

Academic Training of Plant Breeders No Longer Meets Demand

The reduced number of public breeding programs and breeders being trained at public institutions is well documented and was the subject of a symposium at Michigan State University in March 2005. Although there are at least 47 Land Grant Universities offering plant breeding graduate programs in the United States, seven (University of Wisconsin, North Carolina State University, University of Nebraska, Cornell University, University of Minnesota, Iowa State University and Texas A&M) produce 50 percent of the graduates. The majority of these are in the Midwest and only three offer programs in horticulture.

Concomitantly, the decline in public plant breeders is most apparent in horticultural crops with a 20 percent decline reported from 1983-1989. Studies in the 1990s indicated that 65 to 75 percent of plant breeders work in the private sector, of which the majority (80%) is focused on cultivar development. In contrast, 59 to 88 percent of U.S. Department of Agriculture (USDA) or other public breeders are engaged in germplasm improvement or plant breeding research. Interest in the private sector in breeding higher value horticultural crops and large market field crops has increased, leaving mainly lower value commodity crops, such as wheat, or minor crops to be bred by the public sector. Nonetheless, due to the relative sizes of the seed markets, 70 percent of plant breeders work with field crops. Overall, there has been an increase in demand for plant breeding with attractive salaries ranging from \$39,000-48,000 for breeders with bachelors degrees to \$115,000-135,000 for those with PhDs.

Funding for plant breeding programs and education has been decreasing consistently at U.S. public institutions, possibly due to the perception that cultivar development is being addressed by the private sector. The difficulty of maintaining public breeding programs has led many universities to replace breeders with biologists and molecular

geneticists, thus reducing the number of training opportunities and critical mass needed to train breeders.

The expectations for breeders in public and private sectors are different, yet interdependent. Breeders in the public sector must focus on teaching, securing extramural funds, and publishable research in addition to germplasm and cultivar improvement. Often public breeding programs are partially supported by funding from related basic research activities. In contrast, breeding in the private sector demands an active lifestyle with global travel, teamwork and responsibilities for business planning and intellectual property (IP) rights in addition to breeding and cultivar development. The paradoxical result is that education based on public experiences and careers can be vastly different than the skills and knowledge needed for the majority of plant breeders who work in the private sector.

ALTERNATIVE TRAINING NEEDED

The situation described above is not all negative, as the demand for breeders is actually increasing and the positions are rewarding. In addition, the demand to efficiently produce improved cultivars has expanded the range of jobs associated with breeding programs, including pathologists, entomologists, molecular biologists, food chemists, and marketing and legal experts. The definition of plant breeding is evolving from "the application of genetic principles and practices to the development of individuals or cultivars more suited to the needs of humans" to include activities in molecular genetics, genomics for manipulation of quantitative traits and populations, business and marketing strategies, intellectual property (IP) protection and globalization. Both public and private breeders require the same fundamental training, but the priorities and ancillary skills required differ. Alternative approaches to supporting education and

training for plant breeding are needed to serve this evolving need.

The best training programs will combine expertise from both private and public sectors. Some institutions are currently re-evaluating their breeding programs to include internships, non-degree programs or programs specifically designed for professionals. Practical experiences, such as field trips and mentorship programs, are important to attract students and allow them to experience real-life situations. Including private sector representatives on curriculum committees ensures that graduates are prepared to meet industry requirements and expectations. Although the basics of genetics, statistics, crop physiology and plant protection remain essential to plant breeding training, new topics like molecular tools, IP protection, data management, economics, and global communications must be integrated as well.

In evaluating curricula, universities must ask themselves if they have a critical mass of faculty to offer the breadth of courses needed to train plant breeders. Joint programs where a group of universities can each offer complementary courses on a rotational basis should be considered as is done in Argentina, for example. Developing such cross-sector programs will foster better relationships and funding opportunities to train breeders. IP protection has been mentioned as a barrier for such relationships, but IP issues are routinely handled with material transfer agreements and research agreements among private and public entities, and future breeders should become familiar with them. Many public breeding programs currently have collaborative germplasm improvement programs with private companies. For example, the USDA Coordinated Agricultural Projects require both private and public sector input to define goals for the transfer of information from genomics and molecular biology to applied breeding programs for a specific species or plant family. This community-building exercise and fund-

ing opportunity can be extended to the training and support of plant breeding students.

Finally, as methods and approaches improve over time, on-going training for professional plant breeders is required to update and expand their skills and knowledge. Various institutions offer short courses or training sessions targeted toward specific techniques or methods. A more comprehensive approach is the UC Davis Plant Breeding Academy (<http://sbc.ucdavis.edu>), a two-year course targeted to breeding personnel (e.g., technical breeding staff or breeders' assistants) in the private sector, who may lack the full range of plant breeding, genetics and statistical knowledge to advance as independent plant breeders. The timing of the course is designed so that participants can maintain their positions and attend the course in one-week intervals over the two-year period. This provides an alternative to the usual sequence of education in public institutions followed by further training and experience in the private sector. The Plant Breeding Academy provides an opportunity for people already employed in breeding or breeding support programs to enhance their education.

The long-term trend of decreasing numbers of public breeding programs and increasing demand for breeders from the private sector is unlikely to be reversed in the short term. A range of strategies, employing different educational approaches based on cooperation within and among both public institutions and private companies, will be required to meet this challenge.

Authors' note: Some of the above information was summarized from N. Guner and T.C. Wehner (2003, *Crop Science* 43: 1938-1944) and reports from the symposium "Plant Breeding and the Public Sector: Who Will Train Plant Breeders?" in March 2005 (www.hrt.msu.edu/PBSymp/Default.htm). 

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