Indian J. Hill Farmg. 11(1 & 2) : 39 — 43 1998

INHERITANCE OF PHOTOPERIOD INSENSITIVITY AND GENETIC RELATIONSHIP OF GRAIN YIELD WITH SOME OTHER ATTRIBUTES IN SCENTED RICE

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ABSTRACT

Scented rice varieties are highly priced for its unique aroma, grain quality and palatability, but poor yielder and mostly photoperiod sensitive. Five F_2 generation crosses of photoperiod insensitive and photoperiod sensitive varieties of scented rice were tested for inheritance of photoperiod insensitivity during ahu season (March sowing). The crosses, Rangajaha × Rasi, Borjaha × Ratna, Rangajaha × Ratna, Chufanjaha × Ratna and Arabjaha × Jaya segregated at a ration of 15 photoperiod sensitive : 1 photoperiod insensitive indicating the involvement of two dominant duplicate genes for control of photoperiod insensitivity. Sterility percentage, number of effective tillers/plant, days to flowering and maturity, 100-grain weight and paincle length may be effective criteria for selection of plant for yielld imporvement. Grain yield was positively associated with number of effective tillers per plant and number of grains per panicle and negatively with sterility percentage at both genotypic and phenotypic levels.

INTRODUCTION

Scented rice varieties are highly priced for its unique aroma, grain quality an palatability. But, they are poor yielder and mostly photoperiod sensitive. Hence, to increase the production and productivity of this class of rice, it is important to study the genetics of photoperiod insensitivity and aroma nad interrelationship of yield with other characters in order to formulate breeding strategy to transfer this particular trait to varieties with scent and other desirable traits. Several workers studied this character in non-scented rice and arrived at diverse interpretations. The present investigation was therefore, undertaken in indigenous scented rice to unearth the genetics of this particular trait in order to facilitate development of photoperiod insensitive high yielding aromatic rice varieties.

MATERIALS AND METHODS

The materials consists of five F_2 populations of four indigenous scented photoperiod sensitive and three high yielding, photoperiod insensitive varieties of rice. The materials were developed during *sali* season (July sowing) of 1990. The F_2 plants alongwith the parents were laid in RBD with three replications each during long day length *ahu* season (March sowing) in 1991. The individual plants within each cross which came to flower were identified as photoperiod insensitive and the rest non flowering plants as photoperiod sensitive. The ration between photoperiod insensitive and sensitive plants was worked out and tested for goodness of fit by computing χ^2 (chi-square) values. The observations on grain yield per plant, days to first flowering, plant height, number of effective tillers per plant, panicle length, number of grains per plant, sterility percentage and 100-grain weight were recorded from sampled flowered plants of the crosses and sample plants of the parents. The mean data were subjected to anallysis of variance and covariance to estimate biometrical parameters following standard procedures.

RESULTS AND DISCUSSION

The subject of flowering response of rice plant to change in day length is complex and results can only be achieved by devising suitable techniques. But in present study, the technique was restricted the use of natural variation in day length at Jorhat from February to Octorber. The day-length (excluding twilight) begins to increase above 12 hours after summer equinox on 21st March and falls below 12 hours after winter equinox on 21st September. Based upon this fact the inheritance pattern of photoperiod insensitiveness was studied and is presented in Table 1. The F_2 segregation can satisfactorily be explained by the action of two pairs of genes. In Rangajaha × Rasi, a pattern of 99 sensitive to 6 insensitive plants were obtained in the F_2 populations indicating a segregation ratio of 15:1 which would involve two dominant genes controlling photoperiod sensitivity. This postulates can also be applied to Rangajaha × Ratna cross in which 110 sensitive and 10 insensitive F_2 plants were classified. Another F_2 populations Arabjaha × Jaya, gave 97 sensitive to 8 insensitive F_2 plant which indicated a good agreement with 15:1 ratio. Since the F_2 sensitive : 1 insensitive, it is reasonable to bellieve that two duplicate dominant genes control photoperiod sensitivity.

It was, however, observed that not all the insensitive plants in each of F_2 population followed at one date, rather in stretched over a period of time. The mean data for days to flowering were 118, 114, 115, 109 and 119 for Rangajaha × Rasi, Borjaha × Ratna, Chufanjaha × Ratna, Rangajaha × Ratna and Arabjaha × Jaya, respectively. Few plants in the cross Borjaha × Ratna, Rangajaha × Ratna and Arabjaha × Jaya flowered earlier to its parents under consideration and thus exhibited transgressive segrgation towards earliness which could be exploited in breeding for early maturing varieties.

The fact that not all the insensitive plants flowered together, indicated the possible interaction of photoperiod insensitive genes with environmental conditions for its expression. It was observed in the cross combinations that most of the plants flowered during the month of June which possessed a favourablle enviornmental conditions for the crop (Table 3). During July and August, the temperature raised high enough which might have adverse effect on the expression on the genes controlling photoperiod insensitive. The interaction of genes for photoperiod sensitivity with temperature and the resultant effect on flowering duration reported long back by Japanese workers (summarized by Moringa, 1954). Moreover, the role of modifiers in the expression of the insensitive genes can not altogether be ruled out. The existence of *i-Ef* gene which inhibits the genes for early flowering *(Ef)*, was also reported by earlier by Chang et al. (1969). All these information necessitate the importance of critical study on the insensitive plants obtained in the present investigation, to establish proper genetic system working on it.

The estimates of genetic parameters are presented in Table 2. The highest genotypic coefficient of variation was recorded for sterility percentage (32.32%) followed by number of effective tillers per plant (10.91%) and grain yield per plant (10.07%). High heritabillity estimates were recorded for days to maturity, days to flowering, 100-grain weight, panicle length, sterility percentage and grain yield per plant. The genetic advance for the above characters were moderate to high indicating the operation of additive gene action. Therefore, it can be inferred that selection for the above traits are likely to accumulate more additive genes leasing to further improvement in their performance. The estimates of genotypic and phenotypic correlation coefficients between grain yield per plant and other attibutes revealed a strong positive association of grain yield per plant with number of effective tilllers per plants and number of grains per panicle while negative association was evident with sterility percentage at both the genotypic and phenotypic levels. Similar results were earlier reported by Talukdar et al. (1997); Ghosh et al. (1981) and Prasad et al. (1988). The result thus suggested a scope for development of high yielding photoperiod in sensitive scented rice varieties through direct but critical selection for these characters.

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Table 1. Inheritance of photoperiod insensitivity

Cross	Number of F2 plants				Ration	χ^2 value	P value
	Not-flowered (NF)		Flowered (F)				
	Observed	Expected	Observed	Expected			
Rangajaha × Rasi	99	98.44	6	6.56	15.1	0.053	0.90
							0.80
Borjaha × Ratna	123	126.56	12	8.44	15:1	1.66	0.20
							0.10
Chufanjaha × Ratna	11	112.50	6	7.50	15:1	0.32	0.70
							0.50
Rangajaha × Ratna	110	112.50	10	7.50	15:1	0.88	0.50
							0.30
Arabjaha × Jaya	97	98.44	8	6.56	15.1	0.33	0.70
							0.50

Table 2. Genetic parameters for different characters recorded on segregating population of five photoperiod sensitive × insensitive crosses and their parents

Character	Genotypic coefficient of variation (%)	Heritability in broad sense (%)	Genetic advance as % of mean	Correlation coefficients	
				rg	rp
Days to first flowering	7.66	83.66	14.44	-0.016	0.145
Days to maturity	5.78	86.83	11.09	0.003	0.091
Plant height	7.37	54.66	11.23	0.205	0.293
Number of effective tillers per plant	10.91	59.25	17.29	0.880**	0.870**
Panicle length	8.74	73.09	15.42	0.354	0.200
Number of grains per penicle	8.44	55.61	12.96	0.735**	0.830**
Sterility percentage	32.32	72.07	56.52	-0.980**	-0.615**
100-grain weight	9.76	74.68	17.37	-0.379	-0.241
Grain yield per plant	10.07	62.03	16.30		

** Significant at P = 0.01

Table 3. Meteorological data (1991)

Month	Mean temperature (ºC)			Mean relative humidity (%)			Mean total rainfal
	Max.	Min.	Average	Moming	Evening	Average	(mm)
February	25.1	12.2	18.65	92	65	78.5	41.1
March	18.1	16.5	17.30	82	60	71.0	31.7
April	27.7	18.9	23.30	87	67	77.0	151.1
May	27.9	21.9	24.90	91	77	84.0	306.2
June	31.2	25.0	28.10	91	78	84.5	342.3
July	32.7	26.0	29.35	88	25	81.5	322.7
August	32.5	26.1	29.30	90	76	83.0	373.9
September	31.0	24.7	27.85	91	78	84.5	360.9