

## Effect of weather parameters on flowering and panicle exertion in parental lines of hybrid rice

S.R. PRABAGARAN AND A.S. PONNUSAMY

Dept. of Seed Science and Technology, Tamil Nadu Agrl. Univ., Coimbatore-641 001, Tamil Nadu.

**Abstract:** Monthly sowings of parental lines of hybrid rice were carried out for twelve months to elucidate information on the effect of weather parameters on flowering and panicle exertion. Variations were seen among the entries tested, where IR 10198-66-2R showed extreme fluctuation in biometrical parameters recorded. Among the seasons, summer (February-May) followed by samba (October-January) were found to have better expression of floral characters and agronomic traits. Correlation studies with weather parameters (Heat Unit Concepts), showed significant relationships with selected parameters like days to first flowering, duration of flowering in a panicle and panicle exertion percentage and regression equations were arrived using the relationship. (*Key words* : Hybrid rice, Parental lines, Synchronisation, Stigma exertion, Regression equations).

With the current rate of population growth in India, the country has to produce about 150 million tonnes of paddy by the turn of the century to sustain self-sufficiency. The scope for such substantial increase in yield with same cultivable area is limited using conventional high yielding varieties (Siddiqui, 1995). Hybrid rice technology is the most feasible and readily adoptable one. China has realised the fact and proved its commercial success since last decade (Yuan, 1992).

In spite of developing hybrids in India, the success of hybrid rice could be visualised only if there is adequate seed production (Rangaswamy *et al.* 1993). The differential flowering behaviour of parental lines over seasons is one area of research that has been neglected. Climatic factors play a major role in altering the floral biology of rice plant (Konokhova, 1985). The efficacy of seed setting in male sterile lines depends upon flowering synchronisation, period of anthesis and the prevailing weather conditions (Krishnaswamy and Ramaswamy, 1979). The present study was taken up to elucidate the information on the effect of weather parameters on flowering and panicle exertion in parental lines of hybrid rice.

### Materials and Methods

Parental lines of hybrid rice viz. A lines (IR 62829 A and IR 58025 A), B lines (IR 62829 B and IR 58025 B) and R lines (IR 10198-66-2R, AS 89044 and Pusa 150R) were sown on 15th of every month commencing from

August 1996 to July 1997. The seedlings were raised in separate seed beds and 25 days old seedlings were transplanted in the main field. The main plot size was half cent (5 x 4 m). One hundred seedlings were transplanted in each parental line in two rows (50 seedlings/row) at 20 x 20 cm spacing. Each parental line was separated by 30 cm row space. Uniform recommended cultivation practices were adopted for all the monthly sowings to avoid the variations. In all 12 sowings, 10 plants per parental line were selected at random and flowering parameters and plant growth characters were observed.

During the cropping period, data on maximum and minimum temperature, hours of sunshine and day length were obtained from the 'Agromet' documentation of Agronomy Department, Tamil Nadu Agricultural University and the following heat unit concepts were arrived for each crop to study the weather correlation.

1. Growing Degree Days (GDD) (Iwata, 1984)
2. Relative Temperature Disparity (RTD)
3. Photo Thermal Units (PTU) (Major *et al.*, 1975)
4. Helio Thermal Units (HTU) (Rajput, 1980)

### Results and Discussion

Variations were observed in different stages of flowering in all the parental lines due to seasonal influence. Various weather factors such as temperature, sunshine hours, day length and other environmental parameters had caused variation in such observations.

Table 1. Correlation studies of floral characters with weather parameters (Heat unit concepts).

Particulars	GDD	RTD	PTU	HTU
1. IR 62829 A				
a) Days to first flowering	0.034	-0.303	-0.033	-0.278
b) Duration of flowering in a panicle	0.004	0.399	-0.071	-0.253
c) Panicle exertion percentage	0.276	-0.640*	0.341	-0.080
2. IR 58025 A				
a) Days to first flowering	0.027	0.489	0.001	0.080
b) Duration of flowering in a panicle	0.836**	0.572	0.844**	0.263
c) Panicle exertion percentage	0.400	-0.033	0.407	0.371
3. IR 62829 B				
a) Days to first flowering	-0.300	0.476	-0.306	-0.312
b) Duration of flowering in a panicle	0.355	-0.189	0.426	0.219
c) Panicle exertion percentage	-0.152	-0.457	-0.056	-0.319
4. IR 58025 B				
a) Days to first flowering	-0.050	0.563	-0.092	0.024
b) Duration of flowering in a panicle	0.249	-0.079	0.314	0.199
c) Panicle exertion percentage	0.679*	-0.528	0.757**	-0.007
5. IR 10198-66-2R				
a) Days to first flowering	0.323	0.668*	0.292	0.001
b) Duration of flowering in a panicle	0.656	0.282	0.671*	0.176
c) Panicle exertion percentage	-0.587*	-0.199	-0.581*	-0.098
6. AS 89044				
a) Days to first flowering	-0.221	0.473	-0.221	-0.317
b) Duration of flowering in a panicle	0.515	0.146	0.335	0.003
c) Panicle exertion percentage	-	-	-	-
7. PUSA 150R				
a) Days to first flowering	-0.030	0.222	-0.029	-0.251
b) Duration of flowering in a panicle	0.595*	-0.015	0.622*	0.204
c) Panicle exertion percentage	0.253	0.496	0.234	0.389

\*,\*\* - Significance at 0.05 and 0.01 levels

From the investigations made, it is obvious that variations occurred in different parameters are not only due to genotypic characters and seasonal influences but also due to interaction between them. Most of the floral characters are better expressed in summer sowing (February to May) as earlier reported by Seetharamiah *et al.* (1994). Some floral traits such as duration of flowering in a panicle, period of anthesis and stigma exertion were maximum in samba sowing (October to January). This is the very prominent season in Tamil Nadu State with maximum rice crop area and adequate irrigation facilities.

Among the parental lines, A line recorded maximum number of days to first flowering, 50.

per cent, duration of flowering in a panicle, period of anthesis, stigma exertion percentage, percentage of spikelet inside the boot leaf and productive tillers than their respective maintainers (Virmani and Sharma, 1994). Correlation studies proved its significance in all parental lines except AS 89044. Highly significant positive correlation was seen in duration of flowering in panicles of IR 62829 A with GDD (0.836) and PTU (0.844) and panicle exertion percentage of IR 58025 B with PTU (0.757). All the three parameters showed significant correlation for IR 10198-66-2R which clearly indicated that it was more sensitive to environmental changes. This is followed by IR 58025 A and IR 58025 B. The

Table 2. Correlation studies of floral characters with weather parameters (Heat unit concepts)

Particulars	GDD	RID	PTU	HTU	Constant	R <sup>2</sup>
1. IR 62829 A						
a) Days to first flowering	0.134	-8.80 x 10 <sup>-4</sup>	-0.009	-2.5 x 10 <sup>-4</sup>	62.547	0.219
b) Duration of flowering in a panicle	0.459	-0.011	-0.032	-1.05 x 10 <sup>-4</sup>	5.126	0.410
c) Panicle exertion percentage	-0.003	-0.010	-1.63 x 10 <sup>-4</sup>	1.13 x 10 <sup>-4</sup>	115.302	0.468
2. IR 58025 A						
a) Days to first flowering	-0.029	0.015	0.004	-3.00 x 10 <sup>-4</sup>	35.984	0.503
b) Duration of flowering in a panicle	-0.084	0.010	0.010	-0.002	4.316	0.817*
c) Panicle exertion percentage	-0.082	0.001	0.006	1.26 x 10 <sup>-4</sup>	83.041	0.353
3. IR 62829 B						
a) Days to first flowering	-0.065	0.012	0.006	-2.52 x 10 <sup>-4</sup>	52.576	0.553
b) Duration of flowering in a panicle	0.016	-0.027	0.005	-3.21 x 10 <sup>-4</sup>	6.233	0.824**
c) Panicle exertion percentage	-0.211	1.08 x 10 <sup>-4</sup>	0.014	2.42 x 10 <sup>-5</sup>	137.630	0.555
4. IR 58025 B						
a) Days to first flowering	-0.007	0.016	0.003	-3.66 x 10 <sup>-4</sup>	21.947	0.608
b) Duration of flowering in a panicle	-0.246	0.003	0.020	-3.19 x 10 <sup>-4</sup>	7.520	0.692
c) Panicle exertion percentage	-0.216	0.005	0.017	-3.14 x 10 <sup>-5</sup>	87.910	0.894**
5. IR 10198-66-2R						
a) Days to first flowering	-0.234	0.024	0.019	-2.52 x 10 <sup>-4</sup>	20.967	0.889**
b) Duration of flowering in a panicle	-0.093	0.006	0.009	-8.37 x 10 <sup>-4</sup>	5.529	0.718**
c) Panicle exertion percentage	-0.023	-0.006	-6.29 x 10 <sup>-4</sup>	2.79 x 10 <sup>-4</sup>	137.216	0.611
6. AS 89044						
a) Days to first flowering	0.200	-1.37 x 10 <sup>-4</sup>	-0.013	-4.25 x 10 <sup>-4</sup>	44.757	0.270
b) Duration of flowering in a panicle	0.034	-0.007	-4.78 x 10 <sup>-4</sup>	-4.09 x 10 <sup>-5</sup>	6.193	0.580
c) Panicle exertion percentage	-	-	-	-	-	-
7. PUSA 150R						
a) Days to first flowering	0.159	0.017	-0.008	-6.36 x 10 <sup>-4</sup>	-24.700	0.569*
b) Duration of flowering in a panicle	-0.073	0.002	0.007	-4.10 x 10 <sup>-4</sup>	6.063	0.436
c) Panicle exertion percentage	-0.124	0.026	0.012	-1.50 x 10 <sup>-4</sup>	-12.395	0.843**

\*, \*\* - Significance at 0.05 and 0.01 levels

most stable lines are IR 62829 A and IR 62829 B which are used as CMS lines in many of the hybrid programmes. Among all the lines, AS 89044 and IR 62829 B were identified as stable lines for the expression of floral traits for the changed environmental factors. Among the heat unit concepts, HTU plays limited role in altering the floral characters (Table 1). Regression equations were arrived from the observed weather parameters, where highly significant equations were obtained for days to first flowering (IR 10198-66-2R), duration of flowering in a panicle (IR 62829 B) and panicle exertion percentage (IR 58025 and Pusa 150 R). The regression equations were significant in IR 58025 B (duration of flowering in a panicle and panicle exertion), IR 10198-66-2R (days of flowering in a panicle) and Pusa 150 R (days to first flowering) indicating the contribution of weather parameters for the flowering behaviour on parental lines (Table 2).

## References

- Iwata, F. (1984). Heat unit concept of crop maturity. In: "Physiological Aspects of Dryland Farming" Gupta, V.S. (ed). Oxford and IBH, New Delhi, pp. 351-370.
- Krishnaswamy, V. and Ramaswamy, K.R. (1979). Influence of time of sowing and climatic factors on the flowering duration of the parental lines of CSB 5 hybrid sorghum, *Madras Agric. J.* 66: 512-519.
- Konokhova, V.P. (1985). Rice growing. Mir Publisher Moscow, pp. 27-30.
- Major, D.J., Johnson, D.R., Tanner, J.W. and Anderson (1975). Effect of day length and temperature on soybean development. *Crop Sci.* 15: 174-179.
- Rajput, R.P. (1980). Response of soybean crop to climatic and soil environments. Ph.D. Thesis: P.G. School, IARI, New Delhi.
- Rangaswamy, M., Thiyagarajan, K., Ponnuswamy, A.S., Jayamani, P. and Sree Rangasamy, S.R. (1993). Hybrid Rice Seed Production Manual. pp. 1-18.
- Setharamiah, K.V., Kulkarni, R.S., Mahadevappa, M. and Prasad, T.G. (1994). Evaluation of rice cytoplasmic male sterile lines for floral traits influencing out crossing. *Int. Rice Res. News.* 19: 5-6.
- Siddiqui, E.A. (1995). Current status of hybrid rice research and development in India. In: Hybrid rice seed production technology: Theory and practice. pp.1-12, Directorate of Rice Research Hyderabad.
- Viramani, S.S. and Sharama, H.L. (1994). Manual for hybrid rice seed production. Philippines.
- Yuan, L.P. (1992). Recent breakthroughs in hybrid rice research and development in China. *Int. Rice Corn. Newsl.* 41: 7-12.

(Received: August 2001; Revised: November 2001)