

RICE GENETIC RESOURCES PROGRAMME IN THE PLATEAU REGION OF BIHAR

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Rich diversity in rice exists in the plateau region of Bihar owing to diverse growing situations and low coverage under modern high yielding varieties. There is an urgent need to collect and conserve this rich wealth of diversity before genetic erosion depletes this useful genepool. This paper presents an account of current status of genetic resource programme in the region and suggests intensification of coordinated efforts in collection, *in situ* and *ex situ* conservation, evaluation, cataloguing and utilization.

Key words : Rice genetic resources, plateau region Bihar, collection, evaluation, conservation, utilization

There is rich diversity in rice agroecology in the plateau region of Bihar (22.0-22.5° N latitude; 83.95-88°E longitude; 140-1200 m above msl) having 29.2 per cent of the rice area of the state. The region is also endowed with enormous genetic diversity in traditional rice cultivars owing to low coverage under high yielding varieties. Further, the area is largely inhabited by tribals in the inaccessible areas which are not exposed to modern agriculture and hence possess wide array of native types and wild genetic resources. Concerted efforts should be made to conserve the rice genetic diversity in native land races, primitive cultivars and their wild relatives occurring in the region before this wealth is eroded. This paper presents current status of rice genetic resource activities in the region.

Three research centres - Central Rainfed Upland Rice Research Station (CRURRS), Hazaribag, a unit of Central Rice Research Institute, Cuttack; National Bureau of Plant Genetic Resources (NBPGR), Base Centre, Ranchi and Birsa Agricultural University (BAU), Kanke, Ranchi - have active rice genetic resources programme in the plateau region of Bihar.

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GERMPLASM COLLECTIONS

Indigeneous Collections : One hundred and nine landraces were collected from 25 blocks of five districts in collaboration with NBPGR, New Delhi, in 1985 (Chauhan *et al.*, 1989) followed by collection trips during 1987-1991. Fifty upland rice cultivars were also collected from Almora and adjoining areas in western Uttar Pradesh. The NBPGR Base Centre at Ranchi extensively surveyed Bihar, eastern Uttar Pradesh and adjoining areas of Orissa during 1988-1993 and collected 796 accessions, of which 171 were ecotypes of *Oryza nivara* (110), *O. rufipogon* (36), *O. spontanea* (14), and hybrids of *O. nivara/O. spontanea* (9) and *O. rufipogon/O. nivara* (1). BAU is maintaining a collection of 591 accessions. The area surveyed the predominant landraces in different agroecologies are presented in Table 1 & 2.

Table 1. Details of the rice germplasm collection trips

Period	Area surveyed			Collections (No)
	Blocks (No)	Districts		
Oct.-Nov. 1985	25	Hazaribag, Giridih	Gumla, Lohardagga, Ranchi	109
Sept. 1987	5	Hazaribag, Giridih		28
Oct. 1987	2	Hazaribag		7
Oct. 1988	-	Ranchi, Hazaribag and North Bihar		6
Nov. 1988	-	Bolangir (Orissa)		130
Nov. 1989	9	Ranchi, Gumla, Singhbhum		28
Dec. 1989	-	Palamau, Ranchi, Hazaribag, South Bihar and Eastern UP		119
Dec. 1989-Jan. 1990	-	Lohardagga, Palamau, Gumla, Ranchi, Singhbhum, Hazaribag, Purulia (WB)		170
Nov.-Dec. 1990	-	North Bihar		111
Sep.-Oct. 1991	-	Ranchi, Dumka, Sahebganj, Godda, Giridih, Hazaribag, Gumla, Singhbhum, Palamau, Lohardagga		86
Nov. 1991	9	Eastern UP;		67
	-	Giridh, Godda, Dumka		
Nov. 1992	-	Eastern UP		112
Sep.-Oct. 1993	-	Ranchi, Hazaribag, South and North Bihar		21

Exotic collections : Traditional and improved cultivars from South and South East Asia, Latin America and West Africa were received from the International Rice Research Institute, Philippines. These accessions are mostly

of rainfed upland type and constitute a very useful genepool specifically for drought tolerance, blast resistance and root characteristics since many of them are the known donors for these characteristics. At CRURRS, 124 accessions are being maintained. No distinct classification of exotic and indigenous collections is available at BAU although they are having some improved exotics received through international testing programmes. The accessions at NBPGR are exclusively indigenous including wild ecotypes.

Currently, a total of 2091 accessions are in stock at the three centres representing traditional, exotic and improved types for upland, medium- and

Table 2 : Important traditional cultivars of rice in the plateau region

Agroecology	Land type	Cultivars
Upland	Tanr II & III	Black gora, White gora, Brown gora
Medium land	Don III	Dudhi, Dighio, Karhani, Dehule, Asumarto, Marto
	Don II	Tilasar, Dudhras, Ratgoli, Chandragrahi, Lalki, Jonga, Nevair, Chapasair, Areba, Khoya
Lowland	Don I	Sikkinanhia, Panidubki, Bherakaber, Dudjkander, Nardha, Haskalma, Kalamdani, Tulsimanjari, Mainasar, Sarna, Ramsar, Birendrasar, Nakjawain, Dhusra, Mehra, Nauhia

lowlands. The accessions are prefixed with HRC (Hazaribag Rice Collections) at CRURRS, Acc (Accessions) at BAU and NIC (National Indigenous Collections) at NBPGR.

EVALUATION, CHARACTERIZATION AND CATALOGUING

Systematic evaluation, proper documentation and dissemination of findings provide the bridge between conservation and potential use. Accomplishments at the three centres are presented in Table 3.

Table 3. Evaluation status of rice genetic resources in the plateau region

Character	Accessions (No)
Agromorphological	425
Quality	259
Blast	748
Brown spot	205
Bacterial leaf blight	307
Sheath rot	131
Termites	60
Gundhi bug	50
Leaf folder	50

Agromorphological characters : One hundred and eighty one gora collections (traditional upland cultivars) of plateau region have been extensively studied for pigment distribution in plant parts, quality, physiological and agro-morphological characters (Chauhan *et al.*, 1993; Singh, 1993). The accessions HRC28, 621 and 625 were identified as donors for grain weight, panicle length and kernel colour respectively (Sinha *et al.*, 1990). Singh (1993) selected eight accessions Goradhan 1 (Acc 18), Goradhan 8 (Acc 25), Jarang gora 1 (Acc 33), Karanga gora 2 (Acc 35), Lalmati gora 1 (Acc 37), Karanga gora 1 (Acc 34), Naud gora 1 (Acc 40) and Nanhi gora 1 (Acc 41)- as valuable sources for several genetic markers and agronomic characters. The pattern of *in situ* morphological variation for panicle length, type, branching pattern, grains per panicle, grain weight, apiculus colour, sterile glume colour, awning, husk colour, grain size per shape and aroma were studied in 109 traditional cultivars of medium and lowlands. Several potential donors for grain number, grain weight and panicle characteristics were identified (Chauhan *et al.*, 1989). At NBPGR, 83 upland rice accessions were evaluated for pigment and agromorphological characters and the variation in flowering, plant height, panicle length, branches per panicle, spikelets per panicle and leaf length was studied in 52 ecotypes of *Oryza nivara* and *Oryza rufipogon*.

Table 4. Promising accessions of rice for specific quality characters

Character	Accessions
High grain weight (>30 g) Aroma	Raria (268), Sathi 34-36 (35), Ramdi, Rukaminibhog, Raskadam (29), Improved Raskadam (30)
Long slender grains (L = > 6.61 mm) (L: B = > 3.0*)	Brown gora (407, 409), Kalamdani (212), Sukhvel-20 (490)
High milling out-turn (> 70%)	Kalamdani (212), Chandragrahi (606) PTB 10(421), Raria (268), Aus 454 (465)
Intermediate amylose content & gelatinization temperature	Sudha (432), Kalamdani (212), Pakiraj (197), Brown gora (298), White gora (303), Brown gora (371)
High water uptake (> 350 ml)	Raria (268), Dahia (264), Dudhras (271), Nauhia (287), Ramkel (272)
High volume expansion (> 4)	Raria (268), Jonga White (140), Gora (274), Dudhras (271), Lalki (605), Chandragrahi (606)
Kernel elongation (> 1.9)	Sudha (432), White gora (308, 318, 320), Jhulaka (580)

*Length and breadth based on milled rice

Numbers in parentheses are HRC Nos.

Quality characteristics : Chauhan *et al.*, (1990, 1991) evaluated 135 accessions comprising rainfed upland (traditional, 25; gora collections, 57) and

medium/lowlands (53) for 12 physico-chemical and cooking quality components. About 50 per cent of the cultivars had short, bold and red kernels. Sixteen genotypes exhibited desirable combination of intermediate amylose content and gelatinization temperature. A few traditional cultivars possessing desirable quality characters were identified which could be used as donors for quality improvement (Table 4).

Tomar *et al.* (1990) classified 124 indigenous cultivars from Bolangir district of Orissa and based on 12 quality traits, grouped them into 16 clusters. Variar *et al.* (1990) and Shukla *et al.* (1991) reported that Salumpikit, Khao vano veri and Bhattadhan possess many desirable quality characteristics in addition to blast resistance, while Kalamdani, Raria, Ramkel, Tilasar and Lalki showed good cooking quality traits besides BB resistance. Efforts were also made to identify duplicates in a collection of 57 gora rices using physico-chemical characters and phenol test at CRURRS. Only 25 accessions appeared to be distinct cultivars based on grain colour, size/shape, amylose indicated that Brown- and Black gora collections were highly variable as compared to white gora collections.

DISEASES AND PESTS

Blast : Six hundred ninety eight indigenous (449) and exotic (249) accessions were phase-evaluated (each accession atleast for two seasons) in outdoor blast nurseries as per Standard Evaluation System (SES) for rice. Results indicated that only 7.2 per cent had complete resistance and 20.5% had partial resistance. The distribution of blast resistance genes was skewed in favour of the exotic (Fig. 1). Among indigenous types, the cultivars grown under uplands (Bhattadhan, Kalakeri, N 22, Dular) were less susceptible than those of medium/lowlands. Resistance in these indigenous upland 'aus' cultivars and a number of exotic cultivars like Moroberekan, IAC 25, Dourado prescose, Iguape cateto and Salumpikit were reported to be stable (Variar *et al.*, 1990). Resistance in upland rice accessions and improved germplasm was classified based on lesion types and disease progress. Three groups were recognised. Group I had complete resistance represented hypersensitive flecks or no infection symptoms. Group II had partial resistance to leaf blast. The genotypes of this group take up infection slowly, have few scattered susceptible lesions (type 4, SES, <2% Diseased Leaf Area (DLA) in the nursery but they succumbed to neck blast. Group III comprised 'aus' cultivars of the region which take up infection early, have 5-10 per cent DLA at tillering, rapid recovery and adult plant resistance. The donors identified with different types of resistance (Table 5) are being utilized in the breeding programme to combine non-infection resistance with slow blasting resistance and adult plant resistance. At BAU, 50 gora rices were field evaluated for blast resistance and some of them showed tolerance.

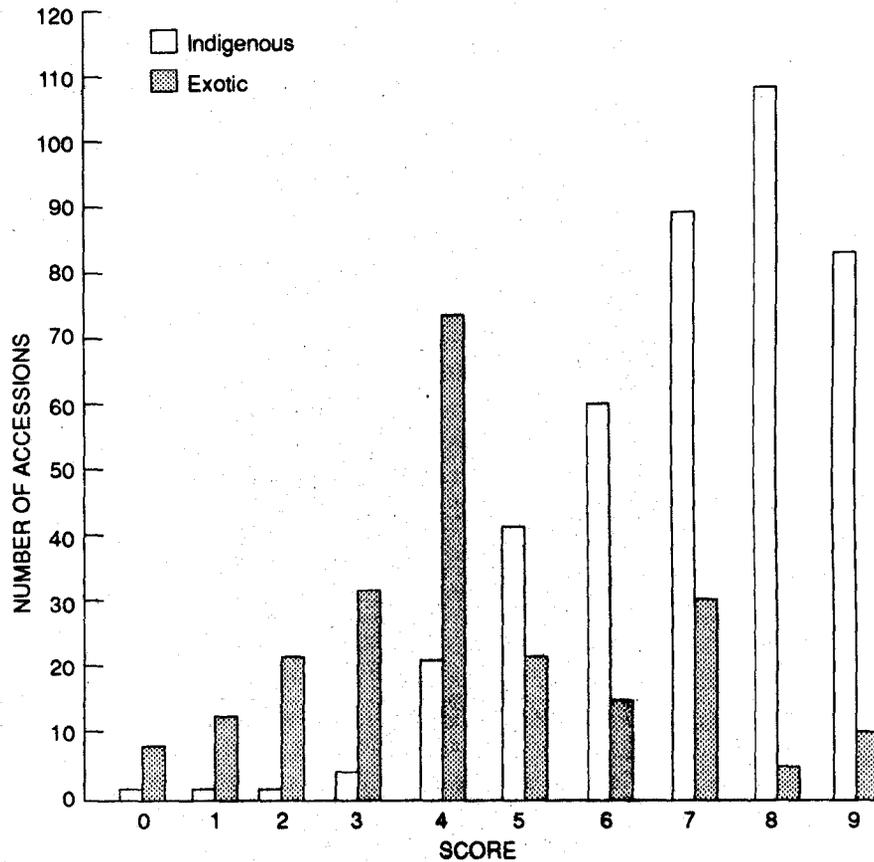


Fig. 1. Frequency distribution of rice germplasm for leaf blast reaction (n = 698)

Bacterial blight : Using clip inoculation method (Kauffman *et al.*, 1973) and SES, 257 accessions of diverse rice ecology were evaluated and 13.6% were observed to be resistant as compared to T (N)1. The cultivars showing high level of tolerance were **Agnisal** (HRC699), **Kalamdani** (HRC 711), **Jhilidhan** (HRC 703), **Chapasair** (HRC 712), **Nanhia** (HRC 726), **Jugudi** (HRC 733), **Tilasar** (NIC 105470), **Goyen** (NIC 105665) and **Jarli** (NIC 105682).

Other diseases : Twenty four brown spot tolerant accessions were identified at CRURRS from 155 accessions, the highly resistant were **Jingasar**, **Rangi**, **Kalamkathi**, **Deeptisal** (NIC 105758) and **Badnasal** (NIC 105783) and at BAU **Goradhan 2** (Acc 19), **Gora 2** (Acc 31), **Gora 3** (Acc 33), **Karanga gora 2** (Acc 35) and **Naud gora 1** (Acc 40) were observed to be resistant to brown spot under field conditions. Screening of 131 traditional cultivars under natural growing conditions results into identification of **Sain** (NIC 105539), **Jarli** (NIC 105682), **Bogna** (NIC 105687), **Gopalbhog** (HRC 716) and **Dudhiras** (HRC 724) as resistant to sheath rot.

Table 5. Donors for blast resistance

Group	Lesion type	DLA (%) *		PBS (%) **	Accessions
		(Nursery) (40 DAS)	(Field) (DAS)		
I	0	0	0	0	Moroberekan (482), IACX 25 (478), MI 48 (483) IRAT 112 (172), Iguape cateto (294), Tres marias (484)
II	3,4	2	0	5-15	Aditya, Akashi (452), Annada (443), Heera, Kalyani II, Rasi (438), Vandana
III	4	5-10	5	1-5	Brown gora (392), Black gora (342), Bhattadhan (19), Kalakeri (17), N 22 (4), ARC 11775 (429)

*DLA Diseased Leaf Area ** PBS Panicle Blast Severity

Number in parentheses are HRC numbers.

Insects : Sinha and Prasad (1992) reported variation in susceptibility to termites in 60 genotypes and observed that N 22, Lalnakanda 41, CR 143-2-2 and RR 50-3 were free from termite infestation while the susceptible check IRAT 112 recorded 98 per cent seedling mortality. Variar *et al.* (1993) reported from a study of 35 traditional and improved upland germplasm that tropical upland japonicas (OS 6, Moroberekan, Kinandong Patong, IRAT 112 and IAC 25, IAC 1131 and IAC 1246) were highly susceptible to termite infestation. Fifty gora collections were also field evaluated at BAU, Ranchi for gandhibug and leaf folder incidence.

Efforts have been made to systematically analyse the accessions for quality and multiple resistance which led to the identification of five potential donors for use in the breeding programme (Table 6).

Table 6. Characteristics of multiple disease resistant donors

Donor	BS	ShR	BLB	Height (cm)	50% flw (d)	1000- g.wt (g)	Length (mm)	L:B
42-34 (HRC 702)	1	1	2	111	95	24.5	6.2	2.6
Jhilidhan (HRC 703)	1	2	3	117	97	22.5	6.2	2.7
Chapsair (HRC 712)	2	1	2	114	98	25.5	6.0	2.7
Samunderdhan (NIC 105750)	2	2	3	114	103	30.0	5.9	2.3
Chandrakanati (NIC 105751)	2	1	2	118	96	30.0	6.4	2.7

UTILIZATION

Several of the landraces and traditional cultivars have been utilized in the varietal improvement programme at CRURRS, Hazaribag and BAU, Ranchi. Of the seventeen traditional cultivars used in the development of 303 crosses at CRURRS, the most frequently used were N 22 (13 crosses), Kalakeri (12 crosses), Lalnakanda 41 (11 crosses) and Black gora (10 crosses). In many other crosses their derivatives were used. At BAU the gora rices have been extensively used. Seven varieties have been released till date for rainfed upland and medium lands and several elite breeding lines are at various stages of testing under Directorate of Rice Research, Hyderabad (Table 7).

Table 7. Promising breeding lines and varieties evolved utilizing indigenous genetic resources

Variety/ lines	Origin	Parentage	Stature	50% flw (days)	Grain type	Blast (0-9)	Land type
Varieties							
Birsadhan 101	BAU	Fine gora/IET 2832	SD	50	M	3	upland
Birsadhan 102	BAU	Pure line sel. from gora (BR 23-19)	T	60	M	6	upland
Birsadhan 103	BAU	Fine gora/IET 2832	SD	55	M	3	upland
Birsadhan 104	BAU	-do-	SD	55	SB	5	upland
Birsadhan 201	BAU	T (N) 1/Br gora 23-19	SD	80	M	6	med-land
Birsadhan 202	BAU	Jaya/BR 34	T	95	M	5	med-land
Vandana	CRURRS	C 22/kalakeri	T	60	M	5	upland
Elite breeding lines							
BAU 120-19	BAU	N 22/CR 245-1	T	48	M	3	upland
BAU 146-16-3	BAU	Mut. gora/IAC 25	SD	66	LB	3	upland
BAU 148-30	BAU	17 Bala/Bl/gora// OS 6/ch 1039	SD	58	SB	2	upland
BAU 149-2	BAU	16 Bala/Bl.gora// OS 6/Ch 1039	SD	53	SB	0	upland
BAU 149-34	BAU	-do-	SD	65	LS	5	upland
BAU 4045-8	BAU	Fine gora/IET 2832	SD	65	SB	5	upland
RR 151-3	CRURRS	N 22/C 22	T	55	LB	8	upland
RR 174-1	CRURRS	RR 51-1//CR 143-2-2/ Kalakeri	T	59	M	1	upland
RR 203-2	CRURRS	Wh. gora/Kalnga III	T	58	LS	1	upland
RR 203-16	CRURRS	-do-	T	58	LB	1	upland

FUTURE NEEDS

The progress of collection and evaluation is rather slow and only a modest collection from the limited geographic area could be made. Collection trips were restricted to easily accessible areas, while a large reservoir of wild types are fast depleting in the remote localities. The major thrust of collections was on medium and lowland ecologies comprising mostly late maturing types while early maturing upland types are yet to be collected from vast unexplored area. Therefore, there is need for intensification of the efforts.

Coordination and collaboration among the three centres should be strengthened. A time bound, detailed plan of the area to be explored coinciding with different maturity periods of the rice crop should be drawn and the progress should be reviewed regularly. The existing and new collections should be assigned a common accession number for database development.

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