IIRR

ICAR-Indian Institute of Rice Research

NEWSLETTER

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7th Annual Hill Rice Research Group Meeting

7th Annual Hill Rice Research Group Meeting - 19 February, 2020

The 7th Annual Hill Rice Research Group Meeting was held on 19th February 2020 at ICAR-IIRR, Hyderabad. Dr. S.R. Voleti, Director ICAR-IIRR briefed the AICRIP guidelines and discussed in brief about the EFC recommendations. During the inaugural session of the workshop, Newsletters of ICAR-IIRR were released. Dr. L.V. Subba Rao, PI, AICRIP-Varietal Improvement presented the consolidated progress report on varietal development under Hill trials conducted during 2019 while Dr. A.V.S.R. Swamy, Principal Scientist, Plant Breeding presented the detailed report on the trials and performance of entries and the entries promoted to next year of testing.

Co-operators associated with Hill trials, Drs Najeb Rehman Sofi, (Khudwani), Neelam Bhardwaj (Malan), J.P. Aditya (Almora), Mayank Rai (Barapani), S.P. Das (Tripura) Chandan Kapoor (Gangtok) and G.N. Hosagoudar (Ponnampet) presented the results of varietal trials conducted in hill ecology. The need for initiation of *japonica* rice improvement programme by *japonica/indica* hybridization programme was discussed. A new centre for conducting low elevation trials- CAU, Kyrdemkulai was identified.

Dr. K.S. Raghuwanshi from Lonawala presented the results of pathology screening. Dr. G. Katti, PI, AICRIP-Entomology reported overall performance of national screening nurseries of hills conducted for different insect pests in the hill ecology. Dr. M.S. Prasad, PI, AICRIP-Plant Pathology briefed about the blast control strategies. Dr. R.M. Kumar, PI, AICRIP-Crop Production presented about weed control in rice. Dr. K. Surekha PI, AICRIP-Soil Science discussed about the aluminium and iron toxicity screening and designing the experiments.

IN THIS ISSUE

It was recommended that a yield advantage of 10% over the best check should be considered for trials conducted in a single location to select the superior genotypes, in varietal improvement programmes. Deliberations were made on the utilization of indigenous germplasm in generating breeding material with due emphasis on the varietal spread.

Varietal releases and ITMU activities

CVRC-Gazette Notification [S.O.99 (E)] dt. 6th Jan, 2020

As per the Ministry of Agriculture and Farmers Welfare (Department of Agriculture, Cooperation and Farmers Welfare) official Gazette notification (Govt. of India) dated 06.01.2020, 25 rice varieties/ hybrids were notified [S.O. 99 (E)] by the Central Government, after consultation with the Central Seed Committee.

- 15 rice varieties, 9 for SVRC and 6 CVRC and 10 hybrids including 3 for SVRC, 4 for CVRC and 3 for area extension were notified.
- The highest number of varieties/hybrids was notified for the States of Maharashtra, Bihar, Uttarakhand and Chhattisgarh.

ITMU Activities

- **Memorandum of Agreement (MoA) signed:** As a part of commercialization, through public private partnership (PPP) and following the ICAR Guidelines for Intellectual Property Management and Technology Transfer/Commercialization 2014, one Memorandum of Agreement (MoA) was signed between ICAR-Indian Institute of Rice Research, Hyderabad, CSIR-Centre for Cellular and Molecular Biology (CSIR-CCMB) and Shree Krishna Rice Mill, Chhattisgarh on 03.03.2020 for commercial production of Improved Samba Mahsuri rice and its manufacturing, processing, marketing and distribution in India.
- **Access: Benefit-Sharing documentation meeting** was held on "Technology Commercialization Case Studies Documentation: ICAR-Indian Institute of Oilseeds Research (IIOR)", on 03.01.2020 at ICAR-IIRR, Hyderabad.

A status report on rice production and trade

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Globally rice is planted in an area of about 162 million ha and 755 million tonnes of paddy is harvested annually (FAO, 2020). Of this, Asia accounts for 90% of the production and consumption. Only about 43 million tonnes of rice is traded through international market. Worldwide rice exports totalled US$21.9 billion in 2019. Leading rice exporting countries are India, Thailand, USA, Vietnam and Pakistan. India is the leading exporter of rice with the export of 9.5 million tonnes of rice worth US$7.1 billion (32.5% of total rice exports). India, Thailand, United States, Vietnam, Pakistan, China, Italy, Myanmar (Burma), Cambodia, Uruguay, Brazil, Netherlands, Belgium, Paraguay and Spain (15 countries) together shipped 92.8% of global rice exports in 2019 by value (worldstopexports.com, 2020).

Global rice trade in 2020 stood at 43.2 million tonnes. Unlike maize and wheat, most of the rice tends to be eaten where it is produced and thus does not enter international markets. Yet, the volume of international rice trade has increased almost six fold, from 7.5 million tonnes annually in the 1960s to 43.2 million tonnes during 2020 (Rice Outlook, 2020).

Rice is one of the most important food crops of India. The area under rice crop was 31 million ha in 1950-51 which has increased to 44 million hectares during 2019-20, which is nearly 42 per cent higher. The rice production has registered an appreciable increase from 20.58 million tonnes in 1950-51 to 118 million tonnes during 2019-20, which is nearly 5.7 times (GoI, 2021). The yield was 668 kg/ha in 1950-51, which has increased to 2682 kg/ha during 2019-20.

India has the world's largest area under rice with 44 million ha and is the second largest producer (118 million tonnes in 2019-20) next only to China. It contributes 23.5 per cent of global rice production. The productivity of rice was 2.7 t/ha during 2019-20 (Table 1). Within the country, rice occupies one-quarter of the total cropped area,

contributes about 40 per cent of total food grain production and continues to play a key role in the national food and livelihood security system.

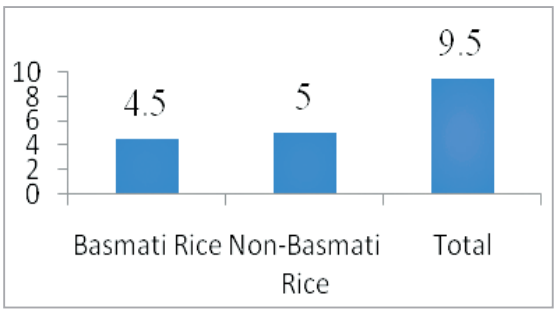
Table 1: Area, production and productivity of rice in 2019-20

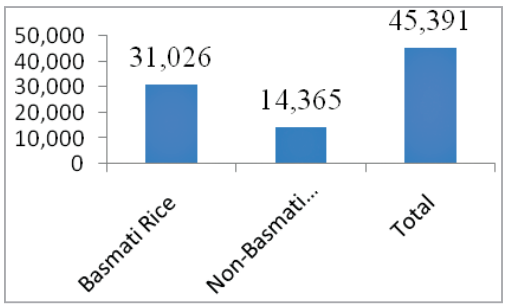
	Area (Million hectares)	Production (Million tonnes)	Productivity (t/ha)
World	162	503	3.1
Asia	139	451	3.2
India	44	118	2.7

Source: http://www.fao.org/faostat

Rice export contributes to nearly 20% of total agricultural exports from the country.

India is the leading exporter of Basmati rice to the global market. The country has exported 4.5 Million tons of Basmati rice to the world for the worth of Rs. 31,025.91 crores during the year 2019-20 (Fig.1&2). The country has exported 5 Million tons of non-basmati rice to the world for the worth of Rs. 14,364.64 crores during the year 2019-20.





India has exported 9.5 Million tonnes of rice to the world worth of Rs. 45,391 crores during 2019-20. The major export destinations for Basmati rice during 2019-20 were Iran, Saudi Arab, Iraq, United Arab Emirates and Kuwait (APEDA, 2021). The major export destinations for non-basmati rice during 2019-20 were Nepal, Benin, United Arab Emirates, Somalia and Guinea.

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1. https://apeda.gov.in.
2. *http://www.fao.org/faostat*.
3. http://www.worldstopexports.com/rice-exports-country.
4. Ministry of Agriculture and Farmers Welfare, Government of India.
5. Rice Outlook, September, 2020, USDA, Economic Research Service.

Research Highlights

New research projects initiated at ICAR-IIRR (Externally funded)

S. No.	Title of the Project	Investigators	Date of start	Duration	Budget	Funding Agency
1	Mainstreaming rice landraces diversity in varietal development through genome-wide association studies: A model for large-scale utilization of gene bank collections of rice	PI: Drs. C.N. Neeraja and L. V. Subbarao, Co-PIs: Drs. C. Gireesh, M. S. Anantha, Ladha Lakshmi, J. Aravind Kumar and Abdul Fiyaz	5th Mar, 2020	5 years	Rs. 143.3592 Lakhs	DBT
2	Development of superior haplotype based near isogenic lines (Haplo-NILs) for enhanced genetic gain in rice	PI: Dr. Jyothi Badri, Co-PIs: Drs. J. Aravind Kumar, M.S. Prasad, Jhansi Lakshmi, A.P. Padmakumari and V. Prakasam	2nd Mar, 2020	3 years	Rs. 117.9028 lakhs	DBT

Identification of blast (*Magnaporthe oryzae*) resistant rice landraces from North East India

Gireesh, C[1†], Basavaraj, P. S.[1,2†], Anantha, M.S.[1], Senguttuvel, P, Srinivasaprasad, M.[1], Prakasam, V.[1], Basavaraj, K.[1], and Subbarao, L.V.[1]*

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Rice blast caused by *Magnaporthe oryzae* is one of the major diseases causing yield loss up to 20-100% under favourable conditions. The deployment of resistance genes i.e. *R* genes have been the foundation for disease resistance

research and resistance breeding. Till date more than 100 *R* genes have been identified, of them 31 R genes cloned and characterized. But there is an arm race between host and pathogen, *M. oryzae* is highly variable and new races are evolving very rapidly resulting in breakdown of resistance. The wild species and land races of rice are treasure trove for many biotic and abiotic stress tolerance genes. The present study was undertaken with the objective of identification of novel source of blast resistance from landraces from North-East India. A total of 39 North Eastern land races (India) along with resistant check Tetep and susceptible check HR-12 were screened for four years (2015, 2016, 2017 and 2018) consecutively in uniform blast nursery (UBN) at ICAR-IIRR, Hyderabad. The standard method was followed and scoring was done after 10-15 days of post infection depending on the severity of the infection on the susceptible check using standard evaluation system (SES, IRRI, 2013).

Among the 39 land races screened for blast resistance, Moirang-Phou-Khokngangbi, Thangjing-Phou and Punshi showed resistance reaction with a score of 2-3 (Fig. 1 & Table 1). These three land races were again screened during 2016, 2017 and 2018 for further confirmation and the results were similar with previous season confirming resistance nature of these three landraces.

It is expected that these landraces may harbour specific R genes for blast resistance and needs to be evaluated further using molecular markers. Similar study has reported NE landraces as novel blast resistance resources with identification of molecular markers associated with blast resistance (Umakanth *et al*., 2017). The three land races identified in the present study can be further utilized for identification of novel blast resistance genes in resistance breeding programmes.

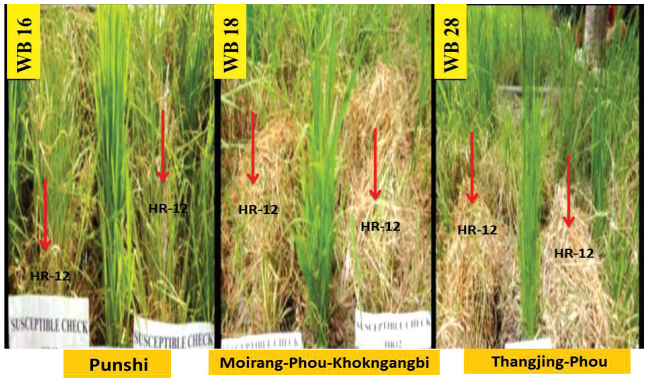

Fig. 1: Disease reaction of land races against blast pathogen isolate IC-16 (IIRR-MSP-28) at Uniform Blast Nursery

Table 1: Reaction of ladraces for blast disease under uniform blast nursery for four Seasons (2015, 2016, 2017 and 2018)

Genotype	Blast score (2015)	Blast score (2016)	Blast score (2017)	Blast score (2018)
Punishi	2	2	3	3
Moirang-Phou Khokngangbi	3	2	3	3
Thangjing-Phou	3	3	2	3
Tetep	1	1	1	1
HR-12	9	9	9	9

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Umakanth B, Vishalakshi B, Sathish Kumar P, Rama Devi SJS, Bhadana VP, Senguttuvel P, Kumar S, Sharma SK, Sharma PK, Prasad MS and Madhav MS (2017). Diverse rice landraces of North-East India enables the identification of novel genetic resources for *Magnaporthe* resistance. *Front. Plant Sci*. 8:1500.

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Completed Projects

ICAR National Professor Project, ICAR-IIRR on Development of chromosome segment substitution lines (CSSLs) of rice from elite x wild crosses and mapping QTLs/ genes for yield traits

Development of Chromosome Segment Substitution Lines (CSSLs) using elite x wild crosses was carried out under ICAR National Professor Project at ICAR-IIRR [PI: Dr. N. Sarla, Dr. Divya Balakrishnan; Malathi, S., Sukumar, M., Krishnamraju, A., Rao, Y.V. and Kavitha, B], during Feb 2013-Feb 2020, which included two years period of project extension. The specific objectives of the project were to develop marker defined chromosome segment substitution lines as a genomic resource in a popular variety using two wild accessions, and discover useful QTLs/ genes for yield and related traits from two wild accessions. 'MTU1010' and 'Swarna' were selected as recurrent parents (RP) and one wild accession of *O. rufipogon* (IC309814) and one of *O. Nivara* (IC283150) (Source: Dr. B. C. Patra, NRRI, Cuttack) with high photosynthetic efficiency were used as donor parents to develop new CSSLs (Rao *et al.*, 2019) (Fig.1).

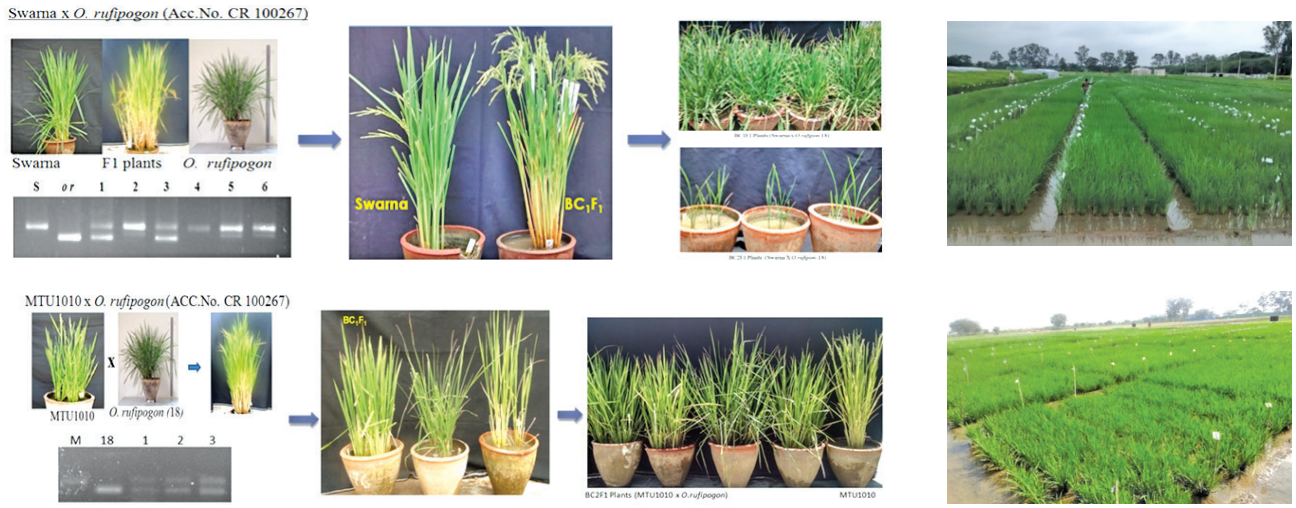
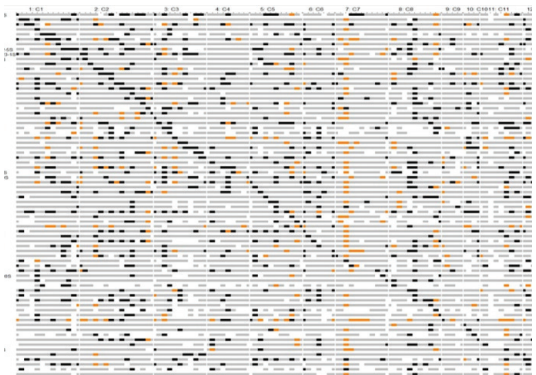


Fig. 1: Development of CSSLs of Swarna / *O. rufipogon* (IC309814) and MTU1010 x *O. rufipogon (IC309814)*

QTLs for yield and related traits were mapped in BC_2F_2 with MTU1010 and Swarna and BC_4F_2 with MTU1010 as RP. In all, 154 CSSLs of MTU1010/*O. rufipogon* IC309814 [cross RP6166] representing 99% of *O. rufipogon* genome were identified from 306 BC_4F_2 lines. In Swarna/*O. rufipogon* IC309814 [cross RP6167], 106 CSSLs were identified from 282 BC_2F_2 and they represented 95.86% of *O. rufipogon* as homozygous and overlapping chromosome segments substituting Swarna segments.

BC_4F_{2-5} populations consisting of 306 lines were developed in RP6166, 314 lines in RP6167 and BC_2F_5 of RP6166, RP6167 and RP6168 (Swarna/*O. nivara*). Four sets of introgression lines (ILs) were also developed from two pairs of reciprocal crosses to study effect of *O. rufipogon* and *O. Nivara* cytoplasm. Advanced backcross inbred lines were also developed from Swarna / *O. nivara* (IC283150) [cross RP6168] and shared with IIRR and NRRI scientists for tolerance to various biotic and abiotic stresses.

Previously developed ILs from Swarna/*O. nivara* IRGC81832 (cross RPBio4918 NPK lines) and IRGC81848 (cross RPBio4918 NPS lines), and KMR3 /*O. rufipogon* WR120 (cross RPBio4919 NSR lines) were also advanced and used to identify CSSLs (Fig. 2) and map QTLs for yield and related traits (Malathi *et al.*, 2017 and Divya *et al*., 2018). At least five secondary mapping populations were also developed and used for mapping/ validating/ fine mapping of important QTLs for yield related traits particularly 1000 grain weight, flag leaf length and flag leaf width.



Swarna /*O. nivara* (IRGC81848) CSSLs using 111 SSRs in BC_2F_8 (Malathi *et al.,* 2017)

Swarna/ *O. nivara* (IRGC81832) CSSLs using 140 SSRs in BC_2F_8 (Divya *et al.*, 2020)

Fig. 2: Graphical genotypes of CSSLs from elite x wild crosses

All the mapping populations were phenotyped for yield and related traits. Some populations were also phenotyped for water use efficiency, nutrient use efficiency and photosynthesis related traits. QTLs were mapped in BC_2F_{2-4} and BC_4F_{2-3}, and BC_2F_8 populations mainly for yield related traits and significantly different lines identified for each trait in these populations.

Backcross introgression lines (BILs) from inter-specific crosses were shared with scientists in IIRR, Hyderabad; NRRI, Cuttack; NIPB, Delhi; RARS, Maruteru, ANGRAU; IIAB, Ranchi to evaluate for yield and tolerance to various abiotic and biotic stresses. Backcross introgression lines derived from cross of Swarna/*O. nivara* IRGC81832 (BC_2F_{10})-90 lines and MTU1010/*O. rufipogon* IC309814 (BC_4F_4)-306 lines were shared with JIRCAS, Japan under MTA with the approval of NBA and the required voucher seeds were deposited in the National repository of ICAR-NBPGR as part of INSA JSPS post-doc research program of Dr. Divya Balakrishnan at JIRCAS during 2018-2019.

In all, 13 research papers were published in peer reviewed journals and 49 papers were presented in national and international conferences as abstracts, posters and oral presentations. In addition, a comprehensive review on CSSLs was published in Theoretical and Applied Genetics. A 10 days ICAR Short course and short duration trainings on molecular breeding tools were conducted for ICAR Scientists and students. 8 students of various universities completed their M.Sc and PhD research work as part of the NP Project during 2013-2020. The marker defined CSSLs and phenotypic data on lines significantly different from recurrent parent for each trait are available for sharing with NARES partners on MTA with ICAR-IIRR.

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Outreach Activities

ICAR-IIRR SCSP

A three days training program "Capacity building of SC rural youth for climate resilient rice cultivation" was organized at ICAR-IIRR during 22-24 January 2020, coordinated by Drs. Amtul Waris & B. Nirmala. Eighty seven farmers from three villages of Timmajipet mandal of Nagarkurnool district have participated in the training program. The farmers were trained in climate resistant rice production practices *viz*, SRI, Aerobic rice, Site specific nutrient management and Integrated Pest Management. Hands on training on soil sample analysis were imparted. Appropriate drying and post harvest management practices were elaborated upon along with distribution of drying sheets under ICAR-IIRR-SCSP scheme.




Demonstrations on rice production technologies were organized under ICAR-IIRR-SCSP in Nagarkurnool district of Telangana. One hundred and fifty sprayers were distributed to SC farmers from three villages of Timmajipet mandal of Nagarkurnool district as a component of asset creation under IIRR-SCSP program. A training program was organised on 17th February, 2020 at Bavajipally village of Nagarkurnool district of Telangana. Pest and disease management practices in rice were elaborated upon along with distribution of sprayers under ICAR-IIRR-SCSP scheme. The program was coordinated by Drs. B. Nirmala PI-SCSP & Amtul Waris, Co-PI-SCSP.

Monitoring of rice demonstrations and distribution of sprayers to SC beneficiaries under IIRR - SCSP at Nagarkurnool, 17 February, 2020

Monitoring of SCSP Demonstrations

ICAR-IIRR conducted 180 demonstrations during *Rabi* 2019-20 at Narayanavanam, Varadaipalem and Nagari mandals of Chittor district, in collaboration with RASS-KVK, Tirupathi, Chittor district, under ICAR-SCSP scheme of the IIRR. The demonstrations were monitored on 25/02/2020 by Drs. B. Nirmala, PI-SCSP and R. Mahender Kumar, Co-PI-SCSP.

Field Days organised in Chittor district under IIRR-SCSP

A 'Field Day' was organised in the paddy field of Sri. C. Chinnaiah of Kondrajkuppam village of Nagari mandal on 25/02/2020. Dr. B. Nirmala, PI, SCSP, appraised the famers about the IIRR-SCSP scheme. The farmers were educated to take up need based application of nutrients and plant protection chemicals. Dr. S. Srinivas, Head, RASS-KVK emphasised the importance of undertaking timely sowing and transplanting. Dr. R. Mahender Kumar elaborated upon the various management practices to be taken up for obtaining higher yields in rice. Smt. Yamini, MAO, Nagari, elaborated upon the pest management strategies in rice. 'Field Day' was organised at Narayanavanam, Puttur circle of Chittor district on 26/02/2020. A farmer-scientist interaction was organised in both the villages.

An off-campus training program was organised in Mallaipally, Pangal Mandal of Wanaparthy district of Telangana on 28/02/2020 under SCSP. Knapsack sprayers were distributed to the beneficiary farmers. Drs. D. Krishnaveni, Brajendra and P. Muthuraman participated in the program.

Training program at Pallegudem, Khammam on 3rd March, 2020

A training program on 'Good Agricultural Practices in Rice' was organised under ICAR-IIRR-SCSP at Pallegudem village of Khammam district on 3rd March 2020. One hundred and fifty sprayers were distributed to SC rice farmers under IIRR- SCSP scheme. Drs. B. Nirmala, R. Mahender Kumar, and Amtul Waris have organised the program in collaboration with Jagruthi NGO, Khammam district, Telangana. Drs. Jhansi, Joint Director of Agriculture, Khammam, Vijaya Lakshmi, Project Director, ATMA, Khammam and Sri. Nageswar Rao, Mandal Agriculture Officer, Khammam (Rural) graced the occasion and addressed the farmers.

Panorama of Institute Activities

ICAR-IIRR celebrated 71st Republic day on January 26, 2020

ICAR-IIRR celebrated Women's day on 8th March, 2020

Staff News

Awards and Recognition

- Dr. Maganti Sheshu Madhav, Principal Scientist (Biotechnology) has been selected as Fellow of 'Telangana Academy of Sciences' for the year 2019.

Deputation

- Dr. P. Revathi, Senior Scientist (Hybrid Rice) was deputed to visit San Diego CA, USA to present paper in "The Plant and Animal Genome XXVIIII Conference during 11.01.2020 to 15.01.2020.
- Dr. Satendra Kumar Mangruathia, Senior Scientist (Biotechnology) attended Botany International Agricultural Science and Technology Fellowship at IRRI, Philippines from 15th Dec 2019 to 8th March, 2020.

Demise:

Mr. B. Venkaiah, Senior Technical Assistant at ICAR-IIRR expired on 26.01.2020

Editorial Committee: Drs. Nageswara Rao DVK, Amtul Waris, Jyothi Badri, Kalyani M Barbadikar, Basavaraj K, Bandeppa S, Senguttuvel P and Arti Singh

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