PROJECT NUMBER:  NC-213

TITLE:  MARKETING AND DELIVERY OF QUALITY CEREALS AND OILSEEDS

DURATION:  October 1, 1998 to September 30, 2003

STATEMENT OF THE PROBLEM:  Grain markets now reward competent handlers of high commodity volume on a low margin basis. Redirecting an increasing proportion of the U.S. cereal and oilseed industry toward a more profitable product-oriented market, based on an underlying commitment to quality, will not be easy. Quality must focus on the needs of diverse customers and it is critical that end-use quality needs of individual users be identified and met (Hobbie, 1993). Legislative and technological changes are creating new opportunities to deliver higher quality products which have added value to end-users. Some changes may also engender risks for different industry sectors. The challenge will be to generate value through quality enhancement at as many points as possible in the production, distribution, and marketing system. At the same time, it remains critical to preserve quality of all cereals and oilseeds, and successfully manage risk. The 1996 Farm Bill will increase the level of risk management expertise needed by all segments of the cereal and oilseed industry. Changes that create value will require improved communication, information, technology transfer, and collaboration between the diverse communities that comprise and affect grain markets. New approaches for maintaining quality of cereals and oilseeds from harvest to delivery, while preserving environmental quality and consumer safety, must be developed and implemented if the U.S. is to remain at the forefront of the world’s major producers.

JUSTIFICATION:  By most estimates, the value of U.S. corn and soybeans could be increased by 10-30 cents per bushel in the near term if quality were more closely matched to user needs (Hurburgh, 1995). Advances in analytical instrumentation and plant breeding and biotechnology are expanding the scope of grain and oilseed products that can be delivered from the farm to domestic and overseas markets (Goss and Kerr, 1993). Identification, selection, and segregation of value-added grains and oilseeds will require appropriate instrumentation. The need to preserve the identity of grain, through segregation in the market stream, may also necessitate changes in the grades and standards. Improved equipment, procedures, and grading criteria quantifying quality differences will permit more equitable pricing among producers, more efficient allocation of different qualities to their best end uses, and a lower cost of marketing.

IMPORTANCE OF THE PROBLEM ..... to the farmer – An outcome of the 1996 farm bill’s provision to gradually eliminate deficiency payments to farmers will be to shift price and income risk away from the federal government to farmers. In addition, changes in trade policies, demographic shifts in the agricultural sector, and globalization of markets will continue to challenge the U.S. farmer’s competitiveness. U.S. farmers need expanded opportunities to produce high quality grain that can attract a premium price. Additionally, farmers require confidence that systems to avoid dockage penalties and preserve the quality of grain, are optimized in their behalf.

...to grain marketers - The cereal and oilseed industry’s ability to develop and implement systems that ensure productivity and sustainability must also meet the end-users’ need to maintain or enhance their competitive position in an increasingly global economy. It must be possible to measure and isolate premium quality grain from ordinary or inferior quality grain. Measurement instruments, and handling and marketing systems, should be designed to convey the value-added product through the distribution system.

... to the consumer – Meeting consumer demands for assured food product safety and quality are paramount. Some microbial pathogens jeopardize food and feed safety through mycotoxin contamination. Periodic contamination of grain by toxins severely undermines consumer
confidence in food and feedstocks. Success in optimizing and preserving the quality and safety of grains, will contribute to stable food supplies and prices for the consumer.

EXTENT OF THE PROBLEM – Industry-wide and public sector needs and expectations have dramatically accelerated the need for new approaches to our existing commodity-based orientation. The recent past will likely be regarded as the period when the U. S. grain industry truly began a fundamental shift in the way cereals and oilseeds are produced and marketed. New genetic technologies such as high-oil corn, and herbicide and insect resistant corn and soybeans, were successfully introduced. Also during the past year, acquisitions and mergers exceeding one billion dollars in transaction costs took place between seed and technology companies. These companies have strategic goals for development of new cultivars with “packages” of several or more value-added traits. New cultivars with enhanced value-added traits will increasingly necessitate changes throughout the production, processing, distribution, and marketing cycle.

Production of quality grain, and maintenance of its quality during harvesting, handling, and storage, are important concerns of the entire grain industry (Hill, 1996). The quality of grain and oilseeds entering the marketing system is at its highest at the time it is harvested. Every event from harvesting onward, and time spent in storage, have a major impact on grain quality and value. Physical disintegration due to handling (including harvesting, drying and transport), and deterioration due to the activity of insects and/or microorganisms add costs and risks to many sectors of the industry.

NEED FOR COOPERATIVE WORK -- A multidisciplinary approach involving biological, economic, and engineering sciences is essential to address the challenges encountered in bringing about positive changes in the U.S. grain markets. Cooperation across stations is vital to effectively conduct the interdisciplinary research necessary to develop, produce, identify and maintain grain quality. The broad scope of the project will link scientists at different stations, and integrate the industry from producer to end-user. The diverse nature of the needed participants essentially precludes comprehensive treatment by any single institution. Independent strategies at individual states would result in duplicated effort in some areas, and absent or inadequate solutions at others. Presentations and discussions at annual meetings provide a dynamic forum for the exchange of information from the diverse community of participants.

Participants are from the states that produce the major proportion of U.S. cereals and oilseeds. Approximately 90 scientists, engineers and economists from 11 North Central Stations, several stations outside the region, several USDA/ARS research locations, the Federal Grain Inspection Service and the Economic Research Service, participate as well. At the annual meeting there is a high degree of interaction among researchers from different disciplines. Such interaction is uncommon at meetings of professional societies where members of only one discipline gather. Representatives of commodity groups participate in meetings and are represented on the executive committee. Representatives from the industry advisory committee actively participate in annual meetings, and the industry usually supplies many of the speakers at the summer workshops. Ideas and needs of producers, merchandisers, regulatory agencies and processors are discussed with researchers so their efforts are focused on timely problems and relevant long-range research goals. In the past, annual reports on each project were submitted to the coordinator and then arranged in a booklet for distribution to the membership (including the industry advisory committee) prior to the annual meeting. In future, newsletters will also be maintained on a web-site to provide even wider access. This level of interaction could not be achieved by researchers working only within state or local regions. The interaction of academia, industry, and government in NC-213 has provided a unique forum whereby systematic, orderly change in the US grain marketing system can be assisted.
BENEFIT TO THE SOLUTION -- Researchers are informed and challenged by this regional committee and the result is leveraging of resources, and a higher proportion of relevant interdisciplinary research. The grain marketing system is spread across many states, and evaluation of alternative marketing strategies is facilitated by a regional approach. Ongoing cooperation of the NC-213 committee also would enable effective responses to "crisis" situations, should they arise.

RELATIONSHIP TO CURRENT PRIORITIES – Development of a quality product-oriented market is highly consistent with priorities developed by the National Agricultural Research Committee. The relationship of the Crosscutting Research Areas and Objectives with NC-213 objectives follows:

- **Food Production Research:** The proposed activities are necessary actions to develop improved plant processing and marketing systems which are environmentally sound and profitable. The proposed work will emphasize the need to identify common interests of producers, industry, and consumers for high quality food and feed stocks.

- **Genetic Resources Development and Manipulation:** The NC-213 program also participates in developing high quality cereals and oilseeds with enhanced end-use characteristics for food use or feedstocks. These efforts tend to rely on interdisciplinary cooperation and long-standing cooperative relationships between university and ARS researchers. Value-added grain products also improve human nutrition and enhance global competitiveness.

- **IPM:** NC-213 participants are conducting research to examine physical and cultural treatments that may be used to reduce the need for fumigation of stored grains. The impact of mold infection, combine adjustments, drying and grain chilling treatments, and biorational control strategies are consistent with the stated priority of reducing pesticide use. Reduced pesticide use alleviates risk to humans, animals, and the environment.

- **Economic Development and Policy:** The potential need for changes in the grain standards, and the market opportunities presented by the introduction of new value-added genotypes to the market, will require new management decision-making models and market development strategies so that value can be garnered for as many sectors of the market as possible. Analysis of factors that could enhance U.S competitiveness are critical areas of the NC-213.

- **Food and Nutrition:** Consumer food safety research is an integral part of the NC-213 objectives to enhance end-use applications of grain. Desirable nutritive effects of enhanced quality grain and superior processing techniques will result in superior and safer products for the consumer.

Impact on science –  The main impact of the committee has been in the sustained delivery of publications ranging from practical extension bulletins to peer-reviewed journal publications, including the journal *Science*. The committee’s cross-regional and multidisciplinary natures will continue to assure the publication and dissemination of knowledge and solutions. Examples include the cooperative contribution by Hill et al. (1995) entitled “Costs and Benefits of Redefining the Grade Factor: Borden Corn and Foreign Material.” North Central Regional Research Publication 336.

OTHER IMPACTS -- Different strata of the grain industry may react differently to any proposed change. For example, an ideal test to segregate grain for a specific end-use (which would obviously benefit producers and processors) may take too long to perform to be applied in the general marketing channel. Also, the profit potential from the volume of grain involved may not justify the cost of segregating it in the general system. Changes may have differential economic impacts on the various strata. This has been the source of a great part of the inertia impeding changes in the system. Successful change has usually been brought about where parties are able to communicate mutually beneficial contracts.

RELATED CURRENT AND PREVIOUS WORK: A CRIS search of projects active during March of 1997, using more key words than used during the 1993 search, revealed 528 projects in contrast to the 900 previously identified. Again, many of the projects were by scientists
involved on this project. They included breeding/genetics projects involving wheat quality, corn, sorghum, and soybean. There were four hybrid/varietal performance testing projects each for corn and soybeans that evaluated quality as a criterion. USDA projects focused on the biology, detection or management of stored product insects, and the economic aspects of grain quality area were in evidence. The grain quality measurement (instrumentation also), management and evaluation category, contained numerous projects. Contributing projects to the eight regional projects are listed below (along with a brief statement).

S-224: "International Trade Research on Commodities Important to the 'Southern Region" does not deal with grain quality, the primary economic focus of this proposal.

S-231: "Analysis of the Structure, Efficiency and Competitiveness of the Southern U.S. Grain Marketing System" has had limited overlap. "Crop quality" was a key word on several of the contributing projects, and there is a "competitiveness" aspect to some of the proposed economic research. Communication of research results between the projects is not a problem since members of this project, e.g. L. D. Hill (IL) are included.

S-235: "Integrated Systems and Controls for Processing and Storing Agricultural commodities" overlaps with some of the dryer control and grain chilling work on this project.

NC-129 - Fusarium Mycotoxins in Cereal Grains and NC-213 historically have shared a few members. The main link is with the ARS National Center for Agriculture Utilization Research (NCAUR) scientists at Peoria. NC-129 is scheduled to terminate 9/2000.

NC188: "Market Quality of Hard Wheat for Domestic and International Foods", has limited overlap, mainly with the single kernel hardness tester and other wheat quality work at the U.S. Grain Marketing Products Research Center (USGMPRC). This project will terminate 9/98.

NCR-152 - Antioxidants: “Their Impact on Food Quality and Human Health” and NC-186: "Structural Changes in the U.S. Grains and Oilseeds Marketing Systems in a Dynamic and Global Marketplace" were terminated 9/97.

As detailed above, there are now fewer projects with similarities to this proposal than when renewed in 1993. The proposed NC-213 project retains its unique strength in that it provides an effective interface for the broad interdisciplinary areas, with the focus on quality of the major cereal and oilseed crops, in the North Central Region.

**OBJECTIVES:**

Objective A: Determine the effects of genetic traits, climatic factors, agronomic practices, pest populations, machine harvesting, and drying on the quality of cereals and oilseeds.

Objective B: Assess the effects of postharvest microbial growth, insect infestation, chemical usage, drying and handling on quality of cereals and oilseeds during storage and transport.

Objective C: Quantify and define quality of cereals and oilseeds for various end use markets.

Objective D: Determine the economic impact of improving the quality of cereals and oilseeds.

The revised project includes the four objectives from the current project. The first two objectives are divided according to the sequence of events which grain follows from the field to the market. The third encompasses tests and techniques for determining quality and value at time of marketing. Economic considerations have been placed in the fourth objective to provide visibility. They will be integrated with the research of the other three objectives.

**EXPECTED OUTCOMES:**

The NC-213 research activities will continue to advance scientific knowledge and generate new technologies and methodologies. Outcomes will be published in scientific journals and extension delivery of information will be achieved using multiple media approaches. Some technology advances will be transferred to the industry through patents to enhance commercialization opportunities. New varieties to expand market opportunities and add value to cereals and oilseeds will be developed and released.
Some examples of expected outcomes include: 1) Enhancement of existing web-sites and development of an NC-213 web-site to increase access to data on grain compositional traits and suitability of genotypes for different end-use applications. 2) Development and expanded application of improved analytical techniques for grain and food quality determinations using updated near infra-red transmittance spectral analysis (NIRT) calibrations, nuclear magnetic resonance and single kernel spectral analysis techniques, HPLC techniques, and applications of digital image analysis technology. 3) Expansion of market opportunities assisted by NC-213 marketing research and release of specialty varieties with improved food and feed quality. 4) Continued refinement of dryer management schemes using ambient-air corn drying and electronic control to reduce harvest-time labor, energy costs, and improve the quality of stored products. Information will be distributed to farmers through press releases, newsletters, and electronic distribution systems. 5) Development of integrated pest management (IPM) programs and their increased adoption by farmers to achieve sanitation, aeration, and effective monitoring programs to preserve stored product quality. 6) Discoveries of additional biorational insect control alternatives, using botanically derived chemicals. 7) New methods for improved processing performance and safety of food and feed products. 8) Additional methodologies that can assist breeders in their crossing decisions and selection processes. 9) Increasing the number of processors who will be offering differential payments to producers, based on protein and oil.

These outcomes will benefit farmers and grain marketers by expanding opportunities to add value at multiple points in the marketing and delivery channels. Cost savings will be accrued by reduced energy costs for grain drying. Consumers, farmers, and the environment will benefit from reduced risk of exposure to insecticides and natural toxins.

PROCEDURES:

a. Breeding for improved quality traits, specialty uses and quality preservation.
   1) Iowa - Maintain a website database of corn and soybean intrinsic quality by hybrid/variety, and geographic location. Develop market applications and interpretive tools.
   2) Iowa - Provide grain quality data for publicly sponsored soybean and corn plot trials.
   3) Iowa/Ohio - Evaluate Latin American X Corn Belt maize populations for value-added grain quality traits. Interregional cooperation.
   4) NCAUR - Provide public soybean breeders with chemical analyses data on protein and oil (by NIR) and fatty acid composition (by gas chromatography) and methods development.
   5) NCAUR - Evaluate corn genotypes developed in different parts of the world for resistance to kernel infection and aflatoxin. NCAUR and Cargill Hybrid Seeds Collaborative effort.
   6) Nebraska - Characterize and identify corn hybrids and experimental (exotic) germplasm with superior end-use properties for wet milling, dry milling, and alkaline cooking (for tortillas and corn snacks).
   7) Ohio - Select maize, soybean, and soft-red winter (SRW) wheat germplasm with superior end-use characteristics.
   8) Ohio - Study the influence of pollen effects on kernel compositional characteristics.
   9) Ohio - Provide compositional analyses on entries in state maize and soybean performance evaluations.
   10) Texas- Evaluate physical, chemical and processing properties of sorghum cultivars. Develop methods to select for improved alkaline cooking properties of white and yellow maize hybrids. Determine milling and baking quality of wheat breeding lines
   11) GMPRC - Perform milling and baking tests on small samples to assign quality measurements to breeder and research samples.

b. Environmental effects on fundamental quality (chemical and physical properties and perishability) of cereals and oilseeds.
   1) Kansas - Develop preharvest prediction of wheat end-use quality using plant and climatic variables.
2) Washington - Evaluate grain quality characteristics of spring wheats grown under broad climatic and soil conditions in the Northwest and relate them to end product quality.
3) NCAUR - Investigate the potential role of soybean lipoxygenase products in suppressing aflatoxin formation in transgenic corn. Characterize lipoxygenase products of cereal grains that suppress fungal pathogens.

c. Resistance to seed-eating insects.
   1) GMPRC - Determine susceptibility of corn hybrids, and other grain varieties, to infestation by storage insects and correlate host susceptibility with grain chemical composition.

   a. Cultural practices impacting yield and quality of grains and oil seeds.
      1) Montana - Determine milling and baking quality and rheological properties of early generation lines of spring and winter wheat.
   b. The origins of fungal infective inoculum in corn fields and management practices to prevent build-up leading to mycotoxin contamination.
      1) NCAUR - Determine the genetic diversity (RFLP fingerprinting) of Aspergillus flavus clonal populations from Illinois and Iowa corn fields and contrast patterns of distribution and abundance for both atoxigenic and toxigenic strains.
      2) NCAUR - Investigate the chemical basis of fungal antagonism associated with mycoparasites and fungicolus fungi isolated from buried Aspergillus flavus sclerotia. NCAUR and University of Iowa collaboration.
   c. Strategies to prevent pre-harvest insect damage of grains and oilseeds.
      1) NCAUR - Identify structural, chemical and biochemical factors that promote resistance to insects in corn kernels and which may also be associated with fungal resistance. Develop field-based methods for determining the presence of resistance factors identified. Develop predictive and monitoring systems to identify conditions favorable for aflatoxin occurrence in the Midwest corn crop. Collaborators will include several scientists in government, academia and industry in the U.S. and other countries with NCAUR.

Proc. A3. Harvesting practices as they affect safe storage and end-use quality of grains and oilseeds.
   a. Effect of combine adjustment and harvest moisture content on damage, storability, and end product yield and quality.
      1) Kansas - Explore relationship between wheat cleanliness and harvester loss and attempt to estimate the economic feasibility of cleaning wheat in the field versus cleaning wheat at the first collection point. Explore market implications of different harvesting and cleaning strategies. Interdisciplinary collaboration.

Proc. B1. Management of the storage environment to maintain end-use value and prevent microbial deterioration and mycotoxin contamination.
   a. Measurement and control of factors that affect mold growth in storage.
      1) Minnesota - Measure and model effect of moisture content, temperature, crop variety, initial crop quality, and mold inhibitors on deterioration rates of stored grains and oilseeds. UM collaboration with ISU and GMPRC.
      2) Iowa/Minnesota/GPMRC - Determine the carbon dioxide production of field-shelled corn under controlled step-change temperature and moisture conditions with exposure time. Compare CO₂ measurements using UM and ISU procedures.
   b. Short term and alternative storage techniques, such as controlled atmosphere, refrigeration, chemical preservatives and underground storage.
      1) Kansas - Evaluate impact of outdoor grain storage on loss and quality deterioration. Provide grain industry with recommendations for outside storage if necessary. Perform economic analysis of the impact of outside grain storage. Interdisciplinary collaboration.
2) Nebraska - Determine the effects of preservatives and fungicides on growth and mycotoxin production by selected molds.

c. Moisture and temperature dynamics during long term storage and during ocean shipment.
   1) GMPRC - Develop and refine a stored grain temperature and moisture prediction model for wheat stored in steel bins with and without forced aeration. Expand the model to include other types of grain, storage structures and conditions.


a. Detection techniques, including X-ray imaging, specific gravity, trapping, and immunological methods.
   1) CMAVE - Analyze and interpret acoustical signals made by stored product insects, develop acoustical devices and computer software for monitoring stored product insects.
   2) CMAVE - Improve and develop electronic and pheromone probe traps for monitoring adult stored product insects.
   3) Montana - Assess the extent of lesser grain borer infestation in stored wheat and barley. Determine the relationship between field and storage populations with PCR/thermal cycling techniques to evaluate genetic relatedness.
   5) GMPRC - Develop methods for automatically detecting insects in stored grain using acoustical detection.
   6) GMPRC - Develop and test pheromone traps and integrate them into more effective monitoring systems leading to optimal control decisions.
   7) Wisconsin - Isolate, identify, and utilize pheromones and grain attractants for pest insects. Develop immunological-based methods for detecting and quantifying insects or their fragments in stored grain or grain products. ARS - UW collaboration.

b. Predicting insect populations through ecological studies and computerized decision support systems.
   1) CMAVE - Develop methods for quantitative interpretation of trap catch, and for precision targeting in bulk grain and warehouses.
   2) Indiana - Investigate behavioral differences between strains of stored-product insects and examine the genetic basis for these behavioral differences.
   3) GMPRC - Conduct quantitative ecological, behavioral and population dynamics studies on stored-grain insects and their natural enemies. Develop computerized decision-support systems for managing stored-grain insects.
   4) Wisconsin - Utilize genetic markers to study migration, gene flow, and population structure of stored grain insect pests. UW and University of Texas collaboration.

c. Integrated pest management techniques, including conventional pesticides, controlled environments, and biopesticides.
   1) CMAVE -
      • Determine the most effective new insect growth regulators for stored product insect control. Develop new methods for application of IGRs to stored commodities.
      • Develop genetic and pheromone-based methods for interfering with the reproduction of stored product insects.
      • Determine the chemical ecology of stored product insects.
   2) Idaho - Develop a feedback control automatic aeration system to prevent insect infestation and simultaneously maintain the desired moisture content in stored cereal grains. Evaluate wheat protein changes during storage.
   2) Indiana - Investigate various time/temperature patterns of ambient and chilled aeration on management of stored-grain pests using small-scale bin experiments and computer simulation.
3) Indiana - Assessment and optimization of chilled grain aeration and storage as a non-chemical, preventive pest control technique; special focus on food-grade cereal grains.

5) Minnesota - Evaluate factors influencing activity of diatomaceous earth (DE) dusts on stored product insects, and examine techniques for improving insecticidal activity of existing DE formulations. MN; ENTM

6) Minnesota - Investigate the potential of a biopesticide (Spinosad®) for controlling stored product Coleoptera and Lepidoptera pests. Interdiscip. collaboration. MN; ENTM, PATH

7) Minnesota - Develop and validate sequential sampling plans for insects infesting stored commodities and confectionery facilities.

8) Montana - Develop new biorational residual and fumigative stored grain and oilseed applications from locally grown insecticidal plants.

9) Kansas/GMPRC - Conduct biological, physiological and genetic studies on insects found in stored grains. Develop insect control strategies. GMPRC and KSU cooperation.

10) GMPRC/Kansas - Investigate the mechanisms of BT toxin activation and larval susceptibility/resistance in Indianmeal moths. GMPRC collaboration with KSU.

2) GMPRC -
   • Develop and evaluate automatic grain aeration control strategies for maintaining grain quality and controlling insects during storage.
   • Assess the efficacy of conventional, physical and biological insect control methods in commercial grain marketing and processing industries, and integrate these approaches into biorational pest management programs for industry.
   • Assess the efficacy of augmentative releases of parasitic wasps for controlling insect pests of farm-stored grain.
   • Develop integrated control strategies for insect pests in raw agricultural commodities and processed food warehouses.
   • Develop recommendations to reduce susceptibility of commercial packages to infestation by stored-product insects. Cooperation with industry.
   • Evaluate the integration of pesticide resistant parasitic wasps into management programs for stored-grain insects.

12) Wisconsin - Investigate the behavior and ecology of parasitic and predaceous insects, and determine the potential for biological control. ARS and UW collaboration.


a. Effects of natural-air and heated-air drying on quality.
   1) Illinois - Effect of variety and drying temperature on milling quality of corn.

b. Efficiency and management of grain drying.
   1) Indiana - Evaluate feasibility of high-speed, high-temperature drying of corn followed by conditioning with natural (or low-temp.) air using a microprocessor-based fan controller.

c. Relationships between physical properties of grains and handling damage.
   1) GMPRC - Determine the effect of hopper angle on the flow rate of wheat, corn and sorghum grain through horizontal square and circular orifices. Develop predictive equations for grain flow rates.
   2) GMPRC - Develop improved methods and procedures to predict corn breakage during handling.


a. Chemical composition and nutrient quality (e.g. protein quantity and type, oil quality and quantity, free fatty acids, amino acids, antioxidants).
   1) BARC - Develop and refine methodology for crude protein determination in wheat single kernels using near-infrared reflectance and transmittance measurements.
2) Iowa - Develop calibrations, calibration transfer and applications for near-infrared instruments in corn/soybean trading situations. Interdisciplinary ISU-Industry (MBS, Inc.) collaboration.

3) Iowa - Optimize the performance of near-infrared analyzers in a trading network situation. Develop quality control procedures for in-house and regulatory purposes.

4) Kansas - Develop NIRT calibrations for whole grain analyzers to predict wheat quality characteristics including sedimentation and dough factor to assist in wheat quality segregation activities at country elevators. Regional collaboration.

5) NCAUR - Examine oxidation of soybean oil and characterization of products and apply technologies to chemical, instrumental and sensory determination of oil quality and stability.

6) GMPRC -
   - Evaluate kernel characteristics, milling properties, dough and bread making properties of hard winter wheat progenies.
   - Develop and adapt tests for determining wheat quality through protein analysis and baking.
   - Develop a standardized mixogram analysis procedure for 10g samples and evaluate the effect of flour mass, absorption and mixing speeds.
   - Design, fabricate and evaluate a prototype mechanical baffle system to reduce dust emission at grain dump pits and reduce worker health risks.

b. Physical properties including breakage susceptibility, kernel hardness, damaged and broken kernels, stress cracking.

1) GMPRC/BARC - Establish relationships between wheat kernel and the following single kernel measurements: NIR transmittance, NIR reflectance, back-lighted digital image, and USDA-GMRL SKH value. Regional cooperation.

2) Illinois - Develop methods using machine vision to automatically detect and measure physical defects and morphologic factors of corn and soybean kernels that relate to quality and/or end-use.

3) Illinois/Kansas/GMPRC - Determine the precision and reliability of existing procedures to properly assess the amount and effects of garlic in wheat. Regional cooperation.

4) Kansas/GMPRC - Evaluate scab and sprout damaged wheat kernels collected by GIPSA field offices using GMPRC single kernel wheat characterization (SKWC) meter.

5) GMPRC/Kansas - Develop equipment and uniform procedures for official determination of dockage and shrunken and broken kernels in wheat. Compare the performance of the uniform procedures to existing official grain grading procedures.

6) Kansas/GMPRC - Correlate physical properties as measured by the SKWC system with milling results to allow for prediction of milling performance based on kernel hardness.

7) Kansas - Single kernel characterization of scab and sprout damaged kernels including density, weight, and size, was performed during 1995-1997.

8) Minnesota - Develop procedures for using machine vision to assess grain quality. Machine vision system will be used to measure quality factors at various levels of dry matter loss for samples in allowable storage tests.

9) GMPRC -
   - Assess wheat classes, mixtures, and uniformity of wheat based on four characteristics: weight, size, moisture content and hardness characteristics, using SKWCS.
   - Examine utility of commercial instruments to determine single corn kernel moisture and extend single kernel analysis to include other properties of corn kernels. Modify the SKWCS to permit similar processing of single corn kernels.
   - Develop and evaluate single kernel optical and NIR quality assessment methods.
   - Develop digital image methodology methods to objectively assess bread quality (quality score) and other factors related to bread quality.
   - Develop digital color image methodology to detect grain defects.
   - Develop digital image methodology to analyze the microstructure of wheat kernels.
• Develop an automated sample handling, inspection and grading system for wheat. Determine if a portion of the official grain inspection procedures can be automated with conventional instrumentation.
• Measure single kernel characteristics such as color and protein utilizing color sensors, NIR sensors and machine vision.
• Develop a methodology to relate the physical properties of wheat kernels to milling energy and optimum mill settings.
10) Wisconsin - Determine various physical properties such as moisture isotherms, breakage susceptibility, friction coefficient, test weight etc. of starch-coated cottonseed and compare properties with those of uncoated counterparts. Evaluate storability of coated cottonseeds.

Proc C2. Identification of physical and chemical factors affecting milling, processing, grinding and end use quality and yield.
a. Cereals (wet and dry milling, snack food processing, flour milling, feed grinding).
  1) Arkansas - Drying, storage, milling, and cooking tests will be conducted with several varieties of rice.
  2) Illinois - Investigate factors affecting wet millability of corn.
  3) Illinois - Effect of variety on quality of tofu. Process tofu from selected varieties of soybeans, for use in consumer preference tests. Coordinated with variety selection and test shipment under Objective D.
  4) Illinois - Produce and process soy yogurt for use in sensory evaluation of these products.
  5) Iowa - Relate nutrient composition and nutrient quality attributes to processing value. Develop and validate process simulation models for determining end-use value. Interdisciplinary collaboration.
  6) Kansas/GMPCR - Investigate wet-processing of whole wheat kernels to separate bran, germ and endosperm. Investigate wet-processing of sorghum grain to devise a low-cost process to isolate readily available starch from the kernels. KSU-ARS collaboration.
  7) Kansas - Characterization of country elevators, burden on receiving equipment during harvest rush, and segregation schemes to optimize quality and profitability. Economic analysis of the optimum binning strategy and development of an expert system will be conducted in 1998 and 1999.
  9) Montana - Determine milling, baking, and end-use properties of neem-treated hard red bread wheat and barley. Establish milling fraction destination of neem kernel extract applied to grain surface.
  10) Nebraska - Determine and identify specific chemical and physical factors in corn and changes in processing conditions which influence corn wet milling product yields.

a. Incipient molding.
  1) GMPRC - Identify fungi-grain interrelationships which may regulate invasion and damage of grain by storage fungi.

b. Identification of mycotoxins responsible for adverse effects in humans and animals, quantitative methods to identify extent of a mycotoxin problem, rapid screening methods for mycotoxins known to be problems.
1) NCAUR- Develop screening tests and quantitative analytical methods for mycotoxins in cereal grains and animal tissues and fluids.
2) Nebraska - Evaluate the use of ergosterol as an early indication of mold activity in grain and/or feeds and correlate this to detection of mold growth on colony count methods and mycotoxin production.
3) Nebraska - Develop high performance liquid chromatographic (HPLC) and enzyme-linked immuno-sorbant assay (ELISA) methods for detection and quantification of moniliformin in cereal grains.

c. Effects of processing on molds and mycotoxins in grains.
   1) Nebraska - Study incidence and levels of contamination of Fusarium spp and fumonisins in corn intended for processing into human foods. Determine effects of processing on Fusarium spp. and fumonisins by monitoring the survival of the organism and the toxins.

   1) Illinois and ERS USDA regional cooperation.

Proc. D1. Determine the economic impact of improving the quality of cereals and oilseeds. Evaluate alternative marketing arrangements in the export market including purchase by specification and identity preserved shipments.
   a. Estimate the demand for quality characteristics by industrial users.
   b. Estimate the demand for different quality attributes for the corn processing industries in the international markets.
      1) Illinois - Evaluate international import-export data from major trading companies on quality specifications for milling. Conduct in-depth analysis using a case study approach for the value of different quality characteristics and their affect on end-product yield.
   c. Estimate price-quality relationships in importing countries.
      1) Illinois - Estimate the differences in value of products derived from processing corn and soybeans based on chemical composition in domestic and foreign markets. Conduct an econometric analysis using historical data on price and quality from different origins.
      2) Ohio - Determine the optimum price strategies for soybean processors using information on geographical differences in quality. Identify price quality relationships in domestic soybean markets and the ability of processors to select quality by specifying a region.

Proc. D2. Evaluate the competitiveness of U.S. quality relative to cereals and oilseeds produced in other countries.
   a. Compare grades and standards of major producing and exporting countries.
      1) Illinois - Contact government and industry agencies in major importing and exporting countries to identify opportunities for increasing uniformity in measurement technology and definitions of important quality characteristics in corn and soybeans.

   a. Calculate costs and benefits of changing grade limits and factor definitions.
      1) Illinois/ERS - Conduct a study of costs and benefits of requiring lower levels of foreign material in grain destined for export markets. Regional cooperation.
   b. Compare the costs and benefits of including quality factors as a grade factor vs. certificate information. (Illinois)
   c. Estimate the costs of private contracts as an alternative to standard grade designation on the certificate. (Illinois)

a. Compare alternative production and marketing practices that influence quality.
   1) Illinois - Introduce composition data into the transaction for soybeans, and make
      information available for decisions by producers, country elevators, and processors.
      Regional and interdisciplinary cooperation.
   2) Iowa - Coordinate shipments and production of specialty grain. Measure differential in
      process output relative to average grain. Estimate the potential and costs of segregation of
      grains by intrinsic quality attributes. Interdisciplinary cooperation

b. Conduct economic analyses of strategies for improving quality.
   1) Illinois - Evaluate economic implications of projects under objectives A, B, and C. As
      alternatives are identified and specified, analyses will be made to determine economic
      aspects of changes to producers and society. Collaborative project.
   2) GIPSA - Provide support services in the determination of official U.S. grades for grains
      and oilseeds in specific projects. Cooperate in economic studies of proposed revisions and
      standards and development of new standards resulting from investigations carried out under
      this and other objectives. Regional collaboration.
   3) ERS - Economic impact analyses on cereal and oilseed crops. Collaborative effort with
      stations and GIPSA.

ORGANIZATION:

OFFICERS: There are four officers: chair, chair elect, secretary and secretary elect. The term of
office is one year and an individual progresses through the chairs from secretary elect through
chair. A new secretary elect is elected every year. As a reflection of the significant USDA
participation, every third secretary elect comes from USDA participants.

COORDINATOR: The coordinator’s role is part of the responsibilities of the Assistant Director
of the OARDC at the Ohio Station’s Wooster Campus. The office includes a half-time secretary.
The coordinator duties include but aren’t limited to:

- Maintaining contact with cooperators through correspondence, the NC-213 Grain Quality
  Newsletter (which includes a current categorized literature search), personal visits, and
  transmitting pertinent information through other means;
- Attending all annual meeting and summer workshop arrangements;
- Assembling and preparing the Annual Report and any other document deemed necessary by the
  coordinator or executive committee.
- Coordinates the review, and award of Anderson Grants to members of the committee.

EXECUTIVE COMMITTEE: This group is composed of the officers, including the immediate
past chair, two objective co-chairs per objective, the chair of the industry advisory committee, the
CSRS advisor, the administrative advisor, and the coordinator. The executive committee conducts
the business of the entire committee between meetings. It meets prior to the business meeting to
serve as a nominating committee, and to make recommendations for the sites and dates of the next
meeting and workshop.

OBJECTIVE CO-CHAIRS: These individuals assemble the agenda for their units for the annual
meeting and provide a communication link between the chair and the scientists on the objective.

INDUSTRY ADVISORY COMMITTEE: This group is composed of individuals representing all
interests in the grain industry from producer to end-user (Attachment). The chair of the Industry
Advisory Committee sits on the executive committee. The first chair, Don Anderson, served until
1990. The chair is now elected by the committee for a three year term. Successive chairs may not
come from the same interest group (ie. producer, marketer/operations, marketer/broker, end-user).
ENDOWMENT: No “off the top” funding is necessary for the coordinator position. An endowment to the Ohio station from “The Andersons” covers the coordinator position, a part-time secretary and office expenses. The fund also provides competitively awarded two-year grants to committee members. There are five-six $15,000.00 per annum grants ongoing.

The administrative advisor is from the Ohio station.

REFERENCES:


SIGNATURES:

Regional Project Title: Marketing and Delivery of Quality Cereals and Oilseeds.

_________________________________________________________  _____________________________
Administrative Advisor                                      Date

_________________________________________________________  _____________________________
Chair Regional Association Directors                         Date

_________________________________________________________  _____________________________
Chair, Committee of Nine                                     Date

_________________________________________________________  _____________________________
Administrator Cooperative State Research Service             Date