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Genetics of Seedling Vigour and Tillering Time in Rice

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Abstract : Genetics of seedling vigour and tillering time was investigated in a cross between two upland cultivatrs, D 6-2-2 (green) and HY-256 Purple (purple) during 1987-1989 at the Agricultural Research Station, Mugad by subjecting the data on parents, F_1 and F_2 to the analyses of frequency and chi-square distrubution. Both the characters behaved as incomplete dominant and were primarily under the influence of three (27:37 for good vx moderate vigour) and four (9:247 for early/inter-mediate vs late tillering) interacting genes, coupled with the action of polygenes or modifers resulting in continuous distribution of segregants in F_2.

Introduction

Agronomic characters viz., height, number of leaves and tillers per plant etc are generally considered to be typical quantitative in nature of inheritance showing continuous variation and highly influenced by environmental factors, suggesting that they are controlled by the polygenes. However, it has been reported that most of these characters were governed by a single or relatively small number of genes (Chang, 1964; Chang and Li, 1980). Therefore, the present study was conducted to know the possibility of understanding the pattern of inheritance of physio-morphological characters like seedling vigour and tillering time in rice.

Material and Methods

Inheritance of seedling vigour and tillering ability was studied in a cross between two upland rice cultivars viz., D 6-2-2 (green) and HY 256 Purple (purple) from 1987 to 1989 at the Agricultural Research Station, Mugad. Seedling height and number of leaves at 25 days after sowing are taken as indices of seedling vigour and early/late tillering ability, respectively. Sixty plants in each parent, 30 plants in F_1 and 2121 plants in F_2 generation wre recorded for their seedling height and number of leaves. The data on each plant of F_2, parents and F_1 were subjected to the analyses of both frequency and chi-square distribution.

Results and Discussion

Tables 1 and 2 present the frequency distributions of F_2s, parents and F1 in respect of seedling height (vigour) and number of leaves (tillering time), respectively at 25 days after sowing (DAS). With regard to seedling vigour, it was observed that of the 2121 F_2 plants, 901 were 14.1 - 21.0 cm tall, with seedling heights equal to that of the D 6-2-2 parent and 959 plants showed seedling height (9.10 to 14.00 cm) comparable to that of HY 256 Purple. The segregants numbering 256 showed poorer seedling vigour (< 9.10 cm) *while five segregants showed excellent vigour* (> 20.00 cm). For tillering time, 1632 F_2

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plants were with number of leaves on par with that of D 6-2-2 parent showing inability to tiller early and 285 were with number of leaves equal to that of HY 256 Purple which possesses an ability of early tillering. 199 F_2s however, showed one or two leaves to indicate delayed germination, while five segregants showed as high as eight leaves at 25 DAS sowing, to reveal their excellence in early tillering.

Table 1 Frequency distribution of parents, F_1 and F_2 for seedling vigour (seedling height in cm) in D 6-2-2 and HY 256 Purple.

Plant height (cm)	Frequency distribution Parents D 6-2-2	HY 256 Purple	F_1	F_2
0–1				3
2.1–3				3
3.1–4				3
4.1–5				15
5.1–6				30
6.1–7				41
7.1–8				62
8.1–9				101
9.1–10		3		105
10.1–11		5		140
11.1–12		14		170
12.1–13		32		337
13.1–14		5	4	207
14.1–15	2	1	7	255
15.1–16	6		12	199
16.1–17	14		5	235
17.1–18	28		2	107
18.1–19	7			60
19.1–20	3			26
20.1–21				19
21.1–22				3
Range	14.3–19.8	9.3–14.2	13.4–17.8	1-22.5
Mean	17.18	12.07	15.30	13.16
δn–1	1.08	0.99	1.09	3.30

Table 2 Frequency distribution of parents, F_1 and F_2 for early tillering ability (number of leaves at 25 DAS) in D 6-2-2 and HY 256 Purple.

Number of leaves	Frequency distribution Parents D 6-2-2	HY 256 Purple	F_1	F_2
1				4
2				195
3	6			938
4	44		3	694
5	10	8	21	217
6		46	6	49
7		6		19
8				5
Mean	4.07	5.97	5.1	3.55
δn–1	0.52	0.49	0.55	0.97

An analysis of chi-square distribution indicated that both these characters behaved as incomplete dominant as F_1s exhibited intermediate expressions to both the parents. Appropriate classification of F_2s in respect these characters has led to two groups. For seedling vigour, genotypes with good seedling vigour (with height > 14.00 cm) numbered 906 and with normal/moderage seedling vigour (with height of < 14.00 cm) numbered 1215. These data appeared to be consistent with the genetic hypothesis of involvement of three dominant complementary genes for good seedling vigour to give the F_2 segregation ratio of 27 : 37 for good vs normal/moderate vigour (X^2 = 0.2425 with P value between

0.70 - 0.50). For the tillering time, the genotype of early tillering (>4 leaves) numbered 290 and late tillering (≤ 4 leaves) at 25 DAS numbered 1831. These data was consistent with the genetic hypothesis of involvement of two dominant complementary genes and one inhibitory gene of incomplete penetrance to show intermediate effect of F_1 kinds. This conforms to the F_2 segretation ratio of 9:247 for early/intermediate vs late tillering (X^2 = 0.2668 with P value between 0.70 - 0.50).

Although, the parents were selected for crossing, because of their differential seedling height and ability in tillering time, the patterns of frequency and chi-square distribution showed that they did not appear to be contrasting to each other for both the characters as substantial number of genotypes of poor seedling vigour and later tillering ability were recovered in F_2. Further, the skewed nature of distribution of F_2 plants indicate the involvement of polygenes/modifying factors in addition to the major genes primarily responsible for the expressions of these physio-morphological characters subject to the assumption that the original data tend to show normal and continuous distribution, after requisite statistical transformation. Such an attempt towards studying genetic analysis of quantitative characters was made earlier by Mitra and Ganguli (1938), Alam (1939) and Dave (1939) in respect of grain length and recently by Dhulappanavar (1975, 1979 and 1981) indicating the operation of major genes besides the action of polygene or modifiers to make the trait behave as quantitative.

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