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Editorial

Integrating Modern Technologies for Sustainable Rice Production Under the Backdrop of Climate Resilient Agriculture

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Global requirement of rice is expected to be about 280 million tons produced over the next 30 years and feeding more than 9 billion people by 2050 will require a doubling of production on a sustainable basis. The sustainability of rice production is facing challenges due to indiscriminate over lifting of groundwater in flooded rice culture, leading to arsenic contamination in irrigated rice ecology, global climate crisis, emission of greenhouse gases, faulty soil, water and fertility management in rice paddies.

Under such a backdrop, there is an urgent need for a paradigm shift in technological intervention for sustainable rice production under the backdrop of a shrinking resource base and global climate anomaly. Crop production methodologies like System of Rice Intensification, Direct Seeded Rice Technology, Aerobic Rice Culture, Mechanized Rice Farming are emerging agronomic production system which use much less agricultural inputs, energy and crop can be established and raised in non-puddle, non-flooded fields to address water crisis, reduction of methane emission, arsenic calamity for mitigating climate crisis under the backdrop of climate resilient agricultural production system. Ecological Intensification platform as futuristic agronomic research for minimizing agricultural inputs and maximization of output through developing a highly productive rice based triple cropping system should be an important arena of research for rice scientists, policy makers and associated stakeholders.

Although there are great opportunities for rice culture under diversified agro-ecosystem, shifts in production technologies bring about specific nutrient deficiency posing challenges in nutrient deficiency or micronutrient malnutrition in the human food chain. Site specific precision nutrient management, intervention of modern tools for nutrient analysis, optimal fertilizer doses, and agronomic interaction with nutrient supply play a pivotal role in Integrated nutrient Management. The nutritional profile of rice can be improved through intervention of bio-fortification to alleviate micro-nutrient malnutrition and combating hidden hunger. Nano-fertilizers have emerged as a promising alternative offering enhanced nutrient bioavailability, restricting losses in agroecology, precise delivery and improved stress tolerance and nanotechnology is rapidly expanding in rice crop management for sustainable crop production. Exploring rice metabolomics will help to characterize biochemical signatures of different rice germplasm and the diversity of metabolites in rice reflects nutritional profiling, abiotic, biotic stress response and can be used as an important omics tool for identification of rice metabolism.

There is an utmost need for implication of cutting-edge molecular tools like gene editing deploying CRISPR/Cas9, that can create precise changes to increase plant disease resistance and to combat stress faced by the crops. The use of Artificial Intelligence (AI), Machine learning for monitoring crop health and implication of disruptive technologies in Agriculture 4.0 like IoT, Robotics, Big Data Analytics, Drone technology are transforming rice production sector towards resilience, more productive and sustainability. Research on interaction between plants and microorganisms will facilitate the role of rice crop associated microbiome for disease suppression and management. Phyto-hormones and their role in plant defense signaling pathways and hormonal regulation in plant immunity as explored may be a sustainable tool in disease management.

Implications of Eco-friendly pest management encompassing judicious cultural practices, habitat manipulation maintaining structural and cultural diversity, utilization of herbivore induced plant volatile, landscape management for conservation of natural enemies and application of ecological engineering, bio-botanicals, and nano-pesticides are some of the modern interventions in rice pest management for sustaining production.

So it is high time for concerted research in rice science for improvement in stable genotypes deploying the available breeding technologies involving even genomics and proteomics, trait based approach with precise understanding of the target environment for cultivation and adaptation including the temporal and spatial heterogeneity for the use of roots and dehydration avoidance traits for improved drought resistance, flash flood tolerance, tolerance to salinity and alkalinity, transgenic, C4 metabolism with transgenic crosses, soil management and bio-fortification to ameliorate nutritional deficiencies, intervention of micro-irrigation practices, integrated crop management with emphasis on weed management with due consideration on eco-physiological approach, herbicide resistance, tolerance and Integrated pest and disease management.

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