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Exploration and Genepool Sampling of Landrace Diversity in *Oryza* from Chhotanagpur Region

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Rich genetic diversity in Oryza *landraces occur in Indian gene centre. Chhotanagpur plateau and adjoining Orissa State possesses amazing variability in its landrace forms. Several wild species also continue to perpetuate in this region. Exploration and germplasm collection work was undertaken in Chhotanagpur region of Bihar comprising districts of Ranchi, Gumla, Lohardaga, parts of Palamau and Girdih and adjoining Keonjhar and Sundargarh districts of Orissa. Ecologically diverse regions and farming systems, representing varying soil and edaphic factors were explored for the collection of primitive diversity. The population samples from each site/micro-niche were obtained randomly, sampling 80-100 panicles/accession. Detailed observations were recorded on 10 randomly drawn panicles/accession. Detailed data were collected on different accessions for panicle and grain characters. The range, mean and standard error of means were calculated. The genepool sampling and its analysis showed occurrence of considerable genetic variability. The differences were prominent for varying degree of adaptation to different soil conditions. More than 150 distinct landraces of* Oryza sativa *var.* indica *were captured. Amazing genetic variability is exhibited in their forms, differing widely in plant height, foliage colour, internode length, stem thickness, stiffness of straw, maturity, grain size colour, aroma and glume colour etc. Several genetically unique forms and wild* Oryza *species were collected during the exploration trip. The analysis of diversity showed the efficiency of random genepool sampling.*

Rich genetic diversity in *Oryza* occurs in the tribal dominated tracts of Chhotanagpur plateau (Bihar) and adjoining Orissa State. The variability in landrace forms is prevalent in diverse agro-ecological conditions; from very high rainfall to very low rainfall areas, under transplanted and direct seeded conditions. Undulating topography of the terrain has diversified the nature of native variability tremendously. The paper highlights the richness of genetic diversity in landrace populations from this region.

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MATERIALS AND METHODS

Exploration and collection of rice germplasm was undertaken in the Chhotanagpur region of Bihar (Fig. 1) comprising Hazaribagh, Ranchi, Gumla, Lohardaga, parts of Palamau, Girdih districts and adjoining Keonjhar and Sundargarh districts of Orissa with varying soil, edaphic factors and farming practices. Population samples from each ecological region (site/micro-niche) were collected by random sampling of upto 80-100 panicles per accession. Passport data were recorded at the site. Comprehensive data on 10 randomly drawn panicles per accession were recorded for panicle length, panicle type, branching pattern, grains/panicle, 1000-grain weight (g), seed size, seed colour, epicule colour, kernel size and colour. For 80 landraces from Chotanagpur region, the range, mean and S.E. of means were calculated using appropriate statistical methods.

RESULTS AND DISCUSSION

The study of the *Oryza* landrace populations showed that Chhotanagpur plateau holds rich genetic variability in primitive cultivars of the *indica* types. The landra-

Fig. 1 Map showing the area/region explored, route followed and collection sites

ces vary in adaptation to rainfed upland/medium elevation areas and lowland catchment or water run-off areas. The emergence and the perpetuation of such unique genetic variability is the result of prolonged selection pressure reinforced by adaptation and socio-economic needs.

Variations in soils, other edaphic factors and rainfall patterns in this plateau region pose serious problem to rice crop in its sowing/planting as well as in adopting improved technology. This holds good for those landraces which are directly seeded. The seeding of rice depends on the adequacy of proper moisture and its retention by soil in a gradiant topography. Only those primitive cultivars continue to survive in this region which have polymorphic alleles for survival and adaptation. Further, since the soils are fairly acidic (pH 5.0-6.5), these landraces have also developed high tolerance to acidity.

The local types may be transplanted or directly sown and harvested accordingly. Depending on the local physiography, they are adapted to upland soils, medium soils and to lowland/catchment areas where water accumulates and drains out gradually. In the first case, water (soil moisture) is a limiting factor and thus only short duration landraces adapt well, while in case of second types, both direct seeding and transplanting is practised. In third case, soils are rich in humus and minerals and also possess high concentration of iron, aluminium and mica. The water is abundant that permits tall, long duration varieties to be grown and generally transplanting is practiced for such cultivars.

The diversity collected comprised more than 150 distinct landraces, mainly of tall types, maturing in 70-140 days. Variability encountered was considerable exhibiting mosaic pattern (Fig. 2 A, B) in attributes, such as plant height, foliage colour, internode length, stem thickness, stiffness of straw, leaf angle, leaf width and maturation period. Variability was pronounced for panicle size ranging from lax to moderately compact types showing distinct differences (Fig. 3) among accessions in shape, size, colour and branchlets; awn/awnless character; glume colour (black, brown, reddish, straw colour, golden); grain shape, size and colour, tiller number, stem thickness and leafiness. Medium coarse-grained/fine-grained types, short, bold/long slender and very bold grain types were found to occur.

Local types represented both directly seeded cultivars and transplanted one. Types adapted to lowland/catchment areas exhibited tall plant habit being vigorous, medium/long grained with variation in glume colour. The most predominent landraces were *Goradhan, Lalka, Chandragarhi, Askalma, Jhonga, Dhusaree, Nardha, Katkai, Sathi, Kalamdani, Ranikajar, Tilasar, Jhingasar, Shyamjeera, Rassi, Mehera, Patharia, Karhani, Dudhiraj, Bhedakaber, Kharkakhochi, Tulasi-manjari, Bhajani, Dahia, Aginsal, Garibasal, Karmusal* and *Jhonsar*. Several accessions of wild/semi-wild types were collected from different sites; one wild form called by tribals as *Jhadkadhan* (C-2021) collected from deep water ponds along Tamar-Parasi road (Ranchi district), appeared to be a perennial with tall plant type and long internodes, bearing straw coloured and awned grains borne on a small panicle

Fig. 2. A. Landrace diversity in Rice in Chhotanagpur Region

Fig. 2. B. Germplasm sampling in scented landrace of Rice.

with a brittle rachis. *O. nivara* (C-2022 and C-2934) also collected along the Tamar-Parasi road from roadside ditches possessed dwarf, bushy plant habit with small panicle, pinkish, convergent awns, highly brittle rachis, black grains and highly shattering habit. A semi-wild rice, '*Pasaradhan*' (C-2023), possessed tall, erect plant habit, black awns and highly shattering grain behaviour. This form

mimics the cultivated landraces till it matures, but due to its brittle rachis, grains shatter and provide a natural mechanism for its survival and perpetuation.

Analysis of variation pattern

The distribution and variation pattern of landrace diversity showed occurrence of several distinct types in varying proportions. Genetic polymorphism prevailed for grain types. Out of the 109 landraces studied, medium types occured in much greater proportion (78), while other categories were represented by short, medium (6), long slender (6), long medium (8), extra long slender (3). Polycaryopsis was found in a collection with 2-3 fruits per spikelet, while extra long glumes with bold flattish grains was prominent in a landrace *Sugathur*. The variation for kernel colour varied from dull white (46), white (28), red (14), brown (7) and light brown (14). Kernel size varied from short bold (4.0-5.0 mm) occurring in very low frequency (8), medium long types (5.1-6.5 mm) were predominent (78), while long slender types (6.6-8.0 mm) were found in 20 landraces. Three landraces possessed kernels longer than 8.0 mm.

The epiculus colour showed occurrence of white colour only in one landrace, straw colour in 63, brown in 13, purple type in 27 and black only in 4 accessions. Light red epiculus was found only in one case. The glume exhibited significant colour variability ranging from light purple (1), deep purple (4), straw (34), light brown (1), brown (23), deep brown (6), golden brown (2), brown furrowed (20) and black (4). Besides, 12 accessions showed mottling, furrowing, etc, ranging from golden with brown furrows, brown with white lining and purple spots on straw colour in only few types. Gold furrows were found in two accessions, while base and apices only being straw coloured and entire surface being brown were observed in six landraces and golden apices in only single landrace in this region.

Among the landraces collected, predominant awned types were *Johondrashar, Kalamkatki, Jonga, Dudhkalma, Mehera, Katkai, Katika, Nawair* and *Gopal Bhog*.

Important variation among landraces collected

Interesting variability in rice landraces represented *Sathi* (early and drought tolerant), *Kanak Champa* (very attractive plant and seed type). *Sugathur*, a landrace with very tall plant type, bold, flattish grains and long extended glume (Fig. 4) was found to be well adapted to lowland areas of Urguttu/Thakurgaon region of Ranchi district. *Ambaghabada* (Fig. 5) collected from Maganpur Ramgarh (Hazaribagh district) possessed polycaryopsis (3 fruits per spikelet) and adapted to lowland terrain, matures late but produces high grain yield. A completely deep purple pigmented landrace, *Aginsar* (also called as *Singalbaba*), was collected from Chaibasa region (Fig. 6). This landrace is also late maturing and lowland type. Among scented types, *Laxmi Bhog*, *Rukmani Bhog*, *Shyamjeera* and *Ramdi* were prominent. *Kalamdani* and *Kalamkathi*, both are tall cultivars, possess long slender grains and have fairly high grain yield potential.

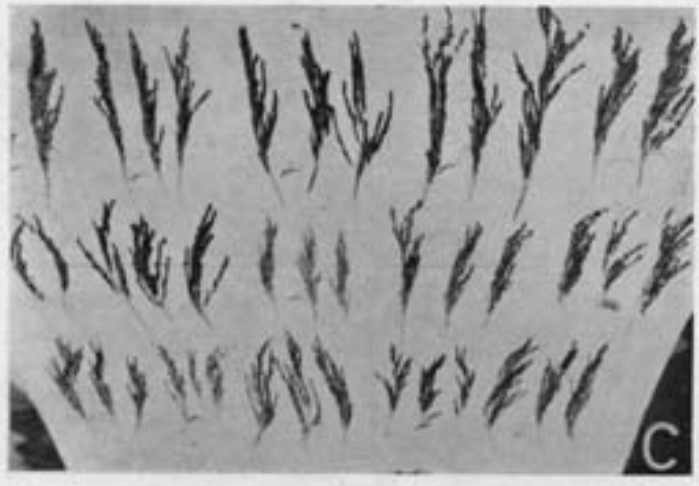

Fig. 3 Variability in panicle, shape, size, colour and grains in *Oryza* landraces.

Fig. 4 *Sugathpur*—A landrace with extra long gloom.

Collection of wild Oryza species

Indian Gene Centre is appreciably rich in the genetic wealth of wild rice, particularly *indica* types (Arora and Nayar, 1984). Wild *Oryza* species, such as *O. nivara* and *O. rufipogon* occur in ponds and ditches in Chhotanagpur region and adjoining tracts of Orissa State. Several accessions of wild rice were collected and it was observed that habitats where wild populations occur and survive are often distributed/encroached by man and his companion domesticates, consequently resulting in the genetic erosion of wild populations much faster than the landrace diversity in the cultivated forms. Thus, the collection, conservation of genepool of wild rice assumes special significance and demands much greater urgency and adequate attention.

Fig. 5 *Ambaghabada*—Unique landrace with polycaryopsis (3 fruits/spikelet).

Fig. 6 *Landrace*—Adapted to heavy metal soils.

CONCLUSIONS

Analysis of diversity clearly indicates that the enormous genetic diversity of gene complexes determining adaptation and productivity, assembled and incorporated over centuries of cultivation in different environments could perhaps be recognised as the most outstanding and unrivalled characteristics of primitive varietal populations (Frankel and Bennett, 1970). Although genetic diversity among landraces is well established from field study, yet there is very little knowledge of genetic structure and population dynamics in landrace populations other than observation on introgression from wild relatives. This paper represents studies on the variation pattern in landraces in their natural and social setting which would be of relevance for crop evolution, ethnobotany and for plant exploration as well as utilization of plant genetic resources for crop improvement (Frankel and Soule, 1981). The new possibilities have become apparent with emergent recombinant DNA technology. The tremendous genetic variability in *Oryza* continues in this tribal dominated tracts. The tribals of Chhotanagpur plateau, while practicing primitive agriculture system, selected only those landraces/types that fitted well in their dry land/rainfed farming system. Thus, it is evident that this natural diversity can be of immense advantage to mankind.

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