

Rice bean in India with Particular Emphasis on the Himalayan Region

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Rice bean Growing States/Areas in India

- North – Eastern states viz. Assam, Meghalaya, Manipur Mizoram, Arunahchal Pradesh and Nagaland.
- Sikkim, West Bengal (North), Jharkhand and Chhattisgarh
- Eastern and Western Ghats (involving several states)
- Himachal Pradesh and Uttarakhand

Himalayan Region

- Eastern Himalaya : Moist subtropical, Shifting cultivation (Jhoom), High biodiversity
- Western Himalaya : Dry temperate, Terraced farming, Low biodiversity

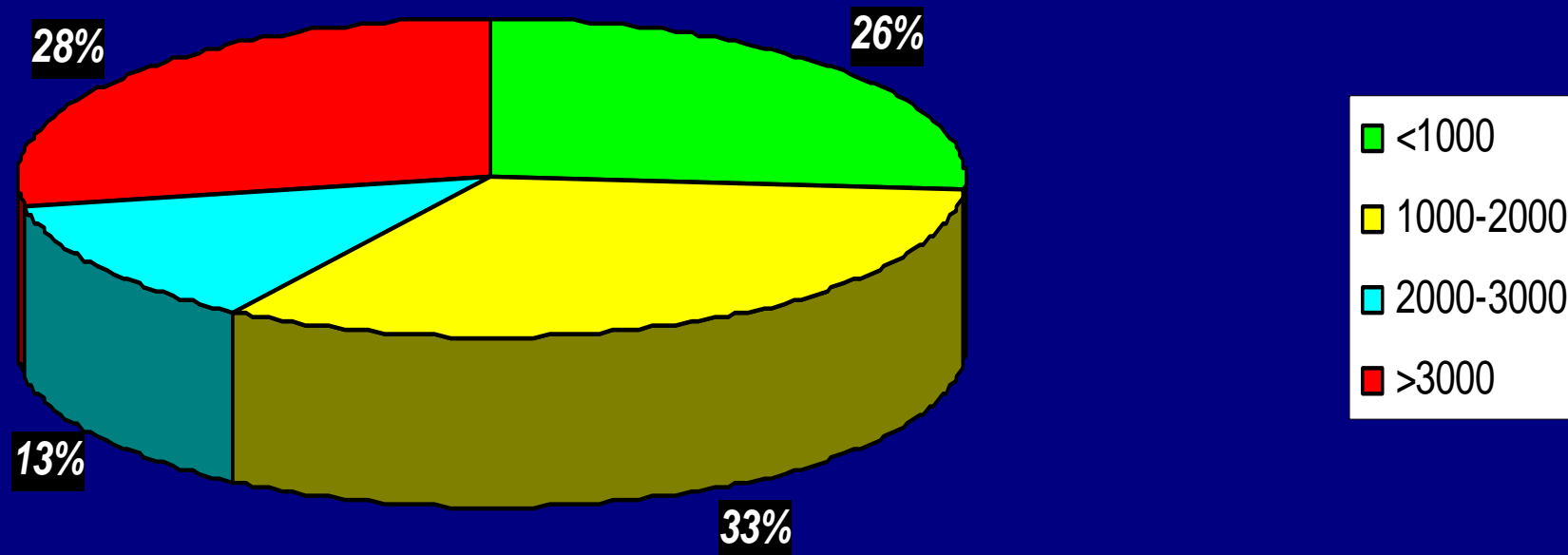
Farming Situations in Uttarakhand

Himalayan Agro Ecosystems

Zone	Altitude (m asl)	Share of area (%)
Irrigated Lower Hills	600-1200 m	12
Rainfed Lower Hills	600-1200 m	08
Mid Hills South Aspect	1200-1700 m	36
Mid Hills North Aspect	1200-1700 m	24
High Hills	1700-2500 m	12
Very High Hills	2500-3500 m	04
Alpine Pastures	Above 3500 m	04

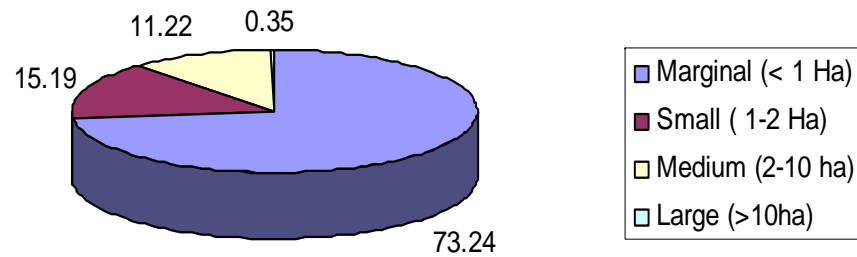
Altitudewise Distribution of Area in Uttarakhand

Altitude-wise Area (%) of Uttarakhand

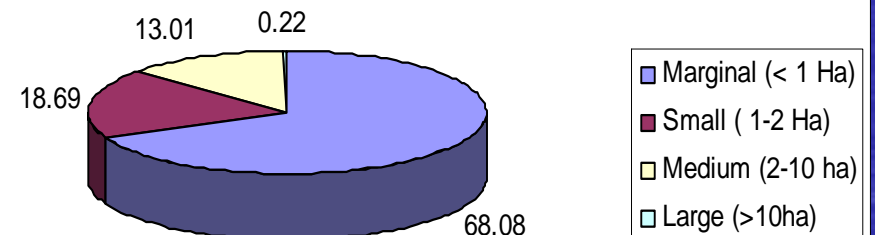


Size of Holdings in Uttarakhand

Kumaon



Garhwal



Inclusion of Rice bean in AICRP on Underutilized Crops

- During 1988-89 (Before this, rice bean was included in AICRP on Pulses)

Exploitation of Rice bean in the AICRP on UC

- Largely as a food grain crop in the project.
- Fodder value of rice bean is being dealt with under AICRP on Forage Crops.
- Potential of grain types mainly in the hills and fodder types mostly in the plains.

Major Cropping Systems Involving Underutilized Crops in the Hills

Ricebean+Fingermillet – Wheat

Ricebean+Grain amaranth – Wheat

Ricebean+ Other pulses -Wheat/ Barley

Germplasm Accessions Evaluated at GBPUAT, Hill Campus

- **Germplasm evaluated so far : 2300**
- **Germplasm lines maintained : 125**

Varieties Developed by GBPUAT, Hill Campus

Variety	Year	Important Characteristics	Recommended area
PRR 1	1998	Black seed	Hills of Uttarakhand
PRR 2	1999	Light yellow seed	North Western Himalaya
PRR 9401*	2006	Chocolate seed	Identified but could not be released

A photograph of a field of green plants with yellow flowers, likely a crop field. A white sign with the text "PRR 2" is placed in the center of the field. The plants are densely packed and appear to be in the flowering stage. The background shows more of the same field extending into the distance. The entire image is framed by a blue border.

PRR 2

Seed Production (kg) at Hill Campus

Variety/ Year	2001	2002	2003	2004	2005	2006	2007	2008
PRR 1	42.0	15.0	8.0	6.0	5.0	15.0	18.0	10.0
PRR 2	23.0	9.0	12.0	8.0	5.0	8.0	16.0	5.0
Total	65.0	24.0	20.0	14.0	10.0	23.0	34.0	15.0 (205)

Seed Production (kg) at Research Sub-Station, Gaja

Variety	2001	2002	2003	2004	2005	2006	2007	2008
PRR 1	30.0	73.0	23.0	-	-	-	10.0	100.0
PRR 2	32.0	74.0	22.0	-	-	-	-	15.0
Total	62.0	147.0	45.0	-	-	-	10.0	115.0 (379)

Agro-techniques Developed

- Planting geometry in rice bean (30x15 cm).
- Source and level of phosphorus in rice bean (acidulated rock phosphate 60 kg /ha).
- Time of sowing and seed rate in rice bean (15 May and 20 kg /ha).
- Acid soil reclamation (Most efficient genotype, RBL 2).
- Nodulation studies in rice bean genotypes (Best genotypes, RBL 100 and RBL 17).
- Nitrogen level in rice bean (40 kg /ha).
- Cropping system and fertility level in rice bean (Rice bean - pea, N₂₀ P₂₀ kg / ha).
- Rice bean genotype suitable for fodder (BRS 1).

Other Studies

- Cooking parameters in rice bean.
- Seed hardness, flower drop and nodulation studies in rice bean.
- Molecular characterization (RAPD) of rice bean parents and their cross derivatives.
- Interspecific crosses of ricebean with cowpea.
- Residual effect of rice bean in succeeding wheat crop.

Cooking Quality of Rice Beans Compared to Green gram

Entry	PRR-1	PRR-2	Green gram
Seed volume (ml/seed)	0.040	0.047	0.027
Seed density (g/ml)	1.460	1.250	1.055
Swelling capacity/seeds	0.0200	0.0370	0.0005
Hydration capacity/seed	0.0250	0.0440	0.0006
Closed pan cooking	96.0	96.0	98.5
Presoaking (42 hr)+ cooking (max. 50 min)	91.0	90.0	98.5
Pressure cooking (10 min)	98.0	96.0	96.0

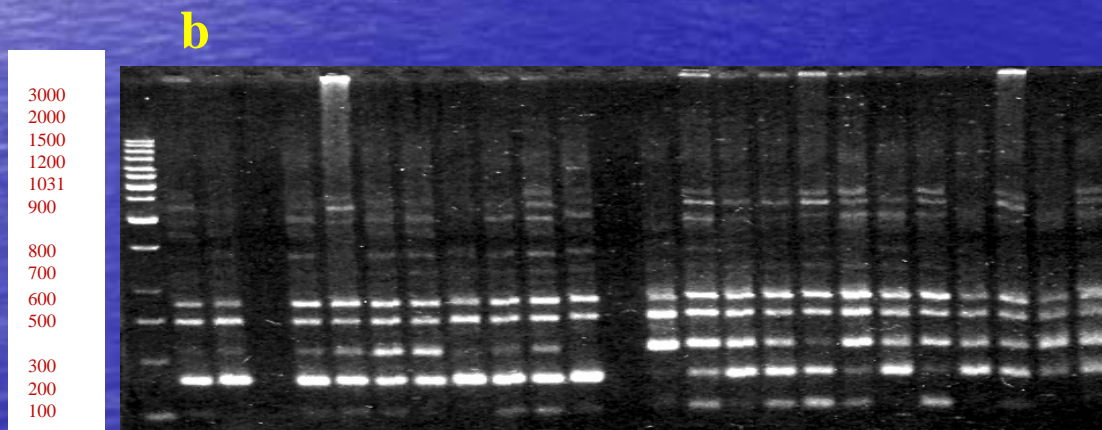
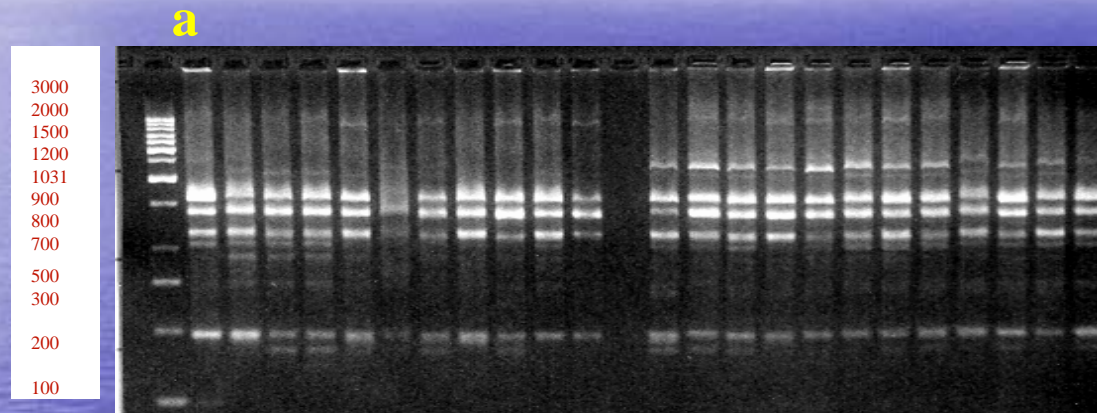
Seed Vigour and Methods to Overcome Seed Hardness

- Field emergence was higher in small seeded types which were high yielding as well.
- Seed viability and vigour index was positively correlated with field emergence.
- Per cent hard seeds ranged from 4.16 to 41.66.
- Among the six treatments applied conc. H_2SO_4 for 120 seconds was found most effective in overcoming seed hardness with an overall germination of 84.08 %.

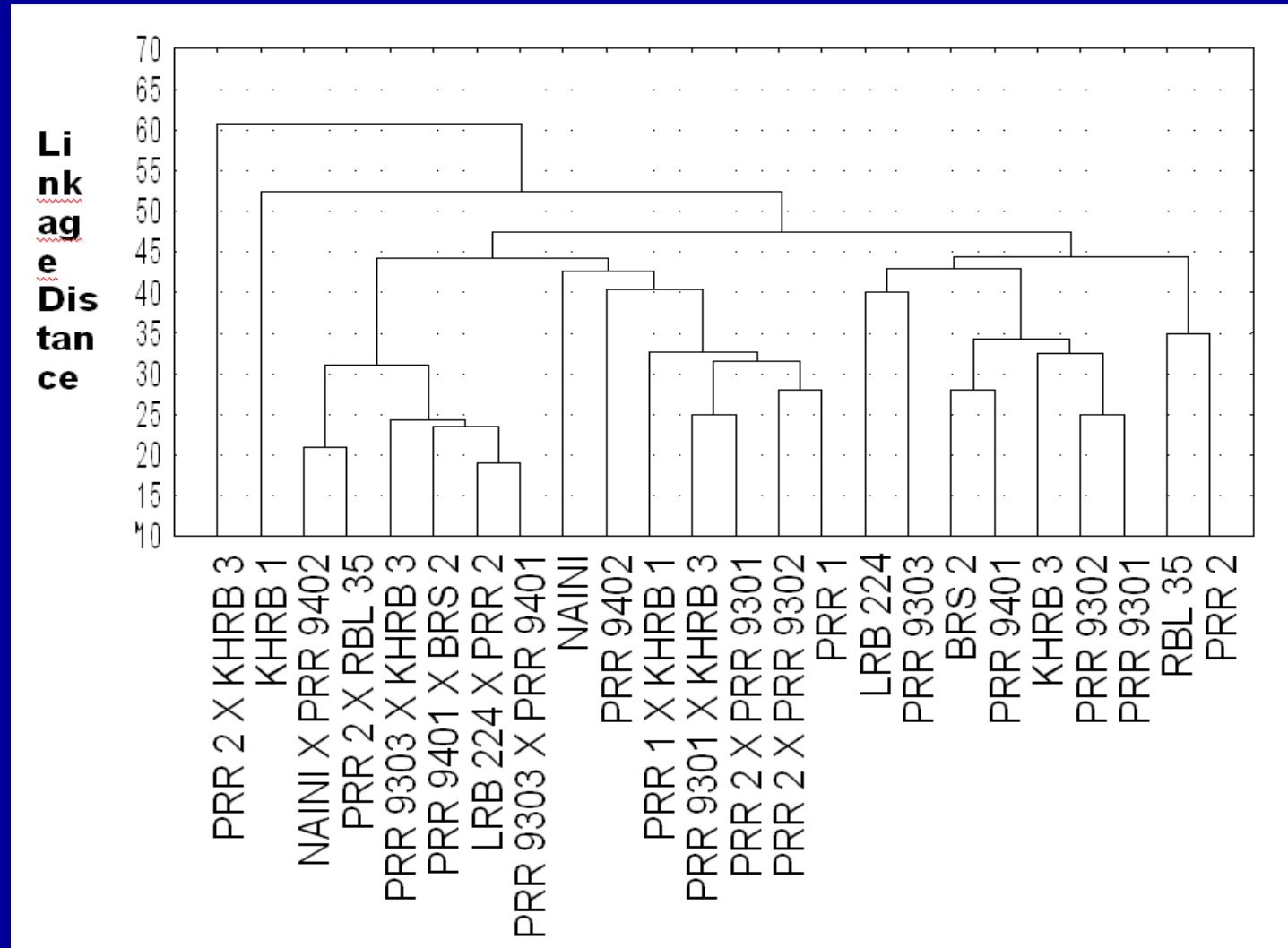
Promising Genotypes Evolved through Hybridization



DNA Fingerprint Patterns Revealed for 13 Rice bean Varieties and their 11 Cross Derivatives by a. Primer No. D17 and b. Primer No. D18



Cluster Analysis with UPGMA Utilizing SED of the RAPD Fragments Generated by 13 Rice bean Varieties and their 11 Cross Derivatives



Value Added Food Products

- Estimated Vitamin C content of sprouted rice bean.
- Developed multipurpose food products (MFP) using rice bean with small millets and grain amaranth for nutritionally vulnerable groups.
- Rice bean as a substitute of black gram in South Indian snacks like Idli, Vada, Dosa etc. (UAS, Bangalore).

Training on Value Added Food Products



Popularization of Improved Technologies

- Conducted Front Line Demonstrations (FLDs)
- Imparted On- and Off- Campus Training
- Organized Farmers' Fairs & Field Days
- Organized Food and Biodiversity Fairs
- Developed Popular Literature (Folder, Pamphlet etc)
- Broadcast Radio and TV Programmes

Linkage and Coordination

- ICUC and GFU on UC, currently Crops for the Future
- GFAR, IFAD, Bioversity International, MSSRF
- Agro-biodiversity Platform
- NARS, SAUs
- State Departments
- Seed Production Agencies
- Organic Commodity Board

Future Thrust Areas

- Extensive collection of genetic resources through national and international collaboration.
- Biochemical and molecular characterization of germplasm lines.
- Development of both grain, vegetable (WVC, Taiwan) and fodder types.
- Extensive hybridization for development of determinate, early and synchronous maturing, high yielding genotypes.

Future Thrust Areas

- Interspecific hybridization and marker assisted selection (MAS).
- Study of genetics of seed coat colour to develop uniform coloured seeds preferably green/black.
- Removal of anti-nutritional factors e.g. phytate.
- Removal of seed hardness for quick and uniform germination.
- Developing leaf blight (*Phoma* sp.) resistant genotypes for the hills.
- Participatory research including participatory plant breeding.
- Marketing strategies.

The background of the image is a photograph of a vast blue ocean meeting a bright blue sky with wispy white clouds. The horizon line is visible in the middle of the frame. The word "Thanks" is centered in the image.

Thanks