Barbara Mazur

A research leader at a major agrochemical company comments on the application of biotechnologies in commercial crop science.

Barbara Mazur, a long-time employee of Dupont and its Pioneer Hi-Bred business (Wilmington, DE), currently heads their biotech research strategy for Dupont Agricultural Biotechnology. In the following interview, she reflects on the technological advances from the past five years and emphasizes the synergies between conventional methods and modern molecular technologies in creating the crops of the future.

What kinds of technological challenges remain in agbiotech?

Barbara Mazur: For transgenic crops, we still use fairly blunt approaches to express genes. The more we can refine expression technologies, the better transgenic products can be. Another need is for a better understanding of gene networks and the gene interactions that can dampen transgene efficacies. Genomics advances have changed our understanding of the corn genome: corn lines can have deletions and insertions relative to each other, and the genome itself is dynamic. As we increase our use of next-generation sequencing technologies, we'll be able to refine our understanding of the functional roles of genes, and of epigenetics and intergenic sequences in regulating gene expression.

When will we see crops with complex traits that benefit consumers?

BM: There's widespread work on drought tolerance, which may require combinations or sets of genes to create effective traits. Groupings of native and transgenic genes could lead to improved traits. For example, we have developed a maize hybrid [Optimum AQUAmax hybrids], which carries a native trait for drought tolerance and can be combined with drought-tolerance transgenes. A soybean line that I'm excited about is Plenish [containing an extra copy of the soybean fatty acid desaturase gene (*gmFAD2-1*)] high-oleic soybeans, which we anticipate being launched next year upon regulatory approvals. These soybeans have 75% oleic acid, which is a monounsaturated, healthy oil. Plenish soybeans have optimized functional properties for foods and can be used in environmentally friendly industrial applications.

Why has the introduction of the high-oleic soybean taken so long?

BM: The high-oleic soybeans were made with a single transgene, but trait deregulation took many years because regulatory requirements have been continually changing. Regulatory requirements are not harmonized globally, and developing a more standardized deregulation process would enable products to reach consumers faster.

Which advances from the past five years do you regard as key?

BM: The use of DNA markers has made a tremendous difference for native and transgenic trait introductions and for breeding. Often, a native trait of interest can be accompanied by yield drag. By identifying markers that flank the trait, breeders can move the trait into high-yielding germplasm without the flanking deleterious genes. Over the past decade there has been a thousand-fold increase in molecular marker use at Pioneer. Another breeding technology that's been particularly important is the use of doubled haploids. Haploid seeds can be genetically induced from diploids and then chemically converted to genetically pure, or homozygous, diploid lines. Significant improvements in both the technologies to produce the haploids and to double the haploids have occurred, and have changed corn breeding timelines. The number of pure lines that we have created as doubled haploids in recent years equals all the lines that we developed in the previous 80 years.

What other biotechnologies are being used in R&D?

BM: Agriculture is benefiting from advances in the field of small RNAs. We can now use microRNAs to control gene expression and double-stranded RNAs for pest protection. We routinely use association genetics for native-trait identification, and a number of automated spectroscopy and imaging technologies for functional-genomics studies. Information management systems, and bioinformatics and computational biology tools are critical to the successful application of all these technologies. We've also been using gene-shuffling technologies to introduce diversity into trait genes. Genes are shuffled and variants selected in parallel: the *gat* [glyphosate *N*-acetyltransferase] herbicide-tolerance gene had almost no activity before gene shuffling, but enzyme variants with increased detoxification activity were produced in successive shuffling rounds.

Can technology address emerging insect resistance in *Bt* crops?

BM: We have developed a 'refuge in a bag' product for insect control, which simplifies insect refuge requirements for the farmer by carrying a mixture of the trait seeds and refuge seeds in a single bag. With integrated seed refuge products, the grower doesn't have to stop planting the *Bt* corn and switch to planting the non-*Bt* refuge product in a separate plot.

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How can we foster adoption of valuable agbiotech crops in developing countries?

BM: I worked with the Gates Foundation [Seattle] in setting up the IMAS [Improved Maize for African Soil] Project. I was impressed with the way the Gates Foundation researched possible projects to ensure that they met important societal needs and could be successfully completed, and also ensured that program objectives and milestones were in place to track progress. I'd also like to comment on the importance of intellectual property [IP] protection, which allows companies to realize a return on their investments that can support future research programs. In countries with good IP protection, we feel more comfortable adding research and commercialization programs. India, for example, has strengthened IP protection, and we have recently established a large DuPont research center in Hyderabad.