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Response of seeding dates and use of fertilizers on flowering synchronization in hybrid rice seed production

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Hybrid seed production involves several technical complications, which have to be tackled satisfactorily to obtain an accepted economic yield. One of the major bottlenecks in production of hybrid seed is the non-synchronization of male and female lines. Information on the effect of various factors such as, differential sowing dates of A and R lines, differential seeding age (Halaswamy *et al.*, 1997), and application of urea, P_2O_5 and recommended dose of GA_3 are meager for hybrid seed production. Synchronized heading between two parental lines of different growth duration is achieved by sowing them on different dates, which is termed as seeding interval (SI). The method of arriving at 'SI' using growth duration is simple to be practised. Transplanting of rice seedling at the right age in fixed row ratio should be managed to obtain higher yields in hybrid seed production. Initiation of heading in parental lines (A and R lines) at same time is absolutely essential for proper seed setting. Better seed setting occurs, when stigma of female parent gets sufficient pollen from male parent at right time. Ideal parents in hybrids are those, which have same heading date and duration. For proper seed setting, parents are artificially managed, that their heading occurs at same time (Maurya, 1998).

The parental lines of hybrid rice NDURH 3, *i.e*. IR 58025A (seed parent) as female line and NDRK 5026 1R (restorer or pollen parent) as male line were used in present study. The A line was sown on only one date *i.e*. June 28, 2009 while; R line was sown in three dates with three days interval. The second sowing of R line was done on June 10, 2009 at eighteen days interval to maintain flowering difference of A and R lines. The first and third sowing of R line were also done on June 7 and June 13, 2009, respectively at three days interval of second sowing of R line for proper pollination in A line. The seedlings of A and R lines (I, II and III sowings) were transplanted on same date with application of all agronomic practices. Fertilizer was applied at the rate of 120, 60, and 60 kg ha^{-1} of N, P_2O_5, and K_2O, respectively. One third of nitrogen and entire dose of P_2O_5 and K_2O were given as basal dressing and remaining N was split into two doses applied at maximum tillering and flowering stages. Recommended package of practices was followed to raise good crop. Need based pest control measures were taken as and when required. A total of ten treatments (Table 1) were assessed in Randomized Block Design with three replications. The single seedling per hill was transplanted with spacing of 20 x 15 cm for A x A and R x R and 30 x 15 cm for A x R. Planting was done in 6:2 row ratio of A and R line in 3 x 2.20 m^2 plot at Instructional Farm of NDUA&T, Kumarganj, Faizabad. One fourth of total nitrogen and phosphorus of normal dose was applied as additional amount just before flowering for the purpose of synchronization of flowering time in R line. Observations were recorded on days to heading time of anthesis, number of filled spikelets $panicle^{-1}$, spikelet fertility (%), harvest index and grain yield $plant^{-1}$ (g).

The comparison of mean performance of 10 treatments, using least significant differences revealed, existence of very high range of variability among the treatments (Table 1). The days to heading of R line was found maximum (111.20) with 1^{st} date of sowing of R line + application of urea. This suggested that urea has considerable role in deviating the days to heading which is helpful in synchronization of A line. The similar results were also reported by Yuan (1985). Minimum time of anthesis (9.48 AM) was observed in R line with 1^{st} date of sowing of R line + application of P_2O_5. This indicated that urea application and seeding interval of male parent has major role for synchronizing of male and female parents. Singh *et al.* (1998) found that seeding interval expressed a significant and positive effect on flowering synchronization. Number of filled spikelets per panicle of A line was maximum (20.35) with 3^{rd} date of sowing of 4 line + application of urea which indicated that urea enhanced the filled spikelets per panicle. Halaswamy *et al.* (1997) was in support of this view.

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Table 1: Yield attributes in A and R lines, influencing by seeding dates and application of fertilizers on R line parent of NDURH-3 hybrid rice

Treatments	Days to heading		Time of anthesis		No. of filled spikelets plant^{-1}		Spikelet fertility (%)		Harvest index (%)		Grain yield plant^{-1} (g)	
	A	R	A	R	A	R	A	R	A	R	A	R
I date of sowing of R line	89.50	109.47	8.40	9.58	11.14	147.13	6.33	93.40	11.94	41.43	3.27	21.41
II date of sowing of R line	90.40	107.33	8.49	9.55	13.28	148.53	8.13	90.60	13.21	42.27	3.82	19.81
III date of sowing of R line	93.05	106.13	8.47	9.53	13.26	156.87	7.53	92.73	13.85	40.18	4.10	22.83
I date of sowing of R line + urea	91.40	111.20	8.54	9.57	12.30	136.33	7.00	97.07	14.37	44.54	4.30	24.95
II date of sowing of R line + urea	92.10	108.93	8.58	9.55	15.72	145.47	8.87	91.87	14.94	42.05	4.63	19.99
III date of sowing of R line + urea	90.20	110.07	8.59	9.58	20.35	137.13	11.2	96.07	17.39	42.20	5.40	20.92
I date of sowing of R line + P_2O_5	90.26	107.67	8.52	9.48	18.42	150.20	10.0	92.20	16.90	41.25	4.70	16.36
II date of sowing of R line + P_2O_5	90.35	108.20	8.53	9.50	16.20	173.03	9.40	95.60	11.98	43.93	3.63	23.02
III date of sowing of R line + P_2O_5	89.20	106.27	8.50	9.52	12.53	167.73	7.13	93.40	12.49	41.71	3.10	22.97
Mixture of R line seedling	92.00	105.53	8.55	9.51	15.98	152.80	9.27	94.00	14.61	42.22	4.26	19..84
Mean	91.46	108.08	8.51	9.54	14.92	151.53	8.49	93.69	14.17	42.18	4.12	21.51
SEm ($\pm$)	**1.56**	**1.16**	-	-	**0.75**	**3.12**	**0.45**	**0.72**	**0.49**	**0.78**	**0.29**	**0.84**
LSD (0.05)	**2.92**	**2.44**	-	-	**1.58**	**6.56**	**0.95**	**1.51**	**1.03**	**1.64**	**0.61**	**1.76**

Table 2: Mean, range, heritability (b), genetic advance and coefficient of variation in parental lines of NDRUH-3 hybrid rice

Characters	Mean		Range		Heritability (%)		Genetic Advance in per cent of mean		Coefficient of variation GCV (%)		Coefficient of variation PCV (%)	
	A	R	A	R	A	R	A	R	A	R	A	R
Days to Heading	91.46 ±1.56	108.09 ±1.16	90.50-96.20	105.53-111.20	39.40	57.50	2.92	2.39	1.06	1.53	2.32	2.02
Number of Filled Spikelet's Plant^{-1}	14.92 ±0.75	151.53 ±3.12	11.14-20.35	136.33-173.07	90.80	90.30	38.00	15.03	19.36	7.68	20.30	8.08
Spikelet Fertility (%)	8.49 ±0.45	93.69 ±0.72	6.33-11.20	90.60-97.07	88.00	83.10	33.92	3.93	17.58	2.09	18.74	2.30
Harvest Index	14.17 ±0.49	42.18 ±0.78	11.94-17.39	40.18-44.54	90.70	59.90	25.96	4.24	13.14	2.69	13.80	3.52
Grain Yield Plant^{-1}	4.12 ±0.29	21.51 ±0.84	3.10-5.40	19.36-24.95	77.80	74.37	29.37	14.50	16.20	8.16	18.36	9.47

Spikelet fertility (%) of R line was exhibited maximum (97.07) in 1st date of sowing of R line + application of urea. The urea has considerable role in enhancing the spikelet fertility (%) also. Tomar and Virmani, (1990) also reported that >80 per cent spikelet fertility in restorer line harvest index of R line was higher (44.54%) with I date of sowing of R line + application of urea. Similar result was reported by Brandon and MeKenzie (1998). The grain yield plant^{-1} of A line was found maximum (5.40 g) mean with 3rd date of sowing of R line + application of urea, same results was also reported by Tomar and Virmani *et al.* (1990).

Heritability (in broad sense) is important to the breeder as it indicated the possibility and extent to which improvement is possible through selection. It also indicates the direction of selection pressure to be applied for a trait during selection, because it measures relationship between parents and their progeny, hence, widely used in determining the degree to which a character may be transmitted from parents to offspring. High heritability alone is not enough to make efficient selection in advance generations unless accompanied by substantial amount of genetic advance. High estimates of heritability along with high genetic advance provides good scope for further improvement in advance generations, if these characters are subject to mass, progeny and clonal selection (Panse, 1957). High magnitude of variability in population provides the opportunity of selection to evolve a variety having desirable characters.

High heritability coupled with high genetic advance was recorded for number of filled spikelets panicle^{-1} in both A and R lines (Table 2). High heritability and low genetic advance was recorded for grain yield plant^{-1} in A line, spikelets fertility percentage in R line and moderate heritability and high genetic advance was observed for spikelets fertility percentage and harvest index in A line and grain yield plant^{-1} in R line. Genotypic coefficient of variations was slightly lower than corresponding phenotypic variations for all the character because there was less influence of environment for expression of these characters (Mokate *et al.,* 1998).

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