Guest Editorial

Special Topic: Rice Breeding

Rice breeding: never off the table

Jiayang Li

There is no doubt that rice is the most important staple food on Chinese dining-table. Among all forces driving rice yield, breeding of new elite varieties is always regarded as the major one. For decades, under intense pressure of food security, Chinese researchers have been chasing high-yield rice varieties as their major task, and great achievements have been made in feeding 21% of world population with 7% arable land in the world. Although the food supply satisfies current demands in China, the decrease in arable land, increase in population, and loosening one-child one couple policy leave us no time to relax. The global crop yield needs to be increased by more than 50% by 2050. More importantly, the global climate changes, exhausting water resources, overuse of chemical fertilizers, pesticides and herbicides, demands for high quality and nutrition, and severe diseases and pests, all are challenges we have to face, raising requirements for breeding super crop varieties within decades.

To meet these challenges, tremendous efforts have been made by Chinese and global scientists. The brand new level of decoding rice genetic information makes it possible to guide rice breeding in solving these problems. In this special topic, we aim at the up-to-date activities in rice research and breeding. In an interview, Qifa Zhang, one of the leading scientists in rice genetics, gives an intimate discussion on recent research progress, rice yield potentials, main breeding objectives, and genome editing and its commercialization in rice breeding. In the perspective by Bin Han, the authors discussed how the rice domestication studies at the genome level could benefit in understanding gene function, identifying elite alleles, and helping modern rice breeders. Besides DNA coding proteins, deeper understanding in genetic contents and their regulation have been found with the novel technologies, and the review article by Xiaofeng Cao introduced recent advances in the epigenetic regulation in rice, which covers cutting-edge results in DNA and histone modifications and variant non-coding regulating mechanisms.

Environment and genetic are two major factors in determining rice yield and quality, and the crosstalk between them is of great complexity. The research on genes related with environment stress can benefit rice breeding on broader farming location and yield stability. The research highlight by Hongxuan Lin discussed the new findings in molecular mechanisms underlying rice adaptation to chilling recently published in Cell by Kang Chong, which makes a breakthrough step in this area. Furthermore, this special issue also discussed the grain starch formation, which is largely influenced environmentally by temperature, causing reduction in rice yield and grain quality under globe warming. In the perspective by Makoto Matsuoka, the authors went through the rice starch metabolic pathways and discussed newly identified genetic components involved in high temperature-induced chalkiness. Besides abiotic stresses, a variety of pathogens could also infect different parts of rice plants and cause various diseases. The review article by Guoliang Wang focused on defense system in rice, which has briefed the regulatory mechanisms for rice against pathogen infection and discussed the novel strategies for breeding disease-resistant rice.

With more and more rice genetic information available, a modern breeding strategy of rice is proposed, which defines a more active way for breeding, from selecting observed traits to selecting the genes determining these traits. In the review article by Qian and his colleagues, the authors have summarized the achievements of rice breeding and new challenges that we are facing. Based on these, authors have discussed the future model of elite rice breeding by taking the advantages of genetic knowledge in increasing and stabilizing yield and quality. However, future rice breeding need integrate knowledge and technologies from different areas, including genetics, genomics, bioinformatics, breeding, crop planting, and other related areas. These will set higher requirement for intimate cross-border collaboration, more innovation, and interdisciplinary talents training.

As the guest editor of this special topic in rice breeding, I would like to thank all of the authors, reviewers, and NSR editorial staffs for their dedication that made this special topic possible. To ensure the ‘rice bowl’ is full of rice, breeding high-yield superior-quality of new elite rice varieties is never off the table, and I sincerely hope that rice scientists and breeders will accomplish greater, new achievements in understanding the mechanisms underlying agronomic traits and applying them in agriculture.

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