Proceedings of 5th International Group Meeting
Climate-Proofing Cereal Agriculture: Strategies for Resilience and Sustainability

Cereal agriculture is a cornerstone of global food security, providing sustenance for billions of people worldwide. However, the escalating impacts of climate change pose significant threats to cereal crops, thereby challenging food production and livelihoods. The 5th International Group Meeting (IGM) on Climate-Proofing Cereal Agriculture: Strategies for Resilience and Sustainability was held ICAR-Indian Institute of Wheat and Barley Research (IIWBR), Karnal March 27-29, 2024 to address these challenges and to come out with the solutions to these challenges. The meeting was conducted under six thematic themes viz., *Theme I: Conventional breeding, biotechnology, bio-informatics, genetic engineering, phenomics, genomics and proteomics for cereal improvement, Theme II: Mitigation Strategies for abiotic stress management in cereal crops, Theme III: Biotic Stress dynamics under changing environments, Theme IV: Cereal quality, nutrition, post-harvest processing, value addition and marketing for food safety and global nutritional security, Theme V: Climate change mitigation strategies, resource management, conservation agriculture, integrated farming for sustainable cereal production system and Theme VI: Industry Linkages and Agri-Business for Food and Nutritional Security*. Speakers from foreign and Indian institutions participated in this meeting and gave their lectures through online and offline mode as lead/keynote speakers. In total, there were 179 presentations, out of which 37 were oral presentations and the rest of them were poster presentations. The following recommendations were made during the scientific deliberations of different sessions.

Recommendations

Session 1: Conventional breeding, biotechnology, bio-informatics, genetic engineering, phenomics, genomics and proteomics for cereal improvement

1. Phenomics and genomics are integral components of modern cereal breeding programs, so it is recommended that these should be used as complementary tools for trait characterization, genetic discovery, and crop improvement as their integration accelerates the development of high-performing cereal cultivars that address the challenges of sustainable agriculture and food security in a changing world.
2. CRISPR technology is revolutionizing cereal improvement by offering precise and efficient methods for targeted genome editing. It should be applied for trait modification, accelerated breeding, functional genomics, and more, paving the way for the development of improved cereal cultivars with enhanced productivity, resilience, and nutritional value.
3. Diversity in wheat and barley needs to be enhanced by the utilization of wild relatives and landraces; this must be a long-term strategy and work should be focused in this direction. Wild genotypes should be utilized for the introgression of novel genes for various biotic/abiotic stresses and quality traits into cultivated bread and durum wheat using modern molecular breeding tools.
4. Genotyping of diverse panels should be done to tag the key genomic regions associated with climate resilience traits.
5. Integration of new tools like molecular breeding, genomics, gene-editing with conventional plant breeding should be done to develop climate-resilient varieties.

6. Developing high malt quality barley genotypes meeting the requirements of the malt industry.

Session 2: Mitigation Strategies for abiotic stress management in cereal crops

1. Researchers should prioritize traits and objectives in cereal studies to generate large-scale data, which will support the development of artificial intelligence tools for field applications.
2. There is a need to investigate the use of cost-effective phenomic tools for precise phenotyping in field conditions across different crops.
3. Developing high-throughput phenotyping platforms is essential for rapid and accurate assessment of traits under abiotic stress, which will aid in identifying genes linked to desirable characteristics.
4. The role of Rhizosheath and its associated biota should be examined in various crops to create advanced strategies for mitigating abiotic stress.
5. Focus should be placed on identifying QTLs associated with biotic and abiotic stress tolerance and utilizing marker-assisted selection (MAS) to transfer these QTLs to agronomically superior genotypes.

Session 3: Biotic stresses in changing climatic scenario

1. The effectiveness of resistance and susceptibility to crop pests is influenced by environmental factors. Therefore, resistance genes that perform well under increased temperatures should be identified and incorporated into high-yielding cereal cultivars.
2. Climate change will continue to be a significant issue, with temperature increases potentially leading to diseases such as Fusarium Head Blight (FHB) and blights, while cooler conditions may exacerbate threats like stripe rust and powdery mildew in wheat and barley. Other cereals may also face challenges like leaf spots, blight, mildews, and blast due to shifting climates. Consequently, ongoing disease and pest surveillance is crucial, and disease epidemiology should be reassessed in light of changing climate conditions.
3. Given the negative impacts of pesticides on human and animal health and their environmental pollution, an integrated approach to disease management, supported by epidemiological data, should be promoted to address major disease issues under changing climate conditions.
4. There is a need to identify diverse sources of rust resistance and the mechanism of their utilization for combating cereal rusts under changing climate scenarios.
5. Multi-institutional collaboration and interdisciplinary research in breeding are recommended to address biotic stresses and the impacts of climate change on crop productivity.

Session 4: Cereal quality, nutrition, post-harvest processing, value addition and marketing for food safety and global nutritional security

1. Hidden hunger, specifically deficiencies in iron and zinc, is a critical global issue that requires immediate attention.
2. It is crucial to develop wheat genotypes enriched with iron and zinc by leveraging genetic variability to improve food security and combat malnutrition.
3. The wild relatives of wheat should be investigated for their potential to either reduce or increase celiac disease toxicity.
4. Advanced technologies such as high-throughput imaging should be employed to enhance screening methods for large populations.

Session 5: ***Climate change mitigation strategies, resource management, conservation agriculture, integrated farming for sustainable cereal production systems***

1. Compiling data from long-term studies is necessary because they are essential for comprehending how different agricultural techniques affect crop productivity, soil health, and the sustainability of eco-systems. These long-term studies aid in the decision-making of scholars, farmers, and policymakers in the development of long-term, profitable agricultural systems. Conservation agriculture helps in mitigating the climate change effect and sustainable crop production. Genotypes should be bred for conservation agriculture by involving agronomists and plant breeders.
2. Effective strategies to combat climate change include smart agriculture techniques like conservation agriculture, diversification, precision farming, resilient crop varieties, and micro-irrigation. It is crucial to focus on educating farmers about these methods.
3. Additionally, traditional cereal production systems contribute significantly to greenhouse gas (GHG) emissions. To combat climate change, it is important to leverage carbon credits by encouraging farmers to adopt practices that lower GHG emissions. Conservation agriculture, which enhances carbon sequestration, could serve as a valuable approach for earning carbon credits.
4. To address herbicide resistance in weeds within the rice-wheat cropping system, it's essential to develop effective resistance management strategies that combine alternative herbicides with non-chemical weed control methods.

Session 6: ***Industry Linkages and Agri-Business for Food and Nutritional Security***

1. Strengthening public-private partnerships and the commercialization of newly released varieties is crucial. Utilizing strategies such as the 5D Seed Model (Development, Deployment, Dissemination, Distribution, and Dividend) can accelerate the adoption of these varieties and enhance their benefits for farmers.
2. There is a need to develop high-yielding durum wheat varieties specifically suited to the North-Western Plain Zone. This is important because industries are currently sourcing durum wheat from central India, leading to higher transportation costs.
3. Greater focus should be placed on exporting wheat-based products rather than exporting whole wheat grains.

The proceedings are issued with the approval of President, SAWBAR.

Dated: 4th April, 2024

(Poonam Jasrotia)
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