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INHERITANCE OF GRAIN SIZE AND SHAPE IN RICE (*ORYZA SATIVA*)

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ABSTRACT

Inheritance of grain length, breadth and shape were studied in three crosses, viz. Pankaj x Badsahbhog; S 214 x Mahsuri and S 214 x S 260. The characters were largely controlled by polygenes, although evidence of major genes governing the traits in some crosses were also observed. Transgressive segregation for the characters was observed in two crosses.

Key words: Grain length, breadth and shape, polygenes, major genes, transgressive segregation.

The size and shape of grains are important features of cultivated rice. They serve not only as diagnostic characters in classifications but also determine consumer preference. In addition, uniform size and shape are important criteria for milling.

Inheritance of grain length, breadth and shape (length/breadth ratio) was studied by several workers [1–3]. Ramaiah [2] suggested the involvement of many genes in the governance of size and shape of rice grain. However, both polygenic and monigenic inheritance patterns have been reported from different studies [2–4]. The present investigation aims to determine the inheritance pattern of grain length, grain breadth, and shape (L/B ratio) in three crosses involving contrasting grain size and shape.

MATERIALS AND METHODS

The experimental material consisted of five varieties with diverse grain dimensions, viz., Pankaj (medium bold), Badsahbhog (short slender), S 214 (short round), Mahsuri (medium slender), and S 260 (long slender), and the F_1 and F_2 generations of three cross combinations. The crosses under investigation, Pankaj x Badsahbhog; S 214 x Mahsuri, and S 214 x S 260 were made in kharif 1989 at the Regional Agricultural Research Station, Titabar, Assam Agricultural University, and F_1 and F_2 were raised along with the parents in 1990 and 1991, respectively. The grain length and breadth were measured with the help of a dial micrometer. Shape of the grain was indicated by ratio of length and breadth (L/B ratio) of the grain. Length and breadth were measured in five random grains drawn from a matured panicle. For the parents and F_1, the grains from twenty panicles and for F_2 from panicles of 250 individual plants were used to record their dimentions. The terminology used to refer grain characteristics are according to the classification of IRRI [5].

RESULTS AND DISCUSSION

Mean, range, variance and coefficient of variation (CV) are presented in Table 1. Frequency distribution of the F_2 populations of the three crosses for three traits are shown in Figs. 1, 2 and 3.

Cross Pankaj x *Badsahbhog*. This cross involved a medium bold (Pankaj) and short slender (Badsahbhog) grained parents. Mean grain length and breadth in F_1 and F_2 were within the parental limits. Although mean L/B ratio in F_1 was beyond finer parent (Badsahbhog), it was again within the parental limit in F_2 generation. The range of variation and variance for all the three characters in F_2 were higher than the parents and F_1s. The CV in F_2 was highest for grain breadth (11.38%), followed by L/B ratio (10.7%) and grain length (9.9%). The frequency distribution of grain

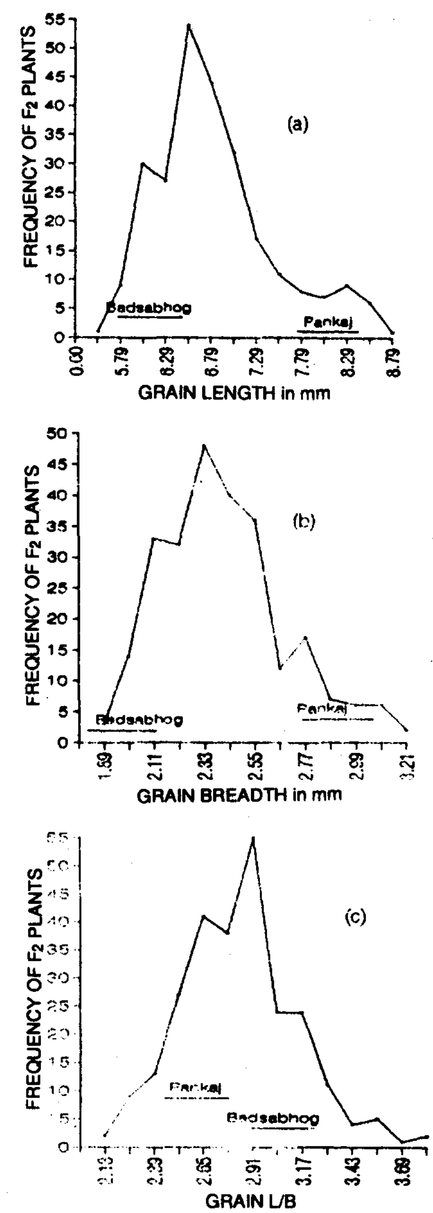

Fig. 1. **Frequency distribution of grain length, breadth and L/B ratio in F_2 generation of the cross Pankaj x Badsahbhog.**

Table 1. Mean, range, variance and coefficient of variation for grain length, breadth and L/B ratio in three crosses of rice

Character	Generation	Mean	Range	Variance	CV
		Pankaj x Badsahbhog			
Grain length, mm	Badshahbhog	6.33	6.02–6.80	0.03	2.8
	Pankaj	8.08	7.84–8.36	0.03	2.1
	F_1	6.89	6.68–7.24	0.03	2.6
	F_2	6.81	5.42–8.91	0.46	9.9
Grain breadth, mm	Badshahbhog	2.01	1.94–2.20	0.00	3.3
	Pankaj	2.97	2.80–3.08	0.00	2.4
	F_1	2.76	2.72–2.86	0.00	1.8
	F_2	2.41	1.84–3.20	0.07	11.3
L/B ratio	Badshahbhog	3.15	2.99–3.27	0.01	2.5
	Pankaj	2.71	2.54–2.84	0.01	3.1
	F_1	2.50	2.41–2.70	0.01	3.2
	F_2	2.84	2.07–3.88	0.09	10.7
		S 214 x Mahsuri			
Grain length, mm	S 214	6.07	5.72–6.24	0.01	1.9
	Mahsuri	7.76	7.42–8.00	0.02	2.0
	F_1	7.07	6.80–7.40	0.02	2.1
	F_2	7.57	6.06–9.94	1.31	15.1
Grain breadth, mm	S 214	3.37	3.22–3.50	0.00	2.1
	Mahsuri	2.49	2.44–2.58	0.00	1.8
	F_1	3.05	2.94–3.24	0.00	2.3
	F_2	3.00	2.69–3.54	0.03	5.7
L/B ratio	S 214	1.80	1.76–1.87	0.00	1.5
	Mahsuri	3.12	3.02–3.28	0.01	2.3
	F_1	2.31	2.22–2.40	0.00	1.8
	F_2	2.53	1.80–3.59	0.20	17.7
		S 214 x S 260			
Grain length, mm	S 214	6.07	5.72–6.24	0.01	1.9
	S 260	10.72	10.45–11.45	0.11	3.1
	F_1	6.99	5.88–7.40	0.19	6.2
	F_2	7.40	6.06–10.62	1.06	14.0
Grain breadth, mm	S 214	3.37	3.22–3.50	0.00	2.1
	S 260	2.26	2.10–2.52	0.02	6.9
	F_1	3.10	2.96–3.32	0.01	3.6
	F_2	2.97	2.54–3.98	0.36	6.3
L/B ratio	S 214	1.80	1.76–1.87	0.00	1.5
	S 260	4.76	4.27–5.02	0.09	6.2
	F_1	2.26	1.79–2.42	0.04	8.4
	F_2	2.49	1.83–3.99	0.19	17.7

length, breadth and L/B ratio in F2 was unimodal (Fig. 1) where the small peaks indicated that these three traits were under polygenic control with some modifier genes. Polygenic control for grain length was reported by Majid [6] for grain breadth by Ramaiah and Parthasarthy [2], for L/B ratio by Jennings et al. [7].

Cross S 214 x Mahsuri. This cross involved a short round (S 214) and a medium slender (Mahsuri) grained parents. The mean grain length, breadth, and L/B ratio were within the parental limit. Range of variation and variance were substantially high in F2, indicating generation of additional variation for the grain characteristics. The CV was highest for shape (17.7%), followed by grain length (15.1%) and breadth (5.7%). The frequency distribution of grain length in F2 formed a bimodal curve (Fig. 2a) with transgression towards longer grain, which indicated predominance of major genes in controlling the trait. This is in agreement with the finding of Ramiah and Parthasarthy [2]. The F2 population showed unimodal distribution for grain breadth, indicating polygenic control of the trait. Polygenic control of grain breadth was also reported by Ramiah and Parthasarthy [3] and Mitra and Ganguli [8]. The bimodal distribution of grain shape with slight transgression for slender types

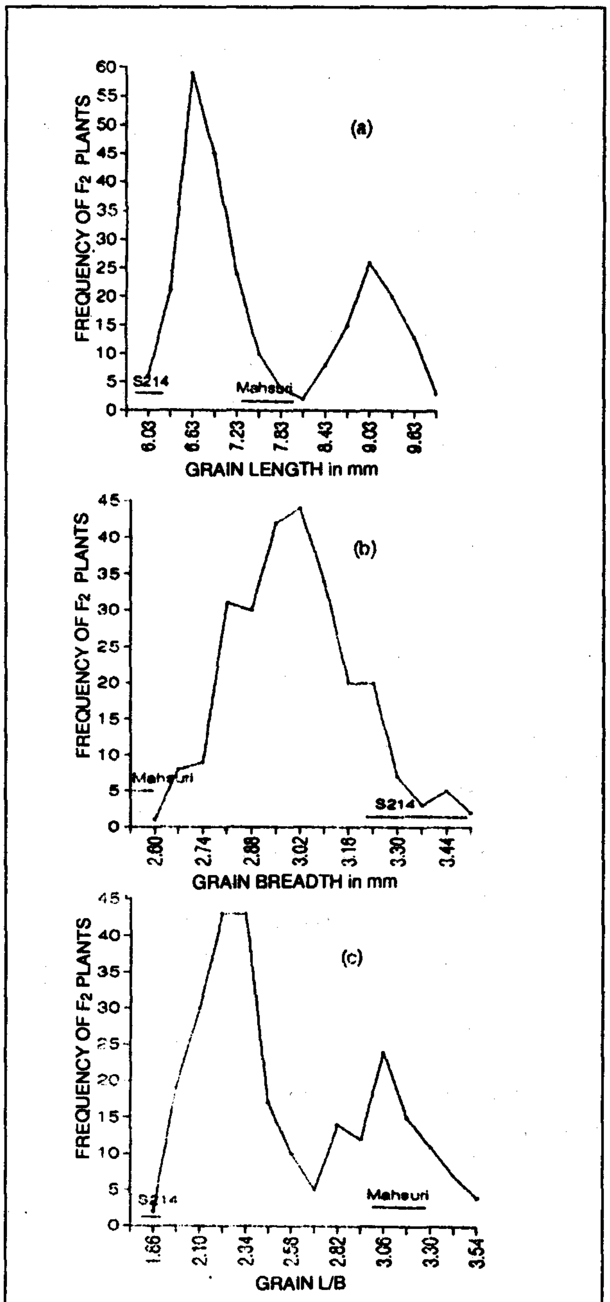

Fig. 2. **Frequency distribution of grain length, breadth and L/B ratio in F_2 generation of the cross S 214 x Mahsuri.**

(Fig. 2c) reveals that the character is controlled predominantly by major genes. However, different results were recorded by Jennings et al. [7].

Cross S 214 x S 260. This was a cross between short slender (S 214) and long slender (S 260) grain parents. The mean F_1 did not indicate heterosis for grain length, breadth or L/B ratio. The range of variation in F_1 and F_2 were also within the parental limits, indicating absence of transgressive segregation. The F_2 variance substantially increased for grain length and L/B ratio, indicating generation of additional variability for these traits. The CV in F_2 was highest for L/B ratio (17.7%), followed by grain length (14.0%) and breadth (6.3%). The frequency distribution curve of grain length and L/B ratio (Fig. 3a, c) formed bimodal pattern, where one of the peaks being much smaller than the other indicates predominance of one major gene along with few modifier genes. Bimodal distribution for grain length was also reported by Ramiah and Parthasarthy [3]. Grain breadth had unimodal distribution (Fig. 3c) with positive transgression, which indicates that the trait is under the influence of polygenes.

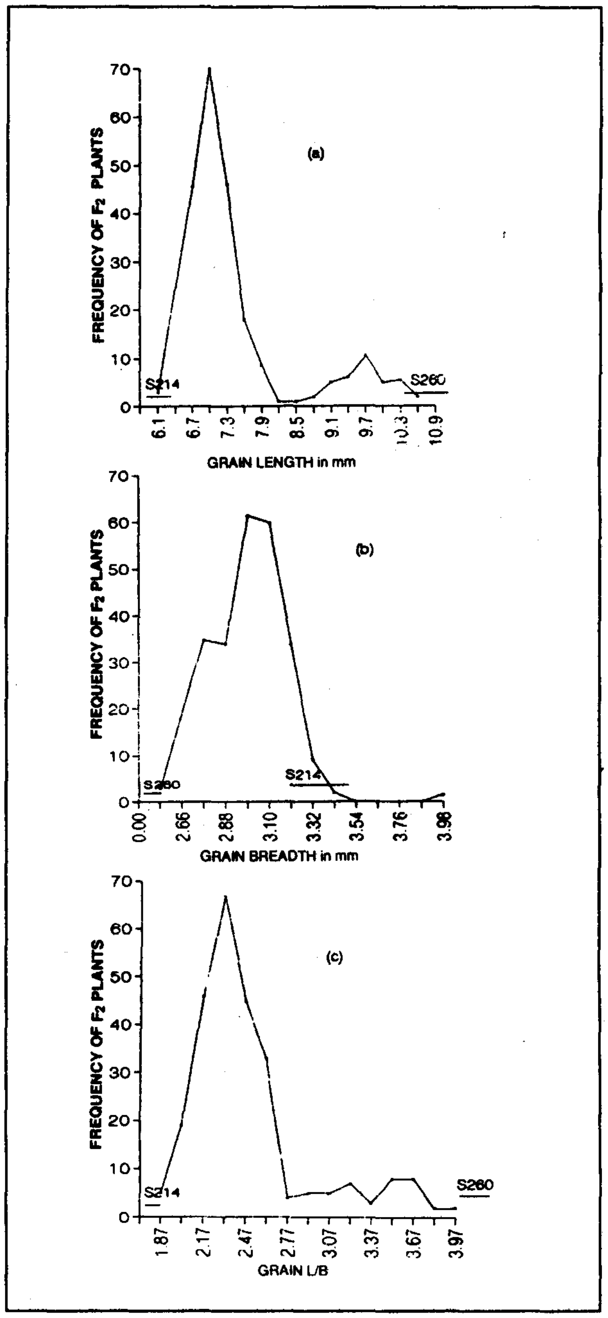

Fig. 3. Frequency distribution of grain length, breadth and L/B ratio in F_2 generation of the cross S 214 x S 260.

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