



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

USDA FVIAC Committee: Research and Grants Working Group

- Plant Breeding and the National Institute of Food and Agriculture's funding priorities
 - Ed Kaleikau, NIFA National Program Leader for Plant Breeding, Genetics and Genomics



BIOENERGY, CLIMATE,
AND ENVIRONMENT

FOOD PRODUCTION
AND SUSTAINABILITY

YOUTH, FAMILY,
AND COMMUNITY

INTERNATIONAL
PROGRAMS

USDA NIFA

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE



NIFA's Mission & Vision

- USDA's primary extramural agency to advance food & agricultural sciences
- We lead & fund initiatives that ensure the long-term viability of agriculture by:
 - Supporting research, education, & extension activities in partnership with institutions across US (*Land-Grant University System, other universities/colleges, government, private, and non-profit organizations*)
 - AGENCY BUDGET:
 - \$1.49 Billion (2016)
 - \$1.88 Billion (2017 Request)



NIFA Provides



- **Competitive grants:**

- Basic & applied research, education, & extension activities
- Projects that integrate research, education, & extension functions.



- **Capacity grants:**

- Distributed by formula to Land-Grant Universities, Schools of vet medicine, & other partners to maintain “capacity” to conduct research & extension.
- 25% research funds → Multi-state Research Committees focus on critical areas needing regional or national coordination

- **Non-competitive grants:** Directed by Congress to designated institutions for research, education, or extension on topics of importance to a state or region.



NIFA Covers Many Topics



Advanced Technologies

- Bioenergy
- Biotechnology
- Nanotechnology



Animals

- Animal Breeding
- Animal Health
- Animal Production
- Aquaculture



Business and Economics

- Markets and Trade
- Natural Resource Economics
- Small Business



Education

- Minority Serving Institutions
- Teaching and Learning
- Workforce Development



Environment

- Climate Change
- Ecosystems
- Invasive Pests and Diseases



Farming and Ranching

- Agricultural Safety
- Agriculture Technology
- Farmer Education
- Organic Agriculture
- Small and Family Farms



NIFA's Many Topics Cont'd



Food Science

- Food Quality
- Food Safety



Health

- Nutrition
- Obesity
- Wellness



International

- Global Engagement
- Global Food Security



Natural Resources

- Air
- Forests
- Grasslands and Rangelands
- Soil
- Water



People

- Community Vitality
- Family Well-Being
- Youth



Plants

- Crop Production
- Pest Management
- Plant Breeding
- Plant Health



United States Department of Agriculture

Overview:

NIFA manages a range of funding programs that can make awards to plant breeding research, education, and extension

NIFA listens to stakeholders in various ways for input on within-program priorities

Success stories from NIFA's plant breeding funding are typically in combination with other funding types.





NIFA's Plant Breeding, Genetics and Genomics Portfolio:

- **Addresses regional, national and global needs** in alignment with the 2014 Farm Bill, USDA REE action plan and NIFA strategic plan and especially in coordination and alignment with USDA ARS National Programs (i.e. NP301 Plant Genetic Resources, Genomics, and Genetic Improvement Action Plan, 2018-2022).
 - **Investments are responsive to stakeholder critical needs** to increase productivity by providing agricultural plants with higher inherent genetic potential.
 - **Focuses on genetic improvement** through more efficient and effective breeding, and exploits new sources of genes and traits, innovative breeding methods, data-mining, bioinformatics tools, and knowledge of molecular and biological processes.
 - **Goals** are to improve the production efficiency, yield, sustainability, resilience, healthfulness, product quality, and value of U.S. agricultural plants.



NIFA's Plant Breeding, Genetics and Genomics Portfolio Align with:

The 2014 Farm Bill:

PRIORITY AREA	SUBPRIORITIES
A. Plant Health and Production and Plant Products	i. plant genome structure and function
	ii. molecular and cellular genetics and plant biotechnology
	iii. conventional breeding, including cultivar and breed development, selection theory, applied qualitative genetics, breeding for improved food quality, breeding for improved local adaptation to biotic stress and abiotic stress
	iv. Plant pest interactions and biocontrol systems
	v. crop plant response to environmental stresses
	vi. [improved] nutrient qualities of plant products
	vii. new food and industrial uses of plant products

The USDA REE Action plan goals 1&2:

- **Goal 1. Sustainable Intensification of Agricultural Production**
 Subgoal 1A. Crop and Animal Production
 Subgoal 1B. Crop and Animal Health
 Subgoal 1C. Crop and Animal Genetics, Genomics, Genetic Resources, and Biotechnology
 Subgoal 1D: Consumer and Industry Outreach, Policy Markets, and Trade
- **Goal 2. Responding to Climate and Energy Needs**
 Subgoal 2A. Responding to Climate Variability
 Subgoal 2B. Bioenergy/Biofuels and Biobased Products

The USDA NIFA Strategic plan Goal 1 (Science):

- **Goal 1: Catalyze exemplary and relevant research, education and extension programs**
 Subgoal 1.1: Advance our Nation's ability to achieve global food security and fight hunger.



Plant Breeding, Genetics and Genomics Programs:

Agricultural Food Research Initiative (AFRI):

- Plant Breeding for Agricultural Production
 - Priorities: Pre-breeding and germplasm enhancement, cultivar development, selection theory, applied quantitative genetics, and participatory breeding. In 2016 included new opportunities for two commodity board topics: (i) Kansas Wheat Commission - Breeding for genetic resistance to wheat viruses and; (ii) Iowa Corn Promotion Board - Environmental influence on phenomics in crop improvement and production.
- Breeding and Phenomics of Food Crops and Food Animals
 - Priorities: development and use of high-throughput genomic technologies, phenomics, and advanced computational informatics to (i) produce varieties and breeds with improved resilience to climate change, drought, and extreme weather; (ii) increase protection of agricultural crops and food animals from disease and pests; and (iii) enhance nutritional composition for improved human health.
- Interagency: International Wheat Yield Partnership
 - Priorities focus on breakthroughs for wheat breeding using new technologies and also discoveries that lead to significantly greater yield e.g. gene editing and Unmanned Aerial Vehicles, hybrid wheat.



Example: Agricultural Food Research Initiative (AFRI)

- National Cereal Germplasm Phenotyping Coordinated Agricultural Project



NIFA Funding Accelerates Wheat & Barley Plant Breeding

The Triticeae* Coordinated Agricultural Project (T-CAP) is a USDA National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative grant that develops new wheat and barley varieties for changing environments. T-CAP addresses food security and nutrition demands of a growing population and helps ensure the prosperity of American growers.

T-CAP VARIETIES represent about 15% of the wheat and 4% of the barley harvested in the United States, with a production value of \$1.8B and \$61M, respectively.

\$1.8B
PRODUCTION VALUE



WHEAT IN AMERICA

- 2014 production: > \$12B
- 2014 harvested acres: > 46.4M
- 2012 consumption per person: > 132 POUNDS
- is grown in 42 STATES with more than 63 VARIETIES developed by T-CAP

USED TO MAKE MANY POPULAR FOODS AND BEVERAGES

BARLEY IN AMERICA

- 2014 production: \$870M
- 2014 harvested acres: 2.5M



T-CAP SUPPORTS PARTNERSHIPS BY:



- **UNITING** the breeding and genetic research communities
- **ENCOURAGING** public-private collaboration
- **INTEGRATING** breeding efforts to avoid duplication
- **FUNDING 56** participants at **28** institutions in **21** states across the country
- **EMPOWERING** the wheat and barley breeders and growers through federal funding
- **ADVANCING** science to maximize productivity

T-CAP TRAINED STUDENTS HAVE BEEN HIRED BY:

MORE THAN
100
TRAINED STUDENTS

- 57 U.S. companies/foundations
- 40 U.S. academic institutions and/or the government
- 18 international venues

*Triticeae: A taxonomic group of grasses that include many domesticated grains such as wheat, barley, and rye.

NIFA FUNDING ACCELERATES WHEAT & BARLEY BREEDING



FUNDS RELEASED TO UNIVERSITIES



IDENTIFY DESIRABLE TRAITS



BREEDING & FIELD TESTING



SEEDS PREPARED FOR GROWERS



FARMERS PRODUCE GRAIN CROPS



GRAIN PRODUCTS SOLD AT MARKET



Plant Breeding, Genetics and Genomics Programs examples Cont'd

Special Research Grants Program:

- Potato Breeding Research
 - The program seeks to enhance the effectiveness of limited state, federal, and industry resources and accelerate the development of superior performing varieties that produce greater benefits to the potato industry.

Multi-state Research Projects involve a team of investigators associated with several State Agricultural Experiment Stations working together to solve complex scientific problems of regional or national interest.

- Corn Breeding Research
 - Facilitates multi-location testing of breeding techniques, training of students, and coordination between public and private breeders.
- Database Resources for Crop Genomics, Genetics and Breeding Research
 - Provide database resources for target crops and further develops a standardized database platform for use by other communities.



Speciality Crops Research Initiative

- Addresses the critical needs of the specialty crop industry by awarding grants to support research and extension that address key challenges of national, regional and multi-state importance.
- First authorized in the 2008 farm bill. Since inception, there have been five legislatively mandated focus areas. Focus area 1 deals with plant breeding, genetics and genomics.
 - *“(1) research in plant breeding, genetics, and genomics to improve crop characteristics, such as—*
 - *“(A) product, taste, quality, and appearance;*
 - *“(B) environmental responses and tolerances;*
 - *“(C) nutrient management, including plant nutrient uptake efficiency;*
 - *“(D) pest and disease management, including resistance to pests and diseases resulting in reduced application management strategies; and*
 - *“(E) enhanced phytonutrient content*
- Since 2012, SCRI has funded 31 projects with some component of genomics, genetics and breeding.



Speciality Crops Research Initiative

Cont'd

- Example: ROSBREED: COMBINING DISEASE RESISTANCE WITH HORTICULTURAL QUALITY IN NEW ROSACEOUS CULTIVARS - Includes work on apple, blackberry, peach, pear, rose, strawberry, sweet cherry, and tart cherry. Provides modern genomic and genetics tools, in a nationally coordinated effort, to augment the efforts of traditional breeders in the efforts to efficiently and effectively deliver cultivars with producer-required disease resistances and market-essential horticultural quality.
- The RosBreed network of over 25 collaborators across North America, Europe, and Australia, are sharing both new genetic and historical breeding information to facilitate more efficient experimentation with varieties in new regions. They are increasing routine use of genetic information through the design and implementation of new DNA tests, online portals for testing DNA and through direct outreach to industry leaders. The project produces a quarterly newsletter, industry briefs, brochures, and DNA test cards.



Potential Future areas of research

- Breakthrough enabling technologies such as genome editing to create defined genetic changes to breed for more nutritive foods for human health benefit and crops more tolerant to adverse environmental conditions;
- Remote sensing of yield and other traits in field plots to rapidly generate more germplasm testing and accelerate breeding cycle improvement;
- Development of data mining tools for analyzing genotypic, phenotypic, and environmental data to improve predictive breeding as part of NIFA's Food and Agriculture Cyberinformatics and Tools (FACT) initiative in data-driven advances.



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Thank YOU!

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