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SELECTION FOR COMBINING GRAIN YIELD WITH HIGH PROTEIN AND BLAST RESISTANCE IN FINGER MILLET (*ELEUSINE CORACANA* G.)

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ABSTRACT

A study was conducted in F_2 and F_3 generations of two finger millet crosses involving lines differing for protein content and blast resistance with the objective of making selections having favourable combination of yield, protein content and resistance to blast. The relationship between protein content and blast resistance and protein content and grain yield was significantly negative. Recombinants having reasonably higher levels of protein with moderate to high levels to resistance and yield were obtained. The complexities involved on such a selection programme are discussed.

Key Words : Finger millet, *Eleusine coracana*, blast resistance, protein, grain yield

Blast caused by *Pyricularia grisea* is the major disease of finger millet. Previous studies have indicated the negative association of protein content and blast resistance on one hand [1, 2] and protein content and grain yield on the other hand [3, 4]. This implies the difficulty in combining higher protein with high yield and blast resistance. The present study was carried out to look into the possibilities of selecting recombinants in segregating generations having high protein with high yield and resistance to blast.

MATERIALS AND METHODS

Two blast resistant cultivars - GE 1409 and GE 1546 were crossed to WR 13 a high protein blast susceptible cultivar. The F_2 and F_3 generations were grown during *kharif* season of 1993 and 1994 along with parents in the experimental farm at GKVK, Bangalore. The F_3 population was grown in two replications adopting Randomised Complete Block Design. A spacing of 22.5 cm between and 10.0 cm within row was adopted. Bangalore, being hot spot for blast disease of finger millet,

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is ideal for such investigations. To aid selection further, all along the borders and after every ten rows, the susceptible check, WR 13 was sown to provide additional inoculum.

Two hundred fifty F_2 plants selected at random from each cross and random five plants from each of the 100 F_3 families were studied for protein content, grain yield and blast incidence. Protein content was determined following the method of A.O.A.C. [5]. The incidence of blast disease in F_3 progeny rows was assessed at dough stage by counting number of blast infested as well as total number of fingers of all tillers and then converting it in to percentage [6]. Data were analysed on basis of individual plant in F_2 and on mean of five plants in F_3. Phenotypic correlation co-efficients were estimated following [7].

RESULTS AND DISCUSSION

An array of high yielding finger millet varieties developed now and in the past lack resistance to blast disease. Attempts made earlier to transfer resistance to varieties of different maturity groups have not been very successful due to the lack of understanding of the intricacies involved in combining these characters. Selection directed against one character has invariably resulted in negative genetic advance for the other. Ravikumar *et al.* [2] and Byre Gowda *et al.* [1] pointed out that, the resistance/susceptibility to blast disease is conferred by the presence of pre-formed multiple biochemical compounds - phenols, tannins and proteins. They showed that higher protein content in the plant would make it more susceptible to blast and vice-versa. It was also revealed that, the resistant genotypes would invariably have higher levels of phenols and tannins. With a view to probe further, in the present study, association among the characters - blast resistance, grain yield and proteins were studied in the F_2 and F_3 populations of two crosses - WR 13 × GE 1409 and WR 13 × GE 1548 (Table 1). As expected, the relationship between protein content

Table 1. Phenotypic correlation co-efficients among protein content, blast disease and grain yield in F_2 and F_3 generations

Character	Cross	Blast resistance		Grain yield	
		F_2	F_3	F_2	F_3
Total proteins	Cross II : WR 13 × GE 1409	–0.671**	–0.672**	–0.413**	–0.659**
	Cross II : WR 13 × GE 1546	–0.690**	–0.711**	–0.392**	–0.660**
Blast resistance	Cross I : WR 13 × GE 1409			–0.517**	–0.758**
	Cross II : WR 13 × GE 1546			–0.595**	–0.662**

**Significant at 1% level

and blast resistance and protein content and grain yield was significantly negative and the association between blast resistance and grain yield was positive. It was evident that higher protein content in the plant resulted in increased susceptibility to blast disease and in turn lowering of grain yield.

Table 2. Grouping of F_3 selections based on protein content along with mean values for blast disease and grain yield

Cross	Protein content (%)	Mean values: Protein (%)	Blast (%)	Yield (g/plant)
WR 13 × GE 1409	< 8.00	7.50	2.20	32.83
	8.00-9.50	8.73	7.52	26.27
	> 9.51	9.94	14.79	17.71
WR 13 × GE 1548	< 8.00	7.66	2.06	32.00
	7.00-9.50	8.67	5.63	24.16.
	> 9.51	9.87	11.41	18.47

Keeping this in view, a systematic selection programme based upon quantification of individuals of segregating population was attempted. The F_3 population was classified into three groups based upon protein content viz., (i) less than 8.0 per cent (ii) between 8.0 to 9.5 per cent and (iii) more than 9.5 per cent (Table 2). From the data, it was clear that, there was inverse relationship between protein content and grain yield and protein content and blast resistance and selection for protein content would adversely affect the other two characters. Since, the data reflected the general trend of events happening in a segregating population, the possibilities of rare favourable combinations of the characters could not be ruled out. So, the values of individual F_3 progenies were critically compared to obtain a clear picture of the possibility of combining these characters favourably (Table 3).

The data (Table 3) point out that it is difficult to have the best of three characters together in a single segregant. Nevertheless, the data do indicate the occurrence of favourable combinations having reasonably higher levels of grain protein accompanied with moderate to high levels of resistance and grain yield. For example, F_3 selections progenies 72 and 31 in cross WR 13 × GE 1409 and 36 and 82 in cross WR 13 × GE 1546 are such rare favourable combinations. Byre Gowda *et al.* [6] have reported moderate heritability and genetic advance for protein content and high heritability and genetic advance for grain yield and pre-formed biochemicals phenols and tannins determining resistance to blast in the same crosses. This implies

Table 3. F_3 selections having favourable combination of protein, blast resistance and grain yield

Cross	Progeny number	Progenies showing favourable combinations		
		Protein (%)	Blast score (%)	Yield (g/plant)
WR 13 × GE 1409	48	9.90	4.22	23.00
	52	9.34	5.22	28.50
	38	9.19	4.95	28.50
	25	8.99	4.98	29.00
	72	8.81	2.21	32.00
	63	8.80	4.59	29.00
	86	8.70	4.70	28.50
	31	8.66	1.50	32.50
	12	8.60	4.16	31.50
WR 13 × 1546	78	9.80	3.26	22.00
	27	9.79	4.12	18.50
	7	9.74	3.16	17.50
	82	9.70	2.98	26.50
	91	9.58	3.62	20.50
	4	9.34	3.89	30.50
	88	9.11	2.89	22.50
	97	9.05	5.18	21.50
	84	8.90	4.07	26.50
	36	8.79	1.90	30.50

that, early detection of favourable combinations in F_3 generation would be desirable for simultaneous selection and fixation in the succeeding generations.

Often the unfavourable association generally met with are due to tight linkages which could be broken by raising a large population. In the present study new favourable combinations obtained could be the result of breaking of tight linkages. Simultaneous improvement of protein content and grain yield has been achieved in wheat [8] and rice [9]. Loffier *et al.* [10] through the use of recurrent selection suggested that such negative relationship may be caused by linkage and improvements can be made for such traits by enforcing simultaneous selection in large segregating populations [11].

No doubt, the effectiveness of selection for multiple traits of this kind discussed here would much depend on genetic - environmental interactions which is difficult to control or manage. Nevertheless, the proper quantification of individual progenies for the agronomic attributes as well as disease and grain quality is not difficult, provided care is taken while screening for resistance by growing them in blast endemic regions along with assessment of protein content and grain yield.

The selected progenies having desirable combination of character have been further advanced and are undergoing field evaluation.

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