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Bringing genomics to the wheat fields

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Recent progress in plant genomics has the potential to initiate a new "Green Revolution." However, these discoveries need to be implemented in commercial varieties to bring this potential to the grower's fields. Recent progress in molecular genetics has resulted in the development of DNA tags, which can be used in Marker-Assisted Selection (MAS) strategies for cultivar development. These molecular markers can be used as chromosome landmarks to make the selection of useful agronomic traits easier. This technique is particularly useful for genes that are highly affected by the environment, genes for resistance to diseases for which screening is difficult, and as a means of accumulating multiple genes for resistance to specific pathogens and pests within the same cultivar, a process called gene pyramiding. Cultivars developed by MAS are not considered transgenic or genetically modified organisms (GMOs) and, therefore, don't face the public resistance seen with transgenic crops.

MARKER ASSISTED SELECTION CAN ACCELERATE WHEAT IMPROVEMENT PROGRAMS

PUBLIC WHEAT BREEDING AND GENOMIC RESEARCH IN THE USA

Wheat is a self-pollinating species and, therefore, growers can save part of the grain from one harvest to use as seed the next year. This has limited the profitability of wheat breeding for the private sector and continued public sector involvement in cultivar development. Public breeding programs developed approximately 60 percent of the cultivars released in the United States during the 20th century.

During the last decade wheat researchers developed powerful genomic

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resources used to clone important agronomic genes and to find molecular tags closely linked to other valuable genes. One efficient way to develop positive synergy between the government supported research and grower's investment in public wheat breeding is by implementing MAS technologies in public breeding programs. The MASwheat project is an initiative that has empowered wheat breeders to accelerate the transfer of valuable genes into public wheat cultivars using modern molecular technologies.

MASwheat: A public MAS program

At the end of 2001, a national wheat MAS consortium including wheat molecular geneticists and breeders from 12 public programs across the United States was begun. The overall goal of the MASwheat project is to transfer resistance genes to fungi, viruses, and insect pests, and genes to improve bread, pasta, and noodle qualities into 75 cultivars and improved wheat lines that are adapted to the main U.S. production areas. Two generations of crosses are advancing per year. Eight generations are required to complete the introgression.

All the information generated by MASwheat is available at http://MASwheat.ucdavis.edu/. MASwheat activities have resulted in seven scientific publications and 23 presentations in grower's meetings, field days and symposiums that have contributed to improving the public understanding of the benefits of biotechnology. MASwheat has also created an integrated network of breeders and researchers across the country facilitating the transfer of knowledge and germplasm.

Impact

The genes incorporated into the different wheat classes will improve quality and resistance to pathogens in wheat cultivars across the United States. However, new races of pathogens appear every year and new resistance genes must be incorporated and pyramided into continuously improved cultivars. The challenge for public wheat breeders and government research agencies will be to generate the integrated proposals and funding to continue incorporating additional valuable genes into these new cultivars. Worldwide competition for the high-quality wheat markets is growing. Other countries, such as Australia, have developed large MAS programs to help their breeding programs develop the cultivars needed to conquer these markets. Most new wheat genomic information is publicly available and, therefore, the speed in which this technology is incorporated into the local breeding programs will determine the degree of competitiveness. This represents both a challenge and a fantastic opportunity for those U.S. public wheat breeding programs with the expertise to successfully utilize MAS technologies.

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