747 a	0.4664 a
Nursery seed rate (g/m^2):								
34	31.83 a	30.68 a	23.17 a	23.24 a	6.51 a	6.47 a	0.4782 a	0.4862 a
46	30.71 ab	29.62 ab	22.13 b	22.03 b	6.11 b	6.17 ab	0.4668 a	0.4592 a
58	29.91 b	28.69 b	21.41 b	21.33 b	5.73 c	5.68 bc	0.4542 a	0.4257ab
70	28.05 c	26.59 c	19.93 c	19.79 c	5.20 d	5.23 c	0.3490 b	0.3418 b
Interaction	ns	ns	ns	ns	ns	*	**	**

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Data presented in Table (2) showed that, the lowest seeding rate (34 g/m^2) in nursery produced the highest number of leaves/seedling of SK2034H variety compared with the other seeding rates (in 2011 season), while the density of 34 and 46 g/m^2 gave more no. of leaves/seedling of SK2046H.

Table (2): Number of leaves per seedling and root:shoot ratio as affected by the interaction between varieties and seed rates in nursery

Variety	Seed rate in nursery (g/m^2)	No. of leaves/ seedling	Root : shoot ratio	
		2011	2010	2011
SK2034H	34	6.395 a	0.418 b	0.4238 a
	46	5.995 b	0.4619 a	0.4350 a
	58	5.388 c	0.4451 ab	0.4378 a
	70	4.788 d	0.2741 c	0.2634 b
SK2046H	34	6.555 a	0.5385 a	0.5486 a
	46	6.345 a	0.4717 b	0.4833 b
	58	5.978 b	0.4634 bc	0.4135 c
	70	5.680 b	0.4251 c	0.4203 c

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Also, data show that, SK2046H variety under 34 g/m^2 recorded the highest root:shoot ratio in both seasons. While SK2034H gave the highest values of root:shoot ratio with the first three seed rates which gave nearly the same values.

Permanent field studies:

Growth characters:

In both seasons, the data in Table (3) indicated that significant differences excised between the two hybrid rice varieties in dry weight, leaf area index, flag leaf area and root dry weight.

In general, SK2046H significantly surpassed SK2034H in dry weight, leaf area index (LAI), flag leaf area (FLA) and root dry weight in both seasons. These results were expected and could be explained on basis that hybrids have stronger and more active root system at early and middle growth stages having 21-34% higher root ability at seedling stage (Virman, 1996). The results of Gorgy (2011) revealed that hybrid rice SK2034H recorded higher values of dry matter production and LAI compared to SK2058 hybrid rice.

Table (3): Dry weight (g/hill), leaf area index (LAI), flag leaf area (cm^2) and root dry weight (g/hill) of the two hybrid rice varieties as affected by seed rates and nitrogen levels in 2010 and 2011 seasons.

Characters / Treatments	Dry weight (g/hill)		Leaf area index (LAI)		Flag leaf area (cm^2)		Root dry weight (g/hill)	
	2010	2011	2010	2011	2010	2011	2010	2011
Variety (V)								
SK2034H	32.92 b	34.36 b	4.78 b	5.09 b	23.70 b	24.09 b	12.36 b	12.18 b
SK2046H	41.95 a	44.83 a	5.47 a	5.99 a	27.78 a	27.97 a	13.00 a	13.02 a
Seed rate (S) (g/m^2)								
34	41.78 a	43.90 a	5.57 a	6.11 a	28.72 a	28.45 a	13.53 a	13.43 a
46	39.12 b	41.33 b	5.35 b	5.83 b	26.76 b	27.08 b	12.93 b	12.90 ab
58	35.57 c	37.48 c	4.91 c	5.28 c	24.51 c	24.97 c	12.47 c	12.43 b
70	33.28 d	35.69 d	4.64 d	4.94 d	22.98 d	23.61 d	11.79 d	11.64 c
N-fertilization (N) (kg/ha)								
0 (cont.)	21.7 e	23.06 e	3.23 e	3.76 e	16.21 e	17.14 e	9.19 e	9.27 e
50	33.0 d	34.90 d	3.98 d	4.35 d	23.29 d	24.0 d	11.62 d	11.64 d
100	38.2 c	40.38 c	5.28 c	5.68 c	27.13 c	27.38 c	13.22 c	13.03 c
150	44.5 b	46.56 b	6.25 b	6.64 b	29.51 b	29.38 b	14.30 b	14.22 b
200	49.3 a	52.09 a	6.88 a	7.23 a	32.55 a	32.25 a	14.90 a	14.85 a
Interaction								
V x S	ns	ns	ns	ns	ns	ns	ns	ns
S x N	**	ns	ns	ns	**	**	ns	ns
V x N	**	**	ns	ns	**	**	ns	ns
V x S x N	ns	ns	ns	ns	ns	ns	ns	ns

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Dry weight, LAI, FLA and root dry weight were significantly affected by different seed rates as shown in Table (3). Data showed that, plots which transplanted with seedling grown under low seeding rate (34 g/m^2) gave the highest dry weight production, LAI, FLA and root dry weight compared with plots transplanted with seedlings raised from the medium and high seeding rate. These finding could be attributed mainly to the sturdy and vigorous seedlings under sparse density which do not have any competition comparing with the other week quality seedlings under high density of seeds in nursery.

These results are in agreement with that recorded by Reddy *et al.* (1986), Hari *et al.* (1997) and Jayawardena *et al.* (2004).

Nitrogen fertilizer levels significantly influenced the growth characters in both seasons (Table 3). Increasing N-fertilizer rate from zero up to 200 kg N/ha caused linear increase in the mentioned studied growth characters. The favorable effect of increasing N-fertilizer levels on rice LAI was reported by Hari *et al.* (1997), Gautam (2004), Ebaid and Abo-Yousef (2006) and Gorgy (2011). They found that increasing N-level increased leaf area due to increases in number of tillers and/or size of leaf per plant, consequently increase dry matter content, resulted in increase in grain yield.

Table (4): Dry weight (g/hill) as affected by the interaction between different seed rates and N-levels applied in permanent field in 2010

N levels (kg/ha)	Seed rates (g/m^2)			
	34	46	58	70
0 (Cont.)	23.88 k	22.91 kl	21.34 L	19.05 m
50	37.04 g	34.45 h	31.61 i	29.11 j
100	42.99 de	39.73 f	36.54 g	33.73 h
150	50.23 b	46.43 c	42.15 e	39.70 f
200	54.75 a	52.09 b	46.19 c	44.81 cd

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The interaction between seedlings raise under different seed rates and N-levels had a significant effect on dry weight production (DM) in 2010 season (Table 4). The combination of low seeding rate (34 g/m^2) and 200 kg N/ha gave the maximum value of DM accumulation. The minimum values of DM were registered under high rate of seeds in nursery (70 g/m^2) and the unfertilized treatments.

The interaction between seed rates and N-levels had highly significant effects on FLA in both seasons (Table 5). The combination of the low seeding rate (34 g/m^2) and 200 kg N/ha gave the maximum values of FLA (cm^2) in both seasons.

Table (5): Flag leaf area (cm^2) as affected by the interaction between different seed rates and N-levels applied in permanent field in 2010 and 2011 seasons.

N levels (kg/ha)	Seed rates (g/m^2)			
	34	46	58	70
	2010			
0 (Cont.)	18.14 k	17.16 k	15.58 L	13.96 m
50	25.90 fg	23.65 hi	22.45 ij	21.18 j
100	29.00 d	28.45 d	26.25 efg	24.84 gh
150	33.47 b	30.44 c	27.56 de	26.58 ef
200	37.06 a	34.10 b	30.69 c	28.35 d
	2011			
0 (Cont.)	18.24i	17.76 ij	16.73 jk	15.85 k
50	25.48 fg	24.70 g	23.49 h	22.33 h
100	29.40 d	28.45 e	26.24 f	25.10 fg
150	32.91 c	30.30 d	27.80 e	26.49 f
200	35.90 a	34.20 b	30.97 d	28.29 e

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The interaction between hybrid rice varieties and N-levels had highly significant effects on DM and FLA in both seasons. Data in Table (6) show that hybrid SK2046H gave the highest DM and FLA under 200 kg N/ha. It might be due to the increase in N-requirement for SK2046H which gave the highest LA consequently more photosynthesis and DM accumulation as well as FLA under the highest N-level (200 kg/ha) These data are in agreement with those of Ebaid and El-Mowafi (2005).

Table (6): Dry weight (g/hill) and flag leaf area (cm^2) as affected by the interaction between hybrid rice varieties and N-levels

N levels (kg/ha)	Varieties			
	2010		2011	
	SK2034H	SK2046H	SK2034H	SK2046H
	Dry weight (g/hill)			
0 (Cont.)	21.72 g	21.87 g	21.96 h	24.16 g
50	27.08 f	39.03 d	27.99 f	41.82 d
100	31.24 e	45.24c	32.59 e	48.18 c
150	39.08 d	50.18 b	40.56 d	52.56 b
200	45.49 c	53.43 a	48.73 c	57.46 a
	Flag leaf area (cm^2)			
0 (Cont.)	15.68 i	16.74 h	16.51 h	17.78 g
50	20.11 g	26.48 ef	21.57 f	26.43 de
100	25.56 f	28.71 d	25.58 e	29.19 c
150	27.23 e	31.80 b	27.13 d	31.62 b
200	29.93 c	35.17 a	29.65 c	34.85 a

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Grain yield and its attributes:

Data in Tables (7 and 8) presented the effect of rice varieties, seed rates, N-levels and their interaction on panicles number/m^2, panicle weight, no. of filled grains/panicle, 1000-grain weight, grain yield and HI in 2010 and 2011 seasons.

Data showed that significant differences were observed between the two hybrids. Hybrid rice SK2046H surpassed SK2034H in panicle number/m^2, 1000-grain weight, grain yield and HI. While, SK2034H gave the heaviest panicle weight and maximum no. of filled grains/panicle. The increase in grain yield in SK2046H variety than SK2034 H could be attributed to the fact that SK2046H variety had a high efficiency in growth characters (Table 3).

Regarding seed rates, data showed that rice plants transplanted with seedlings raised from low seeding density in nursery (34 g/m^2) produced the highest no. of panicles/m^2, heaviest panicle weight, 1000-grain weight and maximum no. of filled grains/panicle. Also, data showed that, when seeding density in nursery increased, more than 46 g/m^2 grain yield and HI were decreased.

These results could be attributed to the superiority of seedlings raised under low seeding density in the nursery (34 and 46 g/m^2) in all seedling characters during the nursery period as a resultant of that, sturdy seedling have rapid and vigorous growth ability after transplanting. Otherwise, using weekly and slow growth ability of seedling grown under high seeding density in the nursery (58 and 70 g/m^2). Thereby, the results concluded that, 34 or 46

g/m^2 seeds in nursery is considered as the reasonable seeding rate in hybrid rice varieties to obtain the highest grain yield and saving high amount of the seeds in the nursery. These findings are in agreement with those reported by Singh *et al.* (1997), Hari *et al.* (1997) and El-Kallawy (2002).

Table (7): Panicles number/m^2, panicle weight and number of filled grains/panicle of the two hybrid rice varieties as affected by seed rates and nitrogen levels in 2010 and 2011 seasons.

Character / Treatments	Panicles number/m^2		Panicle weight (g)		Number of filled grains/panicle	
	2010	2011	2010	2011	2010	2011
Variety (V)						
SK2034H	474.08 b	486.18 b	3.45 a	3.72 a	140.82 a	147.39 a
SK2046H	494.33 a	507.05 a	3.34 b	3.55 b	131.60 b	138.57 b
Seed rate (S) (g/m^2)						
34	532.63 a	551.19 a	3.67 a	3.86 a	146.88 a	153.29 a
46	502.20 b	512.92 b	3.54 b	3.74 a	139.60 b	145.57 b
58	459.50 c	470.65 c	3.29 c	3.55 b	132.31 c	138.76 c
70	442.48 d	451.45 d	3.08 d	3.39 c	126.05 d	134.30 d
N-fertilization (N) (kg/ha)						
0 (cont.)	353.13 e	362.50 e	2.85 e	3.12 e	109.29 e	108.35 e
50	450.50 d	465.47 d	3.13 d	3.33 d	128.18 d	136.67 d
100	489.38 c	501.25 c	3.42 c	3.64 c	138.62 c	147.62 c
150	547.09 b	562.16 b	3.70 b	3.93 b	146.09 b	155.65 b
200	580.91 a	591.69 a	3.89 a	4.16 a	158.87 a	166.62 a
Interaction						
V x S	**	**	ns	ns	**	ns
S x N	**	**	ns	ns	ns	ns
V x N	ns	ns	ns	ns	**	**
V x S x N	ns	ns	ns	ns	ns	ns

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Concerning N-levels effect, results in Tables (7 and 8) showed that increasing level of nitrogen up to 200 kg/ha significantly increased no. of panicle/m^2, panicle weight, no. of filled grains/panicle, 1000-grain weight, grain yield and HI. These results may be due to the increase in photosynthetic products which translocated from source to sink during grain filling a well as the delaying of leaf senescence resulted in heaviest panicle and grains consequent grain yield. Similar results had been reported by Kamal *et al.* (2002), Singh *et al.* (2004), RRTC (2004), Ebaid and Abo-Yousef (2006) and Gorgy (2010).

The interaction between rice varieties and seed rates had a significant effect on panicles number/m^2 in both seasons and no. of filled grains/panicle in 2010 season (Table 9). Data presented in Table (9) showed that the maximum panicles no./m^2 was obtained when SK2046H rice variety was sown under 34 g/m^2 seed rate in both seasons. While, SK2034H hybrid rice variety at the same seed rates (34 g/m^2) gave the highest no. of filled grains/panicle.

Table (8): 1000-grain weight, grain yield and harvest index of the two hybrid rice varieties as affected by seed rates and nitrogen levels in 2010 and 2011 seasons.

Character / Treatment	1000-grain weight (g)		Grain yield (t/ha)		Harvest index (HI)	
	2010	2011	2010	2011	2010	2011
Variety (V)						
SK2034H	22.62 b	22.73 b	8.95 b	9.78 b	0.409 b	0.435 b
SK2046H	24.03 a	24.18 a	9.43 a	10.38 a	0.434 a	0.461 a
Seed rate (g/m²) (S)						
34	24.31 a	24.26 a	10.17 a	10.59 a	0.438 a	0.465 a
46	23.45 b	23.71 b	9.70 a	10.29 a	0.430 ab	0.459 a
58	23.10 b	23.21 c	8.68 b	9.95 b	0.416 bc	0.444 b
70	22.44 c	22.64 d	8.22 b	9.48 c	0.401 c	0.423 c
N-fertilization (N) (kg/ha)						
0 (cont.)	20.96 d	21.04 e	5.48 e	6.09 e	0.347 e	0.380 e
50	22.72 c	22.89 d	8.53 d	9.73 d	0.400 d	0.430 d
100	23.26 c	23.62 c	9.77 c	11.07 c	0.429 c	0.457 c
150	24.47 b	24.57 b	10.73 b	11.55 b	0.455 b	0.480 b
200	25.20 a	25.15 a	11.44 a	11.94 a	0.474 a	0.493 a
Interaction						
V x S	ns	ns	ns	ns	ns	ns
S x N	ns	ns	**	ns	ns	ns
V x N	**	**	**	ns	**	**
V x S x N	ns	ns	ns	ns	ns	ns

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Table (9):Panicle number/m² and number of filled grains/panicle as affected by the interaction between hybrid rice varieties and seed rates

Seed rates (g/m²)	2010		2011		2010	
	Varieties				Varieties	
	SK2034H	SK2046H	SK2034H	SK2046H	SK2034H	SK2046H
	Panicles number/m²				No. of filled grains/panicle	
34	525.10 b	540.15 a	541.40 b	561.00 a	152.41 a	141.34 c
46	481.75 c	522.65 b	491.45 d	534.35 c	146.63 b	132.57 e
58	454.80 e	464.20 d	466.20 f	475.30 e	135.91 d	128.72 f
70	434.65 f	450.30 e	445.65 h	457.55 g	128.34 c	123.76 g

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The interaction between the seed rates and N-levels had a highly significant effect on number of panicles/m² in both seasons (Table 10). Data revealed that the highest number of panicles/m² was obtained when rice sown under low seed rate (34 g/m²) and fertilized by 200 kg N/ha.

The interaction between rice varieties and N-levels had significant effect on number of filled grains/panicle in both seasons (Table 11). Data exerted that, SK2034 hybrid rice variety at high N-level (200 kg/ha) in permanent field produced the highest filled grains/panicle in the two seasons under study.

Table (10): Panicles number/m^2 as affected by the interaction between seed rates and N-levels in 2010 and 2011 seasons.

N-levels (kg/ha)	Seed rates (g/m^2)			
	34	46	58	70
	2010			
0 (cont)	388.38 L	357.75 m	339.75 n	326.63 o
50	491.63 h	465.75 i	427.88 k	416.75 k
100	543.50 d	510.38 fg	461.75 i	441.88 j
150	599.13 b	569.75 c	522.00 ef	497.50 gh
200	640.50 a	607.38 b	546.13 d	529.63 e
	2011			
0 (cont)	398.63 j	366.75 k	348.7 L	335.88 L
50	517.75 ef	477.00 g	441.3 hi	425.88 i
100	560.00 d	518.25 ef	473.1 g	453.63 h
150	624.63 b	582.38 c	533.4 e	508.25 f
200	655.00 a	620.13 b	557.25 d	534.38 e

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Table (11): Number of filled grains/panicle as affected by the interaction between hybrid rice varieties and N-levels in 2010 and 2011 seasons.

N-levels (kg/ha)	2010		2011	
	Varieties		Varieties	
	SK2034H	SK2046H	SK2034H	SK2046H
0 (cont)	110.49 g	108.08 g	107.25 h	109.44 h
50	130.55 e	125.81 f	137.94 g	135.39 g
100	144.02 c	133.21 e	153.81 d	141.43 f
150	152.59 b	139.58 d	163.56 b	147.74 e
200	166.46 a	151.29 b	174.38 a	158.86 c

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The interaction between seed rate and N-level had significant effect in grain yield in 2010 season (Table 12). The best combination was 34 or 46 g/m^2 seed rate with high nitrogen level of 200 kg/ha.

The interaction between rice varieties and N-levels had a significant effect in 1000-grain weight in both seasons and grain yield in 2010 season (Table 13). The combination of SK2046H and 150 or 200 kg N/ha gave the heaviest 1000-grain weight. While, both hybrids sown under high nitrogen level of 200 kg N/ha gave the highest grain yield (11.50 and 11.38 t/ha, respectively) (Table 13).

Table (12): Grain yield (t/ha) as affected by the interaction between seed rates in nursery and N-levels applied in permanent field in 2010 season.

N-levels (kg/ha)	Seed rates (g/m^2)			
	34	46	58	70
0 (cont)	6.43 m	5.38 n	5.17 n	4.93 n
50	8.95 ij	9.29 hi	8.14 kl	7.73 L
100	10.98 cd	10.32 ef	9.26 hi	8.54 jk
150	11.81 b	11.46 bc	10.00 fg	9.66 gh
200	12.63 a	12.07 ab	10.80 de	10.25 efg

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The interaction between hybrid rice varieties and N-levels had positive and significant effects on harvest index (HI) in both seasons (Table 14). The best combination was SK2046H with both 150 and 200 kg N/ha.

Table (13): 1000-grain weight (g) and grain yield (t/ha) as affected by the interaction between hybrid rice varieties and N-levels.

N-level (kg/ha)	2010		2011		2010	
	Varieties				Varieties	
	SK2034H	SK2046H	SK2034H	SK2046H	SK2034H	SK2046H
	1000-grain weight				Grain yield	
0 (cont)	19.95 e	21.97 d	19.99 g	22.08 f	5.54 f	5.42 f
50	22.29 d	23.16 c	22.38 f	23.39 e	7.91 e	9.16 d
100	23.17 c	23.35 c	23.29 e	23.95 cd	9.28 d	10.26 c
150	23.43 c	25.52 a	23.67 de	25.48 b	10.52 c	10.94 b
200	24.27 b	26.14 a	24.31 c	25.98 a	11.50 a	11.38 a

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

The results could be attributed to the superiority of the seedlings raised under low seeding density in the nursery (34 and/or 46 g/m^2) in seedlings characters during the nursery period as a resultant, sturdy seedlings have rapid and vigorous growth ability after transplanting in permanent field.

Table (14): Harvest index (HI) as affected by the interaction between hybrid rice varieties and N-levels in 2010 and 2011 seasons.

N-levels (kg/ha)	2010		2011	
	Varieties			
	SK2034H	SK2046H	SK2034H	SK2046H
0 (cont)	0.345 f	0.349 f	0.376 g	0.384 g
50	0.379 e	0.422 c	0.409 f	0.452 d
100	0.406 d	0.453 b	0.432 e	0.481 bc
150	0.442 b	0.468 a	0.471 c	0.490 ab
200	0.471 a	0.477 a	0.489 ab	0.496 a

In a column, means followed by common letter are not significantly different at 5% level, according to DMRT.

Finally, it could be concluded that:

- Seed rate of 34 or 46 g/m^2 which equal 14 or 19 kg/414 m^2 (nursery area for hectare) combined with 200 kg N/ha improved growth of SK2046H and produced the highest grain yield. The same trend was observed with SK2034H hybrid, but the values of yield and its component were less.
- Increasing seed rates more than 46 g/m^2 significantly decrease the yield hybrid rice even under high N-levels (150 or 200 kg N/ha).

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سلوك صنفين من الارز الهجين الشتل تحت مستويات مختلفة من معدلات التقاوى ومستويات النيتروجين

رفعت نصيف جورجى
مركز البحوث والتدريب فى الارز ، معهد بحوث المحاصيل الحقلية ـ مركز البحوث الزراعية ـ مصر

أجريت تجربتان حقليتان فى المزرعة البحثية لمركز البحوث والتدريب فى الأرز ـ سخا ـ كفرالشيخ فى موسمى صيف ٢٠١٠م ، ٢٠١١م بهدف دراسة سلوك صنفين من الأرز الهجين الشتل تحت مستويات مختلفة من معدلات التقاوى (٣٤ ، ٤٦ ، ٥٨ ، ٧٠ جرام/م^2) ومستويات النيتروجين (صفر ، ٥٠ ، ١٠٠ ، ١٥٠ ، ٢٠٠ كجم نتروجين/هكتار).

ويمكن تلخيص أهم النتائج فيما يلى:

- فى المشتل تفوق الهجين SK2034H (H_1) فى طول البادرة وطول الساق بينما تفوق الهجين SK2046H (H_2) فى عدد الأوراق للبادرة ، النسبة بين المجموع الجذرى والمجموع الخضرى للبادرات وذلك بعد (٢٥ يوم من زراعة المشاتل). كذلك تفوقت النباتات النامية من المعدل المنخفض من التقاوى بالمشتل (٣٤ جرام/م^2) معنويا وأعطت أعلى القيم لقوة البادرة (طول البادرة ـ طول الساق ـ عدد الأوراق للبادرة ـ نسبة المجموع الجذرى للمجموع الخضرى). كان هناك تأثيرا معنويا نتيجة للتفاعل بين صنفى الأرز الهجين ومعدلات التقاوى فى عدد الاوراق للبادرة والنسبة بين الجذر والساق خلال فترة المشتل.
- فى الحقل المستديم تلاحظ تفوق الهجين SK2046H (H_2) بعد الشتل فى صفات المادة الجافة ـ دليل المساحة الورقية ـ مساحة ورقة العلم. الوزن الجاف للجذر ـ كذلك تفوقه فى عدد الداليات/م^2 ـ وزن الـ ١٠٠٠ حبة ـ محصول الحبوب ومعامل الحصاد.
- تفوقت النباتات النامية من المعدل النخفض (٣٤ جرام/م^2) بعد شتلها فى الحقل المستديم وأعطت أعلى القيم للمادة الجافة ـ دليل المساحة الورقية ـ مساحة ورقة العلم ـ الوزن الجاف للجذور. كذلك عدد الداليات/م^2 ـ عدد الحبوب الممتلئة بالدالية ـ وزن الـ ١٠٠٠ حبة. وتساوت المعدلات (٣٤ ، ٤٦ جرام/م^2) فى اعطاء أعلى محصول حبوب ومعامل حصاد وبدون فروق معنوية بينهما.
- أظهرت النتائج أيضا أن التسميد بـ ٢٠٠ كجم نتروجين/هكتار أدى إلى زيادة معنوية فى المادة الجافة ـ دليل المساحة الورقية ـ مساحة ورقة العلم ـ الوزن الجاف للجذر وكذلك المحصول ومكوناته ومعامل الحصاد.
- هناك تأثيرا معنويا نتيجة للتفاعل بين صنفى الأرز ومعدلات التقاوى فى عدد الداليات/م^2 ـ وعدد الحبوب الممتلئة بالدالية ـ كذلك تفاعل بين الأصناف ومستويات التسميد النيتروجينى للمادة الجافة ومساحة ورقة العلم وعدد الحبوب الممتلئة/دالية ـ ووزن الـ ١٠٠٠ حبة ومحصول الحبوب ومعامل الحصاد كذلك تفاعل معنوى بين معدلات التقاوى ومستويات التسميد النيتروجينى فى مساحة ورقة العلم وعدد الداليات/م^2 ومحصول الحبوب.

من النتائج السابقة يمكن تلخيص الآتى:

- أن معدل التقاوى (٣٤ ، ٤٦ جرام/م^2) والذى يساوى (١٤ أو ١٩ كيلو جرام/٤١٤م^2 مساحة مشتل للهكتار) مع معدل ٢٠٠كجم نيتروجين/هكتار يحسن نمو الهجين SK2046H (H_2) ويعطى أعلى محصول حبوب ونفس الاتجاه للهجين SK2034H (H_1) بالنسبه للمحصول ومكوناته وإن كانت بقيم أقل.
- زيادة معدلات التقاوى عن ٤٦ جرام/م^2 يؤدى إلى نقص معنوى لمحصول الحبوب للهجينين حتى مع ارتفاع معدلات التسميد النيتروجينى (١٥٠ أو ٢٠٠كجم/هكتار).

قام بتحكيم البحث

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