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PHENOTYPIC EVALUATION FOR SPIKELETS PER PANICLE IN RICE (*ORYZA SATIVA* L.) UNDER IRRIGATED AND DROUGHT CONDITION

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Abstract

Rice (*Oryza sativa*) grain shape is a key determinant of grain yield and market values. Large number of spikelets per panicle is an important yield component trait. Forty five F_3 lines (Swarna × IR86931-B-6) and sixty F_3 lines (MTU1010 × IR 86931-B-6) were evaluated under both irrigated and rain out shelter I and II condition during wet season 2012-2013 at Research cum Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India. Two lines in irrigated condition, three lines in rain out shelter I and in rain out shelter II condition, lines recorded high number of filled spikelets in cross Swarna × IR 86931- B-6. Overall, based on the three conditions in cross Swarna × IR 86931-B-6 line no. 86 and 64 in irrigated condition recorded high number of filled spikelets. Overall, based on the three conditions in cross Swarna × IR 86931- B-6, two lines in irrigated condition recorded high grain yield. Similarly, two lines recorded high number of filled spikelets and line no. 109 and 97 recorded high grain yield in cross MTU1010 × IR 86931- B-6 in irrigated condition. Further, the phenotypic data was subjected to correlation studies which can the summarized as, number of filled spikelets showed significant and positive correlation with plant height, panicle length in irrigated condition. In rain out shelter I, number of filled spikelets recorded positive significant association with plant height for Swarna × IR86931-B-6. Similarly, number of filled spikelets exhibited positive significant association with plant height and number of filled spikelets and negative relation was in with number of unfilled spikelets in irrigated condition for MTU1010 × IR86931-B-6.

Key words : Rice, spikelets per panicle, correlation, variability.

Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops worldwide belonging to the family *Graminae* and subfamily *Oryzoidea*, the staple food for one third of the world's population and occupies almost one-fifth of the total land area covered under cereals. Rice yield is a complex trait that exhibits a low heritability (Xiong 1992), which creates a challenge to study it directly. Alternatively, yield components like 1,000-grain weight, the number of spikelets per panicle and spikelet fertility, directly contribute to yield. Although, these yield related traits are also inherited quantitatively, they have comparatively higher heritability (Xing *et al*., 2001). The number of primary and secondary branches strongly influences the average number of spikelets per panicle (Yamagishi *et al*., 2002). Increase of the grain weight is a method for increasing rice yield. Genes that affect the grain size have been identified in inter-specific crosses (Xiao *et al*., 1998; Thomson *et al*., 2003; Li *et al*., 2004; Aluko *et al*., 2004; Brondani *et al*., 2002). Most of the world's rice is cultivated and consumed in Asia, Rice, one of the most important food crops for over half of the world's population accounts for around 23% of the global calorie intake (Bernier *et. al*., 2008). Asia is the leader in rice production accounting for about 90% of the world's production. Over 75% of the world supply is consumed by people in Asian countries and thus rice is of immense importance to food security of Asia. Asia is the leader in rice production accounting for about 90% of the world's production. Over 75% of the world supply is consumed by people in Asian countries and thus rice is of immense importance to food security of Asia. In Asian countries, rice is the main major staple crop covering about ninety per cent of rice grown in the world, with two countries, China and India, growing more than half of the total crop. Rice provides about two-third of the calorie intake for more than two billion people in Asia and a third of the calorie intake of nearly one billion people in Africa and Latin America (Shastry *et al*., 2000).

Materials and Methods

Plant material

The planting materials was 60 F_3 progenies of a cross between MTU1010 × IR86931-B-6 (derived from Nagina 22) and 45 F_3 progenies of a cross between SWARNA × IR86931-B-6. Each F_3 progeny had 10 plants/ lines. The characteristic features of parents included in present study are presented in table 1.

Experimental method

Sixty F_3 lines derived from a cross between MTU1010 × IR86931-B-6 and forty five F_3 lines from Swarna X IR86931-B-6 were evaluated in the field during wet season 2012-2013. The field trials for F_3 generation were conducted under irrigated condition. The fields selected for the study were upland in topology with good drainage and percolation rate and had sandy loam soil. The plant material was sown in raised bed nursery on 18th June, 2012 and transplanted after 15 days of sowing under puddled irrigated field condition and after 25 days separate the tiller and transplanted in rain out shelter condition. Under irrigated condition, normal package of practices was followed.The observation on yield and yield contributing traits were recorded on nine traits under irrigated five traits under rainout shelter I (ROS I) and five traits under rainout shelter II (ROS II) condition. The observation on various traits was recorded in all the 10 plants of each F_3 progenies, days to flowering, plant height (cm), panicle length (cm), number of filled grains, number of unfilled grains, total number of grains, number of fertile spikelets, number of sterile spikelets and grain yield (g).

Results and Discussion

The mapping population was phenotyped under three set of environmental conditions, namely irrigated, rain out shelter I and rain out shelter II condition during wet season 2012-2013. The phenotypic data was observed for various traits under all the set of conditions.

Table 1 : Silent features of rice parents.

S. no.	Parents	Pedigree	Salient Features
1.	MTU-1010	Krishnaveni X IR64	Semi-dwarf,grains- long slender, white, resistant to blast and tolerant to BPH
2.	IR86931-B-6	Nagina22	Drought resistant, maturity 120 days, height 110-120 cm
3.	SWARNA	Vasishtha X Mashuri	Drought susceptibility, maturity 140 days, height 90-100 cm

Table 2 : Variability parameters of nine characters of 45 lines of Swarna x IR 86931 - B-6 F_3 generation under irrigated condition.

Parameters	DTF	PH	PL	NFG	NUFG	TNG	NFS	NSS	GY
Mean	103.04	87.96	23.75	102.47	45.40	147.87	66.25	31.53	43.96
SE	2.47	2.62	0.66	7.06	4.46	7.89	3.16	2.86	2.66
SD	16.55	17.58	4.40	47.34	29.95	52.91	21.16	19.21	17.88
Min.	87.0	46.0	18.0	5.0	4.0	48.0	4.16	1.97	16.0
Max.	115.00	110.00	30.00	199.00	131.00	277.00	98.03	95.83	88.00
CV (%)	16.06	19.99	18.53	46.20	65.97	35.78	31.95	60.93	40.67

DTF = days to flowering; PH = plant height (cm); PL = panicle length (cm); NFG = Number of filled grains; NUFG = number of unfilled grains; TNG = total number of grains; NFS = number of fertile spikelets; NSS = number of sterile spikelets and GY = grain yield (g).

Table 3 : Variability parameters of five characters of 45 lines of Swarna x IR 86931 - B-6 F_3 generation under water stress rain out shelter I condition.

Parameters	DTF	PH	PL	NFS	GY
Mean	104	80.0	23.7	84.7	25.6
Standard error	0.7	1.3	0.5	4.3	1.8
Standard deviation	4.5	8.9	3.5	28.8	12.4
Minimum	96.0	55.0	8.0	8.3	2.1
Maximum	114.0	101.0	30.5	141.7	56.0
CV %	4.3	11.1	14.7	34.0	48.4

DTF = days to flowering, PH = plant height (cm), PL = panicle length (cm), NFG = number of filled grains and GY = grain yield (g).

Variability parameters

The variability parameters of nine traits of 45 F_3 lines of cross Swarna × IR86931-B-6 under irrigated condition are presented in table 2. The variability parameter of five traits of 45 F_3 lines of cross Swarna × IR86931-B-6 in rain out shelter I and II condition are presented in the tables 3 and 4. Line no. 86 (199) and 64 (197) in irrigated condition, line no.51 (141) and 63 (133) in rain out shelter I and line no. 76 (175) and 74 (150) in rain out shelter II condition recorded high number of filled spikelets in cross Swarna × IR 86931-B-6. Overall, based on the three condition in cross Swarna × IR 86931-B-6 line no. 86 (199) and 64 (197) in irrigated condition recorded high

Fig. 1 : Panicle structure of Swarna x IR86931 B-6 F_3.

number of filled spikelets. For grain yield line no. 89 (70 g) and 78 (66 g) irrigated, line no 49 (56 g) and 71 (48) rain out shelter I and line no. 55 (41 g) and 51 (40 g) in rain out shelter II condition recorded high grain yield. Overall, based on the three condition in cross Swarna × IR 86931-B-6 line no. (70 g) and 78 (66 g) in irrigated condition recorded high grain yield. However, the variability parameter of nine traits of 60 F_3 lines of cross MTU1010 × IR86931-B-6 in irrigated condition are presented in the table 5 line no. 121 (346) and 114 (282) recorded high number of filled spikelets and line no. 109 (45 g) and 97 (44 g) recorded high grain yield in cross MTU1010 × IR 86931-B-6 in irrigated condition.

Correlation studies

Correlation between yield and yield contributing traits under irrigated and rain out shelter I and II condition were

Table 4 : Variability parameters of five characters of 45 lines of Swarna x IR 86931-B-6 F_3 generation under water stress rain out shelter II condition.

Parameters	DTS	PH	PL	NFS	GY
Mean	105.2	78.7	22.9	96.2	22.3
Standard Error	2.2	0.9	0.3	4.1	1.4
Standard Deviation	14.7	5.8	2.2	27.2	9.6
Minimum	94.0	67.0	19.0	20.0	2.4
Maximum	198.0	96.0	29.5	175.0	41.4
CV%	13.9	7.4	9.6	28.3	42.9

DTF = days to flowering; PH = plant height (cm); PL = panicle length (cm); NFG = number of filled grains and GY = grain yield (g).

estimated and are presented in tables 6, 7, 8, 9. Grain yield under irrigated condition in cross between (Swarna × IR86931-B-6) showed significant and negative correlation with number of filled spikelets, total number of spikelets and number of fertile spikelets. However positive correlation was observed with number of sterile spikelets. Number of fertile spikelets reported highly significant positive association with plant height with number of filled spikelets and negative with number of unfilled spikelets. Total number of spikelets showed significant and positive correlation with plant height, panicle length, number of filled spikelets, and number of unfilled spikelets. Number of filled spikelets showed significant and positive correlation with plant height, panicle length. Number of sterile spikelets showed positive association with number of unfilled spikelets and negative association with plant height and number of filled spikelets. Lastly panicle length positive association with plant height. Association between five traits of 45 F_3 lines of Swarna × IR86931-B-6 in rain out shelter I condition is presented in table 7, the table indicates that none of trait recorded significant association with grain yield. However, number of filled spikelets exhibited significant and positive correlation with plant height (0.31). Correlation studied under rain out shelter II condition in cross between

Table 5 : Variability parameters of nine characters of 60 lines of MTU 1010 x IR 86931 - B-6 F_3 generation under irrigated condition.

Parameters	DTF	PH	PL	NFG	NUFG	TNG	NFS	NSS	GY
Mean	99.5	101.3	25.3	137.7	119.6	257.4	52.8	45.5	17.4
SE	1.9	2.4	0.5	9.0	8.4	11.7	2.5	2.5	1.3
SD	14.5	18.3	3.9	70.0	65.2	90.9	19.7	19.4	9.7
Min	89	72	19.7	10	29	94	4.69	11.41	3.33
Max	113.0	148.0	30.0	346.0	302.0	451.0	88.6	95.3	45.0
CV %	14.5	18.0	15.0	50.7	54.4	35.3	37.1	42.4	55.7

DTF = days to flowering, PH = plant height (cm), PL = panicle length (cm), NFG = number of filled grains, NUFG = number of unfilled grains, TNG = total number of grains, NFS = number of fertile spikelets, NSS = number of sterile spikelets and GY = grain yield (g).

Table 6 : Association among nine characters of 45 lines of Swarna x IR86931 - B-6 F_3 generation under irrigated condition.

	DTF	PH	PL	NFG	NUFG	TNG	NFS	NSS	GY
DTF	1.00								
PH	0.04	1.00							
PL	0.07	0.37*	1.00						
NFG	0.01	0.59**	0.56**	1.00					
NUFG	0.08	-0.15	0.16	-0.21	1.00				
TNG	0.06	0.46**	0.62**	0.80**	0.41**	1.00			
NFS	0.03	0.53**	0.24	0.75**	-0.72**	0.26	1.00		
NSS	-0.03	-0.53**	-0.24	-0.75**	0.72**	-0.26	-1.00	1.00	
GY	-0.06	-0.13	-0.12	-0.35*	0.03	-0.31*	-0.29*	0.29*	1.00

DTF = days to flowering, PH = plant height (cm), PL = panicle length (cm), NFG = number of filled grains, NUFG = number of unfilled grains, TNG = total number of grains, NFS = number of fertile spikelets, NSS = number of sterile spikelets and GY = grain yield (g) * and ** significant at 0.05 and 0.01 probability level.

Table 7 : Association among five characters of 45 lines of Swarna x IR 86931 - B-6 F_3 generation under water stress rain out shelter I condition.

	DTF	PH	PL	NFG	GY
DTF	1.00				
PH	-0.18	1.00			
PL	0.07	-0.04	1.00		
NFG	-0.01	0.31*	0.27	1.00	
GY	-0.27	0.14	-0.25	-0.01	1.00

DTF = days to flowering; PH = plant height (cm); PL = panicle length (cm); NFG = Number of filled grains and GY = grain yield (g. * and ** significant at 0.05 and 0.01 probability level.

Table 8 : Association among five characters of 45 lines of Swarna x IR 86931-B-6 F_3 generation under water stress rain out shelter II condition.

	DTF	PH	PL	NFG	GY
DTF	1.00				
PH	-0.21	1.00			
PL	-0.11	0.07	1.00		
NFG	-0.19	0.09	-0.09	1.00	
GY	-0.08	-0.03	0.23	-0.22	1.00

Table 9 : Association among nine characters of 60 lines of MTU 1010 x IR 86931-B-6 F_3 generation under irrigated condition.

	DTF	PH	PL	NFG	NUFG	TNG	NFS	NSS	GY
DTF	1.00								
PH	-0.19	1.00							
PL	0.12	0.37**	1.00						
NFG	0.08	0.64**	0.15	1.00					
NUFG	0.48**	-0.24	0.24	-0.17	1.00				
TNG	0.43**	0.33**	0.30**	0.67**	0.61**	1.00			
NFS	-0.22	0.50**	-0.10	0.68**	-0.78**	-0.03	1		
NSS	0.22	-0.50**	0.10	-0.68**	0.78**	0.03	-1.00	1.00	
GY	0.26*	0.33**	0.22	0.30**	0.25*	0.43**	-0.03	0.03	1

DTF = days to flowering, PH = plant height (cm), PL = panicle length (cm), NFG = number of filled grains, NUFG = number of unfilled grains, TNG = total number of grains, NFS = number of fertile spikelets, NSS = number of sterile spikelets and GY = grain yield (g)
* and ** significant at 0.05 and 0.01 probability level.

Swarna × IR 86931-B-6 showed non-significant result table 8.

The result of correlation studied under irrigated condition of recorded in cross MTU1010 × IR86931-B-6 is presented in table 9. Grain yield showed positive significant association with days to flowering and total number of spikelets. Number of filled spikelets showed positive significant association with plant height and number of filled spikelets and negative relation was in with number of unfilled spikelets. Total number of spikelets showed positive significant association with days to flowering, plant height, panicle length, number of filled

spikelets, and number of unfilled spikelets. Number of unfilled spikelets showed positive significant association with total number of spikelets and number of filled spikelets. Number of sterile spikelets positive significant association with number of unfilled spikelets but negative significant association with plant height, number of unfilled spikelets. Filled spikelets under irrigated condition in cross (MTU1010 × IR86931-B-6) exhibited positive correlation with grain yield; while in Swarna × IR86931-B-6 showed significant negative correlation. However, under rain out shelter I and II condition, it showed negative correlation with grain yield. Singh *et al*. (2000) reported that number of fertile spikelets per panicle had positive and significant association with grain yield.

Conclusion

Based on the finding that the MTU-1010, IR86931-B-6 and SWARNA rice parent for the spikelets per panicle was beneficial in the indica cultivar backgrounds could be valuable for improving rice yields, the correlation (Swarna × IR86931-B-6) grain yield to number of sterile spikelets, positive significant correlation and in (MTU1010 × IR86931-B-6) grain yield to days to flowering, panicle length, number of filled spikelets, number of unfilled spikelets, total number of spikelets, positive significant correlation under irrigated condition. Indicates that direct selection of grain yield may be beneficial and number of filled spikelets may be included in selection criteria.

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