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Inheritance of grain size and shape in rice

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ABSTRACT

Gene action governing the inheritance of kernel length, kernel breadth and length/breadth ratio were studied in three cross combinations viz., lET 13554/Ranga Joh 2, Pusa Basmati 1 / Ranga Joha 2 and IR 64 / Badshabhog. In all the three crosse, kernel breadth was under polygenic control along with few modifier genes. In the former two crosses, which had Ranga Joha 2 as common short bold grain parent, grain length and length ratio also followed the same pattern as that of kernel breadth. Whereas in the IR 64 / Badshabhog cross the inheritance of grain length and shape was under monogenic control with long and slender grain types being dominant. In all the three crosses studied, transgressive segregation was observed particularly towards longer and slender grain size and confirming the role of minor genes in the inheritance of these characters

Key words: *Rice, grain, charactersitics, inheritance*

The grain size and shape of rice are important characteristics, which determine the consumer preference as well as the commercial success of a variety. These greatly affect the head rice recovery and the milling quality. Hence improvement of these characters is foremost in any breeding programme. In the present investigation the nature of inheritance of important kernel traits viz., kernel length, kernel breadth and length/breadth ratio in three cross combinations were studied.

The material comprised of 3 intervarietal crosses (lET 13554/Ranga Joha 2, Pusa Basmati 1/ Ranga Joha 2 and IR 64/ Badshabhog) derived by crossing five varieties viz., lET 13554, Pusa Basmati 1, Ranga Joha 2 , IR 64 and Badshabhog during wet season of 1998. The F_1 generation along with their parents were raised during wet season 1999 and their F_2 was advanced to F_3 during the year 2000 wet season at Directorate of Rice Research farm, Hyderabad. 30 days seedlings were transplanted (1 seedling hill^{-1}) with a spacing of 20 cm X 15 cm between and within the row respectively. Standard cultural practices and need based plant protection measures were undertaken during the crop growth. Five competitive plants from each of P_1, P_2 & F_1 and 100 F_2 plants per cross replication^{-1} were taken at random to record observations on kernel length, kernel breadth and length/ breadth ratio 20 dehusked grains (brown rice) plant^{-1} were used to record kernel length and kernel breadth using a Satake dial micrometer at quality laboratory, DRR by following the procedure described by Murthy and Govindaswamy (1967). Length/breadth ratio was calculated as the ratio of mean kernel length to mean kernel breadth. After calculating the kernel length and length/breadth ratio, the grain was classified as long slender, long bold, medium slender, short slender and short bold as per Ramaiahs' classification (1985).

The parents involved in the crossing programme differed from each other for grain length, breadth and shape. Pusa Basmati 1 had the maximum mean grain length (7.32 mm) (Table 1) followed by lET 13554 (7.06 mm) where as Badshabhog had minimum kernel length. The minimum and maximum kernel breadth was observed in lET 13554 (1.87mm) and Ranga Joha 2 (2.19 mm), respectively. The highest length/breadth ratio was recorded in Pusa Basmati 1 (4.38) while Badshabhog (2.35) had the minimum length/breadth ratio.

lET 13554/ Ranga Joha 2 and Pusa Basmati 1/ Ranga Joha 2 crosses, IET 13554 and Pusa Basmati 1 were long slender types while Ranga Joha 2 had short bold grains. Mean kernel length, kernel breadth and length/ breadth ratio of F1 and F2 were within the

Table 1. The mean and range of kernel length, kernel breadth and length breadth ratio for three crosses

Character	IET13554/ Ranga Joha2		Pusa Basmati 1/Ranga Joha2		IR64/ Badshabhog	
	Mean	Range	Mean	Range	Mean	Range
Kernel length (mm)						
P_I	7.06	6.98-7.24	7.32	6.84-7.58	6.55	6.34-7.07
P_2	5.31	5.14-5.48	5.31	5.14-5.48	4.56	4.15-4.75
F_1	6.24	6.00-6.33	6.21	5.41-6.47	6.48	6.12-6.83
F_2	6.49	5.37-8.61	6.72	5.29-8.54	6.77	4.47-8.16
Kernel length (mm)						
P_I	1.87	1.83-1.98	1.90	1.81-1.94	2.10	1.94-2.37
P_2	1.91	2.15-2.21	2.19	2.15-2.21	1.94	1.74-2.01
F_1	2.08	2.04-2.10	2.12	2.08-2.24	1.87	1. 78-1. 99
F_2	1.97	1.68-2.54	2.02	1.70-2.4 7	2.01	1.70-2.60
Kernel length (mm)						
P_I	3.82	3.74-3.90	4.38	3.94-4.57	3.32	3.00-3.52
P_2	2.41	2.36-2.48	2.41	2.36-2.48	2.35	2.09-2.59
F_1	3.01	2.89-3.10	3.19	2.95-3.29	3.36	3.12-3.47
F_2	3.27	2.30-4.69	3.51	2.27-4.74	3.29	2.21-4-.34

PI: parent 1; P2: parent 2

parental limits except kernel breadth in lET 13554/ Ranga Joha 2 and the range of variation for all three characters in F_2 was higher than parents and F_1's in both the crosses studied. In both these crosses F_1 mean for kernel length was closer to the mid parental value indicating incomplete dominance. The F_2 distribution for grain length was generally continuous and unimodal with slight transgression towards longer grain length. The small peaks indicated that this character was under polygenic control with few modifier genes. Kenzie and Rutzer (1983), Chauhan & Chauhan (1994) and Ahmed *et al*, (1995) also reported similar results.

The quantitative mode of inheritance was apparent from the continuous and unimodal frequency distribution for kernel breadth in both the cross combinations. The F_1 means for kernel breadth were closer to the wide grain parents indicating the dominance of wide grain over narrow grain. Transgressive segregation of varying extent was observed in these crosses in both the directions suggesting the involvement of modifier complexes of varied intensity in the inheritance of kernel breadth. The result confirms the findings of Mc. Kenzie and Rutzer (1983) and Chauhan and Chauhan (1994). The segregating population showed continuous variation for grain shape in both these crosses. The mean length/breadth ratio of F_1 and F_2 populations was nearer to the mid-parental value indicating the incomplete dominance for this trait. Range of variation and transgressive segregation was observed mostly towards slender grain side. The mode of inheritance for grains shape thus appeared polygenrc and its expression was influenced by modifiers. The results confirm the findings of Jennings *et al*, (1979) and Ahmed *et al*, (1995).

IR 64/ Badshabhog cross had a long slender and a short slender parents. The mean F1 did not indicate heterosis for kernel traits. The mean grain length, breadth and L/B ratio were within the parental limits in F_1 and F_2. In F_2 the range was substantially high, indicating generation of additional variation for grain characters. The frequency distribution of grain length in F_2 formed a bimodal curve with transgression towards longer grain which indicated predominance of major gene action in controlling this trait. The F_2 population showed unimodal distribution for kernel breadth indicating polygenic control for this trait. Ramaiah and Parthasarathy (1993), Mitra and Ganguli (1938) and Ahmed *et al*, (1995) also reported same results for this trait. The bimodal distribution of grain shape with slight transgression towards slender grain type revealed that this character is controlled predominantly by major genes. Prasad and Seetharaman (1991) also observed that also the kernel length/breadth ratio were found to be governed by one

major gene pair with incomplete dominance as influenced by modifiers with enhancing effect to a higher degree. They also reported the polygenic inheritance for kernel breadth.

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