THE EFFECT OF SOWING DATES AND GA_3 DOSES OF THE PARENTAL LINES OF SAKHA.2058H ON HYBRID RICE SEED PRODUCTION UNDER EGYPTIAN CONDITIONS

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Abstract

An Experiment on F_1 hybrid rice seed production was conducted at Rice Research and Training Center Farm, Sakha, Kafr El-Sheikh, Egypt, during 2002 and 2003 summer seasons for the promising rice hybrid combination; SK2058H (IR69625A/GIZA 182R) to study the effect of sowing dates and GA_3 doses on hybrid rice seed production under Egyptian conditions.

This experiment was planted on two sowing dates; May 1 st and June 1 st for the female parent, while the male parent was sown on May 3 rd, May 6 th and May 9 th, as well as June 3 rd , June 6 th and June 9 th during 2002 season. The same experiment was repeated on the same period, on May 1st and June 1st for the female parent, while the male parent was sown on May 6 th, May 9 th and May 12 th, as well as June 6 th , June 9 th and June 12 th during 2003 season. In the present study a commercial local GA_3 chemical (BERELEX) was used with different doses, 300, 250, 200, 150 gm/ha, compared with the control (without GA_3 application,). Split –split plot design with three replications was used. Observations on, panicle exsertion (%), seed set (%), 100-grain weight (gm), harvest index (%) and grain yield (t/ha) were recorded .The results showed that, to get complete flowering synchronization, the female parent should be sown 8 days earlier than the male parent in case of sowing date on May 1st, but the female parent should be sown 10 days earlier than the male parent when sowing date is June 1st. Moreover, the best treatment was obtained from the first sowing date (May 1st) using 300 gm/ha of GA_3 for seed set (%); harvest index (%) and grain yield t/ha. where, the grain yield was 1.95 and 2.07 t/ha in 2002 and 2003 seasons, respectively. But, the grain yield was 2.424 and 1.595 (t/ha) for the first and second sowing dates, respectively. Moreover, the highest value of grain yield (2.967 t/ha) was obtained when spraying 300g/ha GA_3, while the lowest value (1.037 t/ha) was obtained without spraying GA_3.

INTRODUCTION

Rice is an important food crop in Egypt for local consumption, as well as, the demand for increasing population. In this respect, introducing hybrid rice is one way to improve rice yield by exploiting the heterosis in the F1 hybrid. The hybrids yield about 20% higher than inbred rice varieties and have helped China to produce 33 million tons from rice per year over the past decade. Researchers outside China indicate that heterosis in rice can increase yields by 15-20% over the best available semidwarf inbreds, and commercial rice hybrids are being developed. Rice hybrid are likely to show higher yield potential not only under irrigated conditions, but also under

certain rainfed conditions (Virmani *et al.*, 1991). GA_3 application increased panicle extension from flag leaf sheath, cross-pollination, seed set and seed yield. On the other hand, GA_3 application causes poor viability of hybrid rice seed after storage (Duan and Ma, 1992). Rapid commercial development of hybrid rice depends on the availability of high good quality seed at lower cost. Also, Bastawisi *et al.* (2002) and EL-Mowafi *et al.* (2003) reported that two promising hybrids Sk.2034H and Sk.2046H have been identified for large scale verification trials and demonstration in normal and saline soils as well as several second /third generation hybrids combined with high yield and better grain quality with early maturity are in pipe line for the Egyptain hybrid rice program .

Accordingly, improving hybrid rice seed production techniques is the key for maximizing the seed yield of hybrids, Synchronizing of flowering by optimizing sowing dates and regulation of phonological development of seed and pollinator parent are essential aspects of hybrid seed production technology.

The main objectives of this study are to determine suitable date of sowing for male and female parents to insure flowering synchronization in F_1 seed production plot and to detect the optimum dose of GA_3 application for the promising hybrid Sk.2058 H to get maximum seed set.

MATERIALES AND METHODS

The cytoplasmic male sterile line IR 69625A along with the restorer line Giza 182R were used to produce F_1 hybrid seeds for the promising hybrid, SK.2058H at the research farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh , Egypt during 2002 and 2003 seasons.

An amount of 15 kg of IR 69625 A line and 5 kg of Giza 182 R were soaked in fresh water for 24 hours, then, drained and incubated for 48 hours to hasten germination, the female parent was sown in one treatment May 1st.while the male parent was sown in three planting dates, May 3 rd , May 6 th and May 9 th during 2002 season. These groups were repeated again in June with the same intervals for female and male parents to cover the heading period for female line .

In 2003 season, the female parent was sown on May 1st and June 1st, while the male parent was sown on May 6 th, May 9 th ,and May 12 th, as well as, June 6 th, June 9 th and June 12 th. using seedling age of 6-7 leaves (30 days after soaking) that were uprooted and transplanted (2 seedling /hill) for A line and 3 seedling /hill for R line) (Kyu, 2000). A split – split plot design with three replication was used, the main plots was sowing seasons, while the sub plots was sowing dates, sub- sub plots was GA_3 doses (Table 1). The plot size was 10 m^2 . The data were recorded on

heading date (days), panicle exsertion (%), seed set (%), harvest index (%) and grain yield (t/ha).

Table 1. Sowing dates of the parental lines during 2002 and 2003 seasons.

Years	Entry	Sowing date		Transplanting date	
		First	Second	First	Second
2002	IR69625A	May 1	June 1	June 1	July 1
	Giza 182R_1	May 3	June 3	June 3	July 3
	Giza 182R_2	May 6	June 6	June 6	July 6
	Giza 182R_3	May 9	June 9	June 9	July 9
2003	IR69625A	May 1	June 1	June 1	July 1
	Giza 182R_1	May 6	June 6	June 6	July 6
	Giza 182R_2	May 9	June 9	June 9	July 9
	Giza 182R_3	May 12	June 12	June 12	July 12

R_1= First sowing date R_2= Second sowing date R_3= Third sowing date

The F_1 hybrid seed production plot was located in the middle of it's breeder seed production field for R line. Moreover, Sakha meteorological data during rice growing seasons are presented in Table (4).

Pattern of transplanting:

Working alley is 30cm, distance between R rows is 20cm, between R row to A row is 25 cm, and between A rows is 15 cm. Spacing between R plant to R plant in R rows is 15 cm, while the distance between A plant to A plant in A rows is 15 cm too.

Supplementary pollination:

It is done by one person, stirring the canopy layer of the R lines with a bamboo stick, this was done three times per day at heading stage starting from 10:30 am to 12:30 pm at noon, according to Subbaiah *et al.* (1995).

Doses of GA_3 (BERLEX) application:

Four doses; 300, 250, 200 and 150 g/ha and a control (without spray GA_3) were used, splitted in two sprays; the first spray (40% of GA_3) was dissolved in a small amount of 70% ethanol and mixed with 50 L of water and sprayed when 15-20% tillers of A line have emerged, the second spray (60% of GA_3) was also dissolved in a small amount of 70% ethanol and mixed with 50 L of water and sprayed in the second day after the first spray according to Prabagaram and Ponnuswamy (1997).

Statistical analysis:

Analysis of variance for the data collected was done according to procedures of Gomez and Gomez (1984). Differences among treatment means were compared using the revised LSD at 5% level of significance adopted by Waller and Duncan (1969).

RESULTS AND DISCUSSION

The duration from seeding to heading of IR 69625A (A line) and the restorer line Giza 182 R show narrow variation as the duration from seeding to heading of IR 69625 A was 98± 2 while for Giza 182 R was 95± 4 days depending on the date of sowing. In case of early crop sowing, the duration of the parents was identified as showing the best synchronization in flowering. While, for late crop sowing the duration should decrease. For the promising hybrid SK. 2058H (IR69625A /Giza182R), the female line IR69625A was identified after 40 days of transplanting as late one stage (of panicle development stages) than the Giza 182R when it was seeded on May 1st for A line and May 3 rd for R line during 2002 season. Therefore, to complete flowering synchronization, A line should be earlier than R line one stage of panicle development at least. Moreover, A line was late than R line two stages in case of sowning A line on June 1st and R line onJune 3 rd., both the observations were detected for panicle initiation studies according to Viraktmath (1995) who mentioned that panicle development from panicle initiation to flowering passes nine stages.

The data on panicle development stages indicated that the female parent is being early when seeded on May 1st. The same treatments such as spraying 1% KH 2 PO 4 promotes earliness of A line and 2% Urea delays R line. The heading dates were recorded and duration from seeding to heading at 10% tillers emerged was calculated and presented in table (2).

Table 2. Adjustment methods for flowering synchronization of parental lines at Sakha Agricultural Research Station during 2002 summer season.

Parental lines	Sowing date	Days affected by other factors	Treatment for adjustment	Heading date	Duration from seeding to heading
IR 69625 A	May 1	4 E	1% KH 2 PO 4	Aug. 6	95
	June 1	5 E	1% KH 2 PO 4	Sept. 3	93
G. 182 R_1	May 3	3 L	2% urea	Aug. 7	94
	June 3	6 L	2% urea	Sept. 4	91
G. 182 R_2	May 6	2 L	2% urea	Aug. 9	93
	June 6	5 L	2% urea	Sept. 5	89
G. 182 R_3	May 9	2 L	2% urea	Aug. 11	91
	June 9	4 L	2% urea	Sept. 7	88

E= early L= late

Results of the 2003 season indicated that the intervals increased to 8 days instead of 5 days in 2002 season without using any treatment for flowering adjustment of the female and male parent of the first sowing date as shown in Table (3).

For the second sowing date, the A line was later than R line by one stage of panicle development, the female parent was sprayed by 1% KH2PO4 to get early flowering and male parent by 2% urea to delay the flowering to reach to complete flowering.

Results indicated that the Giza 182 R was highly sensitive to date of sowing comparing to IR69625 A line. So, to get complete flowering synchronization it is the female parent should be sown 8 days earlier than the male parent in case sowing on May 1St. However, when sowing on June 1st the female parent should be planted 10 days earlier than the male parent.

Table 3. Adjustment methods for flowering synchronization of parental lines at Sakha Agricultural Research Station during 2002 summer season.

Parental lines	Sowing date	Days affected by other factors	Treatment for adjustment	Heading date	Duration from seeding to heading (day)
IR 69625 A	May 1 June 1	- 4 E	- 1% KH 2 PO 4	Aug. 8 Sept. 2	98 94
G. 182 R_1	May 6 June 6	- 5 L	- 2% urea	Aug. 9 Sept. 4	94 90
G. 182 R_2	May 9 June 9	- 5 L	- 2% urea	Aug. 14 Sept. 6	95 89
G. 182 R_3	May 12 June 12	- 4 L	- 2% urea	Aug. 16 Sept. 8	94 88

The data in Table (4) show the meteorological data obtained from Sakha Meteorological Station during rice growing season, The differences between maximum and minimum temperature is 16.2 °C and 16.7 °C of May 2002 and 2003 seasons, respectively. Those of September were 14.4 °C and 15.2 °C in 2002 and 2003, respectively .The mean temperature was 23.8 °C and 25.15 °C in May of 2002 and 2003 seasons, while the mean temperature was 26.7°C and 24°C in September of 2002 and 2003 seasons, respectively, while mean relative humidity recorded 57.6 and 68.8 of May 2002 and 2003 summer seasons, while the mean of relative humidity was 61.35 and 67.5 of September 2002 and 2003 summer seasons. Also, the highest value of wind velocity (km/ha) was 100.8 and 105.8 in May of 2002 and 2003, respectively, but the lowest value of wind velocity (km/ ha) was 53.4 and 54.9 of August 2002 and 2003 seasons, respectively. The data show that Egyptian weather condition is suitable for seed setting percentage especially in the first sowing date, May 1 st .

Xu *et al.* (1988), in China, mentioned that conditions favorable for good out crossing in rice have been identified as a daily temperature of 24-28 °C, relative humidity of 70-80 %, difference in temperature of 8-10 °C, and sunny days with abreeze.

Results in Table (5) revealed clearly the effect of sowing date and GA3 doses, as well as their interaction on panicle exsertion%, seed set %, grain yield t/ha, harvest index % and 100 grain weight.

Table 4. Some weather factors as recorded at Sakha Meteorological Station.

Weather factor	Year	May	June	July	Aug.	Sept.
Max. Air Temp.	2002	31.9	32.8	36.7	34.0	33.9
	2003	33.5	34.1	33.5	35.0	31.6
Min. Air Temp.	2002	15.7	19.5	21.6	20.0	19.5
	2003	16.8	19.5	21.2	20.1	16.4
Mean Air Temp.	2002	23.8	26.15	29.15	27.0	26.7
	2003	25.15	26.8	27.35	27.55	24.0
R.H.% 7.30 am	2002	74.8	80.8	93.0	81.6	77.0
	2003	85.0	86.1	89.5	96.0	87.0
R.H. % 13.30 pm	2002	40.5	54.7	55.5	48.5	45.7
	2003	52.6	48.5	56.0	58.0	48.0
Mean R.H.	2002	57.6	67.75	74.25	65.05	61.35
	2003	68.8	67.30	72.75	77.00	67.5
Wind velocity Km/h	2002	100.8	57.0	61.0	53.4	75.0
	2003	105.8	57.3	55.68	54.9	72.6

The highest values were 2.07 t/ha and 9.19 % for grain yield and harvest index % when the maximum temperature was 35 °C in August 2003 with good flowering synchronization as shown in Table (2). The lowest values were 1.95 t/ha and 8.78% for the same traits when the maximum temperature was 34 °C in August. 2002, Table (4). The results indicated that the grain yield and harvest index % were highly affected by any of weather fluctuations especially at heading period, so that the increase in max. temp. causes an increase in open spikilets during heading period, and increases outcrossing, but the water level in the soil has to be at 3-5 cm height.

Date presented in Table (5) showed that seed set %, grain yield t / ha and harvest index % significantly increased by early sowing date in both seasons so, the highest values of 26.41 % for seed set, 2.424 t / ha for grain yield and 9.71 % for harvest index were recorded when sowing on the first of May, while the lowest values were 1.595 t /ha for grain yield and 8.25 % for harvest index were recorded when sowing on June 1st. However, panicle exertion % and 100 g rain weight was not affected by the sowing date, whereas the mean values were 83.32% and 82.01% for panicle exertion % of first and second sowing dates, respectively. The corresponding values comparable values for mean 100- grain weight were 2.25 and 2.24 g. respectively. Results show that the lowest values of harvest index for CMS line as refered to the grain yield t/h was less four times than the grain yield of inbred variety, because the seed set % ranged between 15.69% without GA_3 to 29.99% with

applying 300 g GA_3. In a study by Aidy *et al.* (1992) he mentioned that increasing grain yield was not always related to higher biomas, but the varieties showing highest grain yield express higher harvest index and high grain / straw ratio.

The data in Table (5) indicated that panicle exertion (%), seed set (%), grain yield (t / ha), harvest index (%) and 100 grain weight (g) increased significantly as GA_3 doses increased up to 300gm /ha of BERLEX ,where the highest values for these traits were 86.13 %, 29.99%, 2.967 t/h and 10.83%, respectively, except 100-grain weight value that was 2.27 g without GA_3 application. The comparable, lowest values for these traits were 73.78 %, 15.69, 1.037 t/ha and 6.28%, respectively. The lowest value for 100-grain weight was 2.231 gm when 200 gm / ha of GA_3 was applied. These results were always true in both seasons ,the increasing in the 100-grain weight could be attributed to the fact that seed set % decreased . The amount of photosynthates accumulate by plants contribute to the dry matter content and hence for the superiority of 100-grain weight

Table 5. Effect of years, sowing dates and GA_3 doses on some yield traits in seed production plots.

Main effects and interactions	Panicle exertion %	Seed set %	Grain Yield t/ha	Harvest index %	100- grain weight (g)
A-Years (Y)					
2002	82.30 a	21.96 b	1.95 b	8.78 b	2.24 a
2003	83.02 a	23.75 a	2.07 a	9.19 a	2.25 a
F . test	n . s	*	**	**	n . s
B- Sowing date (S)					
S1 1/5	83.32 a	26.41 a	2.424 a	9.71 a	2.25 a
S2 1/6	82.01 a	17.79 b	1.595 b	8.25 b	2.24 a
F. Test	n . s	**	**	**	n . s
C- GA3 doses (D)					
1- 0	73.78 c	15.69 e	1.037 e	6.28 e	2.270 a
2- 150 gm	82.73 ab	19.33 d	1.596 d	8.61 d	2.260 a
3- 200 gm	84.73 b	21.33 c	1.963 c	9.20 c	2.231 b
4- 250 gm	85.95 a	24.16 b	2.483 b	9.99 b	2.236 b
5- 300 gm	86.13 a	29.99 a	2.967 a	10.83 a	2.240 b
F. test	**	**	**	**	*
D- Interactions :					
Y x D	n . s	n . s	**	**	n . s
Y x S	n. s	n. s	**	**	n .s
S x D	n . s	**	**	**	n . s
Y x Sx D	**	**	**	**	*

*: Significant at 5% *.*:Significant at 1% n.s: Not significant

These findings agree with those reported by Ping and Liu (1997) where, the application of GA_3 had a little effect on 100- grain weight but increased the number of effective grain/panicle. Also, yield without GA_3 was 1.13 t/ha and increased to 2.21 t/ha with the lowest rate of GA_3,indicating the highest yield of 2.38 t/ha was given by the application of 150g/ha GA_3. All possible interaction among the three factors under investigation had significant effects on grain yield t/ha and harvest index %in the two seasons, while for seed set %, the interaction was significant for sowing date x GA_3 doses and years x sowing date x GA_3 doses. But, for the panicle exertion % and 100-grain weight, the interaction was significant only in case of years x sowing date x GA_3 doses, these traits must be affected by GA_3 application.

It could be concluded from this study that the best treatment was the first sowing date (May 1st) using 300 g /ha of GA_3 for seed set % , harvest index % and grain yield t/ha, with a grain yield of 1.95 and 2.07 t/ha in 2002 and 2003 seasons, respectively. Also, the grain yield was 2.424 and 1.595 t/ha of the first and second sowing dates, respectively.

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تأثير مواعيد الزراعة وجرعات الجبريللين للسلالات الأبوية للهجين سخا ٢٠٥٨ على إنتاج تقاوي الأرز الهجين تحت الظروف المصرية

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أجريت تجربة إنتاج تقاوى الجيل الأول فى مزرعة مركز البحوث والتدريب فى الأرز سخا كفر الشيخ مصر خلال صيف أعوام ٢٠٠٢ و٢٠٠٣ لإحدى الهجن المبشرة سخا ٢٠٥٨ (السلالة العقيمة ٦٩٦٢٥ والصنف المعيد للخصوبة جيزة ١٨٢) وقد زرعت التجربة فى حقل إنتاج تقاوى الأساس للصنف المعيد للخصوبة فى أول مايو وأول يونيو من كل عام للسلالة العقيمة وتم زراعة الأب المعيد للخصوبة على ثلاث فترات بعد زراعة الأم بثلاثة أيام فى عام ٢٠٠٢ وخمسة أيام فى عام ٢٠٠٣ م٠ وقد تم استخدام حمض الجبريللين المحلى (بيرلكس) بجرعات مختلفة ٣٠٠و٢٥٠ و٢٠٠و١٥٠ جرام / هكتار فى تجربة قطاعات منشقة فى ثلاث مكررات ٠وقد تم تجميع البيانات على صفات معدل خروج السنبلة من الغمد ونسبة العقد ووزن ١٠٠ حبة ودليل الحصاد ووزن محصول الحبوب طن/هكتار ٠

أوضحت النتائج أنه : للحصول على أفضل توافق زهرى يجب زراعة الأم قبل الأب بخمسة أيام أذا كانت الزراعة فى أول مايو أما أذا كانت الزراعة فى أول يونيو فيجب زيادة الفترة الى ١٠ أيام٠ كما وجد أن أفضل معاملة للصفات المحصولية كانت فى حالة الزراعة فى أول مايو وزراعة الأب بعد الأم بخمسة أيام مع استخدام ٣٠٠ جرام حمض جبريللين/هكتار حيث كان متوسط محصول الحبوب الهجينية ٢,٤٢٤ طن /هكتار فى حين كان متوسط محصول الحبوب الهجينية ١,٥٩٥ طن/ هكتار عند الزراعة فى أول يونيو وكان متوسط محصول الحبوب الهجينية ٢,٩٦٧طن/هكتار فى حالة اضافه ٣٠٠جرام جبريللين /هكتار بالمقارنة مع عدم الإضافة حيث كان متوسط محصول الحبوب الهجينية ١,٠٣٧ طن /هكتار٠