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EFFECT OF SEEDING RATES AND PLANT SPACING ON HYBRID RICE SEED PRODUCTION IN EGYPT

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ABSTRACT

Two field experiments were conducted at Rice Research and Training Center (RRTC) Farm, Kafr-El-Sheikh Governorate, Egypt, during two successive seasons of 2009 and 2010. The main objectives of this study are; identifying both the optimum seeding rates and hill spacing to increase the yield of hybrid rice seed for the hybrid IR69625A/Giza181R (2046H), this study included, three seeding rates for cytoplasmic male sterile line (6kg/fed, 8kg/fed and 10kg/fed) and three hill spacing (15×10, 15×15 and 15× 20cm).The treatments were arranged in split plot design with three replications, where seeding rates distributed as main plots while hill spacing were allocated in the sub plots. Data were recorded on different traits relating to yield and its components .

The results showed that, the seed rates had highest significant on plant height , panicle weight, panicle length, panicle exsertion, no. of spikelets/ panicle seed set, 1000 grain weight and grain yield . The optimum treatment to produce high quantity of hybrid rice seed from the hybrid combination of IR69625A/Giza181R (SK.2046H) was 8kg seeds/fed, for the seeding rate.

Moreover, hill spacing treatments had highest significant on all studied characters,except no. of panicles/m^2 character. The best hill spacing for cytoplamic male sterile was 15 x 15cm.

The interaction between seed rates and hill spacing was significant for all studied characters.

It could be concluded that the optimum treatments to produce high quantity of hybrid seed from the hybrid combination IR69625A/Giza 181R (SK.2046H) was 8kg seeds/fed for the seeding rate and (15×15cm) for hill spacing, because this treatment was recorded the highest values of panicle exsertion (81.61%),seed set (46.06%) and grain yield (1.32 t/fed).

INTRODUCTION

Rice (*Oryza sativa L*.) is one of the most important food crops for more than half of the world population. Moreover, its a very important cereal crop in Egypt for both consumption and export. The total cultivated area by rice is about 1.700 million feddan which produced about 6.800.000 million tons of paddy rice (RRTC, 2013) Cultural practices of hybrid rice are differed from those of inbred rice because of its genetic variability, which was true for both hybrid seed production and commercial production level. Among these practices, establishing an optimum plant density, sowing date and seed rate applied for R and Cytoplasmic Male Sterile lines either for commercial use or maintenance which is the most important factor to achieve higher grain yield from different rice cultivars (Kurmi and Sarmah, 1993). Usually, the grain

yield of individual rice plant is decreased when the plant population is increased. However, the total grain yield per unit area may increase because the decrease in grain yield per plant is offset by the increase in plant number. El-Degway *et al. (*2010) reported that grain yield of IR69625A was highly affected by the seeding rate and the best combination for hybrid rice seed production obtained by using 20 or 24kg seed/ha from IR69625A.

Seeding rates depends mainly on the variety characters and the seedling age proper seeding rate is the key factor in raising healthy and vigorous seedlings (Longping, 2003) .

Hill spacing plays an important role in hybrid rice seed production the optimum density, i.e. hill spacing has to be well designated to attain high yield, the low tillering capacity particularly in short duration varieties gave low number of panicles /m^2,while high tillering capacity caused competition and more shading consequently low yield of paddy rice (Viraktamath *et al*. 1998). The optimum package for hybrid rice seed production and Cytoplasmic Male Sterile multiplication investigated by Zaman *et al.* (2002) they reported that, with regarded to plant spacing transplanted rice plants 15x15 cm in plots for Cytoplasmic Male Sterile multiplication as well as in plots for seed production was the optimum. Gorgy (2007) indicated that 20 x 20 cm spacing gave the highest Leaf Area Index (LAI) , panicle weight, no. of field grains /panicle, no. panicles/hill and grain yield for hybrid SK 2047H and Giza 178 (inbred variety)**.**

Therefore, the present study aimed to:

* Determine the suitable seeding rate of female parent (CMS).
* Fined out the suitable hill spacing which affect on density between hills, consequently gave high yield .

MATERIALS AND METHODS

Two field experiments were conducted at Rice Research and Training Center (RRTC) Farm, Kafr-El-Sheikh Governorate, Egypt, during two successive seasons of 2009 and 2010 to identify the optimum seeding rate and hill spacing to increase the hybrid rice seed production for the hybrid combination IR69625A/G181R (2046H).This study included, three seeding rates from CMS line IR69625A 6kg, 8kg and 10kg/fed broadcasting in specific unit area for each fedan as recommended for rice seed bed. Three plant densities for planting of IR 69625A line (female, parent) were used. The distances between rows were 10, 15and 20cm a part, while the distances within rows were fixed (15cm).seedling of 25 days old of female line was transplanted with 5 seedlings $hill^{-1}$.

The treatments were arranged in split plot design with three replications, where seeding rates distributed as main plots and hill spacing were allocated in sub plots, all cultural practices was done as recommended Size plot is for CMS and for R line 3 x 4 m^2

The nursery seed bed was well ploughed and dry leveled Phosphorous fertilizer in the form of single super phosphate (15 % P_2O_5) was added at the rate of 240 kg/ha (100 kg/fed) before tillering. Nitrogen in the form of urea (46

% N) at the rate of 144kg N/h (60kg N/fed) was added in two portions, first at the rate of (40kg N/fed) at basal dressing and the rest (20kg N/fed) at panicle initiation. Zinc sulphate (22 % $ZnSo_4$) at the rate of 50 kg/ha (20kg /fed) was added after pudding and before planting.

The pre-germinated seed was uniformly broadcast in the nursery on three dates for Giza181 R line on 18th, 23rd, 28th May during 2009 and 2010 seasons to provide adequate pollen load to female sterile line IR69625A, which was sown on one date at 31th May during 2009 and 2010seasons, respectively to get complete synchronization of flowering based on the growth duration in previous season for IR69625A line (98±3days and 110±3 days for Giza181).Plot area was adjusted to $10m^2$,the soil was clay.

At harvest ,panicle of ten guarded hills for each plot were conducted to determine the number of panicles/m^{-2} and also plant height (cm) was measured .Ten main panicles from each subplot were packed to determine, number of fertile panicles/m^2,panicle length (cm), panicle weight (g), panicle exsertion (%), number of grain/panicle, setting percentage (%),1000-grain weight (g), grain yield (t/fed) and harvest index (%).

All data collected were subjected to stander statistical analysis following following the proceeding described by Gomez and Gomez (1084) using the computer program (Genstat).The treatment means were compared using Duncan's multiple range test (Duncan,1995).Indicate the significant at 5%level of probability, respectively .

RESULTS AND DISCUSSION

1-Plant height (cm).

Results in Table 1 showed that, plant height significantly affected by seeding rates in the two seasons of 2009 and 2010. The highest values of plant height 109.21 and 106.88cm, in both season, respectively, which recorded when Cytoplasmic Male Sterile Line was planted with seed rate of 8kg seeds/fed in both seasons, while lowest values of plant height were recorded 107.15 and 105.26cm in the two seasons, respectively, which obtained at 10kg seeds/fed.This may be due to the dense rice plants became crowded when used high seeding rate ,consequently affect on the light intensity goes to the plants, These results are in harmony with those reported by Kurmi and Sarmah (1993).

Data in Table 1, indicate that, plant height increased by increasing plant density in both seasons, The highest values of plant height were recorded (110.54 and 108.18cm) in both 2009 and 2010 seasons, respectively, when CMS line plants were transplanted with low hill spacing of 15×15cm in both seasons. In the other side, the lowest values 106.95 and 104.76cm were obtained for the two seasons 2009 and 2010, respectively, when CMS line plants were transplanted in wide spacing of 15×20 cm, this may be due to more rice plants became, crowded and the stems elongated to ensure the light sufficiency. These results were similar to those obtained by El-Shayieb (2003).

Table 1: Effect of seed rates and hill spacing , on plant height (cm) , no. of fertile panicle/m^2 and panicle length (cm) during 2009 and 2010 seasons.

Characters	Plant height (cm)		No. of fertile panicles/m^2		Panicle length (cm)	
Treatments	2009	2010	2009	2010	2009	2010
Seed rates(A)						
6kg	108.78	106.58	679.89	24.10	24.10	23.13
8kg	109.21	106.88	577.11	24.40	24.40	23.46
10kg	107.15	105.26	575.44	23.87	23.87	22.77
F- test	*	*	*	*	*	*
LSD at 0.05	0.55	0.37	0.83	0.39	0.01	0.01
Hill spacing(B)						
10×15	107.65	105.77	703.67	697.03	23.91	22.99
15×15	110.54	108.18	607.36	597.73	24.38	23.29
15×20	106.95	104.76	539.22	532.76	24.09	23.04
F- test	*	*	*	*	*	*
LSD at 0.05	0.39	0.32	0.75	0.52	0.01	0.01
A×B	*	*	*	*	*	*

*** Significant at 5% level of probability.**

The interaction effect:

Results in (Table 2) revealed that, there was a significant interaction between seeding rate and hill spacing on plant height , where the highest values were 112.36 and 109.59cm for plant height with using 8kg/fed under 15 ×15 cm hill spacing in both seasons. While the lowest values were 105.77 and 103.68cm with using 10kg/fed under 15 × 20cm hill spacing in 2009 2010 season.

Table 2. Plant height (cm) as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 seasons.

Seed rates (R)	Plant height (cm)					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	108.74	110.12	107.47	106.71	107.58	105.45
8Kg	107.66	112.36	107.61	105.89	109.59	105.15
10Kg	106.53	109.15	105.77	104.72	107.39	103.68
LSD at 0.05	0.765			0.574		

2-Number of fertile panicle /m^2

Seeding rate induced a significant effect on number of fertile panicles/m^2 in both seasons, (Table 1). The highest values number of fertile panicles/m^2 679.89 and 688.76m^2 were recorded when used seeding rate of 6kg seeds/fed were in both seasons respectively. While the seeding rate of 10 kg seeds/fed gave the lowest values (575.44 and 567.30m^2) in both seasons. These data agreed with Arian *et al.*, (1990). Which they found that increasing seeding rate increased number of panicles /hill.

Regarding for the effect of hill spacing on number of fertile panicles/m^2, it's obvious that with decreasing hill spacing the number of fertile panicles/m^2

were increased significantly in both seasons (Table 1). The highest values were recorded 703.67 and 697.03m^2 under hill spacing (15 ×10cm).While, the lowest values of 539.22 and 532.76m^2were recorded at hill spacing of (15×20 cm) in the two seasons. The increase in number of fertile panicles /m^2 might be a attributed to the increase of number of tiller/m^2 with narrow hill spacing than wide hill spacing, these results are in agreement with those reported by El- Shayieb (2003) and Gab-Allah (2004).

The interaction effect:

Data in Table 3 revealed that there was a significant interaction between seeding rates and hill spacing on number of fertile panicles/m^2 in both seasons 2009 and 2010, the number of fertile panicles/m^2 recorded the maximum values 808.33 and 802.10 at the seeding rate of 6kg seeds/fed under hill spacing of (15× 10cm) in seasons of 2009 and 2010. While under seeding rate of 10kg/fed and hill spacing (15 ×20 cm) it gave lowest values of no. of panicles /m^2 450.67and 441.30 in two seasons, respectively.

Table 3. No. of fertile panicles/m^2 as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rates (R)	No. of fertile panicles/m^2					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	808.33	615.33	670.00	802.10	597.90	666.30
8Kg	636.33	598.00	497.00	629.70	594.00	490.70
10Kg	666.33	609.33	450.67	659.30	601.30	441.30
LSD at 0.05	1.304			0.816		

3- Panicle length (cm)

Data in Table 1 revealed that, the highest panicle length were 24.40 and 23.46cm in the two seasons were recorded under seed rate/fed 8kg as seeding rate, while the lowest values were obtained ; (23.87 and 22.73cm) when using 10kg seeds/fed as seeding rate in the first and second seasons, respectively, These results similar to those reported by Shinde *et al*. (2005*)* which they found that, increasing the seed rate, increased the panicle length Reddy *et al*. (1986) found also the same results. Obulamma *et al*. (2002) they reported that, one seedling/hill recorded the highest grain yield, crop growth rate, and assimilation, rate while three seedlings/hill gave the highest dry matter production.

Panicle length significantly affected by hill spacing in both seasons .The panicle length was significantly increase as hill spacing had been increased in both season (Table 1). The hill spacing of (15x15 cm) recorded the highest values (24.38 and 23.29cm) for the panicle length in the two seasons respectively, But, the lowest values was recorded at hill spacing of (15 ×10cm) were 23.91 and 22.99cm for the panicle length in both seasons under this study. Normally increasing hill spacing increased panicle length markedly, each increment of hill spacing significantly increased panicle

length. Abd El-Hamed (2002) found that panicle length was decreased with closer spacing.

The interaction effect:

Data presented in Table 4 showed that there was significant interaction between seeding rates and hill spacing in the two seasons, the highest values at the rate of 8kg seeds/fed and hill space of 15 ×15 cm which recorded 24.63 and 23.61cm for panicle length in the two seasons. While the minimum values of panicle length were 23.48 and 22.45cm obtained at rate of 10kg seeds/fed and hill spacing 15 × 10cm in both seasons (Table4).

Table 4. Panicle length (cm) as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 seasons.

Seed rates (R)	Panicle length (cm)					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	23.99	24.33	24.00	23.13	23.34	22.93
8Kg	24.25	24.63	24.31	23.40	23.61	23.37
10Kg	23.48	24.18	23.96	22.45	22.93	22.82
LSD at 0.05	0.010			0.009		

4-Panicle weight (g)

Data presented in Table 5 showed that the effect of seeding rates on panicle weight was significant in both growing seasons. The seeding rate of 8kg seeds/fed produced the highest values of panicle weight were 2.08 and 2.03g as compared with 6kg and 10kg seeds/fed in the two seasons. While the lowest values of panicle weight (1.95 and 1.92gm) were recorded at seeding rate of 10kg/fed in both seasons, respectively. These results may be due to the increasing in no. of filled grains /panicle, 1000-grain weight which produce heavy panicle weight. These results are similar to those obtained by Shinde *et al*. (2005).

Hill spacing significantly affected panicle weight in the two seasons (Table 5). Hill spacing of 15×15cm gave the highest panicle weight of 2.16 and 2.11g in the first and second season. While, lowest values were recorded 1.89 and 1.79g at hill spacing of 15×10 cm in both seasons. These results similar to those obtained by El- Gohary (1998).

The interaction effect:

Results in Table 6 indicated that, there was a significant interaction between seeding rate and hill spacing on panicle weight in both seasons. The panicle weight recorded the maximum values 2.21 and 2.15g at seed rate of 8kg seeds/fed 15×15cm hill spacing in the two seasons 2009 and 2010,while, the minimum values of panicle weight were recorded 1.70 and 1.63g at the seed rate of 6kg seeds/fed under hill spacing 15×10 cm in both seasons.

Table 5.Effect of seed rates and hill spacing on panicle weight (g) , panicle exsertion % and number of grains/panicle during 2009 and 2010 seasons.

Characters	Panicle weight (g)		panicle exsertion%		No. of grains /panicle	
Treatments	2009	2010	2009	2010	2009	2010
Seed rate(A)						
6kg	2.03	1.98	78.73	77.64	124.16	121.08
8kg	2.08	2.03	79.43	78.42	132.74	128.86
10kg	1.95	1.92	73.74	72.72	126.23	123.99
F- test	*	*	*	*	*	*
LSD at 0.05	0.01	0.01	0.46	0.50	0.26	0.57
Hill spacing(B)						
10×15	1.89	1.79	77.23	76.15	120.98	117.99
15×15	2.16	2.11	78.86	77.84	136.39	133.03
15×20	2.02	1.99	75.82	74.80	126.36	122.92
F- test	*	*	*	*	*	*
LSD at 0.05	0.01	0.01	0.38	0.34	0.24	0.52
A×B	*	*	*	*	*	*

*** Significant at 5% level of probability.**

Table 6. Panicle weight (g) as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rates (R)	Panicle weight (g)					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	2.00	2.16	1.94	1.83	2.12	1.99
8Kg	1.96	2.21	2.07	1.92	2.15	2.01
10Kg	1.70	2.11	2.5	1.63	2.07	1.99
LSD at 0.05	0.010			0.009		

5- panicle exsertion%

Seeding rate had a significant effect on panicle exsertion percentage in 2009 and 2010 seasons shown in (Table 5), The results showed that, the highest values 79.43 and 78.42 % were recorded when used seeding rate 8kg seeds/fed of female IR69625A during the two growing seasons 2009 and 2010,respectively, while the lowest values 73.74 and 72.72% were recorded by using seeding rate of 10kg seeds/fed in both seasons, respectively. These data indicated that, panicle emergence was related by quantity of seeds, those results are in accordance with those obtained by Al-Shenawey (2009).

The effect of hill spacing on panicle exsertion percent was significant in the two seasons (Table 5). The highest values (78.86 and 77.84%) were recorded at hill spacing of 15×15cm in the two seasons. But, the lowest values 75.82 and 74.80 were recorded at hill space of 15×20 cm in both seasons respectively. These results similar to the results obtained by Hegazy (1996).

The interaction effect:

Results in Table 7 indicated that, there was a significant interaction between seeding rate and hill spacing on panicle excretion in both season.

The panicle exertion recorded maximum values 81.61 and 80.57 % at seeding rate 8kg seeds/fed and hill spacing of 15×15cm in both seasons 2009 and 2010 respectively, but the lowest values 71.80 and 70.76 % were recorded at seeding rate 10kg seeds/fed and hill spacing 15×20 cm in the two seasons.

Table 7. Panicle exsertion% as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rate (R)	Panicle exsertion%					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	77.80	80.92	77.45	76.57	79.90	76.46
8Kg	78.49	81.61	78.20	77.51	80.57	77.18
10Kg	75.40	74.04	71.80	74.36	73.05	70.76
LSD at 0.05	0.685			0.670		

6- Number of grains/panicle

Data in Table 5 sowed that the effect of seeding rate on number of grains/panicle. Data showed that, the number of grains per panicle was significantly affected by seeding rates in both seasons, the highest values 132.74 and 128.86 were recorded by using 8kg seeds/fed in 2009 and 2010 seasons, however the seeding rate of 6kg seeds/fed gave the lowest values 124.16 and 121.08 in of 2009 and 2010 seasons respectively. These data may be due to the density in the nursery will affected on seedling health consequently no. of spikelet's/panicle these data indicated that, panicle emergence was related by quantity of seeds, those results are in accordance with those obtained by Al-Shenawey (2009).

Hill spacing had a significant effect on number of grains/panicle in both seasons. Results showed that, hill spacing was significantly affect the number of grains/panicle in the two seasons. The highest number of grains/panicle 136.39 and 133.03 were recorded with wide hill spacing 15×15cm in 2009 and 2010 seasons. While, the lowest values 120.98 and 117.99 were produced under narrow hill spacing 15×10 cm in the two seasons, respectively. These results were always similar in both seasons of experimentations this might be due to decrease the plant density at permanent field will increase the panicle length and No. of grains/panicle. These results are in confined with the findings of Gab-Allah (2004).

The interaction effect:

Results indicated that, there were a significant interaction between seeding rate and hill spacing on number of grains/panicle in both seasons. (Table 8).Showed that, the maximum values 142.01 and 138.79 were recorded at seedling rate 8kg seeds/fed and 15×15 cm hill spacing. While, the lowest values (119.90 and 116.83) were recorded when using seeding rate 6kg seeds/fed and 15×10 cm hill spacing in 2009 and 2010 seasons, respectively.

Table 8. No. of grains/panicle as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rate (R)	No. of grains/panicle					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	119.90	129.53	123.06	116.83	126.37	120.04
8Kg	122.92	142.01	133.31	119.33	138.79	128.13
10Kg	120.12	137.64	122.72	117.81	134.25	119.92
LSDat 0.05	0.408			0.892		

7-seed set %

Results in Table 9 also illustrate that, the percentage of seed setting significantly affected by seeding rates in both seasons. The seed setting percentage recorded maximum values 38.75 and 38.65 % by using seeding rate of 6kg seeds/fed in the two seasons. Seeding rate of 8kg seeds/fed gave the lowest values 34.31 and 34.29 % in, 2009 and 2010 seasons, respectively.

Table 9. Effect of seed rates, hill spacing on seed set% , 1000- grain weight(g),grain yield t/fed and harvest index % during 2009-2010 seasons.

Characters	Seed set %		1000- grain weight (g)		Grain yield t/fed		Harvest index %	
Treatments	2009	2010	2009	2010	2009	2010	2009	2010
Seed rates(A)								
6kg	36.95	34.54	24.10	23.16	1.068	0.987	10.53	9.96
8kg	39.65	37.15	24.44	23.27	1.173	1.111	10.10	9.43
10kg	31.45	30.24	23.45	21.93	0.935	0.901	10.85	10.20
F- test	*	*	*	*	*	*	*	*
LSD at 0.05	0.34	0.24	0.13	0.36	0.081	0.038	0.13	0.57
Hill spacing(B)								
10×15	35.63	33.39	23.23	22.18	1.087	0.964	10.71	10.07
15×15	40.59	38.36	24.56	23.81	1.188	1.102	10.81	10.18
15×20	31.82	28.96	24.21	22.36	0.901	0.897	9.97	9.33
F- test	*	*	*	*	*	*	*	*
LSD at 0.05	0.24	025	0.11	0.43	0.066	0.036	0.11	0.43
A×B	*	*	*	*	*	*	*	*

*** Significant at 5% level of probability.**

The medium hill spacing caused a significant increase in percentage of seed setting (Table 10).the medium hill spacing 15×15cm gave the highest values of 37.05 and 37.09 % in 2009 and 2010, seasons respectively. While the lowest values 34.32 and 34.25 % was recorded with narrow hill spacing 15×10 cm in the two seasons of 2009 and 2010, respectively. Each increment in hill spacing resulted in significant increase in seed setting percentage. This fact is true in both seasons.

These results might be attributed to more and dense plants per unit area, under narrow hill spacing and number of spikelets/panicle become less than

wider hill spacing (15×20 cm). These results are in harmony with those obtained El-Gohary (1998).

The interaction effect:

Results in Table 10 showed that, there were a significant interaction between seeding rate and hill spacing on seed setting in both seasons. Seed setting recorded the highest values 46.06 and 43.36 % in the two seasons when used seeding rate 8kg seeds/fed with 15×15cm hill spacing. While the lowest values 28.07 and 25.04 % were recorded by using seeding rate 10kg seeds/fed with 15×20 cm hill spacing in both seasons. These data were always the same in both seasons of experimentation and that might be attributed to availability of more pollen and relatively shorter distance the pollen have to traveled and disseminated of pollen.

Table 10 . Seed set % as affected by the interaction between seeding rates and hill spacing in 2009 and 2010

Seed rates (R)	Seed set %					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	36.39	41.24	33.21	33.73	39.63	30.25
8Kg	38.70	46.06	34.19	36.46	43.36	31.63
10Kg	31.80	34.46	28.07	29.98	32.09	25.04
LSD at 0.05	0.462			0.416		

8- 1000 grain weight (g)

Mean values of 1000-grain weight were found to be highly significantly affected by seeding rates as shown in (Table 9).The highest values 24.44 and 234.27g were recorded at seeding rate of 8kg seeds/fed, while, the lowest values of 1000 -grain weight 23.45 and 21.93g were recorded at seeding rate of 10kg seeds/ fed. These data showed that 1000-grain weight was highly affected by the seeding rate. these results are in accordance with those of Al-Shenawey (2009).

The results in Table 9 revealed that,1000-grain weight was significantly affected by hill spacing in 2009 and 2010 seasons, respectively, where as medium hill spacing (15×15cm part) gave the heavier 1000-grain weight (24.56 and 23.21g) followed by wide hill spacing (15×20cm apart). While narrow spacing (15 ×10cm part) recorded the lowest values of 1000-grain weight in the two seasons (23.23 and 22.18 g), these results were confirmed by Gab-Allah (2004).

The interaction effect:

There was a significant interaction between seeding rate and hill spacing in 2009 and 2010 seasons. The results in (Table 11) .Show that, the highest values were 24.83 and 24.84g recorded by using seeding rate 8kg seeds/fed with 15×15cm hill spacing in the two seasons, while, the lowest values 21.86 and 20.93g were recorded at 10kg seeds / fed with seeding rate and 15 ×10cm hill spacing in the two seasons respectively.

Table 11 .1000- grain weight (g)as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rate (R)	Grain yield t/fed					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	1.034	1.291	0.881	0.971	1.158	0.833
8Kg	1.090	1.319	1.111	1.041	1.261	1.030
10Kg	1.137	0.954	0.713	0.881	0.886	0.827
LSD at 0.05	0.109			0.062		

9- Grain weight t/fed

The average grain yield (t/fed) was significantly affected by seeding rate in, 2009 and 2010 seasons (Table 9) the seeding rate 8kg /fed gave the maximum value 1.173 and 1.111 t/fed grain yield in the two seasons, while the minimum 0.935 and 0.901 t/fed grain yield was produced by using 10kg/fed.In the two seasons, respectively. These results may be due to the fact seeding rate produced higher number of panicles/m^2, maximum panicle length, panicle excretion and seed seating percentage, these results agreed with those obtained by Dong *et al*. (1999).

Data in Table 9 showed that, the average of grain yield (t/fed) was significantly affected by hill spacing in 2009 and 2010 seasons. The medium hill spacing 15×15 cm apart gave the maximum grain yield 1.188 and 1.102 t/fed in the first and second seasons, respectively. While the minimum grain yield 0.901 and 0.897 t/fed was produced by using wide spacing 15×20 cm apart in both seasons, respectively. These data were confirmed by the data obtained by Budhar *et al*. (1989).

Table 12 .Grain yield t/fed as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 season.

Seed rates (R)	1000- grain weight (g)					
	Hill spacing (H)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	24.05	24.65	23.60	22.71	23.68	23.08
8Kg	23.77	24.83	24.74	22.92	24.84	22.05
10Kg	21.86	24.20	24.30	20.93	22.92	21.96
LSD at 0.05	0.182			0.806		

The interaction effect:

Data in Table 12 showed that, there was significant interaction between seeding rate and hill spacing on grain yield. Recorded the maximum values at the seeding rate of 8kg seeds/fed and the hill spacing 15×15cm was 1.319 and 1.261 t/fed while, the lowest values was 0.713 and 0.827 t/fed. Recorded at the seeding rate of 10kg seeds/fed and 15×20 cm hill spacing in 2009 and 2010 seasons, respectively.

10-Harvest index %

Harvest index was significantly affected by seeding rates in both seasons. Seeding rate of 10kg/fed seeds/fed gave the highest values of harvest index 10.85 and 10.20% in the first and second seasons, respectively. While the seeding rate of 8kg seeds/fed gave the lowest values of harvest index (10.10 and 9.43 %) in both seasons, (Table 9).

From the obtained data Table 9 hill spacing induced a significant effect on harvest index in both seasons. The highest harvest index values (10.81 and 10.18%) was recorded from medium hill spacing 15×15 cm showed in both season respectively. While, the wide hill spacing15×20 cm gave the lowest values 9.97and 9.33% in the two seasons respectively, the results might be attributed to the gradually decrease in total biomass from 15 ×20cm to medium space 15×15cm.The medium space of 15×15 gave less tillers/m^2 and conseavently less values of harvest index, which were obtained by El-Shayieb (2003).

The interaction effect:

Data in Table 13 indicate that, the interaction between seeding rate and hill spacing was significant on harvest index in the two seasons 2009 and 2010.Values of harvest index recorded the highest values was 11.72 and 11.07 when used seed rate of 10kg seeds/fed and hill space of 15×15 cm was recorded, while the lowest values were recorded 9.84 and 9.17 % at seed rate of 8kg seeds/fed and plant spacing 15×20 cm in both seasons

Table 13.Harvest index % as affected by the interaction between seeding rates and hill spacing in 2009 and 2010 seasons.

Seed rate (R)	harvest index %					
	Hill spacing (cm)					
	2009 season			2010 season		
	15x10	15x15	15x20	15x10	15x15	15x20
6Kg	11.05	10.58	9.95	10.48	10.01	9.39
8Kg	10.33	10.14	9.84	9.66	9.46	9.17
10Kg	10.73	11.72	10.11	10.08	11.07	9.44
LSD at 0.05	0.264			0.028		

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تأثير معدلات التقاوي ومسافات الشتل على إنتاج تقاوي الأرز الهجين في مصر

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أجريت تجربتان حقليتان بمزرعة بحوث سخا- محطة البحوث الزراعية– محافظة كفرالشيخ – مصر خلال موسمي الزراعة ٢٠٠٩ ،٢٠١٠ م وكان الهدف من الدراسة التعرف على أفضل معدل تقاوي ومسافة شتل للحصول على أفضل تقاوي من الأرز الهجين أي أر٦٩٦٢٥/جيزة ١٨١(سخا ٢٠٤٦)، وشملت الدراسة ثلاث معدلات تقاوي من السلالة العقيمة ذكرى سيتوبلازمى وهى ٦كجم،٨كجم،١٠كجم/للفدان وثلاث مسافات شتل هي ١٥×١٠ ،١٥×١٥ ،١٥×٢٠ سم ،وصممت التجربة فى قطع منشقة في ثلاث مكررات حيث خصصت القطع الرئيسية لمعدلات التقاوي بينما خصصت القطع المنشقة لمسافات الشتل وسجلت البيانات مع مختلف الصفات التي لها علاقة بالمحصول ومكوناته .

وكان من أهم النتائج المتحصل عليها :

- وجود فروق معنوية بين معدلات التقاوي لصفات طول النبات (سم) ،وطول الدالية (سم)،وزن الدالية (جم)،ومعدل خروج الدالية ،وعدد الحبوب/ داليه ، ونسبة العقد ، ووزن ١٠٠٠ حبه (جم) ، ومحصول الحبوب طن/للفدان . وكانت أفضل معامله لمعدلات التقاوي لأعلى إنتاجيه من تقاوي الأرز الهجين اى أر ٦٩٦٢٥ /جيزة ١٨١ وكان أفضل معدل تقاوي ٨ كجم /فدان .
- وجود فروق معنوية بين مسافات الشتل للصفات المدروسة ما عدا صفة عدد الداليات /م٢ وأفضل مسافة شتل هي١٥×١٥ سم للسلالة العقيمة.
- كان التفاعل الثنائي بين معدلات التقاوي ومسافات الشتل معنويا على كل الصفات المدروسة.
- من خلال النتائج السابقة نجد انه للحصول على أعلى إنتاجيه من تقاوي الأرز الهجين أي أر ٦٩٦٢٥ /جيزة ١٨١ (سخا ٢٠٤٦) نوصى بالزراعة بمعدل تقاوي ٨كجم/للفدان ومسافة شتل ١٥×١٥ سم حيث أن هذه المعاملة سجلت أعلى قيم لصفات معدل خروج الدالية بمعدل ٨١.٦١ ٪ ونسبة عقد٤٦.٠٦ ٪ ومحصول حبوب ١.٣٢ طن/للفدان.

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