

## Short Communication

# Collection and Conservation of Cold Adapted Indigenous Rice Landraces from Western Ghats, South India

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Efforts were made to collect and conserve cold adapted rice germplasm from parts of Western Ghats in South India which resulted in the augmentation of 56 accessions of rice germplasm. Majority of the landraces (38 accessions) were red kernelled and the germplasm varied significantly for grain and kernel traits *viz.*, grain length (5.58-9.47 mm), grain breadth (2.2-3.79 mm), 100-seed weight (0.9-3.5 g), kernel length (3.72-6.63 mm), kernel breadth (2.4-3.0 mm) and kernel length/breadth ratio (1.67-2.67). Conservation strategies for these cold adapted landraces are also discussed.

**Key Words: Cold tolerance, Collection, Red rices, Rice germplasm, Western Ghats**

Rice is a warm season crop grown broadly in the humid tropical and subtropical regions of the world including the Indian sub-continent. It is the ancient and most important staple food crop of India, grown in diverse eco-systems on a variety of soils under differing climatic and hydrological settings across various agro-climatic zones of the country including cold regions. Domestication of rice is believed to have begun about 9,000 years ago within a broad geographic region spanning eastern India, Indo-China and parts of southern China. The present cultivated form of rice (*Oryza sativa* var. *indica*) which is consumed primarily in India, Bangladesh and other lowland regions of South and Southeast Asia appears to have been domesticated from its wild species *Oryza rufipogon* Griffin. of Indo-Chinese origin. There are evidences to support the hypothesis of multiple geographic and independent domestication of rice across the globe. The Western Ghats of India are known for the cultivation of cold adapted Indica rice landraces since time immemorial. With the advent of high yielding rice varieties, the cultivation of cold adapted landraces is only in very few pockets of Western Ghats mainly patronized by the tribal communities inhabiting the region. Low temperature stress is a major constraint to rice production in the hill tracts of India, including the southern plains and North Eastern region.

In order to combat this stress, the genes from the rice landraces which are under cultivation and well adapted in the colder regions for a long time can be exploited in the breeding programmes to increase productivity. An attempt has been made to collect and conserve the indigenous rice germplasm adapted to cold environment of the Western Ghats in collaboration with Directorate of Rice Research (DRR) and Tamil Nadu Agricultural University (TNAU) under the National Initiative on Climate Resilient Agriculture (NICRA) project of Indian Council of Agricultural Research (ICAR) which aims to enhance gearing up of Indian agriculture to climate change.

Rice is under cultivation since time immemorial in the Western Ghats. Several landraces which are adapted to cold conditions are still under continuous cultivation in this area in spite of the introduction of improved cultivars. In order to collect the endemic genetic diversity in rice adapted to low temperatures, an exploration was undertaken during October, 2011 in parts of Western Ghats covering Nilgiri and Dindigul districts of Tamil Nadu and Wayanad district of Kerala. The planning and logistics and the sampling procedures for the collecting of rice germplasm were followed as per the guidelines suggested by Engels *et al.* (1995) and Brown and Marshall (1995). Farmer's field was taken

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as a unit area and random samples of the populations and biased samples of elite material were collected. Germplasm samples were also collected from threshing yards and farm stores. Geographical coordinates of the collection sites were recorded using hand-held global positioning system (Garmin 12). Passport information on the collected germplasm was recorded and documented. The IRRI descriptors for rice, *Oryza sativa* L. was used for studying the variability in the collected germplasm. SAS enterprise guide version 4.3 was used for statistical analysis.

The survey resulted in the collection of 56 accessions of cold adapted rice landraces from 23 villages of Western Ghats region in South India. The altitude of the collection sites ranged from 974 to 6,225 feet above the mean sea level. Out of 56 germplasm accessions collected, 38 were red kernelled and the remaining 18 accessions possessed white kernels. The white kernelled cultivars include IR-20 and Ponni, two popular released varieties adapted to low temperatures prevailing in the Western Ghats region. Some of the indigenous scented landraces of rice viz., *Jeerakasala*, *Gandhakasala* and *Mallikuruvai* which possess white kernels were also collected. The crop duration of collected rice germplasm falls under early, medium and late groups varying from 120 to >200 days maturity. Majority of them are grown as a rainfed crop and few under semi-irrigated conditions too. The habitat of rice germplasm varied from flooded to aerobic situations depending upon the terrain of collection sites. Sizeable variation was observed in panicle structure, grain morphological traits viz., glume and awn colour (black/brown/gold/straw), shape of grain (slender/medium/bold), grain colour (white/light brown/speckled brown/brown/red) (Fig. 1), 100-seed weight and length and breadth of grain and kernel (Table 1). The variability depicting the grain and kernel shape of collected germplasm is provided in Fig. 1. Similar kind of variability was reported by earlier researchers in landraces of rice augmented through gene pool sampling from various parts of India (Hore, 2005; Kumar et al., 2010; Latha et al., 2013; Dikshit et al., 2013; Rana et al., 2009; Sivaraj et al., 2000).

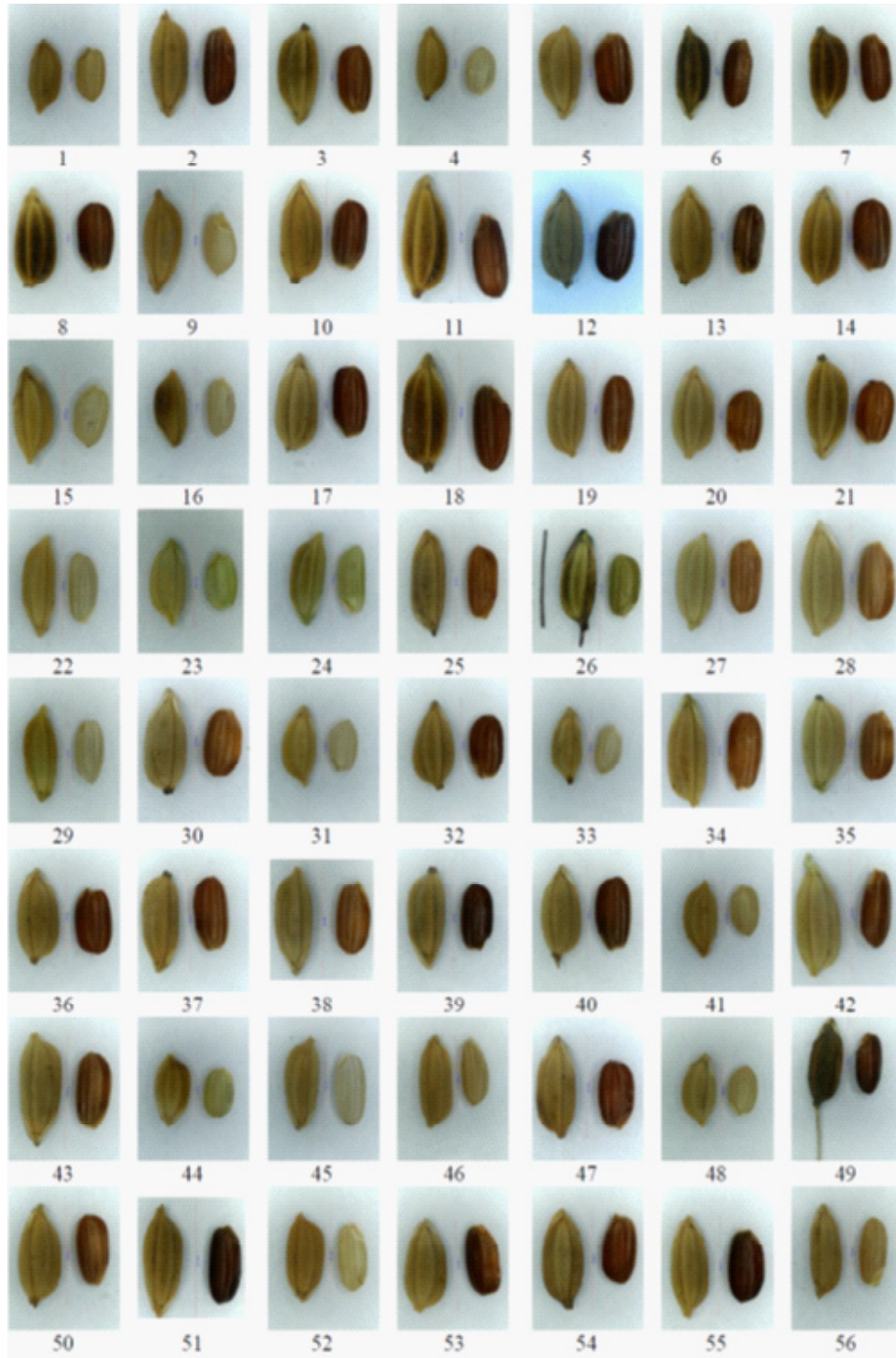
Traditionally, red rices have held a special place in India. *Adhira*, *Adukkam*, *Aiyrankanni*, *Cherutti*, *Chettuvai*, *Chinthamani*, *Edavaka*, *Kadaikannan*, *Kalyani*, *Karunellu*, *Karuvali*, *Kattathondi*, *Kudavali*, *Kudavilaiyan*, *Kuruvatti*, *Malainellu*, *Mannuvilaiyan*,

*Mullampunjan*, *Navara*, *Palthondi*, *Pavalam*, *Thondi* and *Valisuri* are some of red rice landraces which are adapted to cold conditions. Seeds of these landraces possess a red bran layer and a tinge of red remains even after milling. Ancient literature viz., *Taittiriya Samhita* of *Yajurveda* and *Satapatha Brahmana* referred about the offering of coloured rice to propitiate different deities/divinities and in the Ayurvedic works by Susruta, Charaka and Vagbhata also there was a mention of medicinal uses of red rices (Ahuja et al., 2007). Red kernelled landraces form an important group of all the rice landraces grown in Asian countries including India and are considered highly nutritive and having medicinal value as well. Some of the red rice landraces collected in Western Ghats viz., *Mullampunjan* and *Njavara* are reported by the locals as useful for medicinal purposes particularly to relieve rheumatic pains.

Interestingly, *Mullampunjan*, a rice landrace with extra-long awns is reportedly cultivated to prevent entry of elephants into the fields. High market demand for white rices and introduction of improved/ high-yielding rice cultivars resulted in drastic reduction of area under red rice cultivation in India. However, recognizing their importance, improved cultivars of red rice with special traits were released by various institutions in India for various abiotic stresses viz., cold conditions (*Jatu*, *Matali*, *Majehra*, *Jhaildu*, *Lal nakanda* 41), deep water/flood/submergence situations and drought conditions. *Ex situ* and *in situ* conservation strategies are ideally suited for these cold adapted landraces. There is a need for encouragement for the farmers from Western Ghats region to sustain the cultivation of red rice landraces in view of good potential. Two cold adapted rice landraces viz., *Jeerakasala* and *Gandhakasala* were granted protection under Geographical Indications (Registration and Protection) Act, 1999 from Wayanad region of Western Ghats. The utilization of long adapted cold

**Table 1. Variability for grain and kernel characters in cold adapted rice landraces from Western Ghats**

Trait	Minimum	Maximum	Mean $\pm$ standard error	Standard deviation	Coefficient of variation (%)
Grain length (mm)	5.58	9.47	7.87 $\pm$ 0.11	0.88	11.18
Grain breadth (mm)	2.20	3.79	2.97 $\pm$ 0.04	0.37	12.46
100-seed weight (g)	0.90	3.50	2.44 $\pm$ 0.08	0.64	26.23
Kernel length (mm)	3.72	6.63	5.46 $\pm$ 0.08	0.66	12.09
Kernel breadth (mm)	2.40	3.00	2.62 $\pm$ 0.03	0.25	9.54
Kernel length/breadth ratio	1.67	2.67	2.09 $\pm$ 0.03	0.24	11.48



**Fig. 1.** 1) Ghandakasala; 2) Bharathy; 3) Kadaikannan; 4) Ghandkasala; 5) Adukkkan; 6) Mullampunjan; 7) Chinthamani; 8) Karuvali; 9) Ghandkasala; 10) Mannuvilaiyan; 11) Maranellu; 12) Kudaivilaiyan; 13) Mannuvilaiyan; 14) Kalyani; 15) Ponni; 16) Ghandakasala; 17) Maranellu; 18) Chinthamani; 19) Adhira; 20) Palthondi; 21) Kattathondi; 22) Jeerakasala; 23) Mallikuruvai; 24) Jeerakasala; 25) Thondi; 26) Thondi (variant); 27) Valisuri; 28) Cherutti; 29) Jeerakasala; 30) Adukkkan; 31) Wayanad Jeerakasala; 32) Edavaka; 33) Wayanad Ghandakasala; 34) Cherutti; 35) Cherutti (variant); 36) Chettuvali; 37) Kudaivali; 38) Aiyrankanni; 39) Maranellu; 40) Pavalam; 41) Gandhakasala; 42) Valisuri; 43) Adukkkan; 44) Channa; 45) Masuri; 46) Nellu; 47) Kuruvatti; 48) Ghandakasala; 49) Njavara; 50) Maranellu; 51) Vellainellu; 52) IR-20; 53) Malainellu; 54) Karunellu; 55) Malainellu; 56) Nellu

tolerant rice landraces from Western Ghats in breeding programmes to derive varieties and hybrids which are resistant/ tolerant to cold conditions will substantially increase the production and productivity in the regime of climate change.

A set of the cold adapted rice germplasm is being conserved in the National Gene Bank at National Bureau of Plant Genetic Resources (NBPGR), New Delhi and also at Ramiah Gene Bank, Tamil Nadu Agricultural University, Coimbatore. This material was also shared with the breeders of Directorate of Rice Research, Hyderabad and Tamil Nadu Agricultural University, Coimbatore for characterization, evaluation and utilization in breeding programmes.

Cold weather damage is a serious problem affecting rice production in Western Ghat area and with the dwindling patronage for cultivation of native landraces, the collection efforts are timely to conserve the cold adapted rice genetic resources.

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