



*National Association of
Wheat Growers*

&

*National Wheat
Improvement Committee*

*Research Priorities for
Fiscal Year 2003*

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Note: A PDF version of this document is available at <http://www.wheatworld.org> and <http://www.scabusa.org>.

The National Association of Wheat Growers Research Priorities For Fiscal Year 2002

Executive Summary

The National Association of Wheat Growers (page 1) and the National Wheat Improvement Committee (page 2), together represent the entire US wheat industry - growers, researchers, and users (e.g. milling & baking industry). We are pleased to have this opportunity to meet with you and/or your agricultural specialist to discuss federal funding of wheat research programs and other issues.

Wheat production and the manufacture and sale of value-added wheat products (flour, food, livestock) have a significant impact on the US economy, supporting millions of jobs and generating billions of dollars in excise and income tax revenue for the US government. There is potential for growth in domestic and export markets for wheat and its value-added products, which could generate substantial new economic activity.

We recognize that the War on Terrorism requires increased funding for legitimate Defense and Homeland Security needs. At the same time, continued investment by the federal government in agricultural research programs is needed to keep the US at the forefront in agricultural science. A strong public sector research infrastructure is required to realize continued improvements in crop productivity and quality and counter potential bioterrorism threats (e.g. bioengineered crop pathogens). This research capability is vital for the US to maintain and expand its faltering domestic agriculture economy and to improve competitiveness in world markets.

For wheat, federal investment is needed since wheat is primarily a public sector crop, with most variety development and research being conducted at state universities and USDA Agricultural Research Service facilities. The payback from modest federal investments in wheat research exceeds by many times the expenditures.

FY2003 ADMINISTRATION PROPOSED USDA-ARS RESEARCH PROGRAM TERMINATIONS

Agricultural Research Service (ARS)

Several programs of USDA's Agricultural Research Service are proposed for elimination in the President's budget for fiscal 2003. The ARS proposed budget includes program reductions of \$41.678 million for FY 2003; of that total, \$35.565 million (85%) comes from the Plant Sciences area. The following programs are of critical importance to the wheat industry, and we request your help in restoring funding.

Location	Program	Gross cut to ARS	Cut Net to Location
Albany, CA	• Processed foods research, including enhancement of functional and health properties and control of nutritional and sensory properties of grains and other crops (cut in base funding)	3,411,900	3,070,700
	• Crop improvement and utilization, including Molecular Analysis of Environmental Effects on Wheat grain development, productivity and quality (cut in base funding)	1,961,000	1,764,900
Aberdeen, ID	• National Plant Germplasm system small grains collection (cut in 2002 funding)	100,000	90,000

Location	Program	Gross cut to ARS	Cut Net to Location
Manhattan, KS	• Hard Winter Wheat Quality laboratory (2001)	200,000	180,000
	• Genetic enhancement of wheat (2002)	249,450	224,505
Fargo, ND	• Cereal crops research (cut from 2001 and 2002 levels)	1,767,700	1,590,930
	• Hard Red Spring and Durum Quality Lab (2002)	200,000	180,000
	• Hard Red Spring and Durum Quality Lab (base funding cut)*	305,300	274,800
	<i>* Proposed cuts in the Quality Lab would necessitate its complete closure</i>		
Wooster, OH	• Soft Wheat Quality Laboratory (2002)	200,000	180,000
	• Soft Wheat Quality Laboratory (base funding)*	583,200	524,900
	<i>* Proposed cuts in the Quality Lab would necessitate its complete closure</i>		
Pullman, WA	• Western Wheat Quality Lab (2002)	200,000	180,000
	• Root Diseases in Wheat and Barley	74,800	67,320
Head-quarters	• National Wheat and Barley Scab Initiative (with various universities)	798,200	718,380
Soil, Water & Air Sciences earmarks	<p>The following facilities and/or positions are targeted for elimination under the Soil, Water & Air Science objective:</p> <ul style="list-style-type: none"> • Conservation Research (Pendleton OR) • Dryland Production Research (Akron, CO) • Northern Great Plains Research Laboratory (Mandan, ND) • Soil, Plant Nutrient Research/Plant Physiology Scientist/ Research Spt. (Ft. Collins, CO) 		
Plant Science earmarks	<p>In addition to specific projects listed above, the following projects under ARS' Plant Science objective are targeted for elimination:</p> <ul style="list-style-type: none"> • Grain Legume Plant Pathologist position (Pullman, WA) • Grain Research (Manhattan, KS) • Northern Grain Insect Laboratory / Cropping Systems Ecologist (Brookings, SD) • Plant Stress & Water Conservation (Lubbock, TX) 		

NAWG/NWIC also supports funding for these important ARS projects for barley producers:

Location	Program	Gross cut to ARS	Cut Net to Location
Madison, WI	• Improving the Nutrient and Phytonutrient Status of Oats and Barley	249,500	224,500
	• Analysis and Control of Gene Expression in Barley to Influence Quality and Pathogen Resistance	320,000	288,000
	• Malting Quality Improvement in Barley (base)	353,900	318,500
Beltsville, MD	• Barley Food Health Benefits	439,600	395,640

Cooperative State Research Education and Extension Service (CSREES)

The President's budget also eliminated virtually all of the Congressional earmark funds for projects under CSREES. Money was added to the National Research Initiative to replace these reductions, but programs will need to go over an additional hurdle of competing under the NRI to receive funding. NAWG / NWIC requests that these programs be restored in the appropriations process.

- Agricultural Diversity, Red River Valley, MN and ND (\$400,000)
- Air Quality, TX (\$640,000)
- Biomass-based energy, OK and MS (\$960,000)
- Biotechnology, NC (\$306,000)
- Competitiveness of agriculture products, WA (\$665,000)
- Crop diversification, ND and MO (\$800,000)
- Crop integration and production, SD (\$200,000)
- Efficient irrigation, NM and TX (\$1,176,000)
- Exotic pest diseases, CA (\$1,600,000)
- Expanded wheat pasture, OK (\$286,000)
- Feed barley for rangeland cattle, MT (\$833,000)
- Food safety, OK (\$400,000)
- Food safety risk assessment, ND (\$800,000)
- Food security, WA (\$400,000)
- Improved early detection of crop diseases, NC (\$194,000)
- Jointed goatgrass, WA (\$367,000)
- Preharvest food safety, KS (\$208,000)
- Preservation and processing, OK (\$221,000)
- Regional barley gene mapping (\$760,000)
- Regionalized implications of farm programs, MO and TX (\$287,000)
- Russian Wheat Aphid (\$320,000)
- STEEP III – water quality in the PNW (\$588,000)
- Sustainable agriculture, CA (\$400,000)
- Sustainable agriculture systems, NE (\$59,000)
- Sustainable engineered materials from renewable resources, VA (\$400,000)
- Sustainable pest management for dryland wheat, MT (\$452,000)
- Value-added product development from agricultural resources, MT (\$324,000)
- Water conservation, KS (\$79,000)
- Weed control, ND (\$426,000)
- Wheat genetics, KS (\$255,000)
- Wheat sawfly research, MT (\$505,000)

USDA-ARS PROGRAM BUDGET

The National Association of Wheat Growers, in consultation with the National Wheat Improvement Committee, has established its FY2003 funding priorities. These priorities have been selected in regards to their ability to provide the greatest impact on the wheat industry. They are listed below in order of priority.

Priority 1. Provide additional funding to the regional wheat quality laboratories in Wooster, OH (Soft wheat quality laboratory); Manhattan, KS (Hard wheat quality laboratory); Pullman, WA (Western wheat quality laboratory); and Fargo, ND (Hard red spring and Durum wheat quality laboratory). Requested amount: \$2.45 million (\$800,000 – OH, \$800,000 – KS, \$550,000 – WA, and \$300,000 - ND).

In 1936 the USDA established the four regional wheat quality labs to work with breeders to improve the quality of U.S. wheat. The labs need additional funding to handle more samples, modernize equipment, and develop new predictive quality tests to insure that U.S. wheat remains competitive. New and enhanced research at the four wheat quality labs will provide customers with the best knowledge and understanding of the end-use potential of U.S. wheat, which will enhance marketability of our wheat both domestically and abroad.

Priority 2. The National Wheat, Barley, and Oat, Improvement Committees recommend increased funding to enhance regional molecular genotyping laboratories that have been established at Manhattan, KS (partially funded at \$250,000 in FY2001) and Fargo, ND (partially funded at \$600,000 in FY2002); and to establish laboratories at Raleigh, NC and Pullman, WA. Funding of \$750,000 per laboratory is needed, which would require the following funding in FY2003 to make each lab fully operational.

	<u>FY2003 Request</u>
Fargo, ND (north central)	\$150,000
Manhattan, KS (central/south central)	\$500,000
Raleigh, NC (east/southeast)	\$750,000
Pullman, WA (west)	\$750,000

The laboratories will facilitate the development and application of DNA molecular marker information for end-use quality, disease resistance, and other agronomic traits to plant improvement in barley, oat, and wheat breeding programs throughout the US. Regional laboratories are proposed in order to enhance close alignment between breeders and mappers for traits of value to particular geographical production areas, anticipated high genotyping demand, the regional nature of market classes and production systems, and the critical mass of breeding programs in each of the regions. These laboratories will identify markers linked to value added traits which could also hasten the development of emerging markets leading to higher grain prices for farmers.

Priority 3. Increased funding of \$300,000 for the Cereal Disease Laboratory, St. Paul, MN (page 17)

The USDA-ARS Cereal Disease Laboratory (CDL) is a Federal research facility with the national mandate of conducting research on rust diseases of wheat, barley, and oats, and Fusarium head blight (scab) of wheat and barley, to provide improved methods for controlling these diseases. To effectively tackle the rust and scab disease problems of cereal crops in the United States, the Cereal Disease Laboratory (CDL) must maintain its core group of six research scientists and two senior support scientists.

With the retirement of Dr. Don McVey in FY01 and the imminent retirement of Dr. William Bushnell, the CDL will be short two key senior scientists. The average support level per scientist at the CDL is only about \$230,000. Current funding levels will allow the CDL to refill the McVey position, but not the Bushnell position. Thus, the National Barley, Oat, and Wheat Improvement Committees are requesting that Congress approve new program funding of \$300,000 to refill the William Bushnell position and provide adequate funding for the other scientists at the CDL.

Priority 4. A \$600,000 increase in support of the U.S. Wheat & Barley Scab Initiative (page 15)

Fusarium head blight of wheat and barley, also known as scab, has resulted in yield and quality losses estimated to have cost over \$3.0 billion since 1990. During the past four years, thanks to annual funding of \$6.1 million provided by Congress, federal and state scientists have worked closely with growers and end users to design a national, multi-disciplinary, and multi-institutional research system to address the scab problem. The result of these efforts is the U.S. Wheat and Barley Scab Initiative. The structure of the Initiative includes a broad based Steering Committee with representatives from all stakeholder groups and regions. The Steering Committee has recruited national leaders in major research areas to serve on committees that provide scientific review of grant proposals to determine which projects are funded.

This very successful program will fund 109 projects in 26 states in FY2002 (AR, CA, GA, ID, IL, IN, KS, KY, LA, MD, MI, MN, MO, MT, NC, ND, NE, NJ, NY, OH, OK, PA, SD, VA, WA, WI). Significant progress in the battle against Scab has been made, however, a careful analysis by the Initiative's stakeholders reveals a significant gap between the needed and actual funding level. The Initiative turned away excellent and promising research proposals because of a lack of funds and has been unable to fund others with the full amount needed to meet project objectives. The National Wheat Improvement Committee and National Barley Improvement Committee are requesting \$600,000 in increased support to help meet the Initiative's objectives.

USDA-ARS Buildings & Facilities Budget

(1) Funding of \$3.2 million for a laboratory addition for the Cereal Disease Laboratory (CDL), St. Paul, MN Congress provided \$300,000 for building design in FY2002 (page 17)

The research activity at the CDL has increased by 50% over the past two years. Laboratory personnel now include six Ph.D. research project leaders, three support scientists, five research technicians, and two office staff. The expanded research effort has resulted in severe space shortages. The original research facility was constructed in 1972 to house rust investigations of four project leaders and has 7,000 square feet of laboratory and office space, 4,000 square feet for growth chamber and head house activities, and 4,500 square feet of greenhouse space. Research activity has now spilled over into a 450

square foot laboratory temporarily leased in a neighboring U.S. Forest Service research facility. A new 10,000 square foot addition to the laboratory would provide space for the additional new project leaders, with modern laboratories for the latest molecular, genomics, and computer technologies, and space for St. Paul-based ARS administrative staff, who are currently housed in temporary quarters.

(2) Funding of \$4.6 million for a laboratory addition for the National Small Grains Germplasm Research Facility (NSGGRF), Aberdeen, ID Congress provided \$500,000 for building design in FY2002 (page 20)

The ARS program at Aberdeen, Idaho, includes several advanced molecular genetics research programs in barley, oats and potatoes. Ongoing research in genetic improvement of feed and malting barleys, including low phytic acid grains for fish, swine and poultry diets, the genetic improvement of oats for use in the food and feed industry, and potato varieties with enhanced quality and storage characteristics, is greatly constrained by inadequate laboratory facilities. Furthermore, the University of Idaho's (UI) wheat genetic research capabilities at Aberdeen will be greatly enhanced by the proposed advanced genetics laboratory addition at the ARS facility. Currently, the UI wheat genetics program conducts laboratory experiments in limited areas, without a single dedicated laboratory.

The construction of a 12,000 square foot laboratory addition will greatly enhance the research capabilities of the NSGGRF, which will provide significant benefits to the small grains and potato industries throughout the US. The NSGGRF houses one of the foremost crop germplasm collections in the world, including over 100,000 small grain accessions. This institution maintains seed stocks, distributes seed to researchers worldwide and serves as a center of small grains and potato genetics research.

(3) Funding of \$15 million for a new building for cereal crops research at the Red River Valley Agricultural Research Center (RRVARC), Fargo, ND (page 23)

Research conducted by USDA-ARS scientists at the RRVARC is critical to the advancement of crop productivity through reduction of pest losses, and increased agronomic adaptability and crop quality. The amount requested will allow construction of a new facility to increase research capacity and efficiency, and will thus greatly enhance the ability of the RRVARC to respond to problems faced by the small grains industry. Research on other northern-grown crops (sunflowers, sugarbeets, potatoes) will also benefit as a result of this facility improvement.

Current facilities are inadequate to house all RRVARC personnel, requiring the stationing of some in university facilities. Also, the recent addition of six new research positions (four small grains, one sunflower, one sugarbeet) has resulted in space limitations that are hampering current programs and will inhibit future program expansions.

USDA-CSREES SPECIAL RESEARCH GRANTS

Special grant to strengthen research and extension on karnal bunt. Funding of \$1.8 million is requested (page 10).

Funding is requested for research on karnal bunt. Karnal bunt is a serious disease of wheat that poses a major economic threat to the U.S. wheat industry due to its potential impact on exports. Karnal bunt is now established in numerous fields in Arizona, central Texas, and north Texas. Affected growers, seedsmen, and grain handlers have already experienced increased costs and loss of some foreign and domestic markets. Estimated damages were set at \$27 million due to the infestation in four Texas counties in 2001. New research information on KB genetic resistance, epidemiology, disease management, grain quality control and assurance, and resulting methods to mitigate KB economic damage are urgently needed. The USDA already has several modest research programs on KB biology, pest risk assessment, resistant germplasm development, and biotechnology. The International Center for Maize and Wheat Improvement (CIMMYT) in Mexico also has a significant research effort on KB biology and has a large collection of breeding lines with genetic resistance. These programs must be accelerated and expanded and linked to complementary efforts at Land Grant Universities.

National Association of Wheat Growers

The National Association of Wheat Growers (NAWG) serves as the eyes and ears for America's wheat producers in Washington, DC, and is their national advocacy organization. Through a well-developed grassroots network and professional staff, NAWG is in daily communication with the decision-makers in Congress, USDA, and other government agencies and organizations that affect the lives and operations of our farmer members.

NAWG works hard to ensure that the wheat producer's voice is heard loud and clear on Capitol Hill and is hard at work on several key issues. These issues include securing federal financial support for farmers, promoting federal funding of research, making meaningful reforms to the federal crop insurance program, and the elimination of trade sanctions on U.S. agricultural products. In fact, NAWG was a primary facilitator in urging President Clinton to lift sanctions on the commercial sale of agricultural products and medicine to Sudan, Libya, and Iran.

NAWG's long record of achievements would not be possible without the participation and leadership of its 23 state associations, which are made up of nearly 50,000 individual wheat producers. NAWG, in conjunction with its wheat partners, U.S. Wheat Associates, the Wheat Export Trade Education Committee (WETEC), and the Wheat Foods Council, hold a Wheat Industry Conference and Exposition each year that brings together wheat producers, industry leaders, researchers, government officials, and other agribusiness professionals.

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National Wheat Improvement Committee

The National Wheat Improvement Committee (NWIC) is a non-profit, independent organization representing public and private wheat researchers from each of the four major U.S. wheat-growing regions. The NWIC addresses issues that have a direct, or indirect, effect on U.S. wheat; including areas of research, production, marketing and end-use. The committee provides information and counsel to congressional leaders and U.S. Agricultural policy makers, with the long-term goal of improving wheat production and marketing opportunities. NWIC members serve as an expert committee and are willing to provide either written or verbal testimony regarding wheat research issues in the United States.

The NWIC meets annually. Minutes of the Committee meetings, resolutions, and letters are published each year in the Annual Wheat Newsletter.

National Wheat Improvement Committee Members

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FUNDING PROPOSAL FOR USDA-ARS REGIONAL WHEAT QUALITY LABORATORIES

Amount Requested: \$2.45 million

Laboratories and Locations

- Soft Wheat Quality Laboratory (SWQL) – Wooster, Ohio
- Hard Winter Wheat Quality Laboratory (HWWQL) – Manhattan, Kansas
- Western Wheat Quality Laboratory (WWQL) – Pullman, Washington
- Hard Red Spring and Durum Wheat Quality Laboratory (HRS&DWQL) – Fargo, North Dakota

Utilization of the Recent Increased Funding Beginning FY02

Of the original \$3.25 million request, the budgets were increased by a total of \$800,000 with a net increase of \$180,000 to each of the four laboratories. The funds will be utilized as follows:

Soft Wheat Quality Laboratory (SWQL) – Wooster Ohio

- Increase the quality testing of new soft wheats for pastry products, cakes, and cookies.
- Develop methodologies to test soft wheats for crackers.
- Multidisciplinary collaborative research to identify and apply genetic marker assisted selection of new soft wheat quality attributes among new soft wheat test lines.
- Two permanent technicians will be hired as research support and to allow increased quality testing.
- Purchase equipment to produce crackers in the laboratory and two new micro mills to explore cultivar milling quality differences and to increase the capacity of its quality evaluation program.

Hard Winter Wheat Quality Laboratory (HWWQL) – Manhattan Kansas

- Increase relevant quality testing of new breeding lines for white pan-type bread.
- Develop new methods to evaluate hard winter wheats for non-bread products (e.g., Asian noodles, tortillas, pizza crust).
- Identify the molecular basis of specific quality traits and study effects of wheat growing conditions on product functionality through multidisciplinary collaborative research.
- Develop and modify small-scale testing methods that predict performance in automated industry processing.

Western Wheat Quality Laboratory (WWQL) – Pullman Washington

- Increase quality testing of soft, club, and hard wheats for domestic and international products (e.g. white pan-type bread, cookies, Japanese sponge cakes, and Udon noodles)
- Initiate new research and test development for quality assessment of other Asian food products (various types of noodles, steam breads).
- Multidisciplinary collaborative research to define and identify the molecular basis of specific quality traits, and to develop wheat germplasm with altered and enhanced quality traits, including gene discovery and development of rapid tests for the presence of the genes or the products that are controlled by them.
- Evaluate properties and utilization of waxy wheats (both common and durum) for new food uses, enhanced export, and greater utility in the domestic gluten industry.
- Study effects of wheat growing conditions on functionality.
- Purchase additional rheological instruments for characterizing gluten properties of advanced breeding lines.

- Hard Red Spring and Durum Wheat Quality Laboratory (HRS&DWQL) –
- Fargo North Dakota
- Increase quality testing of white pan-type bread and pasta products
- Testing methodologies will be developed or improved for small scale testing to secure and maintain the quality of wheat breeding test lines and commercial cultivars for domestic and export markets.
- Purchase a seed cleaning system to prepare wheat for pilot milling, a whole grain NIR spectrometer for rapid assessment of wheat protein, a Single Kernel Characterization System (SKCS), a texture analyzer for cooked pasta, and a Falling Number instrument to evaluate pre-harvest sprouted wheat.

Proposal for Additional Funds

The additional funds needed by each laboratory amount to \$2.45 million, distributed as follows:

SWQL	\$800,000	HWWQL	\$800,000
WWQL	\$550,000	HRS&DWQL	\$300,000

Target Areas for Additional Funds

Programs : Research programs initiated with new funding in FY 02 will be continued on a permanent basis and new technologies will be implemented to maximize the benefits of additional funding. All laboratories will continue working on developing rapid methods for measuring gluten strength in wheat of all classes, as gluten strength is one of the best indicators of end-use potential, thus, a rapid method would greatly impact the overall wheat marketing system.

Personnel: Unfortunately, the recently acquired additional funds are not sufficient to add permanent scientist positions to the staff (requires \$300K/SY). To successfully accomplish the evolving roles of the wheat quality laboratories, increased funds will allow temporary or postdoctoral scientists to be hired to initiate new research projects. Temporary scientists and technical support positions will be converted to permanent positions. Scientists will be fully funded which includes adequate support in technical staff, equipment, and research budgets. New funding will also allow the addition of new full time technicians and/or postdoctoral scientists.

Equipment: The SWQL (Wooster) will purchase additional rheological, dough testing and baking equipment in addition to supplies to evaluate Middle Eastern-type breads (flat-, pocket-, French-, and hearth-types), two moisture ovens, a medium size mill for research flour production, and a Protein analysis instrument. The HWWQL (Manhattan) will purchase noodle-making machines, a texture analyzer, particle size analyzer, and NIR-SKCS. The HRS&DWQL (Fargo) will upgrade durum and spring wheat milling equipment and purchase imaging equipment to assess grain cleanliness and kernel defect impacts on milling and end-product quality, an extrusion system to test the quality of pasta made from spring wheat farina and durum semolina, and a dynamic stress rheometer. The WWQL (Pullman) will purchase a NIR-SKCS, a HPLC photodiode array detector, a Quadrumat flour mill, and a PCR thermocycler.

Impacts of Wheat Quality Research

The U.S. has lost a significant amount of the world wheat export market. From 1987 to 1997, U.S. wheat exports decreased by approx. 40% (from 43.2 million metric tons [MMT] down to 27.2 MMT). This represents a loss of approx. \$1.6 billion in sales per year in 1999 dollars. During this same time period, U.S. competitors increased or maintained their market shares. For example, Australian exports increased

by approximately 100% (from 9.3 MMT to 19 MMT). Market competition will continue to increase as our competitors enhance their abilities to target specific customer end-use quality needs and thus increase their wheat exports. Securing and improving the quality of the various classes of wheat produced in the U.S. in order to meet the needs of both domestic and international customers has always been a monumental task. Quality is a major factor determining market share. The ultimate goal of providing additional funds to the WQLs is to improve the ability of U.S. producers to meet the needs of domestic and international customers by offering consistently high quality grain with proven end-use performance. This increased funding is essential in order for the U.S. to reverse its decline in market share, since the majority of U.S. released varieties (all wheat classes) are evaluated for end-use quality at the four ARS Regional WQLs.

New and enhanced research at the four WQLs will provide customers with the best knowledge and understanding of the end-use potential of U.S. wheat, which will enhance marketability of our wheat both domestically and abroad. New cultivars of wheat with superior milling, baking, and processing characteristics will be a direct result of cooperation between U.S. breeders and enhanced research at the ARS Regional WQLs. Millers and food manufacturers will benefit with better, more consistent raw materials, and ultimately, consumers will enjoy higher quality, lower-cost, and more varied wheat products. Funded projects also will assist in the development of wheat with novel quality characteristics, such as modified starches and super-strong gluten. Such wheat will expand the demand for the produce of U.S. wheat farmers. A total of \$2.45 million in increased support is urgently needed to fund the activities and enhancements outlined in this proposal. Again, the ultimate goal of these activities is to improve the ability of U.S. producers to meet the needs of domestic and international customers by offering high quality grain with proven end-use performance. This increased funding is absolutely critical if the U.S. is to keep pace with global competition and increase its share of the world market.

USDA-ARS Regional Small Grains Molecular Genotyping Laboratories

Recommendation: The National Wheat, Oat, and Barley Improvement Committees recommend increased funding to enhance regional molecular genotyping laboratories that have been established at Manhattan, KS (partially funded at \$250,000 in FY2001) and Fargo, ND (partially funded at \$600,000 in FY2002); and to establish laboratories at Raleigh, NC and Pullman, WA. Funding of \$750,000 per laboratory is needed, which would require the following funding in FY2003 to make each lab fully operational.

FY2003 Request

Fargo, ND (north central)	\$150,000
Manhattan, KS (central/south central)	\$500,000
Raleigh, NC (east/southeast)	\$750,000
Pullman, WA (west)	\$750,000

The laboratories will facilitate application of DNA molecular marker information to plant improvement in wheat, barley and oat breeding programs.

Precedent: The USDA-Agriculture Research Service has provided leadership and services when local resources have not been available to meet national needs in crop improvement. Current regional ARS laboratories characterize germplasm, improve end-use quality, and improve resistance to rusts, smuts, blights, and insect pests of wheat, barley, and oats.

Justification: Molecular markers are available that are associated with pest resistance and end-use quality traits in wheat, barley and oats. Molecular information for small grains is being compiled daily through the International Triticeae Expressed Sequence Tag (EST) consortium (ITEC), the USDA-ARS Wheat Endosperm sequencing project, the NSF Wheat Genome project, the North American Barley Genome Project and the USDA-NRI-CGP funded barley EST project.

A gap exists between the discovery of molecular information and the use of that information in practical wheat, barley, and oat improvement programs. As markets move away from a commodity basis toward a value-defined, end product basis, plant breeders must equip themselves with gene-specific markers that give them rapid access to traits of value.

Regional genotyping centers will overcome the barriers to practical use through automated DNA extraction, and high-throughput marker screening procedures. They will provide a bio-informatics interface between molecular genetic data and practical public and private breeding programs.

Regional laboratories are proposed in order to enhance close alignment between breeders and mappers for traits of value to particular geographical production areas, anticipated high genotyping demand, the regional nature of market classes and production systems, and the critical mass of breeding programs in each of the regions.

Objectives: *Proposed objectives for the laboratories:*

- Identify new DNA markers associated with end use quality and with resistance to important pests like rust, scab, wheat streak mosaic virus, Karnal bunt, Russian Wheat aphid, and Hessian fly. Map new markers in commercially relevant breeding populations.
- Create marker profiles of cultivars and breeding lines and provide this information to plant breeders. Marker profiles will be cross-linked to other genetic information currently available in the Regional Cooperative nurseries, the USDA-ARS National Small Grains Germplasm Center, and through the USDA-NAL crop databases.
- Develop and deploy breeder friendly markers for widely used genes derived from cereal wild relatives and other germplasm resources.
- Develop and deploy microarray technology for basic gene detection research and selection in breeding programs.

Impact: By providing the biotechnology tools to enhance end use quality and pest resistance, these regional laboratories will benefit all components of the wheat, barley, and oat industries, from producers to consumers in the public and private sectors. For example, in barley, molecular markers are being used to convert traditional high quality malting barley to modern high yielding and disease resistant cultivars that maintain their traditional malting quality.

Other examples of genotyping needs waiting for the personnel, equipment and facilities in the proposed labs are:

- Markers to select for *Triticum diccoides*-derived high protein in wheat.
- Markers to select for resistance to *Fusarium* head blight (scab) in wheat and barley.
- Markers to select for durable resistance to stripe and leaf rust in barley and wheat.
- Markers for slow rusting to develop durable crown rust resistance in oats.

Budget justification:

- Each laboratory will include a **lead scientist**. As a molecular breeder, that scientist will develop new methods to improve molecular marker systems and genotyping in cereal crops.
- A **bioinformatics specialist** is needed to interpret and automate data analysis.
- **Two support technicians** will assist the scientists.
- **Indirect research costs** include utilities, printing, and dissemination.
- **Materials and supplies** costs are significant for a facility of this type and are estimated to be \$1.00 per sample processed.
- **Equipment costs** are significant at startup and reduce time.

Item Description	Cost
1 Scientist	\$ 100,000
1 Bioinformatics Specialist	\$ 75,000
2 Support Technicians	\$ 100,000
Indirect Research Costs	\$ 35,000
Materials and Supplies	\$ 250,000
Equipment	\$ 115,000
ARS HQ Administrative Costs	\$ 75,000
Total	\$ 750,000

data
over

Note that because of the very large operating costs, it is necessary that a total of \$275,000 of funds should be used for personnel (including one Category I scientist and one Category 4 bioinformatics specialist). It is expected that some operating costs for the collaborative research conducted in the laboratory will exceed these requested funds. Those costs will be covered through collaborative research grants between the lead scientist and other scientists in the region.

Location Justifications:

EAST: RALEIGH, NC

The laboratory will be part of the USDA-ARS Plant Science Research Unit. The unit includes two lead scientists in small grains plant pathology. The Department of Crop Science at North Carolina State University has lead scientists in small grain breeding and in molecular genetic analysis. The genetics and statistics departments at North Carolina State University include persons with expertise in molecular marker development and bioinformatics.

Collaboration can be established with breeding programs in MI, OH, NY, PN, MD, VA, KY, NC, SC, GA, FL, LA. Private breeding companies active in the region include Syngenta, Pioneer Hi-bred, Agripro, and Western Plant Breeders.

The crops covered by the Raleigh lab include soft red and white winter wheat, six-row winter barley, and spring oats.

The main traits for molecular genotyping in the East Region are:

Quality traits: Protein functionality, sprouting resistance, milling and baking quality in wheat; groat protein content in oats.

Pest Resistance: Resistance to powdery mildew, Hessian fly, *Septoria* and *Stagonospora nodorum* in wheat; resistance to leaf rust in wheat and barley; resistance to crown rust in oats; resistance to cereal leaf beetle and barley yellow dwarf virus in wheat and oats.

NORTH CENTRAL: FARGO, ND

(The laboratory at Fargo was partially funded at \$600,000 in FY2002).

The laboratory is part of the USDA-ARS Cereal Crops Research Unit of the Northern Crop Science Laboratory with lead scientists in wheat and barley genetics and plant pathology. The Department of Plant Sciences and Dept. of Plant Pathology at NDSU have lead scientists in wheat and barley breeding, genetics, and plant pathology and grain quality.

Collaboration can be established with breeding programs in ND, SD, MN, and WI. There are currently 18 small grain breeding and genetics programs in those four states.

Private breeding companies active in the region include Agripro, and Western Plant Breeders.

The crops covered by the Fargo genotyping center would be six- and two-row barley, spring oat, Durum, hard red, and hard white spring wheat.

The main traits for molecular genotyping in the North Central Region are:

Quality traits: Protein quantity, gluten strength, kernel color and sprouting resistance in wheat; percentage of deoxynivalenol in wheat and barley; protein, malt and nutritional quality traits in barley; milling and nutritional quality (including protein, antioxidants, lipids and nutritional fiber) in oat.

Pest Resistance: Resistance to *Fusarium* head blight in wheat and barley; resistance to sawfly, tan spot, leaf rust, and stem rust in wheat; resistance to leaf and stem rust, barley stripe, net and spot blotch, and scald in barley; resistance to crown rust, and stem rust in oats.

CENTRAL: MANHATTAN KANSAS

(The laboratory at Manhattan was partially funded at \$250,000 in FY2001 and FY2002).

The laboratory is part of the Plant Science and Entomology Research Unit of the Grain Marketing Production Research Center in Manhattan, KS, which has lead scientists with expertise in germplasm development, mapping, and molecular biology. The unit has established the wheat genomics facility in partnership with the Wheat Genetics Resource Center of Kansas State University. At Kansas State University, expertise exists in wheat breeding, molecular genetics, grain quality and virtually all areas of wheat research.

Collaboration has been established with public breeding programs in IL, IN, KY, OH, MN, ND, and VA. Additional collaborative arrangements are possible with programs in AR, KS, IA, MO, NE, OK, and TX. Some of the current collaborative arrangements will shift to other labs once they are established. Private breeding companies active in the region include Agripro, Cargill, Pioneer, and Syngenta.

The crops covered by the Manhattan genotyping center include hard winter wheat, soft winter wheat, spring and winter oat and winter barley.

The main traits for molecular genotyping in the Central Region are:

Quality traits: Improved gluten functionality, noodle quality, and bread baking quality for hard wheat; forage and grain feed/food quality for oat and winter barley.

Pest Resistance: Resistance to Russian wheat aphid, leaf rust, stem rust, scald, wheat streak mosaic virus, *Fusarium* head blight and Hessian fly in wheat and barley and resistance to crown rust in oat.

WEST: PULLMAN, WA

The laboratory will be part of the Wheat Genetics, Quality, Physiology, and Disease Resistance Unit at Pullman WA. The unit includes lead scientists in germplasm development, molecular genetics, breeding, disease resistance, and grain quality in the Western Wheat Quality Laboratory. The Departments of Crop and Soil Sciences and Plant Pathology at WSU have lead scientists with expertise in barley and wheat germplasm improvement, molecular genetic analysis, cropping systems research, and diseases of wheat and barley.

Collaboration can be established with more than 15 public small grain breeding programs in CA, CO, ID, MT, OR, UT, and WA. Private companies active in the region include Agripro, Busch Ag. Res. Inc., Coors, and Western Plant Breeders. Other states including AK, AZ, NM, and WY grow cultivars developed from those breeding programs.

The main traits for molecular genotyping in the Western Region are:

Quality Traits: Starch composition and properties, gluten strength, flour color, noodle color and texture, milling quality, club wheat flour functionality, and sprouting resistance in wheat; improvement of food, feed and malting quality in barley.

Pest Resistance: Resistance to stripe rust, eyespot, *Cephalosporium* stripe, *Fusarium* crown rot, *Rhizoctonia*, Hessian fly, and Russian wheat aphid in wheat; resistance to stripe rust, soil borne diseases, Hessian fly and Russian wheat aphid in barley.

PROPOSAL TO STRENGTHEN RESEARCH AND EXTENSION ON KARNAL BUNT

BACKGROUND:

Karnal bunt (KB) is a disease of bread wheat, durum wheat, and triticale that is caused by the fungus *Tilletia indica*. Infected wheat kernels contain masses of black fungal teliospores. Although yield losses are usually minimal, heavily infected grain has an unpleasant fishy odor and may be unacceptable for milling and baking.

KB is economically important because more than 70 countries have quarantine restrictions on imports of grain with KB. Most importing countries require phytosanitary certificates with additional declarations (ADs) that the wheat was produced in regions where Karnal bunt is not known to occur.

U.S. wheat exports have been protected through a voluntary national KB survey, which has served to document the existence of a “pest-free zone” covering the nation’s major wheat producing regions.

KB was first discovered in India in 1930 and since has been reported in Pakistan, Iran, Iraq, and Nepal. It has been reported in grain from Afghanistan. KB was first reported in northwestern Mexico in 1972 and found in production fields in 1982, presumably after introduction in infected seed. It was first reported in the U.S. in 1996 in a few counties in Arizona and one adjacent county in California. In 1997, it was found in one county in central Texas and in 2001, KB was discovered in four counties in north Texas and an additional central Texas county. The Arizona discovery was linked to infected seed, while the source of the Texas infections is unknown.

USDA-APHIS is attempting to contain all these outbreaks through localized quarantines. The quarantines regulate movement of infested grain, seed, livestock and machinery from the affected areas. Quarantines may control the spread through seed, livestock and machinery, but cannot control other potential pathways, such as movement on wildlife and wind-blown spores. There is a scientific consensus that eradication of *T. indica* is not feasible with current technology. USDA-APHIS is moving toward the goal of deregulation of KB, while at the same time protecting wheat export markets.

RATIONALE:

KB is a major economic threat to the U.S. wheat industry due to its potential impact on exports. KB is now established in numerous fields in Arizona, central Texas, and north Texas. Affected growers, seedsmen, and grain handlers have already experienced increased costs and loss of some foreign and domestic markets. Estimated damages were set at \$27 million due to the infestation in four Texas counties in 2001 (Stan Bever, Texas A&M). Losses also occurred near the area of infestation due to contamination of grain bins and lack of buyer interest. The spread of KB north into the main wheat growing regions of the Plains appears to be possible. KB could also further contaminate our grain transportation systems, storage systems, and export terminals. The situation is inherently unstable and could lead to the inability to deliver KB-free wheat from large production regions in the U.S., resulting in the loss of foreign and domestic markets for affected wheat growers. Loss of these markets could have a large negative impact on the entire wheat industry and associated rural economies, because approximately 50% of total U.S. wheat production is exported.

Deregulation of KB is a logical long-term goal because most of the economic losses, risks, and market distortions associated with KB are a result of quarantine regulations rather than of the disease itself. However, any strategy for deregulation should simultaneously protect pest-free areas and the U.S. wheat export industry.

There are many uncertainties and difficulties that may impede rapid deregulation. Unilateral deregulation by the U.S. does not appear feasible because it would threaten our ability to issue phytosanitary certificates and ADs. This would likely have a strong negative short-term effect on exports and it would require many years for exports to fully rebound, if ever. Global deregulation of KB via the International Plant Protection Convention (IPPC) is possible, but this is a long and arduous process with unknown prospects for success. The most likely scenario is deregulation through bilateral negotiations. Bilateral negotiations to deregulate KB are likely to have some success, especially for countries that do not grow much wheat. Science-based Pest Risk Assessments (PRAs) will be helpful to show other countries that the biological risks of KB are minor. However, some importers are unlikely to agree to deregulation. Other importers may set teliospore or bunted kernel thresholds rather than completely deregulate. In any case, bilateral negotiations are likely to be slow and complex. In the meantime, the U.S. wheat export industry must be protected.

It appears that the U.S. will be in KB management mode for the foreseeable future. The objectives of management will be minimization and mitigation of the economic impact on affected growers, custom cutters, seedsmen, and grain handlers, avoidance of KB through using alternative crops or management practices, suppression of inoculum production and spread, prevention of introduction into new areas, and grain quality assurance.

New research information on KB genetic resistance, epidemiology, disease management, grain quality control and assurance, and resulting methods to mitigate KB economic damage are urgently needed. The USDA already has several modest research programs on KB biology, pest risk assessment, resistant germplasm development, and biotechnology. The International Center for Maize and Wheat Improvement (CIMMYT) in Mexico also has a significant research effort on KB biology and has a large collection of breeding lines with genetic resistance. These programs must be accelerated and expanded and linked to complementary efforts at Land Grant Universities.

A multi-state, federally supported Karnal Bunt program must be funded to strengthen and unify research and extension efforts on KB at Land Grant Universities, the USDA, and CIMMYT. Funding for research on KB is currently limited, particularly at Land Grant Universities. This funding gap must be filled because Land Grant Universities play a critical role in the development of resistant wheat varieties, new crop management practices, and extension programs. USDA basic research programs on KB must be enhanced and increased. Partnership with researchers at CIMMYT is imperative because it has accumulated a wealth of research data on KB and CIMMYT has the world's most advanced breeding program for KB resistance.

GOAL STATEMENT:

The goal of the Karnal Bunt Program is to develop information and technologies to reduce or prevent economic damage to the wheat industry from Karnal bunt.

RESEARCH AREAS:*Epidemiology and Disease Management*

Epidemiology research is needed to support the Pest Risk Assessment, which will be useful in trade negotiations. What concentration of teliospores is required for establishment of a new disease focus? Can we correlate climatic variables to infection risk? Better disease management information for producers, custom harvesters, elevator operators, and plant protection officials will be developed. Research will be conducted in fields that are infested with KB in Arizona, Texas, or Mexico. What is the impact of cultural practices such as grazing, irrigation, seed treatments, or foliar fungicides on the disease? Are there ways to detect the disease prior to crop maturity? What is the role of seed, machinery, wind, or animals in dispersal of KB to new areas?

CIMMYT Cooperative Breeding and Screening Program

In cooperation with U.S. wheat breeders, CIMMYT will screen existing U.S. wheat varieties for resistance to KB. These cooperative programs will transfer several diverse sources of KB resistance into U.S. spring and winter wheat germplasm. Cooperating with CIMMYT provides access to the world's best sources of resistance to KB. CIMMYT also has a naturally infested disease-screening nursery for KB, which is essential and is not available in the U.S. In addition, CIMMYT will conduct studies on disease management and contribute to the pest risk assessment process for KB. CIMMYT will dedicate one full-time scientist and several assistants to the project. If funding allows, CIMMYT will set up additional nurseries in India to screen for resistance in additional diverse environments. This will speed the breeding process and hopefully improve the durability of resistance. CIMMYT already has a successful cooperative breeding program to transfer KB resistance to Australian wheat varieties, even though KB has not yet been identified in that country.

Resistant Variety Development at Land Grant Universities

Public and private U.S. wheat breeders will develop adapted, high-yielding varieties with resistance to KB. The initial goal is to phase out varieties that are highly susceptible to KB. The next step is development of varieties with moderate resistance, which may help slow the spread of KB. Eventually, the long-term goal is to develop varieties that are highly resistant or completely immune. U.S. Wheat breeders will need funding to initiate crossing programs and to travel to CIMMYT to evaluate their materials in the disease screening nurseries. Due to the difficulty of field screening methods, another long-term goal is to move toward marker-assisted selection for the breeding programs. This may be done in conjunction with several new USDA genotyping facilities.

Biotechnology for Marker-Assisted Selection and Novel approaches

The goal of the biotechnology section is to develop new molecular biology approaches to control KB. Development of new molecular markers for KB resistance genes to assist breeding programs is a top priority. Identification of markers will require high quality data from field screening nurseries. Host plant resistance genes need to be characterized and their functions understood at the molecular level. Resistance genes will also be sought in non-hosts of KB such as rice, oats, barley, or maize. We need to know whether strains or races of the fungus exist. Elucidation of the molecular basis of fungal infection and the fungal genes required for virulence is needed. Biotechnology approaches may also be developed for detecting the presence of KB in grain or environmental samples.

Alternative Production Systems, Marketing Systems, and Grain Utilization

Multi-disciplinary research is needed on methods to mitigate KB economic damage. Can producers economically use alternative crops such as oats, barley, triticale, rye, or winter perennial forages for

pasture instead of wheat? When should producers graze out or hay their wheat pasture rather than keep it for grain when KB is a risk factor? Can we reduce risks associated with livestock and wildlife movement from infested fields? Are there innovative ways to market the grain domestically or internationally? Can we design a grain quality management system that will enable the U.S. to reliably deliver KB-free wheat to export markets? Can we develop alternative phytosanitary certification procedures in addition to the pest-free area concept? Do we need new standard operating procedures for important control points in the production-marketing chain? What are the best methods for utilizing grain that tests positive for bunted kernels?

EXTENSION:

Extension plant pathologists, agronomists, grain scientists, and economists will develop best management practice (BMP) recommendations for producers, custom harvesters, elevator operators, and exporters. Information will be disseminated through fact sheets, radio programs, news releases, web sites, and meetings.

PROPOSED BUDGET:

A 5-year program will be required to meet the goals of the Karnal Bunt Program. First year needs total \$1.8 million, as follows:

Research and Extension Areas Amounts: Epidemiology & Disease Management - \$4 00,000; CIMMYT Cooperative Breeding and Screening Program - \$400,000; Resistant Variety Development at Land Grant Universities - \$300,000; Biotechnology for Marker-Assisted Selection and Novel Approaches - \$300,000; and Alternative Cropping Systems, Marketing Systems, and Grain Utilization - \$400,000

As research and extension activities intensify during years 2-5, budget requirements may grow.

IMPLEMENTATION:

The Karnal Bunt program will be funded as a USDA-CSREES special grant to Kansas State University, which will then distribute funds to other organizations. A steering committee will be assembled consisting of growers, grain handlers, millers, researchers, extension specialists, and other stakeholders of the wheat industry from across the country. The steering committee will meet at least once per year to exchange information, discuss and set research priorities, and set policies for operation of the program. An executive committee will be selected by the steering committee. The executive committee will be responsible for accomplishing the business of the KB program. The executive committee will recruit research and extension committees and committee chairs to evaluate competitive research and extension proposals for each area of the program. The executive committee will then make a recommendation to the steering committee on distribution of funds. There will be an annual forum where research and extension project results are presented.

HISTORY OF THE PROGRAM:

The detection of KB in north Texas in May 2001 was a wake-up call to the wheat industry in the U.S. The idea of an enhanced Karnal bunt program was built from discussions at five meetings since June. Plant pathology department heads attending the North Central Division of the American Phytopathological Society in Manhattan, KS discussed the issues on June 20. On August 2, North Central region experiment station directors approved a rapid response committee (NC-503) to coordinate KB research and extension programs (). On August 10, a Symposium on Karnal Bunt was conducted at the Fall Cereal Conference, a regional winter wheat meeting, in Manhattan, KS. Stakeholders and researchers from several states participated in addition to Dr. Guillermo Fuentes from CIMMYT. On

August 27, there was an informal Karnal Bunt Discussion at the annual meeting of the American Phytopathological Society in Salt Lake City. Approximately 60 participants from various agencies shared their experiences and opinions and discussed and endorsed a strengthened KB research program. On Oct. 31-Nov.1, USDA-APHIS hosted a workshop on KB in Oklahoma City. A consensus emerged that more research was needed. On Jan. 16, 2002 NC-503 met in Orlando, Florida in conjunction with the National Association of Wheat Growers and the National Wheat Improvement Committee. All three entities adopted resolutions calling for increased research on KB.

USDA-ARS U.S. Wheat and Barley Scab Initiative

Amount Requested: \$600,000, USDA-ARS Program Budget

Fusarium Head Blight of wheat and barley emerged in the past decade as a widespread and powerful enemy of American agriculture. This disease, also known as 'Scab', inflicts yield and quality losses on farms in at least 18 states. Food industries throughout the U.S. incur losses from the cost of dealing with the mycotoxin-contaminated grain that often accompanies scab infection. Combined losses to all steps in the food system are difficult to estimate, but the bill at the farm-gate alone is estimated to exceed 3.0 billion dollars since 1990.

Scab of wheat and barley is one of several plant disease complexes accorded special status in the federal budgeting system. The existing private, state, and federal research system of the U.S handles most of the newly emergent pests and diseases. But some, like wheat and barley scab, present unusual challenges that warrant new approaches to research. There are several reasons why scab is a special problem requiring new approaches:

- **Scab is an economic threat to growers, processors and consumers of wheat and barley throughout much of the U.S.**
- **Research is required in a wide array of disciplines, with possible solutions including:**
 - resistant varieties (from conventional or biotechnology approaches),
 - alternative residue and rotation management schemes,
 - crop protection via chemical and biological controls, and
 - detoxification or alternative processing of contaminated grain.
- **The interaction of the scab pathogen with local and regional farming practices is complex and poorly understood.**
- **Recent experience clearly signals that no single institution can bring to bear the critical mass of research this problem demands.**
- **Scab solutions are likely to be both site and system specific, which dictates involvement of local experts in all of the at least 18 directly affected states.**
- **Opportunities for acquiring competitive funds for scab research from traditional federal sources are extremely scarce.**

During the past four years, federal and state scientists have worked closely with growers, input providers, millers, and food processors from across the country to design and fund a national, multi-disciplinary, and multi-institutional research system that can win the war on scab in the most efficient manner possible. The result of these efforts is the U.S. Wheat and Barley Scab Initiative. The Initiative's goal is simple: create the conditions necessary for a swift and complete technological triumph in the war against Fusarium Head Blight. In one sense, the Initiative is a self-organized "contact group" on scab. The Initiative seeks to surmount normal institutional, regional, disciplinary, and sector interests in order to resolve and fund a best-case research agenda. Relevance of targeted research is assured by the central role that industry (growers and processors) plays in the Initiative's work. Accountability and relevance to practical solution discovery are guiding principals for the Initiative. The structure of the Initiative is simple and includes a broad-based Steering Committee with representatives from all stakeholder groups and regions. The Steering Committee has recruited national leaders in each of the major research areas to serve on committees that advise the Steering Committee on research agendas.

The Scab Initiative's research and steering committees undertook a process in 1998 that generated a comprehensive first-year research plan involving 111 projects in six research areas to be executed by 66 scientists from 19 Land Grant colleges and the USDA's Agriculture Research Service (ARS). Every conceivable solution area was considered, and the resulting mix of research projects is truly comprehensive. The prioritization process was competitive by its very nature, since researchers had to demonstrate their ability to contribute to the overall solution. On the other hand, the final research agenda consisted of a mix of projects identified via both directed and purely competitive processes. In almost all cases, funds proposed by the Initiative were heavily leveraged by existing sources of investments in personnel, facilities, and supplies.

In 1999, the Scab Initiative's research and steering committees once again collaborated to generate a comprehensive research plan for 2000. This plan incorporated 1999-funded research projects that were successfully meeting their goals, new high priority research projects, and 5 baseline budget additions for USDA-ARS. In total, 73 scientists from 22 land grant universities and the USDA-ARS engaged in 104 projects during 2000.

Congress appropriated an additional \$800,000 that brought the total amount in appropriations to \$6.1M for 2001 and 2002. After various administrative costs were removed, and some funding was directed to the base budgets of ARS scab research projects, the total funding for U.S. Wheat and Barley Scab Initiative-recommended projects was slightly more than \$5M. The Initiative's research plan for 2001 included a total of 83 scientists from 24 land grant universities and the USDA-ARS engaged in 109 projects across 25 states. The recommended research plan for 2002 is similar in scale, with 109 projects funded in 26 states.

Significant and tangible progress in the battle against Scab is accruing at an ever-increasing rate. Below is a list of just a few of the accomplishments resulting from research being conducted through the Initiative:

- ✓ identification and 'retirement' of highly susceptible varieties.
- ✓ release of new varieties with economically significant levels of resistance.
- ✓ resolution of fundamental questions revolving around the life cycle of the pathogen.
- ✓ development of a 14 state uniform fungicide evaluation network that has enabled industry to identify and promote scab-retarding fungicides.
- ✓ coordination and amplification of biotechnology based efforts aimed at the discovery and deployment of genetically engineered genes that diminish scab damage.
- ✓ development of a prototype of a multi-state disease forecasting system that will inform industry and growers alike as the appropriate timing of fungicide application.
- ✓ discovery of new sources of natural resistance genes, leading to significant broadening of the germplasm base with which breeders can work.
- ✓ creation of a virtually seamless network of research assets that makes full use of the real-time communication enabled by the World Wide Web.

However, this is not a time for complacency. A careful analysis by the Initiative's stakeholders reveals a significant gap between the ideal and actual funding level in all research areas. For instance, the Initiative has turned away excellent and promising research proposals because of lack of funds. The combined budgets of the non-funded proposals have exceeded \$1.5M in each of the past two years. **We are therefore requesting that Congress appropriate an additional \$600,000 in FY2003 to the USDA-ARS partnership with the U.S. Wheat and Barley Scab Initiative.**

See WWW.SCABUSA.ORG for up-to-date information on the Scab Initiative.

**USDA-ARS Cereal Disease Laboratory (CDL)
St. Paul, Minnesota**

**Amounts Requested: \$3.2 Million, USDA-ARS Building & Facilities Budget
\$300,000, USDA-ARS Program Budget**

***\$3.2 Million, USDA-ARS Building & Facilities Budget
(In FY2002, Congress provided a first installment of \$300,000 for building design)***

The USDA-ARS Cereal Disease Laboratory (CDL) is a Federal research facility with the national mandate of providing improved methods for controlling cereal (barley, oats, wheat) diseases that are effective, safe, and environmentally friendly, mainly through the deployment of resistant cultivars. The primary focus of this laboratory (formerly the Cereal Rust Laboratory) prior to 1998 was to study and develop control measures for cereal rust diseases. Rusts are fungal diseases that are capable of destroying our nation's cereal crops. Indeed, catastrophic epidemics of stem rust devastated wheat crops across the United States in 1935, 1937, 1954, and 1955. Through the deployment of resistant cultivars and continued monitoring of pathogen races in the field, stem rust has been held in check and significant losses have not occurred for at least 35 years; however, other rust diseases still threaten our cereal crops. For example, losses to leaf rust in wheat alone totaled over \$1.5 billion for 1990–1999. To combat these rust diseases, a sustained research effort is needed to 1) monitor the outbreaks and development of rust diseases across the country, 2) characterize races of rust pathogens to determine if they pose a threat to our current cereal cultivars, 3) discover new types of genetic resistance to rust diseases for use in cereal breeding programs, and 4) investigate basic aspects of host-parasite interactions to develop novel control methods using modern genomic and molecular technologies. As a national center for cereal rust research, these important objectives will continue to be a priority of the CDL.

In the early 1990's, another fungus disease called Fusarium head blight (FHB) or "scab" re-emerged in many areas across the eastern half of the United States. FHB epidemics of wheat and barley occurred as a consequence of minimal tillage practices and successive wet years with losses estimated at \$3 billion for the years 1990–1999. To immediately address the threat of this new disease, the CDL expanded its mission to 1) discover new types of genetic resistance to FHB, 2) evaluate their usefulness against known and emerging strains of the pathogen, and 3) explore other approaches to augment levels of control of FHB that can be achieved with incomplete resistance. Basic research projects are also being conducted on host plant resistance, infection mechanisms of the pathogen, and identification of novel control measures by means of advanced genomic and molecular technologies.

The research activity at the CDL has increased by 50% over the past two years. Laboratory personnel now include six Ph.D. research project leaders, three support scientists, five research technicians, and two office staff. The expanded research effort has resulted in severe space shortages. The original research facility was constructed in 1972 to house rust investigations of four project leaders and has 7,000 square feet of laboratory and office space, 4,000 square feet for growth chamber and head house activities, and 4,500 square feet of greenhouse space. Research activity has now spilled over into a 450 square foot laboratory temporarily leased in a neighboring U.S. Forest Service research facility. A new addition to the laboratory would provide space for the additional new project leaders, modern laboratories for the latest molecular, genomics, and computer

technologies, and St. Paul-based ARS administrative staff, who are currently housed in temporary quarters.

The proposed building addition of approximately 10,000 square feet includes a isolation plant growth room and preparation laboratory with HEPA filter for exhaust air and a sterilization system for discharged water, three fully equipped research laboratories, expanded seed handling and seed storage rooms, offices for CDL staff, a conference room for St. Paul-based ARS functions, and a suite of three offices plus equipment room for the St. Paul Location Administrative Officer and staff. The isolation plant growth room will be used for research with transgenic rust and *Fusarium* cultures as well as with foreign cultures of these fungi. The isolation room will have inoculation and incubation chambers for infecting plants, and a small lab for isolating DNA for study outside the isolation area. The conference room and the location administrative offices will be separated from the research area and will serve all three ARS research units at the St. Paul location.

Rusts and FHB pose a continual threat to our cereal crops. Personnel in the CDL are trying to meet the challenge posed by these devastating fungal diseases, but are severely limited in the physical space for research. **Thus, the National Barley Improvement Committee, National Oat Improvement Committee, and National Wheat Improvement Committee are requesting that Congress approve \$3.2 million for the construction of a new addition to the CDL so it can maintain its vital national mission in reducing the threat of rust diseases and FHB to cereal crops. In FY2002, Congress provided a first installment of \$300,000 for building design.**

\$300,000 Increase, USDA-ARS Program Budget

To effectively tackle the rust and FHB disease problems of cereal crops in the United States, the Cereal Disease Laboratory (CDL) must maintain its core group of research scientists and support staff. In FY01, there were six research scientists (category 1) and two senior support scientists (category 3 level) at the CDL (see below). With the retirement of Don McVey in FY01 and the imminent retirement of William Bushnell, the CDL will be short two key senior scientists.

Research scientists: Martin Carson, Research Leader William Bushnell, Plant Physiologist (will retire FY03) Jim Kolmer, Research Geneticist Corby Kistler, Research Geneticist Don McVey, Research Plant Pathologist (retired FY01) Les Szabo, Research Geneticist	Support scientists: David Long Mark Hughes
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The research efforts of the two retiring scientists are critical to the CDL’s mission of developing effective control strategies against rust diseases and FHB. Don McVey played an integral role in developing rust resistant wheat cultivars for breeding programs and monitoring virulence dynamics in rust populations across the Great Plains region. William Bushnell’s pioneering disease physiology studies have greatly increased our knowledge of resistance mechanisms in cereal crops and the infection process of FHB pathogens.

The average support level per SY at the CDL is only about \$230,000. Current funding levels will allow the CDL to refill the Don McVey position, but not the William Bushnell position. Thus, the National Barley Improvement Committee, National Oat Improvement Committee, and National Wheat Improvement Committee are requesting that Congress approve new program funding of \$300,000 to refill the William Bushnell position and provide adequate funding for the other scientists at the CDL.

For additional information about the Cereal Disease Laboratory visit their website (<http://www.cdl.umn.edu>)

Advanced Genetics Laboratory National Small Grains Germplasm Research Facility, Aberdeen ID

**Amount Requested: \$4.6 million, USDA-ARS Building & Facilities Budget
(In FY2002, Congress provided \$500,000 for building design)**

The National Barley Improvement Committee, National Oat Improvement Committee, and National Wheat Improvement Committee request \$4.6 million for the construction of an advanced molecular genetics laboratory addition to the ARS National Small Grains Germplasm Research Facility (NSGGRF) at the Aberdeen Research and Extension Center in Aberdeen, ID.

This request is also supported by The University of Idaho, Idaho Barley Commission, Idaho Wheat Commission, Idaho Grain Producers Association and Idaho Potato Commission, and Tri-State Potato Research Committee.

Current Status: The ARS program at Aberdeen, Idaho, includes several advanced molecular genetics research programs in barley, oats and potatoes. Ongoing research in genetic improvement of feed and malting barleys, including low phytic acid grains for fish, swine and poultry diets, the genetic improvement of oats for use in the food and feed industry, and potato varieties with enhanced quality and storage characteristics, is greatly constrained by inadequate laboratory facilities. Furthermore, the University of Idaho's (UI) wheat genetic research capabilities at Aberdeen will be greatly enhanced by the proposed advanced genetics laboratory addition at the ARS facility. Currently the UI wheat genetics program conducts laboratory experiments in limited areas, without a single dedicated laboratory.

Background/Justification: Construction of a \$4.6 million laboratory addition for advanced molecular genetics research in barley, oats, wheat and potatoes will provide significant benefits to the small grains and potato industries throughout the Pacific Northwest and the US. The USDA NSGGRF houses one of the foremost crop germplasm collections in the world, including over 100,000 small grain accessions. This institution maintains seed stocks, distributes seed to researchers worldwide and serves as a center of small grains and potato genetics research.

The proposed 12,000 square foot laboratory addition will greatly enhance the molecular genetics capability in both small grains and potatoes for the benefit of barley, wheat, oats and potato industries in Idaho, the Pacific Northwest, and the US. Laboratory space is planned for four grain and potato breeders/geneticists. For personnel safety, a radioisotope room is planned, allowing the localization of radioisotope research to one room that can be readily monitored and contained. A service lab is proposed to provide additional space for centrifuges, incubators, freezers and other large equipment items. The movement of these large equipment items to an adjoining separate service lab allows for more efficient use of laboratory space and will allow the sharing of expensive equipment among researchers. A tissue culture room and growth room are envisioned to accommodate the anticipated increased use of tissue culture methods in both the potato breeding and low phytic acid research. Additional facilities include a loading bay for the temporary storage and processing of plant material and a cold-storage area for long-term storage of plant material such as seed and tubers. Specific research objectives are outlined below:

Low phytic acid barley research -- Barley genetics research at the NSGGRF has led to the development of the world's first feed grains with essentially no phytic acid phosphorous (95% phytic acid free). The

phytic acid or phytate form of phosphorous contained in grains cannot be digested by nonruminant animals and humans, causing antinutritional concerns in the diet as well as phosphorous waste management problems. The objectives of this research are to develop genetic approaches to the phytic acid problem that are useful in crop breeding and improvement; to work with plant breeders in the use of these genetic resources; and to cooperate with human and animal nutritionists in studies on nutritional improvements and phosphorous waste reduction. The development of low phytic acid barley cultivars will lead to the increased use of barley in nonruminant animal and human diets.

Barley and oat genetics research -- The NSGGRF supports extensive research in barley and oat breeding and biotechnology. The genetic complexity in the inheritance of various desirable traits makes the development of superior varieties an ongoing, long-term process involving many generations of crossing, selecting, and testing. This breeding process will be greatly enhanced by more precise genetic techniques. Specific work is currently focusing on understanding the genetics of plant regeneration and developing efficient transformation systems that are less dependent on tissue culture systems that generate undesirable changes in agronomic and quality traits. Barley breeding efforts and associated cultivar and germplasm releases at the location continue to focus on both two-rowed and six-rowed malting barleys in both spring and winter backgrounds. Hulled and hullless feed barley improvement is also receiving significant attention. The protein content of oats is the highest among cereal grains and the quality of the protein is also recognized as superior to other cereal grains for many purposes and the soluble dietary fiber of oats has proved effective in reducing serum cholesterol levels and providing other health benefits. These and other factors are being addressed in the oat genetics and germplasm enhancement program at the location with both covered and hullless cultivars being developed and released in recent years.

Wheat genetics research -- The University of Idaho's wheat genetics program at Aberdeen is a key national program applying molecular and traditional genetics to improving the competitiveness of US wheat in global markets, without genetic transformation technologies. Among its successes is the cultivar Idaho 377s, developed to expand Pacific Rim exports to Asia and Latin America to compete with premium exports from Australia and Canada. Idaho 377s is the most widely grown hard white wheat in the US. Current research is transferring to the marketplace new genetic traits such as high amylopectin starch, low polyphenol oxidase flour, high anti-oxidant wheat, and low phytic acid mill feed. Using a whole systems approach, including advanced genetic screening techniques, on-farm research, industry advisory panels, and innovative grain marketing, the wheat program is facilitating collaboration between the farming, shipping, and food processing sectors to improve the competitiveness of US products. The Advanced Genetics Laboratory will house state-of-the-art gene sequencing and mapping equipment and will strengthen UI-private-public institution partnerships to expand markets for US wheat.

Potato genetics research -- A primary objective of the ARS potato genetics research program at Aberdeen is to develop new superior russet cultivars with the desirable traits of Russet Burbank, without its susceptibility to environmental stresses. Benefits of improved varieties are expected to result in reduced production costs, more uniform quality, less storage problems, and better processing recovery. Ranger Russet is an example of a russet cultivar released from the Aberdeen program that has benefited the Idaho potato industry. Ranger Russet's improved yield, disease resistance, tuber size, and starch content as compared to Russet Burbank has resulted in increased profitability for both growers and the processing industry. It is now the second-most widely grown cultivar in Idaho after Russet Burbank. In

the United States, Ranger Russet is the third most widely grown potato cultivar, which demonstrates the importance of the breeding program to the national potato industry.

The Aberdeen potato breeding program will be developing molecular techniques to more rapidly incorporate desirable traits such as disease resistance from wild potato species to the cultivated potato. Incorporation of these molecular techniques into the program is limited at this time due to inadequate laboratory space with less than satisfactory HVAC properties.

The benefit to the US small grains and potato industries will be the more rapid development of barley, wheat, oat and potato cultivars that are adapted to our region and meet the exacting end-use specifications of global customers.

**New USDA-ARS Building for Cereal Crops Research
Red River Valley Agricultural Research Center
North Dakota State University, Fargo, ND**

Amount Requested: \$15.0 Million, USDA-ARS Building & Facilities Budget

Research conducted by USDA-ARS scientists at the Red River Valley Agricultural Research Center (RRVARC) has had and continues to have a major impact on small grains production. Research is critical for the advancement of crop productivity through reduction of pest losses, and increased agronomic adaptability and crop quality. The amount requested will allow construction of a new facility to increase research capacity and efficiency, and will thus greatly enhance the ability of the RRVARC to respond to problems faced by the small grains industry. Research on other northern-grown crops (sunflowers, sugarbeets, potatoes) will also benefit as a result of this facility improvement.

Current facilities are inadequate to house all RRVARC personnel, requiring the stationing of some in university facilities. Also, the recent addition of six new research positions (four small grains, one sunflower, one sugarbeet) has resulted in space limitations that are hampering current programs and will inhibit future program expansions.

Justification:

Disease resistance, improved marketability, and improved end-use quality are major issues affecting the production of barley, hard red spring wheat, durum, and oats in the upper Midwestern U.S., the nation's leading production region for these small grains. These dynamic issues require ongoing research to maintain the region's leadership in production of these crops. For example, pathogens and pests of small grains are continually changing and adapting to resistance; therefore disease problems are never permanently solved. Fusarium head blight (FHB) has ravaged wheat and barley during the '90s, costing producers billions of dollars. Stem rust, with destructive potential at least as great as that of FHB, has been and continues to be a major threat. Adoption of conservation tillage practices has increased disease problems such as Septoria leaf spot, net blotch, and tan spot. In addition, as consumers become more health and quality conscious and markets more specialized, U.S. producers must have varieties to grow and sell that are able to compete in both world and domestic markets. Germplasm that can serve as a source of disease resistance or improved quality is derived from both basic and applied research such as that done at the Northern Crop Science Laboratory in Fargo. Recent augmentation and expansion of cereal research programs in Fargo has greatly facilitated the ability of ARS researchers to address issues of critical importance to the region's farmers and industry. The success of this expansion has led to additional needs for facility improvements. In particular, there is a need for greater laboratory and greenhouse space for genetics and genotyping research. A new era of molecular plant breeding research has begun, and the technologies utilized and developed through advanced genotyping research will provide the foundation for future success in meeting the needs of farmers and industry in the 21st century.