

AFRI Classical Breeding Analysis and Recommendations

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National Organic Coalition
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*“The greatest service which can be rendered any country is to add a useful plant to its
[agri]culture” - Thomas Jefferson*



Summary

Despite a clear mandate from Congress and significant public input, the USDA National Institute for Food and Agriculture (NIFA) and previously the Cooperative State Research and Education Service (CSREES) has failed to provide real funding for development of public cultivars and animal breeds.

Background Issue

The last several decades have seen a steady decline in development of new publicly available plant varieties and animal breeds. Although classical breeding provides the most cost effective way to develop new publicly available breeds and cultivars, both public and private institutions are failing to direct research dollars to this critical work. It is estimated that it costs approximately one million dollars to develop a new plant through classical breeding and that genetic modification may cost as little as five million dollars, and as much as sixty million dollars¹

This shift away from breeding for publicly available cultivars and breeds has been closely tied to strengthened intellectual property rights and the now widespread practice of patenting new plant and animal varieties. Private funding has been redirected to other technologies such as genomics, and the scientists have followed. Since scientists in the private sector have little incentive to develop public cultivars and breeds, it up to our public institutions to fill this role. Yet our public institutions are failing to provide this public good.

The impacts of these shifts are significant and are a key factor in our narrowing pool of publicly available germplasm. Lack of agricultural diversity undermines national food security and agricultural stability. Encouraging more uniform agriculture makes our crops are more vulnerable to disease and pests. We are also handicapping our ability to adapt to climate change and related changes in precipitation. We are creating an agricultural system that is less agile in responding to economic trends, possibly hindering our global competitiveness. By failing to diversify our crops and livestock, we are failing consumers looking for foods that meet their nutritional needs and taste preferences, and failing farmers looking for locally suitable varieties of plants and animals. Organic farmers and others that rely on markets where GMOs are prohibited or undesirable are particularly affected as they now have fewer choices for commercially available seed.

This shift away from classical breeding has led to deterioration of capacity in our research institutions, including land grant universities. There has been a decline in the number of plant breeders at the State Agricultural Experiment Stations, plant breeding departments at universities are being closed, and we have seen a correlating decline in graduate students being trained in

¹ Goodman, Major M., New Sources of Germplasm: Lines, Transgenes, and Breeders, Department of Crop Science. North Carolina State University Raleigh, NC 27695

classical breeding methods making it even more difficult to assure our future in this critical scientific field.

The role of the AFRI program in reinvigorating the investment in private sector plant and animal breeding is critical. Addressing obstacles for classical breeders to be competitive is essential to ensuring a diverse and globally competitive food supply

Congressional Mandate

Recognizing the concerns about the decline in public plant and animal breeding, Congress has called on the USDA time and again to make funding for classical plant and animal breeding a priority within the USDA competitive research grant programs. Specifically, Congress has included report language calling on the USDA to prioritize classical breeding in most of the annual appropriation bills in recent years. For example:

Fiscal Year 2005 Senate Report language: *Classical Research.--The Committee notes the substantial increase in public and private sector research related to genomics, genetics, and other breakthrough biotechnology developments. However, this shift in emphasis has resulted in a decline in classical research in the animal and plant sciences. The Committee encourages the Department, especially in the establishment of priorities within the National Research Initiative, to give consideration to research needs related to classical plant and animal breeding.*

Fiscal Year 2006 Senate Report Language: *Classical Research.--The Committee notes the substantial increase in public and private sector research related to genomics, genetics, and other breakthrough biotechnology developments. However, this shift in emphasis has resulted in a decline in classical research in the animal and plant sciences. The Committee encourages the Department, especially in the establishment of priorities within the National Research Initiative, to give consideration to research needs related to classical plant and animal breeding.*

Fiscal Year 2007 Senate Report Language: *Classical Research.--The Committee notes the substantial increase in public and private sector research related to genomics, genetics, and other breakthrough biotechnology developments. However, this shift in emphasis has resulted in a decline in classical research in the animal and plant sciences. The Committee encourages the Department, especially in the establishment of priorities within the National Research Initiative, to give consideration to research needs related to classical plant and animal breeding and directs the Department to establish a specific category of grant application requests for classical plant and animal breeding to foster more diverse, energy efficient, and environmentally sustainable agricultural systems.*

Fiscal Year 2009 Senate Report Language: *Section 7406 of the Food, Conservation, and Energy Act of 2008 specifies priority areas within the newly created Agriculture Food and Research Initiative [AFRI], including an emphasis on conventional (classical) plant and animal breeding.*

The Committee strongly concurs with the intent of this section, and requests a report from the agency as to its plans for implementing the intent of this important conventional/classical plant and animal breeding requirement.

Fiscal Year 2010 Senate Report language: *“The Committee recommendation includes \$296,681,000 for the Agriculture and Food Research Initiative [AFRI]. Section 7406 of the Food, Conservation, and Energy Act of 2008 specifies priority areas within the Agriculture and Food Research Initiative [AFRI], including an emphasis on conventional (classical) plant and animal breeding. The Committee strongly concurs with the intent of this section, and requests a report from the agency as to its plans for implementing the intent of this important conventional/classical plant and animal breeding requirement.”*

Such previous recommendations from Congress were seemingly ignored, in 2008 Congress included explicit language in the Food, Conservation, and Energy Act of 2008 (aka the 2008 farm bill) by listing “conventional” breeding within both the “Plant Health and Production and Plant Products” and the “Animal Health and Production and Animal Products” priority areas of AFRI:

“conventional breeding, including cultivar and breed development, selection theory, applied quantitative genetics, breeding for improved food quality, breeding improved local adaptation to biotic and abiotic stress, and participatory breeding.”

Congress further elaborated on these statutory changes in the Statement of Managers which accompanied the bill:

“The Managers are aware of the importance of supporting public sector conventional plant and animal breeding, as evidenced by the specific mention of this priority under the “plant health and production and plant products” and “animal health and production and animal products” priorities in AFRI. The Managers intend that the term “conventional breeding,” also known as “classical breeding,” refer to breeding techniques which rely on creating an organism with desirable traits through controlled mating and selection. Because conventional breeding is critical to the development of seeds and breeds that are well adapted to local conditions and changing environmental constraints, these efforts are important to the food and agriculture sector. The Managers are aware that participatory breeding programs, where producers are involved in the process of developing new plant varieties and animal breeds, yield varieties and breeds that are better adapted to local environments. The Managers encourage an emphasis on funding of conventional plant and animal breeding as part of the new AFRI.”

Public Input

The sustainable agriculture community has been communicating with the USDA about this issue for years, participating in public comment periods, submitting letters, and scheduling meetings with key REE agency staff. Some examples of letters and written comments are below and attached:

- *September 19, 2008:* Sustainable Agriculture Coalition letter to Dr. Hefferan following USDA Listening Session on AFRI recommending AFRI establish two new national programs for conventional plant and animal breeding beginning with the FY 09 RFA.
- *September 24, 2008:* National Organic Coalition (NOC) comments to CSREES on the Agriculture and Food Research Initiative (AFRI) newly authorized in the 2008 Farm Bill regarding the provisions of the Act which specify conventional plant and animal breeding as a priority area of research within AFRI.
- *September 2008:* Union of Concerned Scientists stakeholder comments to CSREES on the Agriculture and Food Research Initiative (AFRI), urging significant funding for classical breeding.
- *April 13, 2009:* Memo to Carol Jett from UCS, NSAC, and OFRF, in follow up to a request made for additional information on the groups' recommendations for classical breeding.
- *May 31 2009:* National Sustainable Agriculture Coalition letter to Research, Education, and Extension Office (REEO) Directors recommended the USDA REEO Roadmap include increased coordination and major investments in classical plant and animal breeding.
- *September 11, 2009:* National Sustainable Agriculture Coalition written comments on fiscal year 2009 AFRI RFA strongly recommended that two new, separate national programs for conventional plant and animal breeding be established within AFRI, beginning with the FY 10 RFA.
- *September 14, 2009:* Sign-on letter regarding the implementation of the Cooperative State Research, Education, and Extension Service (CSREES) Agriculture and Food Research Initiative (AFRI), as authorized by the 2008 Farm Bill. Signed by: Rural Advancement Foundation, International, National Organic Coalition, ACTIVE, AERO, MT, California Climate and Agriculture Network, Carolina Farm Stewardship Association, Chemung County Council of Churches, Classic Organic, Cornucopia Institute, Crawford Stewardship Project, Ecological Farming Association, Edmonds Institute, Florida Organic Growers, Food and Water Watch, Food for Maine's Future, Friends of ETC Group, Frog Farm, Greenpeace, High Meadows Farm, Institute for Responsible Technology, Just Food, NY, Midwest Organic and Sustainable Education Service, National Family Farm Coalition, National Sustainable Agriculture Coalition, North American Limousin Foundation, Northeast Organic Farming Association of Connecticut, Northeast Organic Farming Association of New York, Northeast Organic Farming Association of Massachusetts, Ohio Ecological Food and Farm Association, Old Solar Farm, Oregon Physicians for Social Responsibility, Organic Farming Research Foundation, Organic Seed Alliance, Organic Seed Growers and Trade Association, Organic Trade Association, Peacework Farm, Rainy Creek Farm, Rocky Mountain Farmers Union, Safe Alternatives for our Forest Environment, The Nature Institute, Union of Concerned Scientists, Washington Biotechnology Action Council, Washington Sustainable Food and Farming Network, Wood Prairie Farm, and an additional 43 individuals.

- *December 7, 2009* In a letter to Dr. Beachy, specific recommendations for Establishment of AFRI Conventional Plant and Animal Breeding Programs were offered by the National Organic Coalition, National Sustainable Agriculture Coalition, Organic Farming Research Foundation, Seeds and Breeds for the 21st Century Coalition, and Union of Concerned Scientists.
- *January 27, 2010:* Letter to Secretary Vilsack, copied to Dr. Kathleen Merrigan, Deputy Secretary; Dr. Molly Jahn, Acting Under Secretary; Dr. Roger Beachy, NIFA Director signed by the National Organic Coalition, National Sustainable Agriculture Coalition, Organic Farming Research Foundation, Rural Advancement Foundation International, and Union of Concerned Scientists urging segregated funding streams in the FY 10 RFA for conventional plant and animal breeding.
- *April 13, 2010:* Union of Concerned Scientists submits written comments for the USDA workshop on stakeholder priorities in the area of Plant and Pest Biology recommending NIFA play a more active role in reinvigorating breeding of public cultivars.
- *June 7, 2010:* Union of Concerned Scientists submits written comments in response to the June 2, 2010 AFRI stakeholder meeting recommending the AFRI FY11 RFA fund classical breeding through a funding line distinct from genomics and other technologies.
- *September 24, 2010:* National Sustainable Agriculture Coalition (NSAC) letter to Secretary Vilsack regarding a resolution adopted at the NSAC meeting. One of the points in the resolution was that the USDA AFRI needed to increase classical breeding for public cultivars and that this work should be funded through a separate RFA.
- *November 24, 2010:* Letter to Catherine Woteki, (USDA Under Secretary for Research, Education and Economics), regarding the importance of the Agriculture and Food Research Initiative (AFRI) investments in classical plant and animal breeding, signed by the National Organic Coalition, National Sustainable Agriculture Coalition, Organic Farming Research Foundation, Organic Trade Association, Rural Advancement Foundation International, and Union of Concerned Scientists.

Meeting and public listening sessions where concerns about the need for greater focus on classical breeding were expressed include:

- *September 2008:* NOC and UCS met with CSREES Administrator Colleen Hofferan to discuss specific recommendations for increasing competitive grant funding for classical plant and animal breeding.
- *September 15, 2008 AFRI listening session:* Sustainable Agriculture Coalition and National Organic Coalition made comments that addressed the need for classical plant and animal breeding.
- *June 2009:* Meeting with USDA Under Secretary Rajiv Shah – NOC presented him with the 2005 Seeds and Breeds report and had an in-depth discussion of the need for increased public investment in classical breeding.
- *September 2, 2009:* UCS met with Mary Peet, the NPL for Organic Agriculture, to discuss current research needs including classical breeding.
- *November 19, 2009:* UCS staff met with Maura O'Neill, Chief of Staff to USDA Research, Education, and Economics Under Secretary Rajiv Shah, and Jill Auburn, Under Secretary Shah's Advisor on Sustainability to discuss three research areas, one of which was the need for increased investment in classical public plant and animal breeding.

- *November 24, 2009*: NOC, OFRF and NSAC meeting with Molly Jahn to discuss classical breeding needs.
- *January 6, 2010*: Sustainable and organic agriculture groups met with REE Undersecretary Catherine Woteki specifically to discuss classical breeding, concerns with the AFRI RFA, and possible solutions.
- *April 13, 2010*: At a USDA research stakeholder meeting, UCS presented on its priorities which included classical breeding.
- *June 2, 2010*: CSREES AFRI Stakeholder listening session comments by the Organic Farming Research Foundation, the National Sustainable Agriculture Coalition, the Union of Concerned Scientists, and the AFRI Coalition, all urged stronger emphasis on classical breeding.
- *November 29, 2010*: NSAC and OFRF met with REE Undersecretary Catherine Woteki and discussed the need for classical breeding, among other things.
- *December 3, 2010*: USDA Under Secretary for REE Woteki Stakeholders Session
- *December 9, 2010*: NSAC and OFRF met with Roger Beachy, NIFA Director, and discussed the importance of classical breeding.
- *January 19, 2011*: NIFA Stakeholders Meeting, during which NSAC and NOC provided comments on classical breeding.
- *April 5th, 2011*: UCS met with REE Undersecretary Catherine Woteki and discussed the need for increased classical breeding, among other things.

Requests for Proposals

Despite the clear call from Congress and significant public input for USDA to address our nation's classical plant and animal breeding needs, the AFRI RFAs released since the passage of the 2008 Farm Bill have fallen far short of prioritizing public breed and cultivar development. The Requests for Proposals (RFA) in 2009, 2010 and 2011 all included classical breeding, but put them in the same pool as genomic breeding.

The 2009 RFA stated there was significant opportunity for breeding and mentioned classical breeding specifically in several places. In the Response to Stakeholder Input section the RFA said: *“Conventional plant and animal breeding are receiving greater support in the Plant Breeding and Education Program, Plant Genome, Genetics and Breeding Program, Applied Plant Genomics Coordinated Agricultural Program and in Translational Animal Genomics.”* This basically summed up the situation- the Department was acknowledging the concerns and making incremental steps to address them but failed substantively to do so by lumping classical breeding – development of publicly available breeds and cultivars with genomics work and/or fundamental research. The problem in the RFA was reflected in the lack of classical breeding projects funded.

The 2010 review had several problems. Specifically, conventional breeding was only mentioned in the Climate Change RFA under National Cereal Germplasm Phenotyping. Although there is a need for breeding to develop cultivars resilient to environmental changes resulting from climate changes, the RFA for this program did not have any focus on development of public cultivars.

Although there was good language about participatory plant breeding and organic farming being desirable aspects of a proposal, they were not part of the core needs listed for obtaining a grant. The RFA also failed to fund development of new breeds and cultivars.

The 2011 RFA acknowledged that the 2010 RFA fell short of addressing classical breeding needs and stated that the 2011 RFA was more inclusive of conventional breeding: “*Areas believed to have been under-represented in the FY 2010 RFAs, such as conventional plant and animal breeding, weed science, and food technology are more clearly offered in this FY 2011 RFA ...*”. The RFA included specific reference to cultivar development, but it was relegated to a subheading within the “Biology of Agricultural Plants” subprogram that also includes genomics and biotechnology. The 2011 RFA’s “Animal Breeding, Genetics, and Genomics” was even less specific about classical breeding and again the classical breeding projects competed against other technologies.

Analysis

The combined approach of traditional breeding competing for the same pool of funding as genomics, biotechnology and other breeding technologies is not working. The 2009, 2010 and 2011 AFRI-funded projects (see Appendices I, II, and III) include almost no funding for projects focused on actual development of publicly available cultivars and breeds. On the animal side, almost all the research was focused on fertility issues, not development of new breeds. On the plant side, the majority of the projects were fundamental research focused on genomics. Nearly all projects that did actual breeding involve genomics and/or MAS.

Of 127 funded projects in 2009, 2010, and 2011 related to plant breeding and genomics, we were able to identify only one project that was truly classical breeding, a 2010 funded grant: *Development And Management Of Canola In The Great Plains Region* at Kansas State University for \$210,000. Of the 59 projects in animal breeding, fertility and genomics we found no projects that we considered classical animal breeding.

Based on reviewing actually funded projects and anecdotal information from AFRI applicants, it seems that classical breeders are not finding places in the RFAs that are clear homes for their proposals. Also, the classical breeding proposals that are submitted are not considered competitive if they do not contain use of technologies such as MAS or genomics. Research proposals for classical plant and animal breeding that have sought AFRI or NRI funding in the recent years have been consistently declined. Although information on applications is not publicly available, anecdotal evidence suggests that after being consistently denied, breeders are no longer bothering to submit applications.

Funded projects have had a heavy focus on fundamental genomics. Many of these projects provide genome sequencing that they state will be freely available, through on-line data bases

and other mechanisms. However, it is our belief that such information will primarily be useful to those breeders using advanced technologies rather than classical breeding.

In livestock breeding, there were a significant number of research projects related to reproductive efficiency, but almost no breeding projects.

By confusing genomics-centered research with true classical breeding, we are hindering the ability of our research community to pursue diverse approaches to problems. Research aimed at breeding animals and development of new, publically held plant cultivars is critical for adapting to climate change, increasing efficiency of energy crops, developing resistance to insect, disease and other plant stresses, and supporting regional diversity. Perhaps most significantly, we are failing our farmers by not supporting a diverse array of seed and breed choices that may be suited to their region. This failure may have a direct effect of the competitiveness of US agriculture as well as our national food security.

Recommendations

In order to foster a more environmentally sound and economically sustainable agriculture it is critical to significantly increase Agriculture and Food Research Initiative (AFRI) investments in plant and animal breeding. To this end, we offer the following recommendations:

1. Create two new NIFA programs with segregated funding streams for conventional plant and animal breeding. These funding streams should be for classical breeding only, and be distinct from other breeding research that utilizes genomics, biotechnology, or MAS. These can be programs within AFRI or separate grant programs, but must be managed as separate research areas with distinct RFAs.
 - a. The RFAs for these programs should each include a clearly stated goal that conventional breeding projects result in the release of publicly held cultivars or breeds.
 - b. Combined, these two programs should have a minimum funding of \$20,000,000 per year.
 - c. Awards under each of these programs should be eligible for projects up to ten years.
 - d. The review panels for both of these programs must include a majority of reviewers with strong demonstrated expertise or experience in classical breeding and public cultivar development.

- e. At least in the first 5 years of their existence, do not make the RFAs for these 2 programs commodity specific. The backlog of classical breeding work needed is huge and affects too many sectors to limit requests to only targeted crops or animals.
 - f. Because development of public cultivars and breeds is a public good, serving larger societal goals of diversity and agricultural security, classical breeding projects that propose to develop public cultivars and breeds should be exempted from matching requirements. At a minimum they should be provided more flexible criteria.
 - g. Both RFAs should contain language that specifically encourage proposals with participatory breeding and meaningful farmer and NGO participation.
2. Track grants for new public cultivars or improved breeds separately from genomic or molecular genetics activities. In this way, the funding and overall public breeding capacity trends will be more easily monitored and analyzed. This tracking system should be extended to include USDA ARS projects to provide more accurate assessment of overall USDA commitment to public breed and cultivar development.
 3. Continue strengthening financial incentives for graduate and undergraduate training in classical plant and animal breeding to ensure the next generation of public plant and animal breeders.