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Collection, characterization, conservation and utilization of traditional rice varieties of Karnataka

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Abstract

Traditional rice varieties (TRVs) collected from different locations of Karnataka were evaluated for grain yield, its attributes, reaction to blast, grain quality and cooking parameters (protein, amylose, iron and zinc content using NIR) by adopting standard procedures. Analysis of grain nutrient contents such as protein, amylose, iron and zinc revealed wide variation for the grain protein content (5.57-14.96%), amylose (17.25-44.42 %), iron (9.17-15.72 mg/kg) and zinc (10.24-33.40 mg/kg). Physical, physico-chemical and cooking quality parameters estimated for the selected 49 TRVs also indicated significant difference for water uptake ratio suggesting variation for kernel texture, surface area and amylose content. Screening of the TRVs for field resistance against leaf blast disease revealed that 11 out of 324 TRVs were found resistant at both Mandya and Ponnampet. Molecular validation for leaf blast disease resistance for selected TRVs revealed that, *Pi* 9 resistance type allele present in 48 TRVs; *Pi*sh in 42; *Pi*38 in 46; *Pi*b in 28; *Pi* 20(t) in 26 and *Pi*K in 21 TRVs.

Key words: *Oryza sativa*, traditional rice varieties, blast, rice quality parameters

Introduction

Traditional Rice varieties (TRVs) are valuable genetic reservoirs as they harbour time tested traits that enable stable performance across a range of environments. Considering the importance of TRVs thousands of traditional rice germplasm accessions have been collected from across the world, documented and conserved. The detection and assessment of genetic variability and identification of accessions with desirable combination of traits is a first step towards their use in crop improvement.

Owing to advantages of HYVs and hybrids and their easiness for cultivation through modern technologies *viz.,* use of chemical fertilizers, transplanter *etc.,* the area under these HYVs and hybrids has drastically increased while the area under TRVs decreased in many rice growing area. In several instances many TRVs and land races facing the problem of endangerodness. Hence, collection of TRVs and their characterization and evaluation for biotic and abiotic stresses is treated as most important and priority area for many rice worker [1].

In this contest the rice scientists of Zonal Agricultural Research Station, V.C. Farm, Mandya and College of Agriculture, GKVK of UAS, Bengaluru have made an effort to collect and compile the information on availability and sources of TRVs in different parts of Karnataka. Further, we also attempted to study the genetic variability of these TRVs and conserve all the important traditional rice varieties of Karnataka from last several years.

The information collected on sources and maintainers of TRVs in different parts of Karnataka and results of the investigation on genetic variability, grain quality traits and reaction to blast undertaken on selected TRVs by the rice scientists of ZARS, Mandya, ARS Ponnampet and Collage of Agriculture, GKVK, Bengluru are presented in this paper.

Materials and methods

During 2011, AICRP (Rice), ZARS, Mandya has made an elaborate survey across Karnataka and gathered

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information on sources of availability of TRVs and their maintainers (Table 1). About 324 TRVs were collected from different sources during the survey. These TRVs have been evaluated for their adaptability and agronomic characteristics for three consecutive seasons *viz., kharif*-2011, summer-2012 and *kharif*-2013 at ZARS, Mandya and studied the components of genetic variability *viz.,* GCV, PCV, heritability, genetic advance as per cent mean for grain yield and its components traits following standard methods outlined by [2] for coefficient of variability, [3] for genetic advance and [4] and [5] for heritability.

Using standard criterion for a representative core collection as explained by [6] best core collection possessing more or less the same diversity as that of the base collection and lack of repetition was made and used this core collection for analysis of quality traits. TRVs were also evaluated for their reaction to blast at Agricultural Research Station (ARS), Ponnampet under natural blast endemic area during *kharif 2012* and at Zonal Agricultural Research Station (ZARS), V.C. Farm, Mandya with artificial blast disease inoculums using spreader row technique in two season's *viz.,* early and late *kharif* 2012. Leaf blast disease incidence in field was recorded visually, based on the number of eye shaped specks on the leaf. Intensity of infestation was scored on 0-9 as scale described in Standard Evaluation System for Rice (SES) of IRRI (2001) and classified as below.

Where,

0 = Highly resistant; 1 = Resistant; 2-3 = Moderately resistant; 4-6 = Moderately susceptible; 7 = Susceptible and 8-9 = Highly susceptible

Near infrared reflectance spectroscopy (NIR system, FOSS, Denmark) system was used for the estimation of crude protein, amylose, iron and zinc content. NIR is a fast and non-destructive technique that provides multi-constituent estimates. It works on the principle of detection and measurement of chemical composition of biological materials was based on vibrational responses of chemical bonds to NIR radiations.

Results and discussion

The survey conducted to identify the sources of TRVs and their maintainers in Karnataka revealed that around 2428 TRVs are maintained in Karnataka by four farm universities and 26 farmers / farmers group. The details are given Table 1. The farmers who are maintaining these TRVs are known to be the members of organic farmers association of Karnataka called *Sahaja Samrudha.* Among the TRVs maintainers Mr. Syed Ghani Khan a farmer from Kiragavalu village in Malavalli taluk of Mandya district has got the highest no. of 800 collections (Table 1).

During 2011 and 2012, the TRVs were evaluated and studied their genetic variability for grain yield, yield attributes, grain quality traits and resistance to blast. Study revealed significant differences among the TRVs for 14 yield and yield attributing characters *viz.,* days to 50% flowering, plant height, productive tillers per plant, panicle length, spikelet per panicle, chaffy grains per panicle, spikelet fertility percent, grain length, grain breadth, LB ratio, 1000 grain weight, straw yield per plant, harvest index and grain yield per plant were studied both during 2011 (*kharif*) and 2012 (summer). Based on the degree of photoperiod sensitivity TRVs were grouped into photoperiod sensitive (20%) and photo period insensitive types. The results of the study revealed that days to 50% flowing and grain type (coarse/fine) during *kharif* and chaffy grain per panicles and spikelet fertility in summer contributed greatly to divergence. The TRVs exhibited significant variability for panicle and grain quality traits *viz.,* panicle length, colour of the husk, colour of the kernel, grain length, grain breadth and LB ratio (Figs. 1 and 2).

By following different strategies five core sets were formulated and these core sets were validated based on qualitative and quantitative traits for true representation with that of base collection. Analyses of grain nutrient contents such as protein, amylose, iron and zinc revealed wide variation for the grain protein content. Physical, physico-chemical and cooking quality parameters estimated for the selected 49 TRVs indicated significant difference for water uptake ratio suggesting variation for kernel texture, surface area and amylose content among the TRVs. Screening of the TRVs for field resistance against leaf blast disease revealed that 11 out of 324 TRVs were resistant at both Mandya and Ponnampet. However, 44 TRVs were found resistant at ARS, Ponnampet, 20 and 16 were resistant during early and late *kharif* at ZARS, Mandya.

Molecular validation for leaf blast disease resistance for selected TRVs revealed that, *Pi* 9 resistant type allele present in 48 TRVs; 42 TRVs possess *Pi*sh resistant type allele; *Pi*38 resistant type allele present in46 TRVs; *Pi*b resistant type allele present in 28 TRVs; *Pi* 20(t) resistant type allele present in 26 TRVs and 21 TRVs possess *Pi*k resistant type allele. During 2013

Table 1. Maintainers of traditional rice varieties (TRVs) in Karnataka

S.No.	Name of the Institute/address of Farmers/Farmers Association	No. of TRVs	Remarks
	Farm Universities		
1.	University of Agricultural Sciences, G.K.V.K., Bengaluru	324	Maintained at ZARS, Mandya & CoA, GKVK
2.	University of Agricultural Sciences, Krishinagar, Dharwad.	323	Maintained at ARS, Mugad and ARS, Sirsi
3.	University of Agriculture and Horticultural Sciences, Shivamogga	190	Maintained at Navile and Ponnampet
4.	University of Agricultural Sciences, Raichur	025	Maintained at ARS, Gangavathi
	Farmers/Farmers Association/NGOs		
1.	Syed Ghani Khan, Mandya Dist.	800	Members of *Sahaja Samrudha* – Organic Farmers Association of Karnataka lead by G. Krishana Prasad
2.	Boregowda, Mandya Dist.	70	
3.	Srinivasamurthy, Mysore Dist.	60	
4.	Shrenik Raj, Haveri Dist.	05	
5.	Chidambaraiah, Tumkur Dist.	60	
6.	Ramamurthy ,Yadagiri Dist,	11	
7.	Murali, Mysore Dist.	04	
8.	Rechanna, Chamarajanagara Dist.	200	
9.	Nandish, B.N., Shivamogga Dist.	10	
10.	Anjaneya, Davanagere Dist.	150	
11.	Shankar Langati, Belgaum Dist.	60	
12.	Shankar Guru, Mysore Dist.	11	
13.	Sri V.eerabad., S.Krushi Sangha. Hassan	09	
14.	Gomathe Savayava Krushi Sangha, Hassan	08	
15.	Suvarna SK Sangha, Chikmagalore Dist.	05	
16.	Krishna, C.P., Mandya Dist.	10	
17.	Devendrappa, Yadagiri Dist.	10	
18.	Appaji, Hassan Dist.,	03	
19.	Jyothi Prakash, Shivamogga Dist.	03	
20.	Shivakumar Shastri, Shivamogga Dist.	15	
21.	Padmanab, Hassan Dist.,	03	
22.	Malenadu Bathada Belegarara Sangha, UK	25	
23.	Sharavathi Savayava Krishikara Balaga,SMG	05	
24.	Rohini Savayava Krishikara Balaga, Shivamogga Dist.	05	
25.	Doddamma Devi S K Balaga, Mysore Dist.	04	
26.	Surendra, Ramanagara Dist.	20	
	Total	2428	

Fig. 1. Variation for rice husk and kernel colour among traditional rice varieties (TRVs) of Karnataka

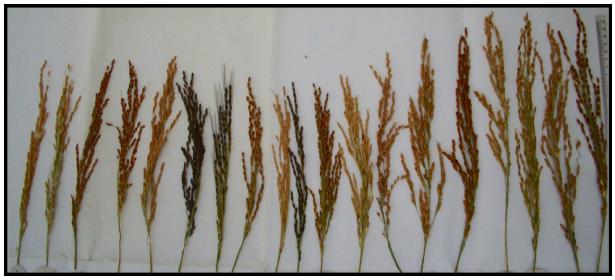

Fig. 2. Variation for panicle length and spikelet colour among traditional rice varieties (TRVs) of Karnataka

kharif 329 TRVs were evaluated to confirm the results obtained during previous two seasons. The TRVs showed variability for all the traits with a range of 61 to 122 days for 50 per cent flowering, 81cm-152 cm for plant height and 6 g to 22g for grain yield per plant. Seeds of selected TRVs like Rajamudi, Rajabhoga, Rathna choodi, Jeerige sanna, Gandhasali are being multiplied and distributed to the interested farmers. Attempts are also being made to characterize for DUS and register these TRVs with PPV & FRA for the benefit of farming community and rice researchers.

Future line of work

Many of the TRVs maintained in different farm universities and farmers are collections from different ecosystems of Karnataka. However, there seems to be collections from neighbouring states like Tamil Nadu, Kerala, Maharashtra and erstwhile Andhra Pradesh and tourism state like Odhisa and Punjab. Further, because many of the farmers are the members of one single association there may be exchange of varieties among them. Hence, in the presently reported TRVs of Karnataka, it seems there are many duplicates and TRVs and HYVs of other states are also included. Hence, all the TRVs maintained by the farm universities and farmers/farmers associations/NGOs need to be evaluated systematically and characterized in order to identify and separate the duplicates and HYVs from the TRVs.

The detailed publication on various investigations viz., genetic variability for grain yield and its components traits in TRVs, genetic variability for grain nutrient contents and cooking quality in core set of TRVs, response of TRVs to leaf blast disease under natural and artificial infection conditions and validation of known SSR markers associated with leaf blast disease resistance and high grain protein content in selected TRVs are made separately.

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