

Coordinating Committee: Sustaining the Future of Plant Breeding

Duration: October 01, 2015 to September 30, 2020

Administrative Advisor(s): Eric Young

NIFA Rep: Ann Marie Thro

Statement of Issue(s) and Justification:

Ensuring the long-term sustainability of agricultural production to supply a burgeoning global population with food, feed, fiber, fuel, green space, and shelter presents an unprecedented challenge. Climate change and heightened competition for diminishing land, water, and nutrient resources add to that challenge. New cultivars having greater yield of economic product with better quality profiles and resistance to a variety of biological and environmental stresses are an essential and proven component for meeting the demands for a plentiful and sustainable supply of plant products.

The recent integration of plant breeding and genomics-derived technologies has revolutionized plant breeding, resulting in increased breeding efficiency and effectiveness. Capitalizing on this opportunity requires human capacity in plant breeding and access to enabling knowledge, technologies, germplasm, infrastructure, and programmatic support (Miller et al., 2010; Tester and Langridge, 2010). There is a primary role for public sector investment in this capacity and infrastructure, as the time-scale of germplasm conservation and evaluation, population development, and selection (“the long arc of research”, Carter et al., 2014) falls outside of the shorter timeframes under which most businesses operate. Deficits in any of the key human, germplasm, and infrastructure categories can severely limit the success of plant breeding, whether in the public or private sector. Knowledge of the current national plant breeding capacity, therefore, is essential to identify opportunities, needs, or emergencies where plant breeding efforts are below capacity to meet future challenges.

As the foundation of plant breeding, genetic diversity serves as the basis for development of locally adapted, high yielding cultivars that are critical for providing livelihood resilience and food and nutritional security. Therefore, it is essential that the U.S. and international communities conserve, characterize, and provide access to diverse germplasm for plant breeding. Agreements such as the International Treaty on Plant Genetic Resources for Food and Agriculture govern the transfer and flow of germplasm and can either help or hinder cultivar development. There is cause for concern over the status of U.S. germplasm collections, as there is a strong perception that resources for evaluation of collections have been stagnant and little new germplasm is entering the system. Data supporting or refuting these perceptions is not currently available. In addition to conserving and accessing germplasm, it is important to explore new methods for efficiently integrating and maintaining genetic diversity in breeding populations, to take advantage of valuable alleles without compromising the potential for future genetic gain.

Access to germplasm for plant breeding has become more complex and regulated. Intellectual Property Rights (IP or IPR) have limited access to privately controlled germplasm and have

become a common component of public plant breeding programs in the U.S., often for economic reasons. Thus, there is a need to determine the best management practices for obtaining and managing IPR. Identifying these practices will help public university administrators and scientists understand how IPR are viewed across the U.S. and how individual institutions develop such policies relative to plant patents, utility patents, and plant variety protection. Of equal importance is how individual institutions protect pre-cultivar germplasm lines or other genetic material relative to disclosure and determining its value to the public. These concepts not only affect the institution, but also can provide barriers that affect how others can access germplasm in the U.S. and around the world. Does the protection have a royalty stream associated with it or is it for some other purpose? Treaties and Material Transfer Agreements (MTAs) that only allow research but not cultivar development can slow progress which will be required to meet the needs of a global population expected to exceed nine billion in 35 years. Some standardization of IP may be beneficial to ensure and increase genetic gain in all crops.

Public and private sector plant breeders have a long history of working together in education and research to meet common goals, but this collaboration can be enhanced. Plant breeding companies are concerned about maintaining the supply of graduates from U.S. universities with proper education and training in plant breeding (Gepts and Hancock, 2006; Guner and Wehner, 2003; Repinski et al., 2011). This concern relates to both the quantity and quality of plant breeding students. Public-private collaborations also provide a mechanism to foster innovation of new tools for plant breeding that are essential to the evolution of this science for providing a safe, reliable and sustainable supply of human-driven plant products. Finally, public-private collaborations provide a means to pool funds for breeding innovation aligned to private industry customer needs.

Previous work:

The Plant Breeding Coordinating Committee (PBCC) was established in 2006 as the Southern Region Coordinating Committee 80 (SCC80). A CC is an approved coordinating committee within the federal-state partnership established to work cooperatively “to solve problems that concern more than one state” (SAES Directors et al., 2006). The purposes of the PBCC were to raise awareness of plant breeding’s contributions to the U.S. economy and to strengthen plant breeding infrastructure and education capacity. In response to the need for a public outreach and advocacy capability, the National Association of Plant Breeders (NAPB) was created in 2008 as an initiative of PBCC. In 2010, NAPB became an independent entity. Whereas NAPB embraces the entire scope of plant breeding, including both private and public sectors, PBCC focuses on issues facing public plant breeding at land-grant universities. The core membership of PBCC consists of representatives of State Agricultural Experiment Stations (SAES) that have plant breeding programs.

In addition to creating the NAPB, the PBCC has issued several ‘white papers’ that analyzed topics of concern to plant breeding, including ‘Breeding Crops for a Healthier Population’, ‘A Safe and Secure Food Supply’, and ‘Plant Breeding and Rural Development in the United States’. The PBCC has also provided input to the USDA Listening Session on Plant Breeding, coordinated responses to USDA leadership on the Plant Breeding Roadmap and coexistence of agricultural production systems, and compiled public plant breeding success stories that demonstrated the impact of federal funding.

This renewal proposal is based on the continuing need for an organized group focused on sustaining SAES plant breeding programs. As public programs within the land-grant university system, they (1) are essential providers of plant breeding education; (2) make invaluable contributions to breeding methodologies and germplasm enhancement; and (3) are especially critical for both germplasm enhancement and cultivar development for specialty crops having little or no private sector investment. In addition, as a coordinating committee, the PBCC fills a unique role in communicating with USDA and other federal agencies on issues of national importance concerning plant breeding. In the other direction, PBCC leadership disseminates information to and initiates discussion with its representatives in the various states. The need for this role in coordination and dissemination of information will be ongoing into the foreseeable future, given the complexity of the issues discussed above, and, no doubt, issues yet to come.

First-line stakeholders for this committee are public and private plant breeding organizations and the growers they serve. Ultimate beneficiaries are domestic and international consumers of food and other plant products, who will benefit from increased quantity, quality, and sustainability of supplies.

Objectives:

1. Collect, analyze, and disseminate information about the U.S. plant breeding effort in both public and private sectors, to include human capacity and access to enabling knowledge, technologies, germplasm, and infrastructure.
2. Promote the conservation, characterization, and utilization of plant genetic resources and access to those resources for plant breeding.
3. Identify Best Management Practices for public sector intellectual property protection to encourage the creation and distribution of improved crops for a broad range of needs and opportunities.
4. Optimize opportunities for public-private collaboration in plant breeding research and education, including continuing education for plant breeders.
5. Foster communication among public plant breeders and federal agencies on public policy issues, including alerts to existing and emerging threats to agricultural security that are relevant to plant breeding.

Procedures and Activities:

An annual meeting will be held, usually in conjunction with a partner organization, to exchange information, plan and coordinate activities, and review progress towards meeting the committee's objectives. Between annual meetings, communication will take place through email, online discussion groups, and conference calls, as needed.

Since all PBCC activities depend on voluntary member contributions, progress toward achieving the objectives will depend on the level of input from participants. It is envisioned that for each of the objectives a subcommittee or task force will be formed to focus on the following activities:

1. Breeding capacity survey

- Partner with the NAPB, CSSA, ASHS, ASTA, and NCCPB (see External Linkages for acronym definitions) to survey U.S. plant breeding capacity with regard to human capital and access to enabling knowledge, technologies, germplasm, and infrastructure. The study will include the following components that will allow the information obtained to be directly comparable with the comprehensive study of Frey (1996): (1) employer category (USDA, University, and Private), (2) crop, and (3) ongoing plant breeding activity (basic plant breeding and genetics research, germplasm enhancement, and cultivar development). New questions will be included to evaluate plant breeders' access to enabling knowledge, technologies, germplasm, and infrastructure.

2. Genetic resources

- Request that this committee be granted liaison status on the National Plant Germplasm Coordinating Committee as a mechanism for assessing and making recommendations on the National Plant Germplasm System.
- Coordinate with partner organizations to promote robust national and international plant germplasm systems and initiatives, encompassing both major and minor crops. This may include development of a science-based position paper on the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) relative to public plant breeding programs.
- Review and discuss new methods for unlocking the potential of genetic resources for crop improvement, including the use of non-elite germplasm and practices for managing genotypic and phenotypic data. This will be accomplished through online discussion groups, where strategies can be shared and knowledge gaps identified. Knowledge gained from these discussion groups can be shared more broadly through white papers and co-sponsoring symposia on exploiting genetic diversity in crop improvement with organizations such as AAAS, CSSA, NAPB, ASPB, and ASHS, and/or at the Plant and Animal Genome Conference. A long term goal will be to develop a set of best practices regarding the use of non-elite germplasm.

3. Intellectual property

- Survey SAES Directors with plant breeding programs to determine different approaches and models used to manage IP, whether the models vary by crop, and whether there are legal issues associated with the models chosen.
- Develop a position paper on science-based Best Management Practices from the SAES survey results obtained.
- Provide science-based recommendations on IP protection of released and unreleased plant breeding germplasm.

- Seek partnership with ASTA and NCCPB to include a liaison member from this coordinating committee on appropriate NCCPB committees.

4. Public-private collaboration

- Promote collaborative models of graduate education in plant breeding, for example through internships at private companies or increased private support for graduate assistantships.
- Analyze and develop recommendations on core competencies for plant breeding students.
- Encourage development of collaborative research proposals between public universities and organizations such as ASTA – for example, public-private matching proposals for funding by FFAR (Foundation for Food and Agriculture Research) on a topic of complementary interest.

5. Communication

- Provide input to USDA representatives, SAES Directors, and other officials on key policy issues related to plant breeding. This will include advising on funding mechanisms and competitive grants programs, and alerting officials to emerging threats to agricultural security that are relevant to plant breeding.
- Improve communication among members of this coordinating committee on technical and policy issues related to plant breeding.
- Collaborate with NAPB to share information with the general public on the value of public plant breeding programs.

Expected Outcomes and Impacts:

1. Breeding capacity

- Survey conducted and results disseminated on U.S. plant breeding capacity.
- Increased awareness of national opportunities, needs or emergencies where plant breeding effort is below the needed capacity.

2. Genetic diversity

- Liaison status granted for this coordinating committee on the National Plant Germplasm Coordinating Committee.
- Analysis provided for the International Treaty on Plant Genetic Resources for Food and Agriculture.
- Symposia organized on exploiting genetic diversity in crop improvement, co-sponsored with organizations such as AAAS, CSSA, NAPB, ASPB, ASHS, or Plant and Animal Genome.

- A set of best practices developed for incorporating favorable alleles from non-elite germplasm into breeding populations.
- Recommendations provided on how best to organize and share genotypic and phenotypic information associated with plant germplasm.

3. Intellectual property

- Better understanding of the divergent ideas associated with IP issues, and the extent to which germplasm is protected for major and minor crops.
- Improved awareness among decision makers of the need for availability of diverse germplasm for plant breeding programs.
- Improved communication among all plant breeders, public and private, through partnerships with ASTA and the NCCPB to ensure the availability of major and minor crop germplasm.

4. Public-private collaborations

- Number and quality of plant breeding graduate students maintained or improved.
- White paper or journal publication produced on core competencies for plant breeding students.
- Public-private collaborative research proposals developed and funded.

5. Communication

- Input provided to USDA representatives, SAES Directors, and other officials on key policy issues related to plant breeding.
- Improved communication among committee members to formulate coordinated responses on plant breeding issues.

Project Participation:

In addition to designated representatives from SAES (Appendix E), who are the voting members of the committee, we will invite participation from anyone interested in furthering the objectives of this committee. This will include persons from public (e.g., USDA-ARS), private, and non-governmental organizations, from the U.S. and other countries. We will especially reach out to plant breeders at 1890 Land Grant Universities.

Educational Plan:

Information obtained or generated through this project will be shared regularly through presentations and discussions at the annual meeting, peer-reviewed publications, and white papers written on selected topics. Information will also be communicated with USDA via interaction with the NIFA representative.

Governance:

Standard governance for multistate research activities will be followed. Officers will include a Chair, Vice-Chair, and Secretary. Each year at the annual meeting the Vice-Chair will become the Chair for the coming year, and the Secretary will become the Vice-Chair. Prior to the annual meeting, nominations for Secretary will be solicited and an election held by email to ensure broad participation. Sub-committees or working groups will likely be needed to achieve some of the objectives while distributing the workload among a larger number of participants. Administrative guidance will be provided by an assigned Administrative Advisor and a NIFA Representative.

Literature cited:

Carter, T.E., Jr., W.F. Tracy, T.R. Sinclair, T.G. Isleib, and R. Joost. 2014. What is the state of public cultivar development? Proceedings of 2014 Summit on Seeds and Breeds for 21st Century Agriculture, p. 54-73. Available at <http://rafiusa.org/docs/2014SummitProceedings.pdf>.

Frey, K.J. 1996. National Plant Breeding Study – 1: Human and financial resources devoted to plant breeding research and development in the United States. Special Report 98 Iowa Agriculture & Home Economics Expt. Station.

Gepts, P., and J. Hancock. 2006. The future of plant breeding. *Crop Science* 46:1630-1634.

Guner, N., and T.C. Wehner. 2003. Survey of US land grant universities for training of plant breeding students. *Crop Science* 43:1938-1944.

Miller, J.K, E.M. Herman, M. Jahn, and K.J. Bradford. 2010. Strategic research, education and policy goals for seed science and crop improvement. *Plant Science* 179: 645-652.

Repinski, S.L., K.N. Hayes, J.K. Miller, C.J. Trexler, and F.A. Bliss. 2011. Plant breeding graduate education: Opinions about critical knowledge, experience, and skill requirements from public and private stakeholders worldwide. *Crop Science* 51:2325-2336.

State Agricultural Experiment Station Directors; Natl. Institute of Food and Agriculture, USDA (NIFA); Experiment Station Committee on Organization and Policy (ESCOP). 2006. Guidelines for Multistate Research Activities.

<http://escop.ncsu.edu/docs/MRF%20Guidelines%20Revised%2008%201%20513.pdf>

Tester, M., and P. Langridge. 2010. Breeding technologies to increase crop production in a changing world. *Science* 327:818-822.

Attachments: None

Internal Linkages:

State Agricultural Experiment Station Directors
State reps appointed by SAES Directors

External Linkages:

American Association for the Advancement of Science (AAAS)

American Seed Trade Association (ASTA)
American Society for Horticultural Science (ASHS)
Crop Science Society of America (CSSA)
National Association of Plant Breeders (NAPB)
National Council of Commercial Plant Breeders (NCCPB)
National Plant Germplasm Coordinating Committee (NPGCC)
Regional Germplasm Coordinating Committees, such as NC7, S9, W6
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