ATTACHMENT E

WORKPLAN: More specific procedures, and the principal investigators names and location, and discipline codes are provided in this section.

PROCEDURES:
A1a. Varietal and hybrid characteristics affecting end-use quality, harvesting, handling and drying characteristics. Breeding for improved quality traits, specialty uses and quality preservation.

Iowa - Maintain a website database of corn and soybean intrinsic quality by hybrid/variety, and geographic location. Develop market applications and interpretive tools. C. R. Hurburgh, Jr., Agricultural and Biosystems Engineering; K. E. Zeigler, and B. K. Voss, Agronomy, Iowa State University, Ames. IA: AGEN AGRY

Iowa - Provide grain quality data for publically sponsored soybean and corn plot trials. C.R. Hurburgh, Jr., Agricultural and Biosystems Engineering; K.E. Zeigler, and B.K. Voss, Agronomy, Iowa State University, Ames. IA: AGEN AGRY

Iowa/Ohio - Evaluate Latin American X Corn Belt maize populations for value-added grain quality traits. Linda Pollak, Dept. of Agronomy, USDA/ARS ISU, Ames and Richard Pratt, Dept. of Hort. and Crop Science, Wooster, Ohio. IA OH; AGRY

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. One of the primary functions is the analysis of uniform check samples for protein and oil. Warren Rayford, Analytical Chemistry Support Unit, NCAUR. IL; AGEN

NCAUR - Evaluate corn genotypes developed in different parts of the world for resistance to kernel infection and aflatoxin. Corn genotypes are ranked according to percent kernel infection, as measured by numbers of bright greenish-yellow fluorescent (BGYF) kernels, and levels of aflatoxin (ng/g) contamination. D.T. Wicklow, Bioactive Agents Research, NCAUR, Peoria and J. Rice, Cargill Hybrid Seeds, Mt. Vernon, IN. IL; PATH

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). Establish rapid methods to identify superior end-use properties that are applicable to both breeding programs and direct commercial use. Identify contribution of environmental and genetic factors to end-use properties. David S. Jackson, Dept. of Food Science and Technology, University of Nebraska-Lincoln. NE; FOOD

Ohio - Select maize, soybean, and SRW wheat germplasm with superior compositional and end-use characteristics. Richard C. Pratt, Kim Campbell, Steve St. Martin, and Ron Fioritto, Dept. of Horticulture and Crop Science, Ohio Agricultural Research and Development Center, Ohio State University, Wooster and Columbus. OH; AGRY

Ohio - Study the influence of pollen effects on kernel compositional characteristics. Richard C. Pratt, Peter Thomison, David Jordan, Dept. of Horticulture and Crop Science, Ohio Agricultural Research and Development Center, Ohio State University, Wooster and Columbus. OH; AGRY

Ohio - Provide compositional analyses on entries in state maize and soybean performance evaluations. Richard C. Pratt, Steve St. Martin, James Beuerlein, David Jordan, Steve St. Martin and Ron Fioritto. Horticulture and Crop Science, Ohio Agricultural Research and Development Center, Ohio State University, Wooster and Columbus. OH; AGRY

Texas - Evaluate physical, chemical and processing properties of sorghum cultivars with improved plant characteristics. Develop methods to select for improved alkaline cooking properties of white and yellow maize hybrids. Determine the milling and baking quality of wheat lines from the wheat improvement program. Javier Betram, L. W. Rooney, and R.
D. Waniska, Dept. of Soil and Crop Sciences, Texas A & M University, College Station. TX; FOOD AGRY

GMPRC - Perform milling and baking tests on small samples to assign quality measurements to breeder and research samples. O.K. Chung and C.G. Lang, Grain Quality and Structure Research Unit, GMPRC, Manhattan. KS; FOOD AGRY

A1b. Environmental effects on fundamental quality (chemical and physical properties and perishability) of cereals and oilseeds.

Kansas - Preharvest prediction of wheat end-use quality using plant and climatic variables. End-use qualities evaluated in this study include kernel protein, flour extraction, and mixograph absorption. Advance prediction of the supply and location of quality wheat should encourage adoption of a quality-based marketing strategy. Four years of preliminary model development using varietal performance plots resulted in regression models with high (R2>.85) predictive ability. Model validation and refinement will be performed using national agricultural statistic objective yield samples. T. Herrman, T. Loughin, G. Paulsen, L. Nelson, G. Krenzer, J. Quick. KS, OK, CO, NE; AGRY STAT

Washington - Evaluate the quality of hard and soft spring wheats grown under broad climatic and soil conditions in the Pacific Northwest and to relate the characteristics of these wheats to the quality of end products. Zuzann Czuchajowska, Dept. of Food Science and Human Nutrition, Washington State University, Pullman. WA; FOOD

NCAUR - Investigate the potential role of soybean lipoxygenase products in suppressing aflatoxin formation in transgenic corn. Determine the physiological role of 4-hydroxy-2-nonenal (HNE), a product of the lipoxygenase pathway which is toxic to fungi. Characterize lipoxygenase products of cereal grains that suppress fungal pathogens. H.W. Gardner, Bioactive Agents Research, NCAUR, Peoria; Nancy P. Keller, Dept. of Plant Pathology, Texas A&M University, College Station; Douglas Doehlert, Dept. of Cereal Science & Food Technology, North Dakota State University, Fargo. IL TX ND; PATH


GMPRC - Determine the susceptibility of corn hybrids, and of other grain varieties, to infestation by storage insects and correlate susceptibility with chemical composition of the corn. J.E. Thorne and J.E. Baker, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

A2a. Agronomic and pest management practices as they affect quality in grains and oilseeds

a. Cultural practices impacting yield and quality in grains and oil seeds.

Montana - Determine milling and baking quality and rheological properties of early generation lines of spring and winter wheat. P. Bruckner and L. Talbert, Plant, Soil, and Environmental Sciences, Montana State University, Bozeman. MT; AGRY FOOD

A2b. The origins of fungal infective inoculum in corn fields and management practices to prevent build-up leading to mycotoxin contamination. IL; APTH

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. D.T. Wicklow and C.E. McAlpin, Bioactive Agents Research, NCAUR, Peoria. IL; PATH

NCAUR - Investigate the chemical basis of fungal antagonism associated with mycoparasites and fungicolaus fungi isolated from Aspergillus flavus sclerotia that were buried for up to three years in Illinois and Georgia corn fields. D.T. Wicklow, Bioactive Agents
A2c. Strategies to prevent pre-harvest insect damage of grains and oilseeds.
NCAUR - Identify structural, chemical and biochemical factors that promote resistance to insects in corn kernels and which may also be associated with fungal resistance. Determine environmental factors that modify expression. Develop field-based methods for determining the presence of resistance factors identified. Identify low input, environmentally, economically and agronomically sound control strategies for sap beetles and associated insects in corn ears related to vectoring of mycotoxinogenic fungi (including sap beetle delivery of biomotors), and combine acceptable strategies into an integrated control program. 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. Patrick F. Dowd, Bioactive Agents Research, NCAUR, Peoria.

A3a. Harvesting practices as they affect safe storage and end-use quality of grains and oilseeds. Effect of combine adjustment and harvest moisture content on damage, storability, and end product yield and quality. 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. Physical characteristics of wheat kernels (collected and lost during harvest) and the nutritional value of grain cleaning by-product (dockage, foreign material, and shrunken and broken wheat) for cattle feed will be measured. Market implications of different harvesting and cleaning strategies will be explored. T.J. Herrman, Dept. of Grain Science and Industry, and M.D. Schrock, Dept. of Agricultural Economics, Kansas State University, Manhattan.

B1a: Management of the storage environment to maintain end-use value and prevent microbial deterioration and mycotoxin contamination. Measurement and control of factors that affect mold growth in storage.
Minnesota - Measure and model effect of moisture content, temperature, crop variety, initial crop quality (mechanical seed damage, initial mold infection, maturity, presence of preharvest disease), and mold inhibitors on deterioration rates of stored grains and oilseeds. Carbon dioxide evolution from seed samples will be used to determine dry matter loss and allowable storage time. Evaluate the appropriateness of criteria and algorithms used to determine allowable storage time. WF Wilcke and RV Morey, Biosystems and Agricultural Engineering, RA Meronuck, Plant Pathology, University of Minnesota, St. Paul; CJ Bern, Agricultural and Biosystems Engineering, Iowa State University, Ames; JL Steel, Engineering Research Unit, GMPRC, Manhattan. MN, IA, GMPRC; AGEN, PATH

Iowa/Minnesota/GMCPRC - Determine the carbon dioxide production of field-shelled corn under controlled step-change temperature and moisture conditions with exposure time. Compare the carbon dioxide production measurements on shelled corn using the UM and the ISU procedures. Validate or determine the failure of customary mathematical translations of existing constant condition carbon dioxide data to correctly predict the results obtained in the step-change temperature and moisture condition tests. W. Wilcke, C. Bern and J.L. Steel USDA-ARS, Grain Marketing and Production Research Center Engineering Research Unit, Manhattan. IA KS; AGEN
**B1b.** Short term and alternative storage techniques, such as controlled atmosphere, refrigeration, chemical preservatives and underground storage.

**Kansas** - Evaluate the impact of storing grain outside in piles on grain loss and quality deterioration. Evaluate the physical characteristics of grain piles (dimensions, quantity, site preparation, grain moisture and pile temperature profile) in an attempt to better understand the effect of piling grain sorghum and corn. Provide the grain industry with recommendations in the event that outside storage becomes necessary. An economic analysis of the impact of outside storing will be performed to help assess the cost of railcar inaccessibility. T. Herrman, C. Reed, M. Boland, J. Harner, D. Trigo-Stockli. KS: GRNSC, PATH, AGEN, ECON (NEW PROJECT)

**Nebraska** - Determine the effects of preservatives and fungicides on growth and mycotoxin production by selected molds. Mold and mycotoxin production will first be studied in a suitable broth substrat. Different levels of the preservatives or fungicides will be added to the broth to determine effects on growth and toxin production. Further studies will be done in sterile rice and corn. Lloyd B. Bullerman, Dept. of Food Science and Technology, University of Nebraska, Lincoln. NE; FOOD

**B1c.** Moisture and temperature dynamics during long term storage and during ocean shipment.

**GMPRC** - Develop and refine a stored grain temperature and moisture prediction model for wheat stored in steel bins with and without forced aeration. Use the model to evaluate automatic aeration control strategies which minimize grain quality losses due to microbial and insect activity. Expand the model to include other types of grain, storage structures and geometries, static pressure and velocity distributions, microbial deterioration rate distributions, insect infestation rate distributions and internal and structural grain pressure distributions. C. S. Chang and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

**B1d.** Health and safety risks to grain handlers.

**B2a.** Detection, monitoring and management of insect populations during storage and transport. Detection techniques, including X-ray imaging, specific gravity, trapping, and immunological methods.

**CMAVE** - Analyze and interpret acoustical signals made by stored product insects, develop acoustical devices and computer software for monitoring stored product insects. D. Shuman, R. Mankin, N. Epsky. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM

**CMAVE** - Improve and develop electronic and pheromone probe traps for monitoring adult stored product insects. D. Shuman, D. Weaver, T. Arbogast, N. Epsky. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM

**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. F. V. Dunkel, Entomology Montana State University, Bozeman, and Tom Phillips, Oklahoma State University. MT OK; ENTM.

**Montana** - Evaluate the postharvest resistance of hard red, hard white, and soft white wheat to Montana strains of storage insects. Study lines will include new releases and lines just prior to release. Insects will include the lesser grain borer, the red flour beetle, Indianmeal moth, and rice weevil. Using feeding inhibitor gene codes from other plant species, conduct transformation of susceptible wheat lines. F.V. Dunkel, Entomology, and P.
Bruckner, L. Talbert, and S. Sivamani, Plant, Soil, and Environmental Sciences, Montana State University, Bozeman. MT; ENTM AGRY

GMPRC - Develop methods for automatically detecting insects in stored grain using acoustical detection. D. W. Hagstrum and P. W. Flinn, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

GMPRC - Develop and test pheromone traps and integrate them into more effective monitoring systems leading to more efficient and effective control decisions. M. A. Mullen, Biological Research Unit, GMPRC, Manhattan. KS; ENTM AGEN

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. W. E. Burkholder, S. Gunasekaran, SPIRU ARS USDA, Entomology, University of Wisconsin, Madison. WI; ENTM AGEN

**B2b.** Predicting insect populations through ecological studies and computerized decision support systems.

CMAVE - Develop methods for quantitative interpretation of trap catch, and for precision targeting in bulk grain and warehouses. T. Arbogast. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM AGEN

Indiana - Investigate behavioral differences between strains of stored-product insects and examine the genetic basis for these behavioral differences. L. J. Mason, Entomology, Purdue University, West Lafayette. IN; ENTM

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. D. W. Hagstrum, P. W. Flinn, and R. W. Howard, J. E. Throne, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

Wisconsin - Utilize genetic markers to study migration, gene flow, and population structure of stored grain insect pests. W. E. Burkholder, S. Gunasekaran, SPIRU ARS USDA, Entomology, University of Wisconsin, Madison; B. Kitto, BIOTECT, Austin. WI TX; ENTM

**B2c.** Integrated pest management techniques, including conventional pesticides, controlled environments, and biopesticides.

CMAVE - Determine the most effective new Insect Growth Regulators for stored product insects and the most sensitive insect stages and species for IGR effectiveness. Develop new methods of application for IGRs to stored commodities. D. Silhacek, H. Oberlander. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM AGEN

CMAVE - Develop genetic and pheromone-based methods for interfering with the reproduction of stored product insects. R. Mankin, P. Shirk. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM

CMAVE - Determine the chemical ecology of stored product insects. N. Epsky. Postharvest and Bioregulation Unit, CMAVE, Gainesville. FL; ENTM AGEN

Idaho - Develop a feedback control automatic aeration system to prevent insect infestation and simultaneously maintain the desired moisture content in stored cereal grains. Evaluate the survival of storage insect populations under different aeration control schemes to develop the optimum control scheme for simultaneous insect and moisture control. Evaluate wheat protein changes during storage. M. E. Casada, Biological and Agricultural Engineering; and Katherine O’Brien and James B. Johnson, Plant Soil and Entomological Sciences, Moscow. ID; AGEN ENTM

Indiana - Assessment of chilled grain aeration and storage as a non-chemical, preventive pest control technique with a special focus on food-grade cereal grains, such as food corn, popcorn, wheat and rice. Optimization of a first-generation grain chilling system using
variable-frequency blowers, supplemental evaporative cooling, and partial rechilling of the bulk. D.E. Maier, Agricultural Engineering, Purdue University.

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. Comparison of the effects of time/temperature aeration patterns against conventional chemical and alternative pest control practices, including fumigation, residual protectants, and ozone. D.E. Maier, L.J. Mason, Entomology, Agricultural Engineering, and C.P. Woloshuk, Botany and Plant Pathology, Purdue University, West Lafayette, J.L. Throne, F. Arthur, USDA-ARS, Grain Marketing and Production Research Center, Manhattan, Kansas. IN KS; ENTM AGEN

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. B.H. Subramanyam, Entomology, University of Minnesota, St. Paul. MN; ENTM

Minnesota - Investigate the potential of a biopesticide (Spinosad®) derived from an Actinomycetes, (Saccharopolyspora spinosa), for controlling stored product Coleoptera and Lepidoptera. B.H. Subramanyam, Entomology, RA Meronuck, Plant Pathology, University of Minnesota, St. Paul. MN; ENTM PATH

Minnesota - Develop and validate sequential sampling plans for insects infesting stored commodities and confectionery facilities. B.H. Subramanyam, Entomology, University of Minnesota, St. Paul. MN; ENTM.

Montana - Develop new biorational residual and fumigative stored grain and oilseed applications from locally grown insecticidal plants. F. V. Dunkel, Entomology Research Laboratory, Montana State University, Bozeman. L. J. Sears Dept. of Chemistry, V. Cohran and N. Spencer, USDA ARS Sidney, Montana, D. MacArthur, U.S. Forest Service, Provo, Utah. MT UT; ENTM

Kansas/GMPRC - Conduct biological, physiological and genetic studies on insects found in stored grains. Develop insect control strategies. K. J. Kramer, R. W. Beeman, R. W. Howard, Biological Research Unit, GMPRC, Manhattan; and D. E. Johnson, Dept. of Statistics, Kansas State University, Manhattan. KS; ENTM STAT

GMPRC/Kansas - Investigate the mechanisms of BT toxin activation and larval susceptibility/resistance in Indianmeal moths. J. E. Baker, Biological Research Unit, GMPRC, Manhattan; and D. E. Johnson, Dept. of Statistics, Kansas State University, Manhattan. KS; ENTM

GMPRC - Develop and evaluate automatic grain aeration control strategies for maintaining grain quality and controlling insects during storage. Samples of grain will be obtained periodically to determine grain quality, moisture content, test weight, grade and insect populations. C. S. Chang and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN ENTM

GMPRC - 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. A. K. Dowdy, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

GMPRC - Assess the efficacy of augmentative releases of parasitic wasps for controlling insect pests of farm-stored grain. P. W. Flinn, D. W. Hagstrum, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

GMPRC - Develop integrated control strategies for insect pests in raw agricultural commodities and processed food warehouses. F. H. Arthur, Biological Research Unit, GMPRC, Manhattan. KS; ENTM
GMPRC - In cooperation with industry test, develop, and make recommendations to reduce the susceptibility of commercial packages to infestation by stored-product insects. M. A. Mullen, Biological Research Unit, GMPRC, Manhattan.

GMPRC - Evaluate the integration of pesticide resistant parasitic wasps into management programs for stored-grain insects. J. E. Baker and J. H. Brower, Biological Research Unit, GMPRC, Manhattan. KS; ENTM

Wisconsin - Investigate the behavior and ecology of parasitic and predaceous insects, and determine the potential for biological control. W. E. Burkholder, S. Gunasekaran, SPIRU ARS USDA, Entomology, University of Wisconsin, Madison. WI; ENTM

Illinois - Effect of variety and drying temperature on milling quality of corn. S.R. Eckhoff, Agricultural Engineering, University of Illinois, Urbana. IL AGEN

B3b. Efficiency and management of grain drying.
Indiana - Evaluate the feasibility of high-speed, high temperature drying of corn to 19 - 21% moisture content followed by conditioning of the hot corn with natural (or low-temperature) air using a microprocessor-based fan controller under Indiana conditions. Fuel and electricity demand, drying capacity and grain quality will be compared against conventional and other combination drying methods. D. E. Maier, Agricultural Engineering, Purdue University, W. Lafayette. IN; AGRN

B3c. Relationships between physical properties of grains and handling damage.
GMPRC - Determine the effect of hopper angle on the flow rate of wheat, corn and sorghum grain through horizontal square and circular orifices. The flow rate data will be used to develop predictive equations for grain flow rate as a function of orifice size, shape and hopper angle. C. S. Chang and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - Develop improved methods and procedures to predict corn breakage during handling. Corn breakage caused by various handling methods will be determined using corn of different breakage susceptibility levels. The data will be used to develop models to predict corn breakage during a series of handling processes which are typically found in grain elevators and corn handling operations. C. S. Chang and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

B3d. Relationship of preharvest damage by frost, mold, etc. to problems in storage, processing, and yield of processed products.

C1a. Development and evaluation of instrumentation and procedures for measurement of factors related to quality. Chemical composition and nutrient quality (e.g. protein quantity and type, oil quality and quantity, free fatty acids, amino acids, antioxidants).

BARC - Develop and refine methodology for crude protein determination in wheat single kernels using near-infrared reflectance and transmittance measurements. S. R. Delwiche, Product Quality and Development Institution, Instrumentation and Sensing Lab., BARC, Beltsville. MD; AGEN

Iowa - Develop calibrations, calibration transfer and applications for near-infrared instruments in corn/soybean trading situations. C. R. Hurburgh, Jr., Glen R. Rippke,
Connie L. Hardy, Agricultural and Biosystems Engineering; L. A. Johnson, Food Science and Human Nutrition, Iowa State University, Ames, IA; T. J. Brumm, MBS, Inc., Story City, IA; AGEN FOOD

Iowa - Optimize the performance of near-infrared analyzers in a trading network situation. Develop quality control procedures for in-house and regulatory purposes. C. R. Hurburgh, Jr., Agricultural and Biosystems Engineering, Iowa State University.

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. C. Hurburgh, T. Herrman KS, IA: GRNSC, AGEN

NCAUR - Extraction and processing of vegetable oil from genetically modified oilseeds; characterization of the major and minor constituents, including triglyceride structure; autoxidation and singlet oxygen initiated oxidation of oil and characterization of products. Application of technologies for chemical, instrumental and sensory determination of oil quality and stability. Strategy envisions extensive interaction with public and private breeders as well a plant molecular biologists. Gary R. List, Sharon Abidi, William E. Neff and Kathleen A. Warner, Food Quality and Safety Research, NCAUR, Peoria, IL; FOOD

GMPRC - Evaluate kernel characteristics, milling properties, dough and bread making properties of hard winter wheat progenies. Determine protein and lipid contents, and compositions and interaction among these components of cereal grains as they relate to storage, handling, and end use properties. O.K. Chung, Grain Quality and Structure Research Unit, GMPRC, Manhattan, KS; AGEN

GMPRC - Develop and adapt tests for determining wheat quality through protein analysis and baking. Wheat proteins from near isogenic lines varying in baking quality will be fractionated by extraction and HPLC chromatography and analyzed by electrophoresis (PAGE and SDS-PAGE) for purity, type and molecular weight. G.L. Lookhart, Grain Quality and Structure Research Unit, GMPRC, Manhattan. KS; FOOD

GMPRC - Analysis and interpretation of digitized mixograms for objective assessment of flour quality from 10g samples. Methods to extract the flour mixing property response regardless of system dynamics will be developed. Develop a standardized mixogram analysis procedure and to evaluate the effect of flour mass, absorption and mixing speeds. Similar analyses will be made using a larger mixograph. J. L. Steele and M. D. Shogren, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN FOOD

GMPRC - Design, fabricate and evaluate a prototype mechanical baffle system to reduce dust emission at grain dump pits and reduce worker health risks. Determine the potential for reducing the volume flow rate of air in a dust collection system specifically designed for grain dump pit use. Evaluate the potential for use of wind baffles to reduce dust emission at grain dump pits. R. Noyes, C. S. Chang and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

Washington - Determine what makes club wheats different from soft white wheats and the basis for the preference of the Pacific Rim market for club wheats. Research the role of the quality of the proteins and starches in both classes. Zuzann Czuchajowska, Dept. of Food Science and Human Nutrition, Washington State University, Pullman, WA; FOOD

C1b. Physical properties including breakage susceptibility, kernel hardness, damaged and broken kernels, stress cracking.

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. Determine the confounding effect of vitreousness on each of the hardness techniques. S. R. Delwiche, Instrumentation and Sensing Lab., BARC,
Beltsville; J. L. Steele and C. R. Martin, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

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. M. R. Paulsen, Agricultural Engineering, University of Illinois, Urbana. IL AGEN

Illinois/Kansas/GMPRC - Determine the precision and reliability of existing procedures to properly assess the amount and effects of garlic in wheat. Characterize the frequency distributions of the physical properties of green and dry garlic bulblets and soft winter wheat. Determine the efficiency of separating green and dry garlic bulblets using various mechanical separation systems and combinations of systems. Determine the effect of garlic on break roll plugging, subsequent mill operations and economic implications. M. R. Paulsen and S. Eckhoff, Agricultural Engineering, University of Illinois, Urbana, D. Eustace, Grain Science and Industry, Kansas State University, Manhattan and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. IL KS; AGEN

Kansas/GMPRC - Evaluate scab and sprout damaged kernels collected by GIPSA field offices will be evaluated using the single kernel wheat characterization meter developed at the GMPRC. Relationships between single kernel hardness and sprout damage, and single kernel size/weight and kernel density of scabby wheat will be quantified. Market implication of these relationships will be explored. T. J. Herrman, Dept. of Grain Science and Industry, Kansas State University; C.R. Martin, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

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 developed to that of existing official grain grading procedures. D. S. Chung and C. K. Spillman, Agricultural Engineering, Kansas State University, Manhattan, and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

Kansas/GMPRC - Correlate physical properties as measured or produced by the single kernel wheat characterization system with milling results to allow for prediction of milling performance based on kernel hardness. C. K. Spillman, Agricultural Engineering, Kansas State University, Manhattan, and J. A. Gwirtz, C. R. Martin and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

Kansas - Single kernel characterization of scab ans sprout damaged kernels including density, weight, and size, was performed during 1995-1997. Additional data analysis using multi-variate techniques will be performed to identify population distribution and the capability of the single kernel characterization system to objectively measure kernel damage. Exploration of single kernel NIR will be performed. C. Martin, F. Dowell, T. Herrman, T. Loughin. GMPRC, KS; GRNSC, STAT, AGEN.

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. WF Wilcke and RV Morey, Biosystems and Agricultural Engineering, RA Meronuck, Plant Pathology, University of Minnesota, St. Paul. MN; AGEN, PATH

GMPRC - Assess wheat classes, mixtures, and uniformity of wheat based on four characteristics: weight, size, moisture content and hardness characteristics, using SKWCS. Evaluate distributional properties and inter-relationships of the characteristics. Improve system performance and determine the significance of the information provided by single kernel assessments. Commercialization and transfer of the technology developed will be continued so that commercial prototypes of the SKWCS can be evaluated for classification performance and instrument reproducibility. Studies to relate
mill performance of pure and mixed wheat classes to the characteristics measured with the SKWCS will be conducted. C. R. Martin and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - 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. Kernel weight, size, moisture content and crushing parameters will be determined. The potential for relating the crushing parameters to breakage susceptibility will be investigated. Relating the single kernel characteristics to end-use value for dry milling, wet milling and feeding will be investigated. C. R. Martin and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - Develop and evaluate single kernel optical and NIR quality assessment methods. The addition of single kernel characteristics to the SKWCS should improve its usefulness in wheat classification and objective assessment of end-use value. Optical measurements would provide kernel color, vitreousness, size and shape information. Single kernel NIR measurements could provide protein, moisture content, oil, hardness and ash information. The feasibility of instrumenting the SKWCS for some or all of these measurements will be investigated. The initial efforts will focus on the use of digital image for size and shape and NIR for protein and hardness of single wheat kernels. C. R. Martin and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - Develop digital image methodology methods to objectively assess bread quality (quality score based on crumb grain, texture, and other factors such as resiliency, crust and loaf volume per unit weight relate to bread quality). The extracted texture parameters will be evaluated for correlation to scoring by experts and for relationships to technical bread making factors. I. Y. Zayas and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN FOOD

GMPRC - Develop digital color image methodology to detect grain defects. Digital image pattern recognition techniques will be applied to determine the reliability of using the methods in automated grain inspection. Blue-eye mold infected, heat damaged, sprout damaged, sick, and sound wheat kernels will be evaluated. I. Y. Zayas and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - Develop digital image methodology to analyze the microstructure of wheat kernels. Digital imaging of starch globules will be used to determine the size, shape and distributional properties of starch globules for a larger number of varieties and environments. Varietal and environmental differences in wheat starch formation will be identified and related to other physical characteristics and end-use performance. I. Y. Zayas, J. L. Steele, Engineering Research Unit; and D. B. Bechtel, Grain Quality and Structure Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - 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. Apply recent advances in machine vision, digital image analysis and sample handling to assemble, demonstrate and evaluate an experimental automated inspection system for wheat. Conduct automatic assessment of: foreign material, dockage, bulk density, absolute density, color and color defects, kernel moisture content, kernel weight, kernel size, kernel hardness, protein, ash and class. J. L. Steel, C. R. Martin and I. Y. Zayas, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN

GMPRC - Measure single kernel characteristics such as color and protein utilizing color sensors, NIR sensors and machine vision. F. E. Dowell, C. R. Martin and J. L. Steele, Engineering Research Unit, GMPRC, Manhattan. KS; AGEN
GMPRC/Kansas - Develop a methodology to relate the physical properties of wheat kernels to milling energy and optimum mill settings. These properties and others will be used to determine optimum mill roll settings associated with input material properties. A mill performance and optimization model based on the properties of the material entering and exiting roll stand pairs will be developed and validated. As methods and procedures evolve for roll setting optimization, the methods will be verified and implemented in an automatic real-time control mode. J. L. Steele, E. K. Hague, Engineering Research Unit, GMPRC, Manhattan; and C. K. Spillman, Agricultural Engineering, Kansas State University, Manhattan. KS; AGEN

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 storeability of coated cottonseeds. S. Gunnasekaran, Biological Systems Engineering, University of Wisconsin, Madison. WI; AGEN

C1c. Moisture measurement (bulk and single kernel, reference methods, standardization and calibration).
Illinois - To identify cause and effect of single kernel moisture variability in corn and soybeans. M. R. Paulsen, Agricultural Engineering; and L. D. Hill, Agricultural Economics, University of Illinois, Urbana. Codes: IL, AGEN, ECON

Illinois - Measure transient moisture content, water diffusivity, thermal conductivity, thermal diffusivity, physical composition, and structure at microscopic resolutions in grains during sorption process, including drying and steeping. Measurements will be made noninvasively in individual kernels and kernel components by microscopic magnetic resonance imaging. Data will be used to understand physical phenomena occurring inside kernels during processing and to develop and evaluate mathematical models. J. B. Litchfield, Agricultural Engineering, University of Illinois, Urbana. Codes: IL, AGEN, ECON

C2a. 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).
Arkansas - Drying, storage, milling, and cooking tests will be conducted with several varieties of rice. The effects of drying conditions and storage history on head rice yield and end-use quality will be evaluated. Residual breakage (post-milling) will be quantified as a function of environmental conditions. Rapid test methods (e.g., near-infrared spectroscopy, nuclear magnetic resonance) will be investigated for prediction of end-use quality (e.g., sensory factors, head rice yield, etc.). Mathematical models will be sought to describe quality as a function of storage history. B. P. Marks and T. J. Siebenmorgen, Biological and Agricultural Engineering, University of Arkansas, Fayetteville. Ar; AGEN FOOD

Illinois - Investigate factors affecting wet millability of corn. S. R. Eckhoff and J. B. Litchfield, Agricultural Engineering, University of Illinois, Urbana. IL; AGEN

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. Karl Weingartner, University of Illinois. ECON, AGEN, FOOD

Illinois - Produce and process soy yogurt for use in sensory evaluation of these products. Karl Weingartner. IL, FOOD

Iowa - Relate nutrient composition and nutrient quality attributes to processing value. Develop and validate process simulation models for determining end-use value. C.R.
Kansas - Investigate wet-processing of whole wheat kernels to separate bran, germ and endosperm. Wet-processing of sorghum grain is being investigated to devise a low-cost process to isolate readily available starch from the kernels. P.A. Seib, Dept. of Grain Science and Industry; D.S. Chung, Dept. of Agricultural Engineering, Kansas State University, Manhattan. KS; AGEN FOOD

Kansas - Characterization of country elevators, burden on receiving equipment during harvest rush, and segregation schemes to optimize quality and profitability was initiated in 1995 and will continue through 2000. Economic analysis of the optimum binning strategy and development of an expert system will be conducted in 1998 and 1999. KS; AGEN

Kansas - An attempt to extend pelletized feed shelf-life in China will be performed in collaboration with Dr. Feng of the South China Agricultural University, Guangzhou. Identification of the causal organisms associated with pellet molding (colony forming units on raw ingredients), processing techniques (residence time, mash temperature, moisture content), and storage conditions will be evaluated to better understand feed quality deterioration. Exploration of high shear conditioning and other mechanisms to control water activity and reduce mold growth will be performed. KS; AGRY

Montana - Determine milling, baking, and end-use properties of neem-treated hard red wheat used for production of bread and of neem-treated barley used for production of baked products. Establish milling fraction (flour, bran, shorts) destination of neem kernel extract applied to grain surface. C. McGuire and R. Newman, Dept. of Plant and Soil Science, and F. V. Dunkel, Entomology Research Laboratory, Montana State University, Bozeman. MT; AGRY FOOD

Nebraska - Determine milling, baking, and end-use properties of neem-treated hard red wheat used for production of bread and of neem-treated barley used for production of baked products. Establish milling fraction (flour, bran, shorts) destination of neem kernel extract applied to grain surface. C. McGuire and R. Newman, Dept. of Plant and Soil Science, and F. V. Dunkel, Entomology Research Laboratory, Montana State University, Bozeman. MT; AGRY FOOD

Nebraska - Determine and identify specific chemical and physical factors in corn and changes in processing conditions which influence corn wet milling product yields. Identify specific chemical/physical characteristics of corn hybrids with improved wet milling starch yields using NIR, Mid-IR and other techniques. Characterize the influence of wet milling steeping conditions (chemicals, chemical concentration and temperature) and alkaline cooking process conditions (cook/steep times and temperatures, lime concentration, etc.) on product yields and process efficiencies. David S. Jackson, Dept. of Food Science and Technology, University of Nebraska, Lincoln. NE; FOOD

C3a. Identification and determination of molds, mycotoxins, and toxic substances. Incipient molding.

GMPRC - Identify fungi-grain interrelationships which may regulate invasion and damage of grain by storage fungi. L.M. Seitz and D.B. Sauer, Grain Quality and Structure Research Unit, GMPRC, Manhattan. KS; PATH

C3b. 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.

NCAUR- Develop screening tests and quantitative analytical methods for mycotoxins in cereal grains and animal tissues and fluids. Evaluate enzyme-linked immunosorbent assays for field testing and determination of aflatoxins, zearalenone and fumonisins. Investigate the application of affinity chromatography utilizing columns containing mycotoxin antibodies for mycotoxin detection and analysis. John Richard, Glenn A. Bennett, Mary Ann Dombrink-Kurtzman, Chris M. Maragos, Mycotoxin Research Unit and Ronald D. Plattner, Bioactive Constituents Research, NCAUR, Peoria. IL; PATH

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. Selected mycotoxin producing molds will be studied and the ability to detect ergosterol in relation to the time to detect mold growth by colony count and mycotoxin production will be compared. Lloyd B. Bullerman, Dept. of Food Science and Technology, Lincoln. NE; PATH

Nebraska - Develop high performance liquid chromatographic (HPLC) and enzyme-linked immuno-sorbant assay (ELISA) methods for detection and quantification of moniliformin in cereal grains. Lloyd B. Bullerman, Dept. of Food Science and Technology, Lincoln. NE; FOOD

C3c. Effects of processing on molds and mycotoxins in grains.
Nebraska - To study the incidence and levels of contamination of Fusarium spp and fumonisins in corn intended for processing into human foods, and to determine the effects of selected processes on the survival and fate of the organisms and fumonisins. Determine effects of processing on Fusarium spp. and fumonisins by monitoring the survival of the organism and the toxins using the methods previously described. Lloyd B. Bullerman, Dept. of Food Science and Technology, Lincoln. NE; PATH


foods.

1) Illinois ERS regional cooperation. Lowell Hill and Max Leath. IL USDA ERS; ECON

D1. 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.

D1b. Estimate the demand for different quality attributes for the corn processing industries in the international markets.
Illinois - Assemble import-export data for major trading companies and evaluate the quality specifications for milling in each country. Conduct in-depth analysis using a case study approach for the value of different quality characteristics and its effect on the yield of final products. L. D. Hill, Agricultural Economics, University of Illinois, Urbana. IL, AGEN, ECON

D1c. Estimate price-quality relationships in importing countries.
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. L. D. Hill, Agricultural Economics, University of Illinois, Urbana. IL, AGEN ECON.

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. E. D. Baldwin, Dept. of Agricultural Economics, The Ohio State University, Columbus. IL, OH, ECON.

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.
Illinois - Based on the results of the workshop, "Uniformity By 2000," various government and industry agencies in major importing and exporting countries will be contacted to identify opportunities for increasing the uniformity in measurement technology and definitions of important quality characteristics in corn and soybeans. L. D. Hill, Agricultural Economics, University of Illinois, Urbana. IL, ECON.

b. Identify policies and regulations in major exporting countries that have an influence on quality.

D3. Calculate costs and benefits of changing grades and reporting supplemental quality factors on grade certificates.

a. Calculate costs and benefits of changing grade limits and factor definitions.

Illinois/ERS - Conduct a study of costs and benefits of requiring lower levels of foreign material in grain destined for export markets. Alternative strategies for achieving the lower levels will be evaluated along with the costs of changes required in the market channel. L. D. Hill, Agricultural Economics, University of Illinois, Urbana; M. N. Leath, ERS, USDA, Washington, D.C. IL, ERS, USDA

b. Compare the costs and benefits of including quality factors as a grade factor vs. certificate information. IL, ECON

c. Estimate the costs of private contracts as an alternative to standard grade designation on the certificate. IL, ECON

D4. Conduct economic analyses of alternative techniques, practices, and procedures for improving and maintaining quality.

a. Compare alternative production and marketing practices that influence quality.

Illinois - Introduce composition data into the transaction for soybeans, and make the information available for decisions by producers and country elevators, and processors. To increase competition based on composition. L.D. Hill, University of Illinois, C.R. Hurburgh, Jr., Iowa State University, Illinois Dept. of Agriculture, and Illinois Crop Improvement Association. IL, IA, ECON, AGEN.

Iowa - Coordinate shipments and production of specialized quality grain. Measure differential in process output relative to average grain. Estimate the potential for segregation of grains by intrinsic quality attributes, and the cost of such segregations, at key points in the market chain. C.R. Hurburgh, Jr., Agricultural and Biosystems Engineering, Roger Gunder, Economics, Iowa State University, Ames. IA; AGEN ECON

b. Validate models estimating the value of quality with in-process data.

Illinois - Evaluate the economic implication of projects under objectives A, B, and C. As alternatives are identified and specified, analyses will be made at the University of Illinois to determine economic feasibility and the net gains to producers and society from changes.
GIPSA - GIPSA provides 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. D. E. Kelso, GIPSA, USDA, Kansas City.

1) ERS - Economic impact analyses on cereal and oilseed crops. Collaborative effort with stations and GIPSA. Mack Leath, ERS, USDA, Washington, DC. ECON

**Expected Outcomes**

**KS Impact:** Expected impact is a reduction in feed waste, improved animal performance, increased efficiency of feed mill use, increased market territory, and increased imports of U.S. feed grains.

**Neb.**

**C2a:** Determine and identify specific chemical and physical factors in corn and changes in processing conditions that influence corn wet milling and alkaline cooking product yields. The installation of a complete alkaline cooking process line at the University of Nebraska will enable researchers to develop response surface cooking experiments using various kinds of corn and to vary process conditions. It is hoped that cooking procedures can be developed to minimize alkaline cooking waste and to maximize yield for both traditionally “good” alkaline cooking corn hybrids as well as softer corns, currently considered unacceptable. Additional efforts, in the area of wet milling, will focus on determining optimum process conditions for corn that has been improperly dried and/or is otherwise physically damaged. Some results will be available in 1998/99, with additional data available in subsequent year. It is hoped that this information will allow processors to use a wider range of corn hybrids (in both wet milling and alkaline processing) as well as allow processing of corn that has not considered optimum for these processes.

**C3b:** Methods for detection and quantitation of mycotoxins. We intend to develop a high performance liquid chromatographic (HPLC) method for detection and quantification of moniliformin. These techniques will be needed to study the fate of moniliformin in thermal food processes. Anticipated delivery date May 1998.

**Stability of moniliformin in thermal food processes.** In this work we will determine the incidence and concentrations of moniliformin in U.S. corn and corn-based foods. We will also determine if moniliformin co-occurs with fumonisins. We also intend to study the effect of heat on the stability of moniliformin in aqueous buffered solutions at different temperatures, pH levels and heating times and in corn using different selected thermal processes, such as canning, baking, frying, roasting, extrusion and alkaline processing (tortilla process). Similar studies will be done with deoxynivalenol and zearalenone. This work will develop more information which will increase understanding of the stability of Fusarium mycotoxins in processed.