DRR

Directorate of Rice Research

NEWSLETTER

Volume : 12, Number : 2 RICE IS LIFE April - June, 2014

From Director's Desk...

The activities of DRR continued at a brisk pace during the quarter under report. The 49th Annual Rice Group Meetings were organized at DRR, Hyderabad from 6-8th April, 2014 which served as an excellent platform for all the rice workers in India and scientists from IRRI, Philippines to come together to review and finalize the research programmes to be conducted in the ensuing *Kharif* season. Timely dispatch of seed materials and other inputs for the AICRIP related activities were also accomplished in time. The Variety Identification Committee under the Chairmanship of Dr. Swapan K. Datta, DDG (CS) on April 6th, 2014 identified 15 cultures and 4 hybrids for different ecosystems. The third meeting of Research Advisory Committee (RAC) was held during 2-3rd May, 2014 at DRR under the Chairmanship of Prof. E.A. Siddiq, Former DDG (CS) (ICAR), presently Honorary Professor, ANGRAU and the committee suggested valuable recommendations. The Institute Research Council Meetings (IRC) were organized from 5-8th May, 2014 under the Chairmanship of Dr. B.C. Viraktamath, Project Director, DRR wherein thorough deliberations took place on the ongoing research activities of each of the scientists and new project proposals were discussed.

Since April, Indian Meteorological Department (IMD) was predicting shortfall in rain due to the effect of El Nino. The onset of monsoon, its proper distribution are crucial and influence all the agricultural operations across the length and breadth of our country. The adage that Indian agriculture is a gamble with the monsoon is apt this year with respect to its onset itself being inordinately delayed causing great deal of concern. On the directions from the ICAR head quarters, we are already preparing contingency plans and various advisories to help the farming community with technological support and suitable crop management options.

The newsletter is a medium to compile and disseminate information, short research notes covering recent developments in all areas of rice research. It also reports various activities that were organized at our centres including DRR, which keeps the scientific community apprised of all the happenings related to rice. I once more place my request to cooperators to participate in this endeavor by submitting brief scientific articles and write up on any events of significance.

N. Shobha Rani

(N. Shobha Rani)

IN THIS ISSUE

General Articles

Scenario of Rice Pests in Haryana

Bacterial blight, blast, sheath blight, foot rot & bakanae, false smut, planthoppers, leaffolders, root weevil, *Echinochloa* spp. and *Cyperus* spp. were the important pests of rice during last three decades in Haryana. However, shift in crop production practices have resulted in a significant variation in intensity of these pests, which is described below.

Bacterial blight (*Xanthomonas oryzae pv. oryzae*) appeared in moderate form during 1983 to 1987 on high yielding varieties. The disease assumed serious proportion during 1989, 1995, 1996 and 1998 mainly due to excessive use of N fertilizers and build up of inoculum on summer planted susceptible varieties. The disease intensity decreased significantly after 2000 except for its outbreak during *kharif* 2008 when the disease was observed in nursery also. **Blast** (*Pyricularia grisea*) appeared in moderate intensity during 1987 in scented tall varieties and attained epiphytotic form during 1989 and 1992 with neck blast incidence ranging from 30-80% in Taraori Basmati in north-eastern Haryana. The disease was found more damaging in district Jind and parts of Panipat and Sonepat in Taraori Basmati, CSR-30 and Pusa Basmati-1 due to late planting, water stress and limited adoption of recommended control measures. The disease incidence declined significantly after 1999. However, in isolated fields, neck blast incidence ranged from 10-55% in CSR-30, Taraori Basmati and Pusa Basmati-1 in district Jind during *Kharif* 2004 and 35-50% in Pusa Basmati-1, Pusa Basmati-1121 and Pusa RH-10 in Kaithal, Sonepat and Jind districts during *Kharif* 2008. **Foot rot & bakanae** (*Fusarium moniliforme*), recorded during 1998, has become a major disease of scented varieties particularly Pusa Basmati-1121, Pusa-1509, CSR 30 and Taraori Basmati. The disease incidence increased significantly during 1989 and 1991. Build up of inoculum in seed and soil, increase in area under highly susceptible scented varieties particularly Taraori Basmati and limited adoption of recommended control measures resulted in disease epiphytotics during 1992 in Kaithal, Kurukshetra, Karnal and Jind districts. The disease incidence declined considerably during 1995 to 2004. However, during 1999, 2006, 2008, 2011 and 2012, it was recorded to the extent of 25-55% in scented varieties (Pusa Basmati-1121, CSR-30 and Taraori Basmati) in Kaithal, Karnal, Kurukshetra, Jind, Panipat, Sonepat and Panchkula districts mainly due to use of farmers' own infected seed. **False smut** (*Ustilaginoidea virens*), considered to be a minor disease up to 1987, has attained the status of a major disease in high yielding dwarf varieties and hybrids. The disease caused considerable qualitative and quantitative losses particularly in HKR-126, PR 106, Arize 6444 and PHB 71 during 1990 to 1996 and 1998. The maximum disease incidence (35-90% infected panicles) and severity (10-12% infected grains) during these years was recorded in HKR 126 in Kurukshetra and Karnal districts. However, rice varieties HKR- 47 and HKR-127 were found to be the least infected. **Sheath blight** (*Rhizoctonia solani*) occurring sporadically upto 1999, has attained economic significance after 2000. The disease severity increased from low to moderate during 2006 to 2009 and its outbreak was recorded during 2010 due to continuous build up of inoculum and susceptibility of the cultivated varieties (Table 1).

Among insect-pests, **rice root weevil** (*Hydronomidius molitor*), considered as a major pest during 1980's, is presently recorded in low intensity in isolated pockets of Kaithal and Karnal districts. In contrast, the incidence of **rice hispa** (*Dicladispa armigera*) remained low during 1983 to 1994. However, it appeared in severe form during 1998 particularly in late planted crop. Rice leaffolder (*Cnaphalocrocis medinalis*) continued to be the major pest both in scented and non-scented cultivars. It appeared in moderate to severe form and the pest outbreaks were recorded during *Kharif* 1987, 1992, 2005 and 2012. Prior to 2006, yellow stem borer (*Scircophaga incertulas*), white stem borer (*S. innotata*) and pink stem borer (*Sesamia inferens*) were recorded to occur in the state. Of these, yellow and pink stem borer were the major pests of Basmati rice. The borers appeared in severe form during *Kharif* 1988 to 1999 but the pest incidence decreased significantly thereafter. Planthoppers (white- backed planthoppers-*Sogatella furcifera* and brown planthopper-*Nilaparvata lugens* appeared in low to moderate intensity during last three decades. However, their outbreaks were recorded during 1995, 2008 and 2010.

Table 1. Scenario of rice diseases and insect-pests in Haryana during 1983 to 2013

Disease/Insect-pest	1983-87	1988-94	1995-99	2000-04	2005-08	2009-13	Year of outbreak
Bacterial blight	***	***	****	***	***	**	1983, 1984, 1989, 1995, 1996, 1998, 2008
Blast	***	****	***	**	**	**	1986, 1989, 1992
False smut	**	****	***	**	***	***	1990
Foot rot & Bakanae	-	****	**	**	***	***	1992
Sheath blight	*	**	**	***	***	****	2010
Planthoppers	***	***	****	**	***	****	1995, 2008, 2010
Leaffolder	****	****	***	***	***	****	1987, 1992, 2005, 2012
Stem borer	*	****	****	***	**	**	1998
Rice hispa	*	**	***	*	*	*	1998
Root weevil	***	*	*	-	*	*	-

*-: Not recorded; *: Very low; **: Low; ***: Moderate; **** Severe*

Ram Singh, Lakhi Ram and Mangat Ram, *CCSHAU Rice Research Station, Kaul - 136021, Haryana*

Weedy Rice - A New Emerging Menace for Rice Growers

Rice crop is seriously affected by the infestation of several weeds. Weeds jeopardize rice production to a level unacceptable economically. The advent and persistence of recalcitrant hard-to-control weed like wild rice/ weedy rice/ red rice is one of the major challenges before rice farmers. The most troublesome weeds in rice are species of the genus *Echinochloa* but weedy rice is emerging as threat with reduced yields up to 40 -74% and lowering quality traits. Weedy rice problem was earlier confined to direct seeded crop but it is fast emerging as problematic weed even under transplanted conditions.

In a collaborative survey conducted by Jammu centre of All India Co-ordinated Rice Improvement Programme and Directorate of Rice Research, Hyderabad, infestation upto 8% has been reported from different rice growing areas of district Jammu.

In Jammu, two kinds of weedy rice variants called as *'Chauba'* and *'Kharshoo* are seen locally. Chauba grows and matures together with main rice crop having same height, so weeding is very difficult with no morphological differentiation. At the time of maturity, its awns become light pink in colour and after maturity the seed changes to black colour which decreases market value especially of Basmati rice. Its high shattering rate reduces chance for weeding at maturity stage. 'Kharshoo' has just opposite characteristic. It grows and matures before the main rice crop with lesser height. The grains are small and of same color as rice and awns are spreading type. Shattering rate of *kharshoo* is also high but less than chauba. Due to less height and same colour of seed, it is very difficult to weed out.

Reasons for increasing WEEDY RICE problem:

- Contaminated seed - Mostly farmers use different source of seed which is the major source of contamination. Due to high labour cost, it is not possible for farmers to thoroughly clean the seed.
- Multiplication of weedy-rice seed-Very long dormancy period of 2-3 years, high shattering nature and no proper differentiation from main crop are the cause of multiplication of weedy rice at faster rate.
- Through flooding in rainy season-In the rainy season, flood water will contaminate fields with weedy rice from other farmers fields.

How different is WEEDY RICE: Fewer tillers, Easy shattering, Black or pigmented grains

Control of Weedy Rice

Great morphological variability within species and high biological affinity to cultivated varieties makes its control difficult than other weeds. Chemical weed control with herbicides selective to rice is usually not effective for weedy rice. The only exception is transgenic variety which could be able to tolerate herbicide which is selective to cultivated rice with a wide spectrum of activity. Chemical weed control with wick or wipe spraying system in combination with short variations could be effective. The effective weedy rice control could be its effective management through preventive, cultural, mechanical and genetical practices.

Prevention-Involves regular as well as intensive inspection of the rice fields and removal of the weedy rice plants manually, use of accurate cleaning of the equipment and certified rice seeds.

a) Cultural

Crop rotation: Growing weed suppressing crops like fodder maize or sorghum for one *kharif* season after few years of growing rice.

Stale Seedbed Technique: After preparation of the field, it is kept idle to allow weedy rice to germinate by frequent irrigations. Weedy rice seedlings are then destroyed by blade or rotary harrowing carried out on both dried and flooded soils or by applying non-selective herbicides like Glyphosate etc.

Water Management: Direct seeding rice field faces more problem than transplanted rice. After germination of direct seeded rice a thin water level should be maintained. Puddling combined with the presence of a thin layer of water over the well leveled soil maintains anaerobiotic conditions in the top layer and prevents germination of weedy rice.

b) Mechanical

Field preparation: Proper tillage operation or good field preparation can control weedy rice. Seed bed and main field preparation with disc plough followed by mould board plough would destroy the seed or reduce germination of weedy rice. Studies have indicated reduced seed bank if placed 10 cm deep below soil through ploughing.

Farmer showing *'Chauba'* variant awns

'Kharshoo' variant with spreading type

Removal of panicles: Cutting the weedy rice panicles before seed set as post planting control method is quite effective to control the weedy rice.

c) Chemical

Close similarity to the rice crop makes the control of weedy rice plants with selective post emergence herbicides very difficult.

Post-emergence or post transplanting: Weedy rice control under post transplanting stage with foliar systematic herbicides such as glyphosate or cycloxydim at 20 and 5% with wipe/ wick application technique.

d) Genetical

Introduction of herbicide tolerant varieties which allow the selective post emergence control of weedy rice plants.

Effective control of weedy rice cannot be based on one single practice but should be based on an appropriate combination of preventative, cultural, mechanical, and genetic means. In future, weedy rice infestations are likely to increase and will threaten sustainability of production systems, therefore control measures with location specific modifications needs to be practiced by the rice growers.

Anuradha Saha[1], Vijay Bharti [2] B. Sreedevi [3] and R. Mahender Kumar[3]

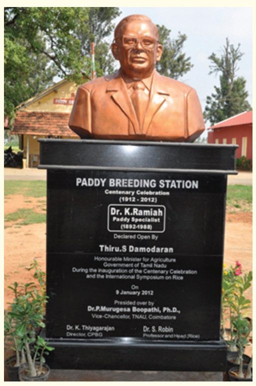
[1]AICRIP Rice, Division of Plant Breeding and Genetics and [2]Water Management Research Centre,Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu, Main campus, Chatha, [3]DRR, Hyderabad

Centre Profile

Paddy Breeding Station, Coimbatore, TNAU

Nation's First Completes 100 Years of Rice Research

The Department of Rice previously known as "Paddy Breeding Station" is a constituent of the Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. This station conducts multidisciplinary research for rice improvement. In 1912 during the British colonial period, one Government Economic Botanist (GEB) was posted at Coimbatore to initiate research on this most vital crop of the country. Thus, Paddy Breeding Station came into existence at this place as the oldest rice research station in the modern India. Geographically this research station is located at an elevation of 426.72 m, between 11° N latitude and 77° E longitude. The station has a cultivable land area of 12.96 ha uniformly laced with clayey soil with a pH of 7.8. The average rainfall is 670 mm per year. This centre is internationally renowned with its record in rice history, headed by British Scientists like F.R. Parnell, R.O. Iliffe and also by the famous first Indian Paddy Specialist, Padmashri Dr. K. Ramiah. During the initial period, strenuous efforts were taken to collect and conserve the biodiversity of the crop through establishment of gene bank.



Landmark varieties were developed through Pure Line Selection from this station which had triggered the growth of rice production in the state. In the post Mendelian era, hybridization was followed among the landraces and then with semi-dwarf donors from IRRI which paved the way for the phenomenal increase in rice production in the state which stood at 15.29 lakh tonnes with a productivity of 805 kg/ha during 1920, has increased steadily to the current level of 71 lakh tonnes with the productivity of 3.7 t/ha, despite the marked decrease in the total rice area.

The first variety of this station, GEB 24 (*Kichili samba*) released during 1921, played unique and significant role in the subsequent development of rice not only in this country but also in the global level. This variety became very popular with large coverage and attained worldwide distinction and since then has been used in several National and International rice breeding programmes. Several other varieties from this station transformed the rice cultivation in the state. Noteworthy among them are blast resistant CO 4 and CO 25, inter-specific cross derivative CO 31, semi-dwarf varieties CO 37 and CO 38, high yielding long duration variety CO 40, salt tolerant CO 43 and CO 47, etc. The medium duration varieties *viz.,* CO(R) 48 and CO(R) 49 are fine grain rice varieties that could cater to the current market demands. Recently, the Central Variety Release Committee (CVRC) has released two varieties *viz.,* CO(R) 50 and Rice CO 51. Among these, the CO(R) 50 has new plant type characters and high yield. The Rice CO 51with short duration and short slender grain quality caught the attention of the farmers and it has spread across length and breadth of Tamil Nadu covering an area of 5000 hectares within a year of its release.

Significance of hybrid rice technology to bolster the yield potential of rice was realized and the research on hybrid rice at Coimbatore was commissioned in the year 1989. Four hybrids *viz.,* CORH 1, CORH 2, CORH 3 and CORH 4 were developed, released and notified for commercial cultivation in the state. CORH 3, the early duration rice hybrid can yield 25% higher than the inbred variety in that duration group. This is also the first hybrid developed through indigenously synthesized male sterile line and yields non-sticky non-aromatic rice with acceptable cooking quality. The medium duration hybrid TNAU Rice Hybrid CO4 was released in the year 2011 utilizing the locally developed COMS 23A as the male sterile parent and CB174R as the male parent. The hybrid is found to be resistant to blast, brown spot and moderately resistant to WBPH, GLH, sheath blight, sheath rot and RTD. This hybrid is released by CVRC and recommended for cultivation in many states *viz.,* Tamil Nadu, Gujarat and Maharashtra, Uttarakhand, Uttar Pradesh, Chhattisgarh, West Bengal and Bihar.

The contribution of this department so far includes 23 varieties, 28 hybrid derivatives, one spontaneous mutant (GEB 24), one introduction (Bhavani) and four hybrids which brought remarkable improvement in rice production in the state.

The station celebrated its Centenary year by organizing "International Symposium on 100 years of rice research and looking beyond" in the year 2012. The station won "The Best Centre Award in Rice Breeding" for its overall accomplishments in rice varietal improvement efforts, during the year 2012 and "The Best AICRIP centre Award" for Crop Physiology during the year 2014.

The station possesses state-of-the-art facilities to enable the rice scientists for conducting high quality research in rice cultivar development. Modern biotechnological tools of DNA markers are also currently employed for rice breeding which is supported by sound precise phenotyping facilities. The current areas of rice research include development of pre breeding materials for enhanced photosynthetic activity through Indo-UK-IRRI collaborative, MAGIC project, induced mutagenesis in rice variety Nagina 22, Biofortification in rice, genetic analysis of aerobic adaptation, breeding of multiple abiotic stress tolerant climate resilient rice, bioprospecting genes for drought tolerance from Tripogon grass through an Indo-Australia project, deciphering genes for durable blast resistance, identification of effective novel resistance genes against brown plant hopper and enriching rice with more nutritional and therapeutic values.

Department of Rice
Tamil Nadu Agricultural University, Coimbatore – 641 003.
Phone No. : 91-422-2474967; Email: rice@tnau.ac.in

Research Highlights

New Genetic Stocks of Basmati having bacterial blight resistance

Basmati, the aromatic rice prized for its unique quality, is a gourmet delicacy and is a high foreign exchange earner for the country. But one of the major constraint in basmati growing areas is Bacterial blight caused by Xanthomonas oryzae to which most of the traditional and evolved basmati varieties are susceptible. Many backcross derived lines developed earlier by crossing two traditional Basmati varieties (Taroari Basmati and Basmati 386) and an evolved Basmati (Vasumati) with Improved Samba Mahsuri which is a MAS derived product resistant to bacterial leaf blight (BB), to transfer the three major BB resistant genes *viz., Xa21+ xa13 + xa5* into the genetic background of the aforementioned Basmati cultivars. Based on repeated phenotyping and genotyping, a total of 42 Basmati pyramided lines (BPLs) were selected. The presence of the three major BB resistant genes was done using candidate gene specific markers *viz.,* for *Xa21*(pTA248), *xa13* (xa13-prom) and for *xa5* (xa5-FM). During *Kharif* 2013, 42 BPLs were tested in station trial and were inoculated with BB inoculum to thoroughly assess the BB reaction in the field conditions. On genotyping, it was found that there are 25 valuable BPLs of which six lines are in the background of Taroari Basmati and 19 in the background of Basmati 386 having the BB resistant genes either singly or in combination and on phenotyping showed high degree of resistance to BB both in the field and glass house inoculated conditions. This simultaneous field and glass house phenotyping and accurate genotyping clearly confirmed the presence of the target resistance genes and unequivocally demonstrated their resistance against bacterial blight. The single-gene, two-gene and three-gene pyramid lines, being near-isogenic lines (NILs) of Taroari Basmati and Basmati 386, with few variations for agromorphological traits are similar to IRBB lines (NILs of IR 24 possessing different single and multiple genes conferring resistance against bacterial blight and developed by IRRI, Philippines). These BB resistant BPLs are the materials developed first of its kind in basmati background through this study which can be deployed as varieties and also as elite donor lines for resistance breeding programmes. The salient features of some of BB resistant lines are given below.

There are four outstanding BPLs *viz.,* **BPL 104** (RP 4691-326-1-1-1-1-1-1-1), **BPL 105** (RP 4691-326-1-1-2-1-1-1-1), **BPL 106** (RP 4691-326-1-1-2-2-1-1-1), and **BPL 123** (RP 4700-35-1-2-2-1-1-1-1), which are three-gene pyramids possessing *Xa21 + xa13 + xa5*. Among these, mention may be made of BPL 123 which has a constellation of long slender basmati grains and BPL 106 which has medium slender aromatic grains both with excellent cooking characteristics.

There are 4 BPLs which have a combination of 2 genes *xa13 + xa5* with long slender aromatic grains with good cooking quality and elongation on cooking. These lines include **BPL 120** (RP 4700-30-1-1-3-1-1-1-1), **BPL 121** (RP 4700-30-1-1-3-2-1), **BPL 122** (RP 4700-30-1-1-4-1-1) and **BPL 127** (RP 4693-35-2-1-1-1-1).

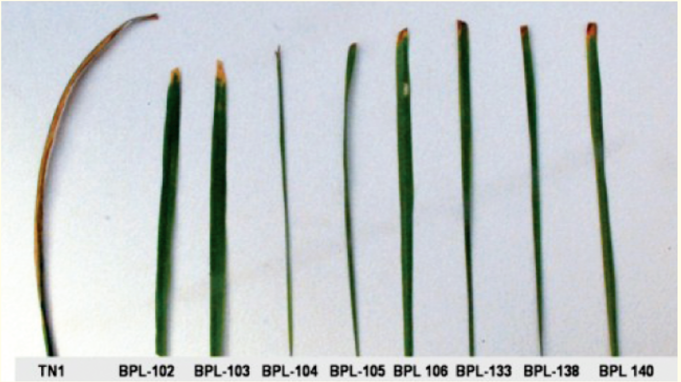
BPL 131 (RP 4693-40-2-2-2-1-1), is exclusive in possessing a dominant and a recessive gene combination (*Xa21 + xa5*) , with BB resistance and desirable Basmati grain quality traits.

Eight BPL lines could be identified with the gene introgression being a combination of *Xa21 + xa13*. They include **BPL 101, BPL 103, BPL 128, BPL 134, BPL 135, BPL 137, BPL 139 and BPL 140.** Although, all these lines were highly resistant to bacterial blight, **BPL 134** (RP 4700-41-2-2-4-1-1), **BPL 137** (RP 4700-42-2-1-1-1-1) were immune under repeated phenotyping. These 8 two-gene pyramids have excellent basmati grain quality traits. Special mention may be also be made of **BPL 135** (RP 4700-41-2-2-5-1-1), **BPL 101** (RP 4693-44-5-2-2-2-2-1-1) and **BPL 103** (RP 4693-101-2-1-1-1-1-1-1) in this category.

Eight BPL lines have the single recessive gene xa13. These include BPL 108, BPL 109, BPL 110, BPL 111, BPL 124, BPL 133, BPL 141 and BPL 142. Among these, five lines have extra long slender aromatic grains, good elongation and preferred range of ASV and AC. While all the lines recorded high degree of resistance to bacterial blight, **BPL 133** (RP 4700-41-2-2-1-1-1) is a unique genetic stock which was observed to be consistently immune in repeated glass house tests. Few other valuable lines with *xa13* gene include **BPL 108** (RP 4694-193-3-1-1-3-1-1-1), **BPL 109** (RP 4694-193-3-1-1-3-2-1-1), **BPL 124** (RP 4693-28-2-1-1-1-1) and **BPL 142** (RP 4694-130-1-1-1-1-1-2-1).

Efforts are being made to nominate some of elite bacterial blight resistant basmati lines into AICRIP trials and also to identify unique lines of potential academic, scientific value for registration with NBPGR, New Delhi as they will be a valuable resource for use in basmati improvement programmes.

Basmati pyramided lines exhibiting resistant BB reaction in glass house



Morphological, phenotypic screening and quality data of Basmati pyramided lines.

BPL No	Phenotypic Screening Data								Quality Data					
	FD days	PH (cm)	NET/P	Field score	Glass House score	Mill (%)	KL (mm)	L/B ratio	GT	KLAC (mm)	ER	ASV	AC (%)	Aroma
Xa21+xa13+xa5														
104*	116	118	15	1	1	66.0	4.98	2.89	MS	8.8	1.76	4.0	20.84	MS
105*	119	98	13	1	1	63.7	4.85	2.77	MS	10.5	2.16	4.0	20.09	SS
106*	116	105	12	1	1	68.7	4.98	2.76	MS	12.5	2.51	4.0	22.37	SS
123*	116	120	12	1	1	66.2	7.48	4.22	LS	13.6	1.81	4.0	23.00	SS
Xa13+xa5														
120*	113	140	11	1	1	66.0	7.08	4.06	LS	14.8	2.09	5.0	20.61	SS
121*	103	138	13	1	1	66.0	7.76	4.33	LS	15.4	1.98	5.0	20.75	SS
122*	109	138	13	3	3	63.5	7.64	4.19	LS	14.5	1.89	5.0	21.15	SS
127^	98	105	12	3	3	62.6	8.13	4.61	LS	14.8	1.82	3.0	20.70	SS
Xa21+xa5														
131^	96	118	11	3	3	64.4	7.36	4.08	LS	15.7	2.13	4.0	19.26	SS
Xa21 +xa13														
101^	99	118	12	1	1	68.0	7.41	4.11	LS	14.3	1.92	4.0	21.17	SS
103^	102	107	12	1	1	65.0	7.19	3.80	LS	15.2	2.11	4.0	21.34	SS
128^	100	117	11	1	1	60.3	7.63	4.36	LS	15.5	2.03	3.0	19.40	SS
134*	98	118	11	1	1	63.9	7.77	4.11	LS	15.1	1.94	3.0	20.03	SS
135*	98	76	14	3	1	64.9	7.91	4.32	LS	16.5	2.08	4.0	20.66	SS
137*	97	111	17	1	1	60.7	7.77	4.36	LS	16.2	2.08	3.0	22.06	SS
139*	99	118	16	3	3	62.1	7.69	4.13	LS	16.2	2.10	3.0	19.33	SS
140*	98	112	10	1	1	64.6	7.87	4.37	LS	17.5	2.22	3.0	19.60	SS
Xa13														
108*	104	87	16	3	3	68.2	7.99	4.64	LS	13.7	1.71	4.0	21.78	SS
109*	111	85	13	3	3	69.6	7.36	4.20	LS	14.4	1.95	4.0	20.79	SS
110*	109	82	11	3	3	65.3	7.22	4.12	LS	14.3	1.98	4.0	20.68	SS
111*	107	91	18	3	3	71.1	7.86	4.44	LS	15.4	1.95	4.0	22.10	SS
124^	96	118	11	3	3	62.1	7.85	4.31	LS	14.3	1.82	4.0	21.98	SS
133*	99	113	11	3	1	60.2	7.91	4.37	LS	15.9	2.01	4.0	20.05	SS
141*	111	86	13	3	3	65.0	7.51	4.36	LS	14.1	1.87	4.0	23.27	SS
142*	112	90	12	3	3	69.2	7.73	4.27	LS	14.4	1.86	4.0	20.75	SS
Checks														
143	112	104	10	9	9	68.9	7.68	4.77	LS	15.4	2.00	4.0	24.32	SS
144	105	95	14	9	9	61.4	7.25	3.96	LS	13.9	1.91	4.0	19.35	SS
145	105	92	12	9	9	65.6	7.33	3.89	LS	13.8	1.88	4.0	20.66	SS
146	120	109	13	1	1	69.9	4.82	2.70	MS	9.2	1.90	4.0	21.47	NS
147	105	113	10	9	9	66.5	7.45	4.40	LS	13.9	1.86	4.0	22.25	SS

BPL 143-Vasumati; BPL 144 -Taraori Basmati -BPL 145- Basmati 386; BPL 146-RPBIO 226, BPL 147-Pusa Basmati 1; FD: Flowering duration; PH-Plant height; NET-No of effective tillers/plant, GT-Grain type, NS - Non Scented, SS-Strong Scented, MS - Medium Scented
* Basmati 386 background; ^ Taraori Basmati background

N. Shobha Rani, S. Srikanth, G.S. Laha, G.S.V. Prasad, K. Suneetha, R.M. Sundaram and M.S. Madhav, *DRR, Hyderabad*

Glycemic index (GI) of the selected popular rice varieties

Change in life style is enhancing the gap between calories ingested and that is required and the excess calories are the chief cause for the alarming increase in type-2 diabetes mellitus cases among human beings. Carbohydrate rich diets provide excess glucose to the body and part of it is converted into fats which on deposition in the tissues increase obesity and decrease responsiveness towards insulin that controls blood glucose level. Generally, all high carbohydrate foods are rated as high in GI which evaluates the glucose contributed by a carbohydrate food using glucose as standard (GI of glucose is 100). Various foods were also categorized into low (≤ 55), medium (56-69) and high (≥70) GI and rice falls in all of the categories. Hence, there is a need to assess the GI of all rice genotypes.

Amylose -a linear polysaccharide contains glucose with free OH group at 4th carbon at one end whereas amylopectin – a branched polysaccharide contains such glucose at the end of all chains. Starch digesting enzymes except debranching enzyme bind to the free 4-OH group end and successively hydrolyze the chain into maltose. Simultaneously many enzymes can act on amylopectin and thus the rate of glucose release is more from amylopectin than amylose. High amylose content increase the digestion time leading to periodical release of glucose and its consumption may help the diabetic patients. However, GI can also be influenced by other components of the diet and some of them (tubers) are also rich in carbohydrates and eventually affect the cumulative GI value. It is also important to remember that enzyme secretions into gut (alimentary tract) vary among individuals and this is the chief reason for non-reproducibility of *in vivo* tests compared to in vitro. Total starch, resistant starch (RS), amylose and amylopectin contents vary among the rice varieties and hybrids.

In continuation with the earlier report, another set of ten rice varieties were subjected to *in vivo* GI estimation in collaboration with NIN, Hyderabad. Among the ten genotypes evaluated in this study, BPT 5204 was found to be low in GI, Dhan Rasi as medium GI and the remaining as high GI varieties (Tables-1 and 2). Range of % amylose was more in the present set than the earlier set *(DRR News Letter. Vol. 11, No.4. Oct-Dec, 2013)* and in lieu with previous reports, but significant negative correlation was only observed in the present set (Table-2). Thus, this relationship is only applicable to varieties having similar or same total starch and resistant starch contents with varying amylose. The presents study indicates a negative correlation with amylase and positive with amylopectin. As amylopectin and RS (indigestible fraction of starch) contents of rice also influence GI, it is economical to estimate amylopectin and RS along with amylose to select low GI rice varieties prior to clinical studies.

Table 1. GI and Starch Composition of Rice Varieties

Variety	Available carbohydrate	% Amylose content	%Amylopectin	Amylose/amylopectin	Glycemic index
MTU1010	70.55	21.64	48.91	0.44	81.86
Chittimuthyalu	71.15	20.37	50.78	0.40	73.64
BPT-5204	70.55	27.02	43.53	0.62	51.42
DRR Dhan-38	71.85	22.87	48.98	0.47	75.07
Dhan Rasi	72.68	20.38	52.30	0.39	66.74
Varadhan	74.47	22.29	52.18	0.43	77.49
DRR Dhan-39	72.44	21.13	51.31	0.41	75.97
Akshayadhan	77.81	20.86	56.95	0.37	75.72
MTU-7029	76.07	22.23	53.84	0.41	80.74
Jaya	75.97	20.29	55.68	0.36	78.43

Table 2. Comparison of earlier and present values.

Parameter	Present set	Earlier set
% amylose	20.29 to 27.02	24.69 to 27.9
Glycemic index	51.42 to 81.86	53.17 to 82.02
% amylopectin	43.53 to 56.95	47.48 to 55.88
Correlation between GI and % Amylose	-0.70*	-0.48
Correlation between GI and % amylopectin	0.65*	0.43
Correlation between % amylose and % amylopectin	-0.78*	-0.63

*Significant at P≤0.05

V. Ravindra Babu, *T. Longvah, D. Sanjeeva Rao and B. C. Viraktamath, *DRR, *National Institute of Nutrition (NIN), Hyderabad*

Effect of washing on iron and zinc content of rice samples collected from Hyderabad market

Starch is the chief component of the rice grain followed by proteins, lipids, minerals and traces of some vitamins. Poor people only depend on rice for energy as well as vital nutrients and therefore, micronutrient deficiency is prevalent among them. Except Basmati varieties, iron and zinc content is comparatively less in other popular cultivated varieties of India. As nutrient distribution is inconsistent in the grain, nutrients present in the aleurone layer and endosperm are lost during polishing. In addition, loss of micronutrients is expected during washing before cooking while loss during cooking varies with cooking pattern at domestic level. Mostly, urban and educated population add adequate quantity of water during cooking whereas most of the rural population add more water than required for cooking and the excess water having some of the nutrients is generally ingested by the poor. During cooking, grain swells depending on the peak viscosity followed by leaching of even polymers like amylose and short-chain amylopectin (Rosa and Melissa, 2008). This indicates that there is a definite chance for the escape of monomers like aminoacids, sugars and elements into the solvent during cooking. Therefore, the practice of cooking rice with exact amount of water is healthier than adding more water and draining and discarding it.

The objective of this study is to identify the iron and zinc levels of rice being sold by various vendors in Hyderabad and also to understand their loss during washing. Iron and zinc content was estimated by X-ray fluorescence spectrophotometer (XRF) before and after washing (Table-1). Results indicate that iron and zinc levels in the market samples contribute much less than the recommended dietary allowance (RDA) of 10-15 mg and 12-15 mg respectively (FAO/WHO, 2000). Further, loss of iron was observed during washing whereas zinc content remained same and this observation will be encouraging for breeders working for enhancing zinc content and also simultaneously alerts the breeders working for improving iron content also to analyze loss of iron by washing.

Table 1. Iron and zinc contents before and after washing.

Grain type	Range before washing		Range after washing	
	Iron in ppm	Zinc in ppm	Iron in ppm	Zinc in ppm
Medium Slender (MS)	1.3 to 5.8	6.3 to 12.2	1.3 to 4.7	6.1 to 12.0
Parboiled (MS)	2.6 to 4.3	9.1 to 12	1.9 to 2.4	9 to 12
Bold	2.3 to 4.1	7.3 to 10.7	1 to 2.6	7 to 10.2

D. Sanjeeva Rao, V. Ravindra Babu, P. Madhu Babu, V. Praveen, Y. Satyanarayana and P. Swarnalatha, *DRR, Hyderabad*

Metabolic and Molecular Profiling of Aromatic Rice Germplasm of India for Gaining Insights about Aroma

Aroma is a unique character among all the quality rices and especially for long grain Basmati type for which India is a major exporter. A major gene for aroma, encoding betaine aldehyde dehydrogenase *(badh2)* was mapped and cloned. There is need to study nucleotide polymorphism of badh2 which exists among aromatic germplasm of India. It will help in correlating these allelic variants with the level of 2AP so as to identify and isolate novel and efficient alleles and at the same time to identify several other compounds in addition to 2AP, from diverse aromatic germplasm. A DBT funded multi-institutional Network project "Metabolic and molecular profiling of aromatic rice germplasm of India for gaining insights about aroma" started with an outlay of Rs 288.44 lakhs in 2012 for a period of three years. DRR is coordinating this project with 10 other centers. To do allele mining of *badh2* and badh1, 556 aromatic accessions were collected from different parts of India. The collection includes Basmati cultivars; short grain aromatic traditional land races, semi-dwarf high yielding varieties and elite lines of both indigenous and exotic origin. These accessions were thoroughly purified and characterized for 8 yield and 20 DUS descriptors. Entire collection of 556 accessions was also subjected to diversity analysis with 85 SSR markers which were uniformly spread across the genome. These markers were selected from

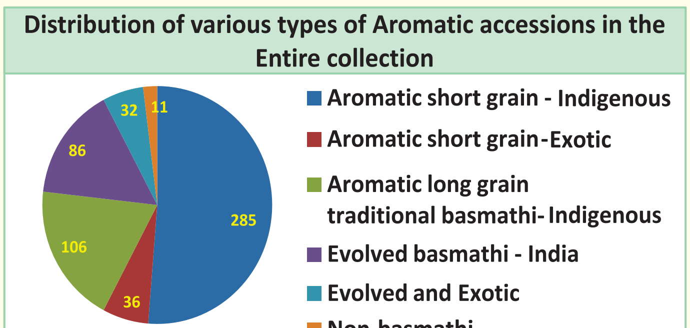


Figure:1

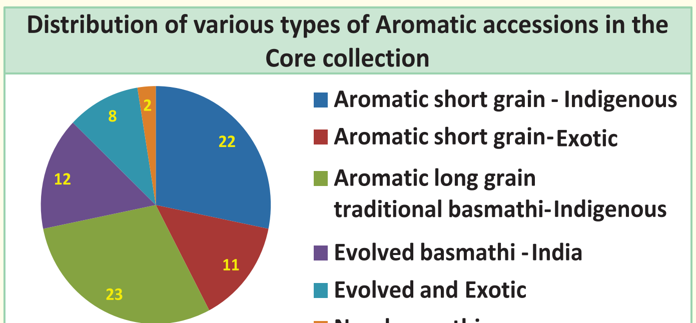


Figure: 2

Universal Core Genetic Map (UCGM) of rice. This task was accomplished at DRR in collaboration with IARI, PAU and TNAU. Using DUS as well as molecular data, a core set of aromatic germplasm consisting of 78 accessions was developed using Power Core Software (Figure-1 & 2). This initiative is first of its kind in the aromatic rice germplasm in India. The core set includes 21 of 285 indigenous aromatic short grain (ASG) collections; 11 of 36 exotic ASG types; 22 of 106 traditional Basmati; 12 of 86 evolved basmati; 8 of 32 exotic aromatic long grain and 2 of 11 non-Basmati varieties. The core set was very robust based on Nei index which was similar for various traits in the whole collection. Core set was analyzed with functional marker for aroma (BADEX 7.5) to know the presence of 8 bp deletion in badh2 gene which is responsible for the accumulation of 2 AP, which revealed that 23 accessions were without deletion which indicates presence of novel alleles of badh in them. The core set was grown at 4 geographical indicator (GI) centers (PAU-Ludhiana, IARI- New Delhi, GBPUA&T-, Pantnagar, SVPUAT & R.S-Nagina-UP); 6 non GI centers of Basmati (DRR - Hyderabad, AAU-Nawagam, TNAU-Tamil Nadu, NDUA&T-Faizabad, JNKVV-Jabalpur, IGKV - Raipur) as well as used for allele mining of *badh2* and *badh1* and metabolic profiling of various aromatic compounds with network partner, IICT, Hyderabad. Thus, superior alleles identified would be utilized for the improvement of aroma trait and identification and quantification of several other compounds contributing for aroma will help in development of molecular markers for these compounds which will aid in marker-assisted selection (MAS) in conjunction with other quality characteristics.

N. Shobha Rani[1], M.S.Madhav[1], P. Sathish Kumar[1], R. Praveen Kumar[1], SRSC Sekhar Maddala[1], S. Gopala Krishnan[2], A.K. Singh[2], Kuldeep Singh[3], S. Robin[4], G.S.V. Prasad[1] and R.M. Sundaram[1]

[1]Crop Improvement, DRR; [2]Division of Genetics, IARI; [3]School of Biotechnology, PAU; [4]Department of Rice, TNAU

Panorama of Institutional Activities

49th Annual Rice Group Meeting held at DRR, Hyderabad

The 49th Annual Rice Group Meeting (ARGM) was organized at the Directorate during April 5-8, 2014. About 500 rice researchers across India representing ICAR institutions, State Agricultural Universities, private seed companies and scientists from IRRI, Philippines participated in the meeting. The inaugural meeting was graced by Dr. A. Padma Raju, Vice Chancellor, ANGRAU, Hyderabad; Prof. E.A. Siddiq, Retired DDG (CS) & Honorary Professor, ANGRAU; Dr. Mathew Morell, DDG (Research), IRRI; Dr. Swapan K. Datta, DDG(CS); Dr. J.S. Chauhan, ADG(seeds); Dr. B.C. Viraktamath, Project Director, DRR and Dr. G.R. Katti, Principal Scientist and Convener of 49th ARGM. The meeting was chaired by Swapan K. Datta, DDG(CS).

Dr. B.C. Viraktamath briefly presented the highlights of the progress of research under the AICRP and lead research at DRR. The chief guest, Dr. A. Padma Raju, VC, ANGRAU pointed out the practical problems faced by the farming community and emphasized the need for refining the system of varietal release through paid mini kits and seeking the opinion of rice millers/traders for the popularization of new varieties. He also advocated farm mechanization in rice cultivation with particular emphasis on manufacturing of indigenous trans-planters to overcome the problems associated with foreign made machines. Dr. J.S. Chauhan, called for strengthening the seed certification chain, for 'foundation and certified seeds' as the present seed replacement rate was only 33%. Dr. Swapan K Datta, highlighted the new innovative developments taking place in rice science such as discovery of '*spike*' gene by Japanese Scientists, which had the potential to boost the yields by 36%. He reiterated that second green revolution was possible through science and technology with support of the Government and could be obtained by integrating components like management of water, soil fertility, genetic resources, exploitation and sustainability of crop intensification despite climate change. On this occasion, eight publications, six from DRR and two from ANGRAU were released. This was followed by presentation of AICRIP award-2013 for overall performance to Agricultural Research Institute (ARI), Rajendranagar, Hyderabad. The discipline wise awards were bagged by IGAU, Raipur (Plant Breeding); ARI, Rajendranagar (Agronomy); RRS, Chinsurah (Entomology); PAU, Ludhiana (Pathology); PBS, Coimbatore, TNAU (Physiology); APRRI, Maruteru (Soil Science).

The variety Identification committee met under the Chairmanship of Dr. Swapan K. Datta, DDG(CS), ICAR on April 06, 2014 and identified 15 cultures and 4 hybrids for different rice growing states. Two special sessions were organized on 'IRRI-India Partnership' and 'Enhancing Rice Production through Cutting Edge Technologies'. The first special session was chaired by Dr. Mathew Morell, DDG (Research), IRRI and co-chaired by Dr. B.C. Viraktmath, Project

Director, DRR and Dr. T. Mohapatra, Director, CRRI. The presentations were made by Drs J.K. Ladha, R.S. Hamilton, K.K. Jena, N. Sreenivasulu, Samarendu Mohanty, Noel Major, Aravind Kumar (IRRI) and Dr. S.N. Meera (DRR) on various aspects of ICAR-IRRI work plan and collaborative research activities.

The special session on 'Enhancing Rice Production through cutting edge technologies' was chaired by Prof. E.A. Siddiq, Former DDG(CS), ICAR & Honorary Professor, ANGRAU and co-chaired by Dr. T. Mohapatra Director CRRI, Cuttack. The presentations were made by Dr. T. Mohopatra on 'Leverage Genomic tools for rice improvement'. Dr. K. Majumdar on 'Precision Management for improving rice production' Dr. K. S. Subramanain on 'Potential role of nanotechnology in enhancing rice production', Dr. M.V.R. Sesha Sai on 'Remote sensing technology for rice' and Dr. V.P. Sharma on 'ICT's enabled extension for agricultural development.

The plenary session was chaired by Dr. J.S. Chauhan, ADG (seeds), ICAR and co-chaired by 'Dr. B.C. Viraktamath, Director, DRR in which respective Principal Investigators presented the proceedings including the technical programme for 2014-15 and recommendations of the concurrent session. The scientists due for retirement during the current year were felicitated for their long service and outstanding contribution to AICRIP.

Research Advisory Committee Meeting organised

The third meeting of the Research Advisory Committee was held at DRR from May 2-3, 2014 under the chairmanship of Prof E.A.Siddiq, Former DDG (CS), ICAR & Honorary Professor, ANGRAU. The participating members included Dr T. Mohapatra,

Director, CRRI; Dr. Ramesh V Sonti, Chief Scientist, CCMB; Dr S.N. Sinha, Ex-Head, IARI Regional Station, Karnal; Dr. R.P. Singh, Former Project Director, Project Directorate on Cropping System Research, Modipuram; Dr R.K. Samanta, Vice Chancellor, BCKVV (WB); and Dr Gururaj Katti, Principal Scientist & Member Secretary, RAC, DRR. At the outset, Dr B.C. Viraktamath, Director, welcomed the Chairman and all the members and presented an overview of DRR research activities and accomplishments covering crop improvement, crop production, crop protection and social sciences sections. Dr G Katti presented the proceedings of RAC-2013 and action taken report. This was followed by detailed presentation of research accomplishments of each discipline by respective heads of sections. A Special publication 'Genetic Diversity and Genealogy of Rice Varieties of India' was released by the Chairman, RAC during the meeting.

Institute Research Council Meeting organized

Institute Research Council Meeting (IRC) was organized from May 5-8, 2014 under the chairmanship of Dr. B.C. Viraktamath, Project Director, DRR. All the Scientific Staff of DRR participated in the meeting. At the outset, Dr. V. Jhansi Lakshmi, Principal Scientist, Entomology and Secretary, IRC welcomed the chairman and all the members of IRC. The chairman in his opening remarks highlighted the importance of IRC and the sequential system of conducting QRT, IMC, ARGM, RAC and IRC before *Kharif* season starts. This was followed by presentation of the work done during 2013-14 by individual scientists of each discipline. Each presentation was thoroughly discussed by the members. Four new projects were approved by the chairman. In his concluding remarks, the chairman emphasized that a) the hybrid rice scientists should focus on product delivery with emphasis on yield enhancement and pest resistance, b) minikit programme should be reintroduced and atleast 5000 minikits to be given for new varieties and technologies c) mechanization should be intensively popularized d) comprehensive contingency plan should be prepared due to the predicted El nino effect and monsoon abnormalities. The meeting ended with vote of thanks by Dr. B. Sreedevi, Principal Scientist, Agronomy and Joint Secretary, IRC.

Training Programmes Organized

Students of final year, B. Tech. (Agri Engineering) KCAET, Tavanur, KAU, Kerala underwent a training at DRR for one month on "In plant training on farm machinery operations for water management in rice" during 1-30 May, 2014 under the guidance of Dr. T. Vidhan Singh, Principal Scientist (FM&P) and Dr. Mahendra Kumar, Principal Scientist (Agronomy). DRR Scientists interacted with the students in

the form of class room lectures on all aspects of rice cultivation. The students were also exposed to practical classes at Water Technology Center of ANGRAU, Hyderabad.

MOU Signed

To popularize the DRRH-2 hybrid and to increase the hybrid seed production, DRR has signed MOU with M/s. Super Agri Seeds Pvt Ltd., on May 13, 2014.

Jaya Hostel Building Inaugurated

The Jaya Hostel Building which was recently renovated was inaugurated by Dr. B.C. Viraktamath, Project Director, DRR, on 30.5.2014.

Staff Activities

Awards/Recognitions

Dr. Satendra Kumar Mangrauthia has been selected as Member of National Academy of Sciences, India (NASI), prestigious Science Academy of the country. He will be the member of this academy from 2014.

Deputations

Dr. M. Sheshu Madhav, Senior Scientist Biotechnology was on deputation to IRRI, Phillipines to attend the training course on 'SNP data analysis' under the Project 8 & 11 of IRRI-ICAR collaborative work plan 2011-16 during May 5-9, 2014.

Dr. R.M. Sundaram, Senior Scientist, Biotechnology was on deputation to Germany to participate in the Sixth Indo-German Frontier of Engineering Symposium, held at Potsdam, Germany during May 22-25, 2014.

Retirements

- Dr. B.C. Viraktamath, Project Director retired from service upon superannuation on May 31st, 2014. He made significant contributions in the hybrid rice research & led the Directorate for more than eight years and strengthened the AICRIP programme.

- Mr. P. Shankarnarayana, T-5 retired from service upon superannuation on May 31st, 2014. He worked in various sections of the Directorate and contributed significantly in all the technical activities.

- Mr. T. Jagannadha Rao, T-5 retired from service upon superannuation on April 30th, 2014. He worked in various sections of the Directorate and contributed significantly in all the technical activities.

All DRR staff wishes them and their families a very happy and healthy retired life.

Promotions and Staff additions

The following staffs were promoted to the next higher grade

S.No.	Name	Promoted		
		From	To	w.e.f
1	Dr. M.M. Azam	Senior Scientist	Principal Scientist	01.01.2009
2	Dr. Chitra Shanker	Senior Scientist	Principal Scientist	20.02.2010
3	Mr. Sadanandam	T-5	T-6	16.04.2013

- Dr. Laxmi Prasanna joined the DRR team as Senior Scientist (Agricultural Economics) on transfer from NCAP, New Delhi on 2nd June, 2014.

Forthcoming Events

- ICAR sponsored programme on "Soil health management in rice and rice based cropping systems" from 19-28 Aug, 2014
- ICAR sponsored winter school on "New Frontiers in rice breeding for improving yield quality and stress tolerance for sustaining future production", 10-30 Sept, 2014

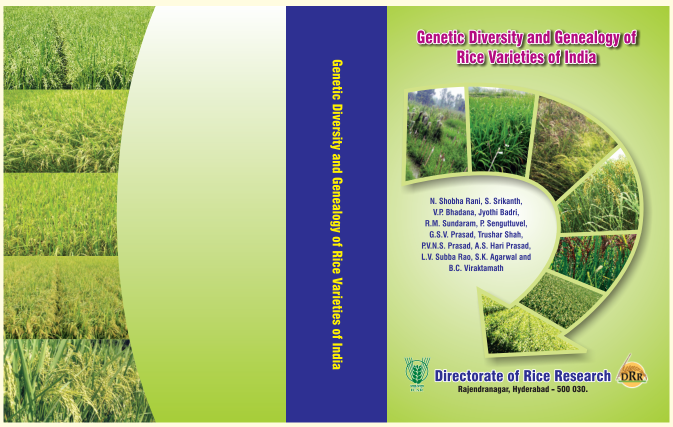
Interesting News on Rice

Eating rice boosts diet quality, reduces body weight and improves markers for health

In a study published online in the peer-reviewed journal Food and Nutrition Sciences, it is reported that the consumers can improve their diets simply by enjoying white or brown rice as part of their daily meals. The authors of the study reported that the adults who eat rice had diets more consistent with what is recommended in the U.S. Dietary Guidelines, and they showed higher amounts of potassium, magnesium, iron, folate and fiber while eating less saturated fat and added sugars and also stated that eating rice is associated with eating more servings of fruit, vegetables, meat and beans. Further details can be obtained from: dhenbest@pollock-pr.com.

Latest publication on 'Genetic Diversity and Genealogy of Rice Varieties of India'

India is the secondary centre of origin for rice with an estimated number of 1,40,000 rice genetic resources, comprising of land races, modern and obsolete varieties, genetic stocks, breeding lines and wild relatives, which are the basis for food security. The tripling in rice production during the green revolution witnessed since late 1960's has dramatically transformed India from a net importing country to a potential exporter of rice since early 1990s. This paradigm shift was possible with the introduction of plant type based high yielding rice varieties (HYRVs) which enabled the country to become self-sufficient. About 1020 HYRVs including hybrids released so far spread rapidly to 84% of rice growing area in the country replacing thousands of land races, drastically bringing down the genetic diversity. It is a common belief that every quantum jump in yield is accompanied by narrowing of genetic base and lack of genetic divergence among the improved germplasm and this has been perceived to be the main cause for the yield stagnation witnessed in rice in the recent years. In the studies done so far to trace the trend of genetic diversity in crop varieties, there is no clear indication about narrowing genetic diversity. Till now no systematic attempt has been made in the country to study the genealogy of all the HYRVs to assess the genetic diversity that has been utilized in the breeding programmes in the past few decades. To address this issue, Dr. N. Shobha Rani and colleagues from the Directorate of Rice Research, Hyderabad, India have exhaustively analyzed the genealogy of HYRVs released in the country since 1960, studied the level of diversity used in development of these varieties decade-wise and quantified the contribution of indigenous and exotic germplasm in a systematic manner. A book entitled "Genetic Diversity and Genealogy of Rice Varieties highlighting the findings of the study was recently released by Prof. E.A. Siddiq, Padma Sri and Ex-DDG (Crop Sciences) - ICAR and Ex-Project Director-Directorate of Rice Research on 2nd May, 2014.



BOOK POST

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Editorial Committee : Dr. A.S. Hari Prasad, Dr. A.P. Padmakumari, Dr. V.P. Bhadana, Dr. Brajendra and Dr. B. Nirmala
Address : Directorate of Rice Research, Rajendranagar, Hyderabad – 500 030, Telangana, India
Phone : +91-40-24591216, 24591254 Fax: +91-40-24591217
e-mail : pdrice@drricar.org Website:http://www.drricar.org