

EVALUATION OF RICE GERMPLASM FOR BLAST AND QUALITY ANALYSIS IN SOME RESISTANT DONORS

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Evaluation of three hundred and five diverse rice (Oryza sativa L var. indica) genotypes against leaf blast led to the identification of 16 resistant and 28 tolerant cultures. Among 125 gora rices, only 10 showed tolerant reaction; none exhibited complete resistance. Six upland rice cultivars (Brown gora— HRC 14, Black gora – HRC 358, Kalakeri, Bhattadhan, N 22 and Dular) appeared to possess durable resistance. Quality analysis of 15 resistant donors suggested that some of them like Salumpikit, Bhattadhan, Kalakeri, CR 143-2-2, Brown gora HRC 14 and Khao Vano Veri possessed multiple desirable quality traits and hence should preferably be used in the varietal improvement programme to enhance the possibility of recovering segregants simultaneously improved for blast resistance and quality.

Blast caused by *Pyricularia oryzae* Cav. is the major disease of rice in the rainfed upland agro-ecological situation. Upland rice is predominantly grown with traditional varieties. The spread of high yielding varieties with increased use of nutrients, especially nitrogen, results in the increase of blast incidence. Since host resistance is better and economic than chemical control to combat diseases, breeding for stable, blast resistant cultivars is important. Sources of resistance to blast available in high yielding cultivars are narrow and can be traced in donors like Tetep and Tadukan. However, it has not been possible to transfer the whole complement of genes as they have been often broken down. (Ou, 1985).

Efforts to identify appropriate donors for developing blast resistant cultures need to be intensified. A wider genetic base and its accumulation is essential in the varietal improvement programme to avoid the danger of genetic vulnerability. Hence, evaluation of diverse native landraces, elite cultivars/strains, exotic and indigenous collections was undertaken. Further, it is desirable to have donors combining high resistance with good agronomic base and superior grain/cooking quality so as to have breeding lines simultaneously improved for several traits. The present paper reports systematic blast diseases screening and quality traits of a few resistant donors at this station.

MATERIALS AND METHODS

Three hundred and five diverse rice genotypes (125 'gora', 112 indigenous, 9 exotic and 59 improved lines and cultivars) were evaluated for blast resistance during wet seasons of 1986 and 1987. The nurseries were raised in August-September as natural air borne inoculum was adequate and weather favourable for disease development (Fig. 1). The test entries were sown in one-row plots in an augmented design with resistant (Rasi) and susceptible (HR 12) checks after every 50 test entries. Conventional uniform blast nurseries were slightly modified to include an additional spreader variety (Brown gora) that is partially killed by blast but provides inoculum for extended periods of time. This local susceptible variety has early seedling vigour and develops profuse foliage which helps to trap and conserve moisture within the canopy to accelerate disease spread. The nurseries were irrigated during dry spells in the afternoons. Evaluation of germplasm started in the nursery with disease appearance and continued until the susceptible checks were completely killed (usually one month after sowing or even further depending on epidemic development). Scoring was done following Standard Evaluation System for rice (Anonymous, 1988).

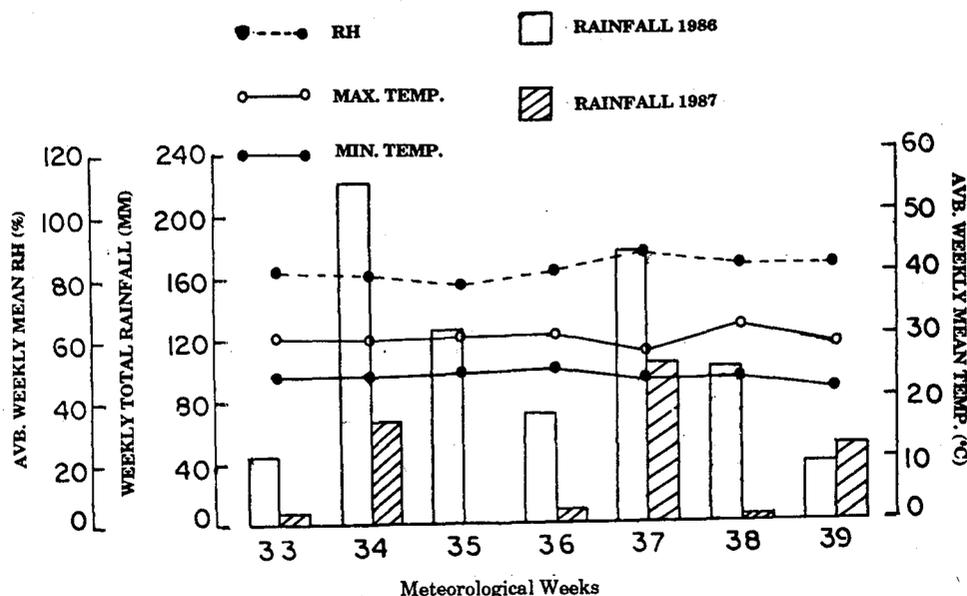


Fig. 1. Average weather conditions during blast nursery test (1986-87) at Hazaribag

Nine blast resistant (consistent score of 3 or less) and six partially resistant genotypes were direct seeded (10 g/m²) during 1988 wet season at moderate fertility level (40 : 20 : 20 NPK) in three-row plots with 20 cm row to row spacing to study the quality traits of these genotypes. These were analysed by a composite sample from the central row and observations were recorded on hulling, milling and head rice recovery (Govindaswamy and Ghosh, 1969), milled

kernel length and breadth using dial micrometer (Mitutyo, Japan), alkali digestion value (Little *et al.*, 1958), amylose content (Juliano, 1971), water uptake and volume expansion (Beachell and Stansel, 1963) and kernel elongation (Azeez and Shafi, 1966).

RESULTS AND DISCUSSION

In the present study, 16 genotypes (5.2%) exhibited resistant reaction (8 were exotic and 8 improved) and 28 test entries showed moderately resistant reaction (Table 1). Among the entries with scores of 3 or less, Tres Marias, Salumpikit, IAC 25 and CR 143-2-2 appeared to have broad spectrum vertical resistance as they were observed to be resistant in diverse agro-environments. These genotypes could be utilized as donors in the rice breeding programme for race specific resistance.

Table 1. Rice genotypes with qualitative and quantitative resistance to blast

Reaction	Frequency of genotypes		Genotypes
	Number	Percentage	
0	0	0	-
1	0	0	-
2	3	0.98	CR 143-2-2, Rohini, Mannuthy 24-20
3	13	4.26	Annapurna, CR 544-1-1, CR 544-1-6, CR 544-1-14, Aditya IAC 25, IAC 1131, MI 48, Dao Pao, Salumpikit, Khao Vano Veri, Lai Iwang Tres marias
4	10	3.28	CR 544-1-2, RR 145-22, CR 636-7, CR 635-9, CR 666-362, CR 666-59, CR 666-68, CR 666-862-7, RP 2219-7964-22, RP 2346-2325-148-7
5	18	5.90	Sukhawel 20, HRC 101, 113, 146, 154, 231, Br. gora 270, 280, 408, 409, RP 2217-8209, 42, Lalnakanda 41, HRC 83, 85, 127 ARC 11775, HRC 14, RR 167-982
6	261	85.86	

The development of cultivars with durable or horizontal resistance may be another way for blast management. This approach would be desirable as there is a risk of breakdown of vertical resistance because of the highly variable nature of the blast pathogen. Cultivars with durable resistance have been suggested as an economic proposition in an area with subsistence farming (Crill, 1982). Identification of donors for durable resistance is difficult because durability can only be recognised retrospectively after a cultivar has been grown for many years in an agro-ecosystem where disease is prevalent above the economic threshold level (Bonman and Mackill, 1988). It is also suggested that cultivars with

consistent rating between 4-6 with overall average not exceeding 5.5 may have a good level of durable (quantitative) resistance (Anonymous, 1988). The findings of the present investigation coupled with earlier work of (Variar and Maiti, 1988) confirmed that six indigenous upland rice cultivars, viz., *N 22*, *Dular*, *Bhattadhan*, *Kalakeri*, *Brown gora* and *Black gora* possessed durable resistance. These cultivars are characterised by moderate diseases in early growth stages followed by rapid recovery and adult plant resistance. They have been grown in sufficiently large areas for many years in disease prone environments but under sub-optimal nutrient levels. Agronomic value of such resistance under optimal nutrient management needs to be evaluated and may prove valuable if combined with broad spectrum vertical resistance.

One of the approaches that could be adopted in the management of blast with host resistance is the incorporation of major gene(s) into cultivars with good agronomic base which provide complete protection to the cultivars against prevalent pathogenic race(s) – Vertical Resistance. Since cultivar development with wide genetic base is essential in a breeding programme, it is useful to have donors with multiple desirable traits. Hence, the evaluation of blast resistant donors for quality characteristics is of significance. Quality characteristics of the blast resistant genotypes (score 3 or less) are presented in Table 2. There was not much variation in the hulling and milling out-turn of the donors but the head rice yields varied substantially. *Salumpikit*, *Rohini* and *CR 143-2-2* had high head rice yields. Only *CR 544-1-14* exhibited LS grain whereas *Rohini*, *Khao Vano Veri* had LB grains (Table 2). Only three blast resistant cultures possessed desirable level of intermediate gelatinization temperatures (alkali score of 4-5). Except *Khao Vano Veri*, *Salumpikit* and *CR 143-2-2*, donors exhibited intermediate amylose content. Besides blast resistance, *Salumpikit Annapurna* and *Khao Vano Veri* also provided good sources for high water uptake (Table 2). *Salumpikit*, *CR 143-2-2* and *Annapurna*, *Kalakeri* and *Brown gora* showed a fairly high degree of kernel elongation whereas maximum volume expansion was recorded for *Mannuthy 24-20*.

Of the six possible donors for durable resistance, *Brown gora* and *Kalakeri* could also be useful sources for grain weight, while *Dular*, *N 22* and *Bhattadhan* had high head rice yields in addition to partial resistance. *Bhattadhan* and *Kalakeri* also exhibited high water uptake - a desirable cooking quality trait and high volume expansion, a valuable cooking quality character was observed in *Brown gora* and *Dular* (Table 3).

Blast resistant donors identified in the present study can be used in the development of improved rice cultivars with built-in resistance. However, enhancing the chances of getting segregants with improved resistance and grain/cooking quality, donors like *Salumpikit*, *Annapurna*, *Khao Vano Veri*, *CR 143-2-2*, *Kalakeri*, *Bhattadhan* and *Brown gora* (HRC 14) should be utilised in the breeding programme.

Table 2. Physico-chemical and cooking quality attributes of blast resistant donors in rice (*Oryza sativa* L.)

Character	Cultivars (Donors)								
	1	2	3	4	5	6	7	8	9
Hulling (%)	74.10	76.40	78.10	75.30	76.90	76.30	75.20	76.00	71.60
Milling (%)	68.50	71.30	73.10	70.30	71.70	68.90	69.80	70.40	66.70
Head rice recovery (%)	65.60	59.00	63.00	45.50	56.50	36.40	32.40	35.90	31.40
Milled kernel length (mm)	5.18	5.52	6.54	5.47	6.72	6.02	6.22	6.05	6.30
L : B ratio	1.90	2.22	2.55	2.15	2.60	2.24	2.47	2.45	3.00
Alkali digestion value	3.50	3.50	2.50	3.50	5.50	5.50	2.50	2.50	2.50
Amylose content	19.10	19.20	22.80	20.91	16.70	20.60	22.44	21.60	20.30
Water uptake	365.00	235.00	265.00	340.00	330.00	303.00	275.00	280.00	288.00
Volume expansion	4.00	3.70	4.00	3.70	3.70	4.10	3.85	3.70	3.70
Kernel elongation	2.05	1.74	1.62	1.75	1.49	1.56	1.58	1.59	1.56

1. Slaumpikit (HRC 20), 2. CR 143-2-2 (HRC 297), 3. Rohini (HRC 4248), 4. Annapurna (HRC 431), 5. Khao vano veri (HRC 505), 6. Mannuthy 24-20 (IET 11403), 7. CR 544-1-1 (IET 11409), 8. CR 544-1-6 (IET 11413), 9. CR 544-1-14 (IET 11415).

Table 3. Quality characteristics of rice genotypes with durable resistance in rice (*Oryza sativa* L.)

Character	Genotypes	Br. gora (HRC 14)	Bl. gora (HRC 358)	Kalakeri (HRC 17)	Bhattadhan (HRC 19)	N 22 (HRC 4)	Dular (HRC 21)
1000 grain weight (g)		28.50	24.40	28.20	25.60	21.40	23.80
Hulling (%)		74.10	72.80	74.10	75.30	74.20	70.70
Milling (%)		66.90	67.10	64.20	65.90	69.10	63.70
Head rice recovery (%)		49.30	40.00	43.10	58.00	60.50	58.80
Milled kernel length (mm)		5.68	5.29	5.72	5.51	4.94	6.08
L : B ratio		2.08	2.17	2.21	1.93	2.10	2.59
Alkali digestion value		3.10	2.50	3.50	3.50	2.50	3.50
Amylose content (%)		19.10	20.90	19.90	19.60	17.50	19.10
Water uptake (ml)		340.00	330.00	345.00	395.00	300.00	335.00
Volume expansion		4.00	3.70	3.60	3.60	3.70	4.00
Kernel elongation		1.76	1.62	1.81	1.63	1.62	1.48

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