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GENETIC STUDIES IN RICE (*ORYZA SATIVA* L.). XVI. INHERITANCE OF PANICLE TYPE AND SPREADING PANICLE BRANCH

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ABSTRACT

Inheritance interrelationship of two panicle characters, viz., panicle type and spreading panicle branch were studied in the cross D 6-2-2 x HY-256 Purple of rice. Lax panicle was found to be monogenic while spreading panicle branch was under the control of two complementary and two inhibitory duplicate genes. Tight linkage between the gene for lax panicle and one of the two inhibitory duplicate genes for spreading panicle branch was detected.

Key words: *Oryza sativa*, rice, panicle type, spreading panicle branch, inheritance.

Panicle type refers to the density of panicle that represents the number of grains per unit length which is involved in determining the grain yield, hence is considered as an important economic attribute in rice. It is described as lax (open) or normal (dense/compact). Spreading panicle branch refers to the primary panicle branches that extend obliquely outward so that the panicles appear spreading and lax. The panicle density varies greatly in different varieties of cultivated rice. The wild rice is characterized by a very low density and the panicles are very open with sparsely arranged spikelets in spreading branches. There is only one report on the inheritance of spreading panicle branch which indicates that it is recessive to the nonspreading type [1], hence an attempt in this direction has been made in this investigation.

Lax panicle has been reported to be monogenic dominant to normal/dense panicle [2–5] as well as monogenic recessive [6]. A digenic segregation of 9 lax : 7 normal has been also recorded in some studies [4, 7–9]. Further, a tetragenic interaction ratio of 21 dense : 235 normal was reported by Dhulappanavar [10] to indicate the involvement of one basic gene controlling dense panicle along with the actions of one independent dominant inhibitor and two inhibitory complementary genes.

MATERIALS AND METHODS

Inheritance of panicle type and spreading panicle branch were studied in a cross between two upland rice cultivars, D 6-2-2 (a green variety with a normal panicle) and HY-256 (a purple variety with a lax panicle) developed at the Agricultural Research Station, Mugad, Dharwad, Karnataka. The cross was made in 1987 and the F_1, F_2 and F_3 generations were studied in subsequent seasons.

The F_2 population consisted of 2458 individuals and 114 families were studied in the F_3 to confirm the F_2 segregations. The goodness of fit of assumed ratios in F_2 and F_3 breeding behaviour and the joint segregation were tested using χ^2 tests. Linkage value was estimated applying the product-ratio method developed by Fisher and Balmukand [11]. The gene symbols recommended by the International Rice Commission [12] have been used.

RESULTS

Individual characters. Table 1 presents the phenotype for panicle type and spreading panicle branch in the parents, F_1 and F_2 as well as segregation in F_2. Lax panicle type was observed to be monogenic dominant in inheritance conditioned by the gene Lx while spreading panicle branch was recessive owing to its absence in F_1 and was found to be under the control of two complementary genes, Spr_a and Spr_b, and two inhibitory duplicate genes, I-Spr and I-Spr_2, as indicated by the segregation ratio of 9 presence : 247 absence of spreading panicle branch. The segregation ratios were confirmed by testing the breeding behaviour of the F_3 families (Tables 2, 3).

Interrelationship of genes. The combined segregation data (Table 4) revealed that the gene responsible for lax panicle. (Lx) is tightly linked with one of the two inhibitory duplicate genes, I-Spr_1 or I-Spr_2.

Table 1. Inheritance of panicle type and spreading panicle branch in the cross D 6-2-2 x HY-256 Purple of rice

Character	Parental traits		F_1 phenotype	Expected ratio in F_2	O/E	F_2 frequency		χ^2	P
	D 6-2-2	HY-256 Purple				+	–		
Panicle type	Normal	Lax	Lax	3:1	O	1825.0	633.0		
				3:1	E	1843.5	614.5	0.743	0.50–0.30
Spreading panicle branch	Absent	Absent	Absent	9:247	O	75.0	2383.0		
					E	86.4	2371.6	1.562	0.30–0.20

Note: + denotes lax and – denotes normal panicles for panicle type.

+ denotes presence and – denotes absence for spreading panicle branches.

Table 2. Breeding behaviour of panicle type (F_2 ratio 3:1) in F_3 generation of rice

Observed/expected group	Number of F_3 families from different F_2 plants			χ^2	P
	F_2 lax true breeding for lax panicle	F_2 lax segregating in 3:1	F_2 normal true breeding for normal panicle		
Observed	34.0	51.0	29.0	—	—
Expected based on 1:2:1 ratio	28.5	57.0	28.5	1.702	0.50-0.30

Table 3. Breeding behaviour of spreading panicle branch (F_2 ratio 9 : 247) in F_3 generation in rice

Observed/expected group	Number of F_3 families obtained from different F_2 plants										χ^2	P
	F_2 presence	F_2 absence	F_2 presence	F_2 absence	F_2 absence	F_2 presence	F_2 absence	F_2 absence	F_2 absence	F_2 absence		
	true breeding for presence	observed/expected F_3 segregating into 1:3	3:1	1:15	3:13	9:7	1:63	9:55	9:247	true breeding for absence		
Observed	0.00	1.00	1.00	1.00	9.00	1.00	9.00	8.00	10.00	74.00		
Expected based on 1:4:4:14:16:4:16:16:175 ratio	0.44	1.78	1.78	1.78	7.13	1.78	7.13	7.13	7.13	77.92	4.247	0.90–0.80

Note. Segregation in F_2 and F_3 recorded for the presence or absence of spreading panicle branch.

Table 4. Joint segregation of panicle type (F_2 ratio 3:1) and spreading panicle branch (F_2 ratio 9:247) in F_2 generation of rice

Basis of expectation	Expected ratio	Genes in linkage	Recombination %	O/E	Phenotypic frequencies AB (a)	Ab (b)	aB (c)	ab (d)	χ^2	P
No. of plants	—	—	—	0	0.0	1825.0	75.0	558.0	—	—
Independence	27:741: 9:247	—	—	E	64.8	1778.7	21.6	592.9	200.870	0.001
Linkage	—	Lx-I-Spr_1	0.00	E	0.0	1843.5	86.4	528.1	3.386	0.50-0.30

DISCUSSION

The segregation ratio of 3:1 for lax to normal panicles was also reported earlier [2–5, 13]. The ratio of 9 presence : 247 absence of spreading panicle branch was not reported earlier,

hence this is a new report for this character. However, spreading panicle was reported to be monogenic recessive only in one case [1]. It was detected through combined segregation analysis that the gene Lx is tightly linked with one of the inhibitory duplicate genes, I-Spr$_1$ or I-Spr$_2$. This is an interesting observation in establishing genetic relationship between the two panicle characters in rice. Based on the above hypothesis, the genotypic constitution of each parent for both the characters was worked out as:

	Var. D 6-2-2	**Var. HY-256 Purple**
Spreading panicle branch	Spr$_a$ Spr$_a$ Spr$_b$ Spr$_b$ i-Spr$_1$ i-Spr$_2$ i-Spr$_2$ i-Spr$_2$	Spr$_a$ Spr$_a$ Spr$_b$ Spr$_b$ I-Spr$_1$ I-Spr$_1$ I-Spr$_2$ I-Spr$_2$
Panicle type	lx lx	Lx Lx

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