Seed Tech News

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A year to celebrate plants: The International Year of Plant Health. The UN General Assembly proclaims 2020 as the year to recognize and protect plant health. The purpose of the IYPH is to raise global awareness on how protecting plant health can help end hunger, reduce poverty, protect the environment, and boost economic development.

From President's Desk...

Dear Members,

Greetings from the Secretariat!

The year 2020 started with a Red Alert worldwide. A new strain of Corona virus (Covid 19), causing an outbreak of respiratory illness disease, struck us!

We were caught unprepared for such a pandemic, which is termed as the most devastating event since the Spanish flu that occurred exactly a century ago. Starting from the Wuhan province of China towards the end of the last year, it has spread to each and every part of the world in no time, affecting the mankind globally. Our lives came to a halt with the clamping of nationwide 'lockdown' from 24 March. While it proved an effective measure in restricting the rapid spread of Covid 19, millions suffered unemployment, became homeless, the economy suffered a major setback and several major changes had to be made to adjust with the 'new normal' in personal lives, professional engagements, business strategies as well as political realignments.

On the positive side, the pandemic taught us many valuable lessons in lifestyle, and brought forth the importance of maintaining the critical balance between the human kind and its environment. It is most redeeming to note that agriculture is the only sector which remained least affected due to this pandemic, and helped keep the economy viable. The governments (both at central and state levels) took immediate measures with respect to harvest, transport, processing and marketing and as a result the seed sector functioned reasonably well and no major shortage of seeds were reported. Positive shifts such as crop diversification, adoption of biofortified crop varieties, conservation agriculture practices like Direct Seeded Rice (DSR) gained popularity.

As seed is the starting point in agriculture, our role as the seed professionals assumes greater importance. We must ensure that right information reaches the farming community regarding the right choice of crops and varieties, and good quality seeds are made available to the farmers along with the production technologies for a sustainable and remunerative agriculture. The battle against Covid 19 has just started. Let us fight it together and come out stronger than before.

Wish you all a safe, healthy and peaceful time ahead!

Malavika Dadlani

Seed Tech News

AWARDS AND HONOURS

Dr. Aniruddha Maity, Scientist, ICAR-IGFRI, Jhansi, who is pursuing Ph.D. at Texas A&M University, USA, has received Dean's Outstanding Achievement Award of 2019 for Graduate Research on January 10, 2020. The Dean's Outstanding Achievement Awards are the highest awards in the College of Agriculture and Life Sciences presented to faculty, staff and students of Texas A&M University, USA.

Dr. Monika Joshi, principal scientist of DSST, ICAR-IARI has been conferred with outstanding woman in Agricultural Sciences on 7th March 2020 for the contribution and achievement in the field of Seed Science & Technology by Centre for Advanced Research and Design, Venus International Foundation, Chennai, Tamil Nadu.

SCIENTIFIC BREAKTHROUGHS

Deterioration of ovary plays a key role in heat stress-induced spikelet sterility in sorghum

In sorghum (*Sorghum bicolor* [L.] Moench), the impact of heat stress during flowering on seed set is known, but mechanisms that lead to tolerance are not known. A diverse set of sorghum genotypes was tested under controlled environment and field conditions to ascertain the impact of heat stress on time-of-day of flowering, pollen viability, and ovarian tissue. A highly conserved early morning flowering was observed, wherein >90% of spikelets completed flowering within 30 min after dawn, both in inbreds and hybrids. A strong quantitative impact of heat stress was recorded before pollination (reduced pollen viability) and post pollination (reduced pollen tube growth and linear decline in fertility). Although viable pollen tube did reach the micropylar region, 100% spikelet sterility was recorded under 40/22°C (day/night temperatures), even in the tolerant genotype Macia. Heat stress induced significant damage to the ovarian tissue near the micropylar region, leading to highly condensed cytoplasmic contents and disintegrated nucleolus and nucleus in the susceptible genotype RTx430. Whereas, relatively less damages to ovarian cell organelles were observed in the tolerant genotype Macia under heat stress. Integrating higher tolerance in female reproductive organ will help in effective utilization of the early morning flowering mechanism to enhance sorghum productivity under current and future hotter climate. For more details of the research, refer to the published paper in the February 2020 issue of Plant cell & Environment at https://doi.org/10.1111/pce.13673

A multiscale approach reveals regulatory players of water stress responses in seeds during germination

Seed germination is regulated by environmental factors, particularly water availability. Water deficits at the time of sowing impair the establishment of crop plants. Transcriptome and proteome

profiling were used to document the responses of sunflower (*Helianthus annuus*) seeds to moderate water stress during germination in two hybrids that are nominally classed as drought sensitive and drought tolerant. Differences in the water stress-dependent accumulation reactive oxygen species and antioxidant enzymes activities were observed between the hybrids. A pathway-based analysis of the hybrid transcriptomes demonstrated that the water stress-dependent responses of seed metabolism were similar to those of the plant, with a decreased abundance of transcripts encoding proteins associated with metabolism and cell expansion. Moreover, germination under water stress conditions was associated with increased levels of transcripts encoding heat shock proteins. Exposure of germinating seeds to water stress specifically affected the abundance of a small number of proteins, including heat shock proteins. Taken together, these data not only identify factors that are likely to play a key role in drought tolerance during seed germination, but they also demonstrate the importance of the female parent in the transmission of water stress tolerance. For more details of the research, refer to the published paper in the May 2020 issue of Plant cell & Environment and can be obtained at https://doi.org/10.1111/pce.13731

AGC protein kinase AGC1-4 mediates seed size in *Arabidopsis*

Seed size is a crucial factor to influence final seed yield in plants. Researchers identified a novel AGC protein kinase AGC1-4, which encodes a serine–threonine kinase, belongs to the AGC VIIIa subfamily. The seeds of agc1-4 mutant were significantly larger than that in the wild type. Overexpression of the AGC1-4 gene reduced seed size. Regulation of AGC1-4 seed size is dependent on embryonic cell number. To further determine AGC1-4 functions in seed size, we analyzed AGC1-4 phosphoproteins using label-free quantitative phosphor-proteomics coupled to the transcriptome of agc1-4 using RNA sequencing (RNA-seq). The RNA-seq analysis showed 1611 differentially expressed genes (DEGs), which cover a wide range of functions, such as cell cycle and embryo development. The 262 unique phosphoproteins were detected by phosphor-proteomics analysis. The differentially phosphorylated proteins were involved in cell cycle and post-embryo development. Overlay of the RNA-seq and phosphoproteomics results demonstrated AGC1-4 as an important factor that influences seed size by mediating cell proliferation and embryo development. For more details of the research, refer to the published paper in the June 2020 issue of Plant Cell Reports at https://doi.org/10.1007/s00299-020-02533-z

Identification of novel seed longevity genes related to oxidative stress and seed coat by genome-wide association studies and reverse genetics

Seed longevity is a polygenic trait of relevance for agriculture and for understanding the effect of environment on the ageing of biological systems. In order to identify novel longevity genes, researchers have phenotyped the natural variation of 270 ecotypes of the model plant, Arabidopsis thaliana, for natural ageing and for three accelerated ageing methods. Genome-wide analysis, using publicly available single-nucleotide polymorphisms (SNPs) data sets, identified multiple genomic regions associated with variation in seed longevity. Reverse genetics of 20 candidate genes in Columbia ecotype resulted in seven genes positive for seed longevity (PSAD1, SSLEA, SSTPR, DHAR1, CYP86A8, MYB47 and SPCH) and five negative ones (RBOHD, RBOHE, RBOHF, KNAT7 and SEP3). In this uniform genetic background, natural and accelerated ageing methods provided similar results for seed-longevity in knock-out mutants. The NADPH oxidases (RBOHs), the dehydroascorbate reductase (DHAR1) and the photosystem I subunit (PSAD1) highlight the important role of oxidative stress on seed ageing. The cytochrome P-450 hydroxylase, CYP86A8, and the transcription factors, MYB47, KNAT7 and SEP3, support the protecting role of the seed coat during seed ageing. The research was first published on 10th June 2020 in Plant Cell & Environment at https://doi.org/10.1111/pce.13822

EVENTS OF INTEREST

Stakeholders Dialogue on Way Forward for the Indian Seed Sector – A Road Map

A "Stakeholders' Dialogue on Way Forward for the Indian Seed Sector" was jointly organized by the Trust for Advancement in Agricultural Sciences (TAAS), a neutral Think Tank for strengthening agricultural research and innovation for development (ARI4D), and the Indian Society of Seed Technology (ISST) at NASC Complex, Pusa, New Delhi on 22 February, 2020 in which 65 eminent seed experts, administrators, policy planners, seed industry stakeholders and farmers participated.

The main objectives of the Dialogue were:

i) to discuss major constraints and find possible solutions for faster growth of Indian seed sector,

ii) to seek views of different stakeholders on the revised draft 'Seed Bill 2020',

iii) to suggest measures to strengthen seed health and quality assurance system in the country, and

iv) to review options for promoting seed export from India

During the dialogue, detailed deliberations took place on the global perspective for Indian seed sector, role of research institutions and public seed system, growth of the seed from private sector perspective; future of seed sector in Asia and the Pacific region; and the regulatory reforms required for growth of Indian seed sector. It was felt that private seed sector has made significant contributions to Indian agriculture in the past and is expected to contribute in future as well but to do so, it would require much needed and stronger partnership with public research institutions. The need for all out effort to increase India's share in global seed export market was recognized, wherein responsible partnerships and confidence building among stakeholders through enabling policy environment would indeed be vital. It was strongly felt that all the stakeholders would have to play a synergistic role and build mutual understanding to 'Serve the Farmer to Save Farming'.

In India, nearly 60-70 per cent of the seed requirement of farmers is primarily met through farm saved seed or the seed procured from informal sources. Making the quality seed of improved crop varieties available to farmers at the right time is thus a bigger challenge than production per se. Seed, being the principal input in determining productivity, its timely replacement need to be given high priority. Increasing the seed replacement rate (SRR), by using certified/quality seeds other than farm saved seed, is currently a major challenge. Though some progress in this regard has been made in the recent years, still we have a long way to go for making available quality seeds at the farmers' doorsteps. In order to harness the full potential of seed sector,

there is need to re-visit the existing policies and regulations, strengthen seed research, production and quality assurance systems, and explore the seed export potential expeditiously. To ensure faster growth in the Indian seed sector, the following Road Map was proposed based on detailed deliberations during the dialogue.

I. Revisiting the Policies and Regulatory Framework

The discussion on policies and regulatory framework centered around:

i) important suggestions needed for improvement in the draft New Seed Bill 2020;

ii) creation of an autonomous National Seed Registration and Promotion Board (NSRPB);

iii) regulations for ensuring quality of commercial seeds including truthful labelled (TFL) seed; and

iv) enabling policies including intellectual property (IP) regimes for scaling innovation in agricultural biotechnology, plant breeding and seed technology.

The important recommendations emerged were:

1. The regulatory system along the seed value chain should be judiciously and effectively implemented to ensure that quality seed reaches the small and marginal farmers at reasonable price and in time to enable them reap the full benefits of their yield potential. Regulatory system needs to be efficient and foolproof with no slow down in the release process. The Ministry of Agriculture and Farmers' Welfare (MoA&FW) has, therefore, to play a leading and coordinating role in harmonizing seed related regulations, both at the central and state levels.

2. The proposed registration of varieties/ hybrids in the new Seed Bill is indeed a welcome step. For this, the variety registration process has to be efficient and undertaken in time bound manner. Hence, for this it is recommended that a "National Seed Registration and Export Promotion Council" be created immediately. This council should have exclusive responsibility for the varietal registration based on conduct of independent trials by it and also the data provided by the developer concerned. The test period for value for cultivation and use (VCU) should not be for more than one year but must ensure multilocation testing under defined agro-ecological conditions (2 years testing should be only under exceptional cases), using the infrastructure facilities available with both the public and private R&D institutions/ companies.

3. The New Seed Bill 2020 proposes only fruit nurseries for registration. It is suggested that the word 'fruit nursery' be replaced by 'plant nursery' so as to include also the vegetable and other crops.

4. A distinction among the seed producer, processor and the seed dealer has been proposed in the New Seed Bill 2020, especially for the purpose of licensing. However, recognition of national level seed companies with R&D capabilities, variety evaluation system, seed production, testing and storage facilities is missing and hence be included. The accreditation of laboratories both under public and private sectors for seed certification and quality testing shall reduce pressure on the existing government system. Also, unique identification number (UIN) could be assigned under the National Registry System. All information relating to seed production, quality assessment and performance be recorded at the national level and shared with the State organizations. States within given agroclimatic conditions be asked to use the same UIN and allow sale of seeds under the same registration process.

5. Currently, a large percentage of seed is sold as truthfully labelled (TFL) seed. The provision of TFL seed is serving good purpose and hence it shall be permitted in the Act. However, provision of safeguards needs to be made

in the New Seed Bill 2020 so as to reduce the footprints of poor quality seeds sold by 'Fly by Night Companies'. As per Section 30 (1) of the proposed New Seed Bill 2020, seed certification is being proposed to be voluntary. This means that self-certification of the TFL seed category will continue and the challenge to ensure desired quality of such seeds would remain. Accordingly, the provisions in the guidelines would be necessary for self-declaration and accountability. As an incentive, the quality assured TFL seed of registered varieties produced either by public or private seed companies should also qualify to get seed subsidy. Subsidies in future be also linked to area coverage under new HYVs/hybrids so as to increase the productivity of different crops.

6. The New Seed Bill 2020 be based mainly on science-led evidences and guided by the principle of science with a human face. The legislation should give broad framework of the New Seed Bill 2020 and its implementation be based on mutual trust and data verification. The Act should create conducive environment for enhancing growth of seed sector both in private and public sector. The self-regulation should, in principle, be the key element of new seed bill. Laws under it need to be liberal with strict enforcement to build a strong seed system. It will also be desirable to create a platform for continuous dialogue with stakeholders to find solutions to the problems rather than entering into the legal battles.

7. The practice of seed price control by the Government, adopted lately, is serving as disincentive to the seed sector also affecting adversely the access to new innovation. This policy, therefore, needs to be re-examined. In fact, the provision of price control in the Act should be implemented only in exceptional situations that too under well defined guidelines by the Ministry of Agriculture and Farmers' Welfare (MoA&FW), Government of India, and not individually by the State Governments. In its absence, farmers are getting an impression that the seed companies are fixing seed price to exploit them and hence increasing their cost of cultivation.

8. Under the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, if a registered variety fails in its performance, farmers can file claims for compensation before the PPV&FR Authority. This provision is not included in the New Seed Bill 2020. Instead, it is proposed that the disputes on compensation shall be decided as per the 'Consumer Protection Act 1986'. Consumer courts are not so favourable to the farmers presuming that they are producers and not consumers. Moreover, under the New Seed Bill 2020, farmers are eligible for compensation if a plant variety fails to give expected results under the 'given conditions' which are invariably difficult to be defined. Seed companies on the contrary would try to justify that 'given conditions' were not provided/ensured by the farmers. Thus, invariably it would be difficult for the farmers to submit a claim and provide evidence in the consumer court thus leading to unresolved disputes. There is also likely possibility that the States may use this provision to penalize some seed companies even on grounds like delay in seed supply by a few days. The dialogue recognized full justification for powers to regulate seed price in emergent situations (such as seed shortage, abnormal increase in price, monopolistic approach, profiteering etc.) to remain only at the discretion of Central Government and not by the States. In nutshell, the mechanisms of addressing farmers' grievances should be simple, accessible and time bound.

9. Criminalization of violations and imprisonment may be categorized either as a major or a minor penalty and clear guidelines be defined for proper understanding by the State Government and all others concerned. Deliberate violations with intent to cheat the farmers may be categorized as an offence for heavy penalties with provision of compensation to the farmers

once proved through an assessment by the expert committee constituted mainly for the purpose. On penal provisions, the draft New Seed Bill 2020 differentiates the agronomic performance of the seed, the physical quality of the seed and the supply of spurious seed and consequently penalizes the offenders and prescribes punishment. It must be understood that all offences are not criminal. Thus, there is a need to differentiate between minor offences, unintended offences and major offences made intentionally. The best course would be to have a provision for compounding of minor offences. In view of above, the criminal penalties which impose imprisonment and fines would need to be re-visited. For example, the penalties for the first offence could be a monetary penalty only, whereas the subsequent offences may attract major penalties.

10. Under Section 14, the seeds of varieties imported for commercial use will have to be registered. The New Seed Bill 2020 does not make any provision for phytosanitary standards for the import of large quantity of seeds after pest risk analysis (PRA). This needs to be specified in the guidelines after the New Seed Bill 2020 is passed by the Parliament.

11. In the New Seed Bill 2020, 'farmer' means any person who owns cultivable land or any other category of farmers who are engaged in agricultural work as may be notified by the Central/ State Governments. Actually, 'farmer' includes the farmer himself or another person engaged in cultivation on behalf of the farmer. The New Seed Bill 2020 definition limits the farmers only to land owners. 'Any other category' is rather discretionary. Hence, clarification needs to be provided on other categories of farmers.

12. Under the proposed Central Seed Committee (Section 4-viii), the Director, ICAR-Directorate of Medicinal and Aromatic Plants Research (DMAPR) is also proposed to be a member which is not necessary since Deputy Director General (Crop Sciences) and Deputy Director General (Horticulture Sciences) are already included as members. Instead, ADG (Seeds), ICAR, who coordinates the production of Breeder Seed be included as a member of the Committee.

13. The New Seed Bill 2020 is silent on crop diversification which can help farmers in choosing alternatives for increasing income. Diverse crop varieties and different cropping patterns would demand diversity in the seed requirements. Hence, the New Seed Bill 2020 should ensure varietal as well as crop diversity, check the trend towards monopolization and provide space to different seed players to grow.

II. Strengthening Seed Research, Production and Quality Assurance Systems

For strengthening seed research, production and quality assurance systems, the discussion was focused on:

i) strategic areas for seed enhancement research;

ii) strengthening the system for seed quality assurance bringing precision in seed certification through accreditation of testing centers/laboratories and PQPs;

iii) increasing area under hybrids by providing a level playing field through public-private partnership (PPP) and performance and acceptance linked incentives; and

iv) strengthening of 'National Mission on Seeds (NMS)' to facilitate the seed sector through research and capacity building.

The following major recommendations emerged:

14. The national seed system must ensure smooth and timely flow of quality, genetically improved, healthy, safe, and need-based seed in adequate quantity from breeders' plots to farmers' fields. To ensure this, realistic state-wise and crop-wise five year rolling plans for breeder, foundation and certified seed-must be finalized keeping into consideration the desired improvement in seed replacement rate

(SRR) in different crops.

15. There is need to intensify research in a Mission Mode on seed quality enhancement technologies, including the seed priming, coating, pelleting, treatments with nano-molecules, micronutrients, plant growth regulators, biologicals and seed biomes; and identifying substitutes for micro-plastics in polymer coating. These should include standardization of effective protocols for seed quality enhancement, providing clear guidelines for commercialization of plant protection and non-plant protection seed treatment products, standardized procedures for disposal of treated seeds, and evaluation of new seed treatment molecules in PPP mode.

16. From the stage of release of a variety to its use, maintenance of varietal purity plays a critical role. Therefore, research on maintenance breeding in self and cross-pollinated species needs priority attention. Every research institute involved in crop breeding must establish a Maintenance Breeding Unit on the lines of IARI Regional Research Station, Karnal. This unit will also oversee the quality of Breeder Seed produced by the respective institutes/ university.

17. It will be highly desirable to build a reliable database on the current situation of seed production and availability in the country and prepare an effective seed plan for the next decade using Big Data Analytics tools. Data also need to be generated for actual availability and use of seeds by different public and private sector organizations.

18. There is an urgent need to have a full fledged 'National Mission on Seeds' by elevating the current Sub-Mission especially to accelerate the quality seed production, strengthening seed technology research, ensuring maintenance breeding, capacity building through short-term Diploma Courses to have required professionally qualified persons (PQPs) and establishing incubators in each of the State Agricultural Universities (SAUs). This would ensure seed-oriented entrepreneurship as well as attract and retain youth in agriculture - all contributing to the goal of doubling farmers' income (DFI). Under the Mission on Seeds, a provision need to be made for employing only the qualified Seed Technologists in each of the Krishi Vigyan Kendras (KVKs) to undertake and promote quality seed production and availability, Also, the Mission could target one accredited Seed Testing Laboratory in every district or at sub-divisional level.

19. In view of changing climate scenario, there is need to select the most suitable/alternate areas for high quality seed production. The Indian Minimum Seed Certification Standards (IMSCS) also need to be revisited particularly in case of vegetable crops, flowers and medicinal plants based on scientific data from multi locations. Seed testing protocols must also be upgraded on the lines of international protocols followed by the International Seed Testing Association (ISTA), Association of Official Seed Analysts (AOSA) and Organization for Economic Cooperation and Development (OECD) for better seed quality assurance and easy access to international seed trade. Since only a few ISTA accredited laboratories exist at present, there is an urgent need for accreditation through National Accreditation Board for Calibration Laboratories (NABL), International Organization for Standardization (ISO), etc. Use of biochemical and molecular markers including electrophoresis/ isoelectric focusing of proteins, isoenzymes and DNA fingerprinting involving first and second generation markers for establishing the distinctiveness of varieties, particularly the essentially derived varieties (EDVs). Lab based tests could also supplement the Grow Out Test (GOT) for genetic purity. Particular attention would also be required for distinguishing closely related and essentially derived varieties.

20. Focus is needed on development of user friendly molecular detection kits for fast and

accurate identification of varieties, hybrids, pathogens and genetically modified organisms (GMOs). With increasing biotechnological interventions in different crops and development of GM crops, research on seed certification, traceability, isolation distance from non-GM crops and cost effective kits for detection of transgenes by using micro-array chips and proteomic approaches have to be carried out. There is need for fiscal incentives like tax exemptions, advancing credit on soft terms, duty free import of equipment for R&D and seed processing; and infrastructure development through public private partnership.

III. Accelerating Seed Export Potential

For accelerating seed export potential, three important points discussed were:

i) creation of 'Seed Export Council (SEC)'and establishing special economic zones (SEZs);

ii) strengthening the system for seed quality assurance bringing precision in seed certification through accreditation of testing centers/ laboratories and PQPs; and

iii) increasing area under hybrids by providing a level playing field through PPP and performance and acceptance linked incentives were discussed.

The following major recommendations had emerged:

21. There is an urgent need for conducting 'scoping study' to identify country's strengths, assessment of need in the target countries for export, preferred products for exports etc. Such study would provide useful guidance to both public and private sectors to identify most potential export destinations. This will obviously help in identifying crops and country specific SPS requirements thus enabling an ease in seed exports.

22. In order to ensure production of good quality seeds/planting materials meant for export, the seed assurance and seed quality systems need to be revamped to match the international standards. For this, seed testing/ certification process should henceforth be exclusively through accredited laboratories/testing centers, be those under public or private sector institutions or those under private service providers. As already emphasized, seed companies of the national stature need to be recognized through a process of granting National Seed License. This will eliminate considerably the present need for obtaining licenses from each State, being a time consuming and tedious process. However, the manufacturing license for processing and packing of seeds from respective State Government could continue.

23. The Indian Agricultural Research Institute (IARI), National Bureau of Plant Genetic Resources (NBPGR), and any other institution under ICAR or the Ministry of Agriculture and Farmers' Welfare is presently not responsible for testing the seed samples of private companies meant exclusively for export although there are a few internationally/ nationally accredited laboratories to cater to this requirement. Therefore, there is an urgent need for highly competent human resource for crop inspection, especially for the export related seed production in defined zones.

24. The well defined seed testing protocols would help in promoting a forward looking, long-term seed export policy. The Dialogue did emphasize that current opportunity during an era of globalization should not be missed. To achieve this, an enabling policy environment is required to be created through a single-window system of clearance of export related proposals.

25. In view of emerging opportunities and the strength of Indian seed sector, time is ripe to promote seed export to various countries, especially in South Asia and Africa. In fact, the current contribution of India to the global seed

market is only one per cent which could easily be enhanced to five per cent in the next one decade provided a long term export policy is put in place. In this context, for ease of doing business, those varieties meant exclusively for export and not to be grown for commercial purpose within India could be exempted from the registration process. India needs dry port facilities with necessary infrastructure for which private seed sector could be invited to invest. These dry ports should have all modern warehouses, good seed testing laboratories and efficient processing and packaging facilities. Also there is need to streamline the guidelines for international movement of seeds to promote exports, including developing the framework for implementation of IPPC Standard ISPM 38 in India.

26. As emphasized already under recommendation '2', a National Seed Registration and Export Promotion Council be established on priority for undertaking activities relating to seed registration, certification, and export. This Council be entrusted with the responsibility to ensure:

i) variety registration process in a time bound and scientific manner,

ii) facilitation of an efficient seed certification system through creation of a network of accredited laboratories having competent human resource,

iii) promoting the use of seed of improved varieties by the farmers while increasing the seed replacement rate (SRR),

iv) building effective public-private partnerships (PPP)

v) regulating smooth quality seed movement both within and outside India. For accelerating the seed and other agricultural exports, the position of Agricultural Counselor in selected Indian Embassies abroad is fully justified and needs to be created.

SIGNIFICANT RESEARCH FINDINGS

Evaluation of Rice Genotypes for Direct Seeded Conditions

Rice transplanting is a time consuming, labor-intensive and arduous operation which is about 25 per cent of the total labour requirement for the crop production. Many farmers are shifting from transplanting to direct sowing. Therefore, increasing energy prices, limited water and labour availability for transplanting necessitates development of alternate production systems for rice. Genetic improvement is one of the most efficient approaches to develop rice cultivars suited to direct seeding. The varieties developed for conventional tillage system do not necessarily have the same performance and specific genotypes are recommended for no-till system. For such cropping system, vigorous modern rice cultivars are increasingly required, which would not only facilitate rapid seedling establishment under a wide range of field conditions but also have increased competitive ability against weeds. Development of varieties, which can resist moisture stress, is necessary for increasing overall water productivity. Efforts to identify the genotypes with specific traits for Conservation Agriculture and to develop genotypes responsive to direct seeding have been initiated. Experiments on reduced tillage dry direct seeding and puddled transplanted condition were conducted at Indian Institute of Rice Research, Hyderabad. Each year, a set of genotypes were screened under direct seeding as well as puddled transplanted conditions. More than 2000 rice genotypes consisting of germplasm, released varieties as well as genetic stocks were screened to identify promising genotypes with specific traits under field condition in alpha lattice design.

Differential response of genotypes for yield and yield components under direct seeding and puddled transplanted conditions was observed (Table 1). Under direct seeding, early maturity, reduced plant height and increased spikelet sterility was observed as compared to puddled transplanted flooded rice.

The per se performance of the genotypes varied under transplanted and direct seeded condition (Fig 1). Interestingly, some of the genotypes were found to be perform better under both conditions, while some of them exhibited superior performance under direct seeded condition and vice versa. The genotypes like Aathira, Swarna Prabha, S- 467, Kalinga II, S-147, S-194 etc. exhibited more than 10% yield superiority under direct seeding condition as compared to their performance under transplanted condition. It is interesting to note that some of the genotypes totally failed to perform under direct seeding condition either due to failure during initial emergence and crop establishment or remained stunted throughout the crop growth. The average yield under direct seeded condition was found to be 2822 kg/ha with yield range between 644 kg/ha (N22) to 5384 kg/ha (IET 22051: RP 5125-2-4) wheras, the yield range was between 2665 kg/ha (Panvel 3) and 5946 kg/ha (IURON 98) with an average yield of 4526 kg/ha under puddled transplanted condition. In the succeeding year, although there was significant yield reduction under direct seeding as compared to transplanted condition, some of the genotypes exhibited superior per se performance under direct seeding. The O. *glaberrima* introgression lines viz., RP 5219-9-6-7-3-2-1-1 (4856 kg/ha), RP 5125-2-4(5384 kg/ha), RP 5129-17-8-3-2 (3489kg/ha) recorded superior performance under direct seeding situation. In addition, the genotypes Kalinga II (4570 kg/ha), B644F-MR-6-0-0 (3645 kg/ha), Aathira (3906 kg/ha), Shakuntala (3847 kg/ha), Swarna Prabha (3782 kg/ha), IURON 82 (3678 kg/ha) etc. exhibited superior performance during all the years and seasons of testing. *Oryza rufipogan* introgression lines viz., S-467, S-478, S-194 also exhibited superior performance under direct seeded condition based on their performance per se. Under zero tillage direct seeded conditions also, the genotypes Aathira, IURON 26, IURON 73, Kalinga III and Swarna prabha were found to be promising.

In view of the increasing coverage under resource conservation technologies, crop improvement programmes need to be reoriented according to the demand of the changing situation. An efficient genotype having specific traits to direct seeding that could give added advantage to the growing plant and a clear understanding of the traits is needed as priority in breeding programmes is required. With continued breeding, future rice varieties will possess sufficient adaptation to resource conservation conditions such that they will consistently achieve yields comparable to the potential yield of conventional methods.

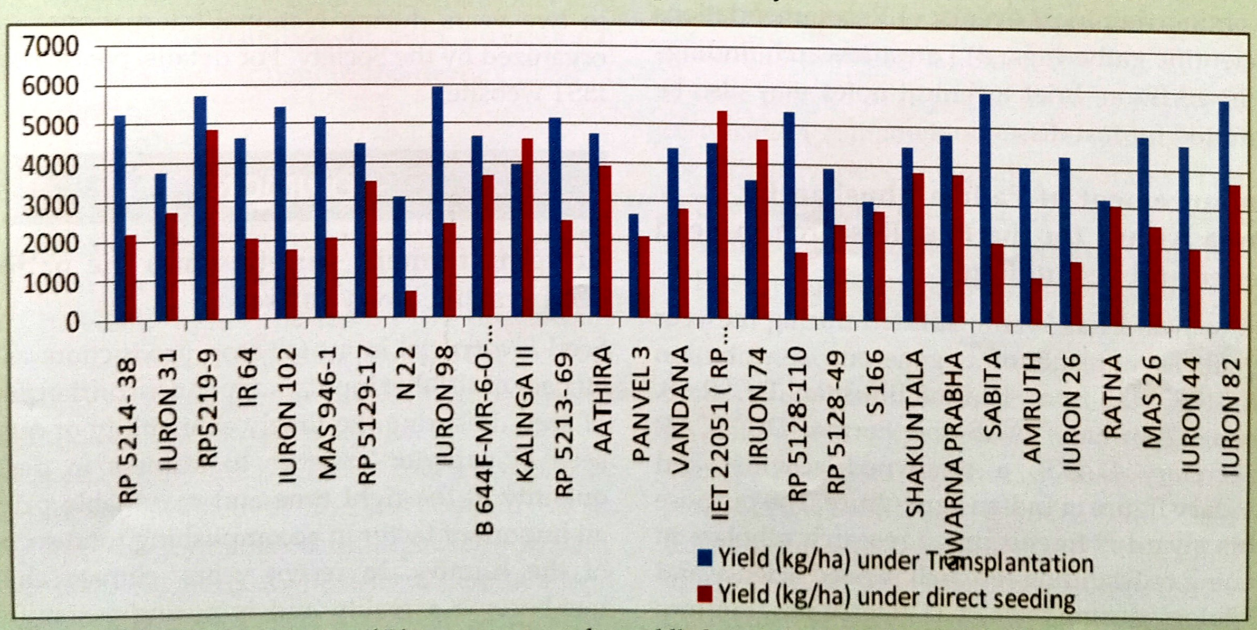

Fig 1: Differential response of Rice genotypes under puddled transplanted and direct seeding environments

Table 1: Summary of mean, range and SD under direct seeded and transplanted condition for various traits in rice genotypes

	Direct seeding condition				Transplanted condition			
Variable	Mean	Std Dev	Minimum	Maximum	Mean	Std Dev	Minimum	Maximum
FD	81.64	11.51	56.00	97.67	100.6	8.82	86.00	118.00
PH	89.53	16.22	65.00	123.67	99.69	18.77	66.60	147.67
SHB	11.03	3.32	7.05	26.06	17.03	3.15	9.40	24.53
NT	11.82	2.12	8.00	17.67	8.38	1.92	5.67	13.67
PT	8.93	1.22	6.00	12.00	6.21	1.18	4.33	10.33
PL	20.59	1.86	12.60	23.60	21.88	1.60	17.80	25.20
SPY	16.06	7.26	4.40	46.00	14.34	3.51	6.53	22.17
STERILITY	20.86	8.94	8.11	55.10	13.09	6.19	2.75	26.17
LA	20.20	6.68	12.54	38.58	40.96	8.38	26.93	63.99
LT	0.57	0.31	0.29	1.10	0.41	0.08	0.30	0.75
SLA	176.09	31.22	123.03	252.27	162.7	15.40	135.33	194.69
YIELD kg/ha	2822	244.01	644	5384	4526	174.5	2665	5946

FD- 50% flowering; PH- Plant height (cm); SHB- Shoot Biomass(s); NT- No. of tillers; PT- Productive Tillers; PL- Panicle length (cm); SPY- Single plant yield (g); Sterility-Sterility %; LA- Leaf Area (cm^2); LT- Leaf Thickness (mm); SLA- Specific Leaf Area and yield (kg/ha)

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ANNOUNCEMENT

All the ISST members are requested to contribute to various columns of Seed Tech News by providing information on a) Awards and Honours received; b) Upcoming trainings/ events; c) Recommendations of scientific gatherings; d) Latest research findings etc. In addition, brief technical notes may also be submitted for fast dissemination.

Announcement of Padma Bhushan Dr. R. S. Paroda Award for the Best Research in Seed Science and Technology

A new award has been instituted during the year 2019-20, as a result of a generous contribution of Rs. 200,000 from Padma Bhushan Dr. R. S. Paroda, Chairman, TAAS and Former DG, ICAR & Secretary DARE, a renowned scientist and legendary figure in Indian agriculture. The purpose of this award is to encourage research scholars in pursuing outstanding research in Seed Science and Technology during their Ph.D. degree programmes and to provide incentive for enhancing the quality of doctoral research in the field of seed science and technology. The award is meant exclusively for the doctoral thesis in Seed Science and Technology from any Indian University. This award, consisting of a cash grant of Rs. 10,000/-, a scroll of honour, a memento and a certificate, will be presented once in two years during National/International event organized by the Society. For details, please see the ISST website.

OPINION

Bringing farmers' varieties into the national seed system: a way forward

Seed is a crucial input for crop production, as the efficacy of all other inputs is dependent on the quality of seed. Ensuring the timely availability of quality seed of superior varieties to farmers in desired quantity at the right time and reasonable price is an important factor in accomplishing food security of the country. In recent years, climate change has become a reality and is posing a significant challenge to crop production and sustainability. In

this context, crop genetic diversity plays an essential role in sustaining crop productivity. The landraces and local farmers' varieties (FVs) are well adapted and suitable for climate-resilient agriculture due to their tolerance to biotic and abiotic stresses. Even though their yield levels are moderate to low than high yielding varieties, their adoption can help in yield stability and benefit small and marginal farmers from crop failure. These landraces are severely threatened by genetic extinction primarily due to their replacement by modern genetically uniform high yielding varieties.

The varieties that prove their value for cultivation and use (VCU) are released and notified as per Seed Act, 1966 and enter into the formal seed production chain. The PPV&FR Act, 2001 allows for the registration of FVs that conform distinctness, uniformity and stability (DUS) criteria. However, many FVs are unable to meet the DUS requirements. Although the Government has amended through regulation for the furtherance of PPV&FR Act implementation, stipulating that uniformity standard could be relaxed for FVs to allow double the number of off-types as otherwise permitted for registration of other categories of varieties. This act provides a balance between plant breeders' rights along with farmers' and researchers' rights and also recognizes the contribution of both professional plant breeders and farmers in the development of new varieties.

The category-wise analysis for granting of PVP certificates under the PPV&FR Act till 08 June 2020 revealed that 1721 FVs (41.9%) received PVP protection out of total 4106 protected varieties. The plant breeders' rights granted on FVs provide the exclusive right to produce and market the seeds of registered varieties, though Indian seed regulatory system does not promote commercialization of landraces/FVs. In India, a crop variety needs to be released and notified by the Government for its entry into the formal seed multiplication system. Thus, the FVs, need to be tested, released and notified under the existing system to bring them into the seed chain.

As a key step to restore crop diversity, FVs which perform better under various climatic stresses, have to be included in the standard seed supply system. Variety testing and release are critical elements in the formal seed system, consisting of the breeder, foundation and certified seed classes for quality assurance. Crop varieties developed under organized plant breeding programs usually pass through this process and thereby become eligible for seed quality control procedures, such as certification. Only certified seeds, multiplied through generation system of seed production are eligible for subsidies under various government schemes. However, this highly structured process discriminates against FVs that may have genuine merit but lack the official status to qualify for certification. Such discrimination may restrict the wider multiplication and distribution of promising FVs. To address these concerns, the plant variety testing system should accommodate FVs by initiating a new category of testing similar to EDV testing. Testing of specific quality traits is needed, instead of yield margins in identifying the FVs for release. Farmers' varieties with particular characteristics have a lot of demand from specific niches of society. However, the availability of quality seed is a major constraint to cater to their needs. Bringing the FVs into the seed-chain will solve this problem. Another critical issue of FVs is their genetic purity. The Indian minimum seed certification standards are to be maintained even for farmers varieties for quality assurance. Thus, the public sector organizations like SAUs and ICAR/CSIR Institutes can help in purification/maintenance of FVs through participatory purification approach. Breeder seed of those varieties can be produced under the supervision of committee involving plant breeder/seed technologist involved in purification of that variety, farmers who have registered that variety, Associate Director of Research of SAU, State Seed Certification agency, NSC, State Seed Corporation and representative from Department of Agriculture. Therefore, by allowing the FVs into the mainstream seed multiplication and distribution not only helps in maintaining crop biological

diversity but also encourages farmers to bred and preserve the highly critical landraces with unique traits for human health, taste, quality, resistance to pests and diseases and climate resilience.

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Seed Labelling requirements in India

Seed is the strategic input of agriculture. Among various inputs used during agriculture, seed is the primary input, and thus the usage of all other inputs depends on the seed chosen. The farmer will first choose to select his seed or crop before going for production. Once the seed is sown, he has to use all other inputs as per the standard requirement. In India, the seed regulation started with enacting the Seeds Act of 1966, which provided necessary legal provisions for quality assurance. The seed quality is assured through certification and by following generation system of seed multiplication.

Why is labelled seed present in India?

- In India, certification is voluntary. Even though seed certification ensures high-quality seed to the farming community, it is not made compulsory in India. Because, with the existing infrastructure and human resources, making available certified seed to all the clientele is very difficult in a vast agrarian country like India.
- The certification of seed production done exclusively by the state seed certification agencies is a time-consuming task due to limited infrastructure and delay in government procedures.
- The certification is restricted only to the notified varieties, which pass through the AICRP/similar system of varietal identification, release and notification. However, the AICRP system is not a fool proof system for the varietal identification as some of the national and mega varieties got rejected by the system. The alternate truthful label system allows for selling the seeds of promising varieties decided by the breeding institutes or private sector.
- To encourage the private seed sector for taking up research and development and make available their proprietary seed to the farming community, particularly in the absence of the plant variety protection system before 2001.

Importance of seed labelling

The declaration of quality of seed helps in identifying the suitable seed by the end-user. Labelling has been made compulsory in India to assure the quality declaration. Labelling is the most critical input for the regulatory system to ensure the quality of the seed. The self-regulation of quality through truthfully labelled seed helped in providing sufficient quantities of quality seed to the country's farming community.

Legal provisions of labelling

The information provided on the label must comply with the seed laws of the country. In India, the seed labelling is regulated as per the provisions of the Seeds Act, 1966, Seed Rules, 1968 and Seed control order, 1983 and respective amendments thereafter.

- The section 7, clause (c) of the Seeds Act, 1966 indicate that the container of the seed of any notified kind or variety under sale shall bear the mark or label as specified by the central government in accordance with the powers conferred by section 6, clause (b) of the Seeds Act, 1966.
- The section 7, clause (b) of the Seeds Act, 1966 indicates that the seed for sale shall conform to the minimum limits of germination and purity specified by the central government as per the section 6, clause (a) of the Seeds Act, 1966.
- Section 17, clause (b) of the Act, indicates that these labelling specifications shall apply to the notified seed during import and export.

The seed rules of 1968 elaborate the above sections dealing with labelling. Rule 7 explains the responsibility for labelling and marking. Rule 8 deals with contents of the label as specified by the central government along with the weight of the seed packet, date of testing, specific statements if the seed is treated, name and address of the person who sells the seed and name of the seed as notified under section 5 of the seed act. Most of the seed sellers print the labelling specifications on the seed

packet directly instead of attaching a label as per the provision provided in rule 9 which allows to print or paint or mark the packing with the labelling specifications.

Based on the powers vested with the central government as per section 6, clause (b) of the Seeds Act, 1966, the label specifications were notified in the gazette vide S.O.767 (E) dated 6th November, 1991. Later amendments were made vide S.O. 519 (E) dated 10th July 1992, S.O. 939 (E) dated 4th September 2002, and S.O. 124 (E) dated 2nd February 2005. Thus, the final label specifications are,

Label specifications:

(1) Label size: 15 x 10 cm
(2) Label contents:
(i) Label No.
(ii) Kind
(iii) Variety
(iv) Lot No.
(v) Date, month and year of test
(vi) Valid up to
(vii) Germination (minimum) --- %
(viii) Physical purity (minimum) --- %
(ix) Genetic purity (in case of variety) (minimum) --- %
(x) Weight
(xa) Recommended for cultivation - Name of the states or union territories and season
(xi) *Name of the chemical used for seed treatment, if seed is treated
(xii) Name and address of the person who offers for sale, sells or otherwise supplies the seed

(3) The colour should be a close match to opaline green (ISC No. 275 of IS-5)

Note: (a) *If seed is treated and the substance is harmful to human beings and other vertebrates, the following statement shall be printed on the label: "Do not use for food, feed and oil purposes". If mercurial and similar toxic substances are used the word "POISON" shall be prominently displayed on the label.

(b) If the label is to be fixed on a smaller container, the label's size may be reduced proportionately by maintaining the same length and breadth ratio and contents.

Whether labelling specifications are compulsory for the truthfully labelled seed and e-marketed seed?

The label contents notified by the central government in 1991 and later amendments in 1992, 2002 and 2005, as detailed above, are applicable only to the notified varieties. The non-notified seed sold in the market, mostly by the private sector, is not covered under the Seeds Act, 1966. To regulate the seed sale and hoarding of the seed, the seeds (control) order of 1983 was passed on 30th December 1983 under the Essential Commodities Act, 1955, which made seed an essential commodity. To regulate the quality of non-notified seed the central government with an amendment to the seeds (control) order vide G.S.R. 444(E) dated 26th July 2006, added clause (8A) which says that the dealers shall ensure seed standards as prescribed for the notified varieties under section 6 of the Seeds Act, 1966 and additional standards relating to size, colour and content of the label as specified. Further with an amendment to Seeds (Control) order vide G.S.R.547(E) dated 2nd June 2017, the e-marketing and e-marketer dealing with seeds will also come under the purview of this order. Thus, from 2006 all the seed (including non-notified seed) under sale and from 2017, even the e-marketed seed shall comply with the labelling specifications similar to the notified varieties.

Difference between label and tag

The terms tag and label are often used interchangeably by most scholars/ seed producers/ researchers/ students, but they are not. The term tag is specific to the seed certification agency's docket and is limited to the foundation and certified class of seed in India. The label is the docket that contains the information as specified by the central government through its gazette notification under section 6 of the Seeds Act, 1966. In the generation system of seed multiplication, the breeder seed also contains a golden yellow docket which is nothing but a label. But the breeder seed label is different from the label mentioned in the gazette as some of the contents and colour are different.

D. Vijay, DSST, ICAR-IARI, New Delhi

ANNOUNCEMENT ABOUT ADDRESSES

Names of the ISST members whose postal addresses need to be updated/verified

In the recently held election of ISST office bearers, many of the ballot papers were returned back to Returning officer because of outdated postal address. The list of some of the members of ISST whose addresses need to be updated is given below. All these members are requested to send updated addresses to the Secretary, ISST.

S No.	Name of Members
1	Dr. P.C. Bhatt
2	Dr. B.L. Soni
3	Dr. S.D. Raikar
4	Dr. U.S. Chandrashekar
5	Dr. Rajiv Rai
6	Dr. K. Vanangamudi
7	Dr. M.N. Karuna
8	Dr. B.K. Dharmaraju
9	Dr. K. Nataraju
10	Dr. N.C. Banerjee
11	Dr. S.V.R. Rao
12	Dr. B.L. Sharma
13	Dr. N. Ghose
14	Dr. N.K. Bora
15	Dr. R.K. Prasad
16	Dr. U.S. Prasad
17	Dr. Rafi Ullah Khan
18	Dr. (Mrs) Aruna Kumari
19	Dr. A.K. Dixit
20	Dr. K. Goswami
21	Dr. J.S. Grewal
22	Dr. A.K. Jain
23	Dr. K.C. Katyal
24	Dr. Umesh Kumar
25	Dr. Anup Kumar
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62	Dr. B. Gopal Singh

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