TEXAS SMALL GRAINS RESEARCH AND EXTENSION PROGRAM STRATEGIC PLAN

EXECUTIVE SUMMARY

I. PURPOSE AND SCOPE OF THE STRATEGIC PLAN

The Texas small grains strategic plan was developed as a guide for restructuring the small grains program to: a) clearly define objectives, b) give an appropriate statewide perspective to the small grains production regions of Texas, c) ensure efficient use of all available resources, and d) assure a sound financial basis for the program. The strategic plan covers all aspects of the small grains program from scientific manipulation at the molecular level to public education and marketing of released varieties. We emphasize the statewide perspective in the strategic plan to maximize coordination and cooperation among regionally administered programs so that their activities complement each other and pursue common goals. The proposed structure seeks to concentrate personnel and other resources in fewer locations, minimize unnecessary duplication, and eliminate major deficiencies in expertise, and thereby improve efficiency throughout the program. Finally, the strategic plan proposes a financial management package that seeks to balance income and expenses for program stability and scientific currency.

II. ORGANIZATION OF THE TEXAS SMALL GRAINS PROGRAM

- The proposed Texas small grains program is organized into two Centers of Excellence, one at the Amarillo Research and Extension Center and one at College Station.
- Each Center of Excellence will have a complement of scientists who work in multi-disciplinary teams to address a broad range of small grains improvement, management, and extension issues.
- Specific needs will be addressed at the Vernon and Dallas Research and Extension Centers and possibly at other locations as appropriate.
- Increased emphasis is placed on small grains as dual-purpose, grain and forage crops to fully develop Texas' competitive advantage as a premier winter pasture region of the U.S.
- The Center of Excellence at Amarillo will develop varieties for the High Plains irrigated and dryland acreage and for the Rolling Plains, using technical support in the Rolling Plains that the Vernon Center provides.
- Multi-disciplinary teams at Amarillo and Vernon will develop production and management programs for small grains as dual-purpose crops with the objective of optimizing income from grain and livestock in integrated crop/livestock systems on the High Plains and Rolling Plains.
- The Center of Excellence at College Station will develop varieties and management programs for small grains in the humid regions of central, eastern and southern Texas, provide classroom instruction to undergraduate and graduate students, and focus on grain quality improvement through close interdisciplinary ties, especially among scientists in the biotech, cereal quality, and breeding programs.
- The small grains extension program will be coordinated by a full-time small grains Specialist who, in cooperation with regional Specialists from various disciplines and County Agents, will conduct a statewide educational program that includes highly visible on-farm demonstrations and crop testing activities.
- New varieties will be produced and marketed through Texas Foundation Seed Service and private companies with royalties being returned to the small grains research and education program.

III. FINANCIAL MANAGEMENT FOR THE SMALL GRAINS PROGRAM

- Actual and potential sources of income have been identified to provide long-term financial stability to the program.

- Budgets are proposed in spreadsheet form, and allocate income to specific statewide goals and distribute the funds across locations proportional to their requirements for achieving the goals.

IV. IMPLEMENTATION AND OVERSIGHT

- The Ag Program Administration will implement the Texas Small Grains Strategic Plan by stating a clear intention to do so, by encouraging Unit Heads to endorse the strategic plan, by encouraging reallocation of resources within and among units to support the strategic plan, and by following this strategic plan when approving requests for new faculty positions.

- The Small Grains Advisory Committee will annually review implementation and functions of the newly restructured program and make recommendations to the Agriculture Program administration.

A STRATEGIC PLAN FOR SMALL GRAINS RESEARCH AND EXTENSION
THE TEXAS A&M UNIVERSITY SYSTEM
AGRICULTURE PROGRAM

A STRATEGIC PLAN FOR SMALL GRAINS RESEARCH AND EXTENSION

THE TEXAS A&M UNIVERSITY SYSTEM

A. INTRODUCTION

The pervasive impact of small grain crops (wheat, oat, triticale, and barley) on society has led to ever increasing improvement of the crops and their production systems by researchers and educators. Small grains research and extension programs within the Texas A&M University System are a local, state, regional, national and international source of knowledge, education, and training. The strengths of the TAMUS small grains programs reside in its people, and their ability to carry out six broadly defined goals. These goals are (1) Integrate conventional and biotechnological research to increase our knowledge base for small grains; (2) Develop superior plant materials for local, state, national and international use; (3) Characterize the biotic and abiotic stresses of small grain crops, and provide solutions for their management; (4) Facilitate and develop management practices and cropping systems that maximize the genetic potential of plant materials and which optimize and sustain land and water resources; (5) Meet and exceed end-use requirements for marketability of our small grain commodities; and (6) Develop and disseminate science-based information for the production of small grains. The strategic plan presented here was developed and will be reviewed annually and revised as needed by the Texas Small Grains Advisory Committee.

B. BACKGROUND INFORMATION

In the 1990s, Texas producers have annually sown 6 to 7 million acres of small grains, consisting of approximately 86% wheat, 11% oat, 2% rye, and 1% barley and triticale. The farm-gate production value of the grain averaged $420 million per year. Beyond grain production, these crops are also valued as winter pasture for domesticated grazing animals, i.e., beef, dairy cattle, sheep, goats and wildlife. Thus, production schemes can focus on grain production only, grazing plus grain, grazing only (graze-out), or hay (or silage) production. Estimates suggest that about 65% of the small grain acreage is grazed annually to some degree, with a value (in pounds of animal production) greater than $400 million. Oats, rye and triticale are often valued more for their vegetative production rather than grain. Approximately 60-80% of oats are grazed-out each year.

Small grains research and extension programs in TAMUS include scientists who specialize in agronomy, animal science, biotechnology, breeding, entomology, genetics, information technology, pathology, physiology, and quality. The vast land area and varied climate in which the small grain crops are produced in Texas offer unique challenges and opportunities unparalleled in the United States and perhaps, the world.

C. TEXAS SMALL GRAINS ADVISORY COMMITTEE

History - Dr. E.A. Hiler established The Small Grains Advisory Committee (SGAC) on August 23, 1999 to "establish a framework of activity and issues for an External Assessment Panel to pursue" during their review of research and education programs in small grains. The initial SGAC consisted of eight current and one former unit head (Drs. Appel, Davis, Frisbie, Gilmore, Long, Milford, Mullet, Robinson-Chair, and Sweeten). The external assessment of the Texas Small Grains Program occurred between October 24 and October 28, 2000.

Current Membership - The present SGAC was established on January 14, 2000. Membership of this committee includes two faculty from the small grains program (David Marshall-Dallas and Travis Miller-College Station), four members external to the TAMU System (David Cleavinger and Rodney Mosier (Texas Wheat Producers Board), David Worrall (Agri-Pro), and A. Klatt (Oklahoma State University), and the administrator of four units with key faculty participation in the statewide Small Grains Program (Tim Davis -Dallas, Mark Hussey-College Station, Don Robinson-Vernon and John Sweeten-Amarillo).

Committee Charge - As defined by Dr. Hiler in his Memorandum of January 14, 2000, the charge of the SGAC is to 1)develop a long-term statewide small grains improvement strategy that addresses all major points identified in the

Small Grains Review, 2) to monitor progress on the small grains strategy, and 3) to recommend actions that will properly position the Texas Small Grains Program to be among the very best in the U.S.

Interaction with Research and Extension Center, Departments, and Ag Program Administration - The SGAC will be an advocate for Small Grains Research and Educational activities within the Agricultural Program. To accomplish this, the SGAC will:

- Articulate a "statewide" vision for the small grains program to the Agriculture Program.
- Make specific recommendations to the Agriculture Program Administration for enhancing the effectiveness of small grains research and educational activities.
- Provide a mechanism for faculty, farmers, and industry to share ideas and develop a common vision for addressing the needs of small grains in Texas.
- Coordinate solicitation and prioritization of all small grain research and education programs administered by TAES and TAEX.

Committee Structure - The SGAC will be composed of three subcommittees including 1) administration (center directors, department heads, and TAES administration), 2) research and extension programs (Ag Program faculty), and 3) external issues (farmers, agribusiness, regulatory (TDA), etc.). These subcommittees will include appointed SGAC members and each subcommittee is encouraged to solicit input from outside the SGAC. The purpose of this structure is to engage as many interested individuals as possible and to assess opportunities for new strategic alliances.

D. VISION STATEMENT

We envision the multi-disciplinary, statewide program in small grains research and extension to be the premier source for new knowledge, plant materials, applied problem solving, and outreach education for the local, state, national, and global community.

E. MISSION STATEMENT

In the land-grant tradition, we exist to develop and deliver science-based, site-specific and global information, knowledge, and plant materials related to wheat, oat, triticale, and barley.

F. GOALS AND OBJECTIVES

The goals and objectives for the TAMUS small grains research and extension programs flow logically from our mission and relate directly to the TAMUS agriculture and core science activities. Our goals and objectives translate our mission into actions and seek to fulfill our vision. In this strategic plan, our goals are broadly conceived targets that the small grain research and extension programs will focus on to achieve their mission. Collectively, the goals provide direction for focusing small grains activities, and the objectives are more specific, tangible and measurable for achieving the goals.

Goal 1. Integrate conventional and biotechnological research to increase our knowledge base for small grains.

Objectives:

- Improve our understanding of the molecular genetics of wheat, oat, triticale and barley.
- Incorporate both input-based and end-use based molecular genetic traits into adapted germplasm.

Goal 2. Develop superior plant materials for local, state, national and international use.

Objectives:

- Develop high-yielding, disease and insect resistant, excellent quality varieties and germplasm of wheat, oat, triticale, and barley.
- Develop small grain varieties and germplasm for dual-purpose (grazing and grain) uses.
- Develop small grain varieties and germplasm having broad and narrow adaptation and appropriate end uses.

- Contribute to and participate in regional, national and international small grain nurseries and promote the free exchange of germplasm.

Goal 3. Characterize the biotic and abiotic stresses of small grain crops, and provide solutions for their management.

Objectives:

- Evaluate the evolutionary progenitors of wheat, oat, and barley for improved traits and incorporate those traits into adapted small grains.
- Develop and implement strategies for long-term management of important disease and insect pests of small grains.
- Pursue research into the genetic basis of plant resistance to important diseases and insects of small grains.
- Investigate the molecular basis of pathogenicity.
- Investigate the biotic and abiotic interactions that negatively impact wheat yield and quality.
- Evaluate the biology of water, heat, and cold stress on small grain plants.
- Evaluate conditions important to pathogen ecology and epidemiology.

Goal 4. Facilitate and develop management practices and cropping systems that maximize the genetic potential of plant materials and which optimize and sustain land and water resources.

Objectives:

- Determine optimum cropping systems for small grains that emphasize moisture conservation and storage.
- Expand research and education activities to provide knowledge on soil management, tillage, seedbed preparation, and erosion control.
- Develop nutrient requirements, and fertilizer placement and timing, for all small grain production areas of Texas.
- Conduct research and education for weed, insect and disease management in small grains.
- Expand and coordinate research and education on production and grazing management of dual-purpose wheat, oat and triticale, including grazing intensity, frequency and duration as they influence both animal and grain production.

Goal 5. Meet and exceed end-use requirements for marketability of our small grain commodities.

Objectives:

- Improve our knowledge base on the nature of end-use quality of wheat, oat, triticale, and barley.
- Expand research into alternative uses for grain of small grain crops.
- Identify qualities that meet or exceed end use requirements.

Goal 6. Develop and disseminate science-based information for the production of small grains.

Objectives:

- Improve the capability for small grain producers to be successful through timely knowledge transfer and dissemination.
- Develop farmer-friendly recommendations for dual-purpose small grains management that would optimize economic returns from wheat and livestock production.
- Expand public understanding of small grains to help create an informed citizenry.

G. CURRENT SMALL GRAINS PROGRAM

1. Faculty, Technical Support and Operating Budgets

As of summer 2000, the Texas small grains research program was located primarily at four Research and Extension Centers (Amarillo, Vernon, Dallas, Overton) and in the Soil and Crop Science Department at College Station (Table 1). Additionally, major extension programs were located at the Amarillo, Vernon, and San Angelo Centers and in the Soil and Crop Sciences and Agricultural Economics Departments (Table 2). Furthermore, the Uvalde Center allocated 25% of one faculty position to research, and the Plant Pathology Department allocated 20% of one faculty position to extension activities. Total TAES faculty positions allocated to small grains research was 5.8 FTE receiving annual salaries of $429,000. TAEX faculty positions in small grains totaled 3.9 FTE at annual salaries of $260,000. Combined allocations to small grains for the two agencies totaled 9.7 FTE faculty and $689,000 in salaries. TAES also had 11.2 FTE support personnel positions salaried at $344,000, and TAEX and TAES shared 1.8 FTE support positions at about $65,000 (Table 3). Operating funds for small grains research totaled $93,000 (Table 4). Operating funds for small grains extension programs were not determined. Total allocations for small grains research and education included approximately 10 faculty and 13 support positions plus $1,098,000 for salaries and $93,000 for research operating budgets.

Faculty positions in small grains breeding and genetics were generally dedicated 100% to small grains, with the one exception being the breeder at Overton working 50% in small grains. Research positions in disciplines other than breeding and genetics and all extension faculty generally allocated 30% or less of their time to small grains, the one exception being the Small Grains Extension Specialist who devoted 50% of his time to small grains. Thus, the total number of faculty members involved in the small grains program is actually 2 to 3 times greater than the number of FTEs reported. This situation lends itself well to development of multi-disciplinary programs that address problems from a systems perspective. The faculty FTE allocations to each discipline can be determined in Tables 1 and 2 and are summarized in Table 5.

2. Equipment, Facilities, and Land

Each Research and Extension Center has plot equipment for small grains research programs as shown in Appendix 1. Most of the equipment is in good to fair condition, but has been in the program ten or more years. The major items that need repaired or replaced include plot combines, tractors, planters, and pick-up trucks. While scientists have obtained grant funds to pay for labor, operating costs, and supplies, getting grants for major equipment items is difficult.

Programs requiring specialized laboratories are located mostly in College Station, and include the grain quality laboratory and the biotech laboratory. The grain quality laboratory clearly needs more equipment and personnel to serve the wheat improvement program with research on grain quality and new products. In the rapidly changing area of molecular biology/genetics, continuous updating of equipment and facilities is very important and challenging. The Amarillo Center also has a wheat genetics laboratory in which DNA research with molecular markers is conducted by staff that includes a faculty geneticist/breeder and a postdoctoral plant geneticist. Additional greenhouse facilities are urgently needed for the breeding program at Amarillo.

H. FUTURE ORGANIZATION OF THE TEXAS SMALL GRAINS PROGRAM

The Small Grains Advisory Committee (SGAC) endorses the recommendation of the Texas Small Grains External Assessment Panel to develop and adequately support two (2) “Centers of Excellence” for small grains research in Texas. The SGAC recommends that all small grains research and extension efforts have a focused, multi-disciplinary team approach.

Centers of Excellence will be located in Amarillo and College Station. These Centers should be developed as financial resources and staffing questions are resolved. Development and staffing of the Amarillo Center should be given immediate priority. The Center at College Station will require additional developmental time, but this program should be fully operational in 2-3 years.

The Amarillo team will focus on research for the High and Rolling Plains regions of Texas, including both dryland and irrigated small grains in dual-purpose production systems. The team should consist of a breeder and a germplasm enhancement specialist, and support from a research or extension entomologist, pathologist, agronomist, at least one animal scientist, an economist, and a water management scientist.

The College Station team will focus on research and extension efforts for the higher rainfall areas of Texas, especially the Blacklands, and central and south Texas. Small grains breeding, pest management, and production research will be primary objectives. This team will be responsible for all oat research in Texas. In the short term the team will include a small grains pathologist/breeder at Dallas, a breeder at Overton, and a breeder, a molecular biologist, a wheat quality specialist, and an extension specialist at College Station. However, in 2-5 years these positions and personnel should all be located at College Station for maximum resource efficiency.

Texas has diverse climatic and environmental conditions, and small grains are grown throughout the state. Winter wheat predominates in the northern and southern High Plains and Rolling Plains regions (approximately 80% of the total wheat area). Oats are grown in central and south Texas and are an important forage crop in these regions. Triticale has potential as a winter forage crop throughout the state, and barley may have promise as a feed grain/silage crop in selected areas of the state.

It is an opportune time to consolidate the small grains research program in Texas and develop true Centers of Excellence. Teams of scientists must be developed to conduct research in plant breeding and genetics, crop management, pest management, biotechnology, and dual-purpose crop management systems (forage plus grain). The teams must investigate the production constraints in the respective regions and develop new technologies that will serve the interests of the Texas small grains industry.

The Centers concept will enhance coordination and encourage multi-disciplinary research, while increasing financial efficiency and effectiveness. The "team" approach based on the "Center" concept should be more effective in attracting new sources of funding and be more successful in winning outside grants. TAES must provide sufficient financial support and appropriate personnel to achieve the goal of two nationally and internationally recognized "Centers of Excellence" for small grains research in Texas.

The Amarillo Center is located in the major wheat growing region, and the existing small grains research program has strong support from the agricultural community. This Center will be responsible for developing winter wheats and winter forage triticales for irrigated and rain fed conditions of the High Plains and Rolling Plains regions. Developing varieties and improved management practices for the dual-purpose system will also be a primary objective, and a multi-disciplinary research and education team in Vernon will complement this research effort for the Rolling Plains region. The Amarillo team, with professional and technical support from the Vernon Center, will be primarily responsible for developing varieties for the Rolling Plains region, which is ecologically different from the High Plains. Resources and staffing allocations will be required to address the specific constraints and requirements of this region.

The following personnel will be required for the small grains research program at Amarillo:

- Small Grains Breeder (1 FTE)—Develop winter wheat and triticale varieties for the High Plains and Rolling Plains regions. We envision that this person will contribute significantly to coordinating the small grains improvement program in Texas. Main breeding objectives include varieties for rain fed and irrigated conditions, improved varieties for the dual-purpose system, and varieties with improved yield potential, broader adaptation, drought and heat tolerance, insect and disease resistance, etc.
- Geneticist/Germplasm Development Specialist (1 FTE)—Work closely with the small grains breeder. Responsible for introgressing greater genetic variability into the breeding program and development of breeding materials with improved resistance to biotic and abiotic stresses. Also will pursue biotechnology applications (eg. markers) for the breeding program.
- Support Staff—Require 3 FTEs at the research associate, research assistant, or technician level to work with the breeder and germplasm development specialist.
- Multi-disciplinary Team—Will provide support for the small grains improvement program and conduct research on production constraints of small grains. Team scientists may not work full-time on small grains research, but will be responsible for research activities related to their discipline. The following disciplines should be represented (as a minimum):

    - Dual-purpose system—agronomists (0.5 FTE), economists (0.1 FTE), and animal scientists (0.4 FTE) to investigate the complexity of the management system, especially for the High Plains. The Vernon Center has a research program on dual-purpose wheat and will soon expand its multi-disciplinary research and education team (1.95 FTE).

The Vernon and Amarillo research efforts should be closely coordinated, which will probably require the identification of a "dual-purpose" team leader.

- Entomologist (0.25 FTE)—primary emphasis on aphid resistance and management practices. Some research on BYDV is also needed.
- Pathologist (0.40 FTE)—major responsibility will be related to leaf rust in the Rolling Plains and to soil borne fungal diseases and virus diseases in the High Plains regions. Other diseases of small grains should be accorded a priority relative to their importance as a constraint to production.
- Agronomist (0.3 FTE)—further investigate management practices of irrigated and rain fed wheat in the two regions, with priority given to the fertilizer requirements and soil and crop management practices of the dual-purpose system. Some research on winter triticales for forage will be required.
- Molecular genetics/biotechnology (1.0 FTE)—develop new technology for the small grains improvement program with special emphasis on genetic markers for specific traits.
- Extension (0.5 FTE)—emphasize disease diagnostics, crop loss estimates, disease management strategies, transfer of new technology to small grains producers through publications, workshops, field days, and other educational activities. Assistance will be given to varietal demonstrations at the farm level. Close coordination and effective cooperation will be required between the research and extension activities of the small grains program.
- Facilities-urgent need for better greenhouse facilities at the Amarillo Center (some funds are available for this purpose and additional funds are being solicited). Adequate and appropriate transportation will be required for the program personnel, and also sufficient budget for travel expenses ($15,000-$20,000 per year). Budgetary resources and an effective capital asset management strategy are needed for timely replacement and upgrading field and lab equipment, e.g., combines, plot seeders, threshers, centrifuges, imaging systems, etc. (probably $30,000-$40,000 per year).

The Center at College Station will be developed over the next 2 to 3 years as budgetary resources and staff are identified. Increased emphasis should be given to molecular genetics/biotechnology research on small grains, industrial quality assessment of breeding materials, and the involvement of graduate students in the small grains research program. The following personnel and facilities will be required for the program at College Station:

1. Small Grains Breeder (1.0 FTE)—Work on wheat and oats for the Blacklands, central and southern regions of Texas. Main breeding objectives are increased grain and forage yield potential, cold tolerance in oat, and better disease and insect resistance, especially Hessian fly resistance and resistance to leaf and crown rust and tolerance to BYDV. Would facilitate the testing of breeding materials from Amarillo for leaf rust resistance, and serve as advisor for students interested in graduate programs in breeding and genetics.
2. Molecular Geneticist/Biotechnology (1.0 FTE)—Identifying new methodologies and technologies to enhance and streamline the small grains improvement program. Special attention will be given to identifying and using genetic markers, and to incorporating genes for specific quality characteristics. Some work on transformations and gene mapping will be considered. Work closely with Crop Biotechnology Center (CBC) and with crop breeders at the two Centers. This position should be 100% devoted to research on small grains.
3. Support Staff—Require two research associates/research assistants (2.0 FTE) for the breeder and one research associate (1.0 FTE) for the molecular geneticist.
4. Multi-Disciplinary Team—Conduct research relevant to goals of the small grains program and provide support for the improvement program. Team scientists may not work full-time on small grains research, but will research areas related to their discipline. The following disciplines should be represented:

- Cereal Chemist (1.0 FTE)—evaluate advanced breeding lines for quality characteristics required by industry. Additional support on quality is urgently needed for the wheat improvement program to provide high quality varieties for Texas producers. The necessary support personnel is shown in Section K.
- Dual-purpose system—agronomists (0.25 FTE), economists (0.1 FTE), and animal scientists (0.3 FTE) to investigate the complex management system for central and south Texas. This research will be closely coordinated with the research at Vernon and Amarillo. Research on oats as a forage crop is probably justified for the central and southern regions of Texas.
- ! Extension Small Grain Specialist (1.0 FTE)–coordinate and help deliver statewide small grains education programs and coordinate on-farm, multi-county research and demonstration activities in close cooperation with TAEX and TAES faculty at the county, district, and state levels. Coordinate programs closely with the Extension Plant Pathologist.
- Plant Pathologist (1.0 FTE)—major responsibility will be leaf rust, with work on other diseases based on their importance as a production constraint. Scientist will contribute to coordinating pathology research within the small grains program.
- Extension Plant Pathologist (0.75 FTE)—emphasis on educational programs and transfer of information to small grains producers throughout the state. Work closely with the Extension Small Grains Specialist.
- Entomologist (0.5 FTE)—emphasis will be given to research on aphids and to vectors of BYDV.
- Facilities-adequate transportation is required for the program, with sufficient financial support for travel requirements (approx. $15,000 per year). The capital asset management strategy must replace and upgrade field and lab equipment on a timely basis (approx. $35,000 per year or more depending on the requirements of the Molecular Geneticist/Biotechnology).

Vernon and Dallas will continue as selection and testing sites for small grains germplasm. The Amarillo program will develop materials for the Rolling Plains and South Plains regions and provide leadership for improvement activities at Vernon. The program in College Station will develop materials (wheat and oats) for the south, central, and Blacklands regions and provide leadership for improvement activities at the Dallas Center. To facilitate research, support staff (research associate or research assistant) must be stationed at the Vernon (1.5 FTE) and Dallas (1.0 FTE) Centers. Sufficient travel support will be needed for off-station trials and field and lab facilities at respective sites, and appropriate equipment will be needed for the small grains improvement program and related research activities. Timely replacement of the field and lab equipment will require a budget for this objective (approx. $15,000-$20,000 per year).

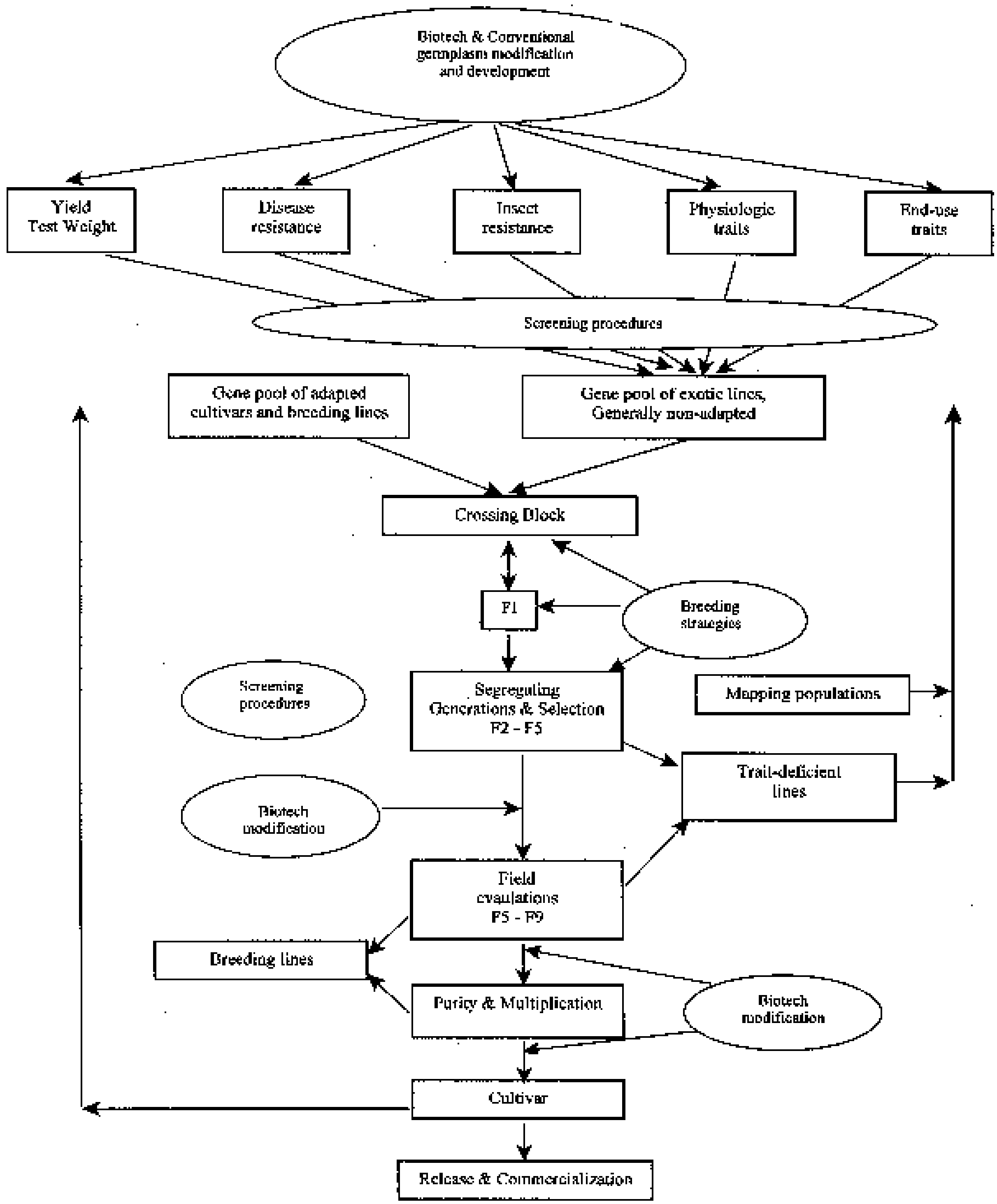
I. VARIETY AND GERMPLASM DEVELOPMENT

The cornerstone of prosperous crop production is adapted, high-yielding plant material. Developing such material requires input from many diverse scientific disciplines and methodologies. Figure 1 outlines components of a successful plant improvement program, and each program step is described below.

1. General Plant Improvement Program

a. Biotech and Conventional Germplasm Modification and Development – Germplasm can be defined simply as the pool of genetic diversity of a crop species, and includes wild relatives, land races, plant introductions, intermating populations, haploid lines, breeding lines, mapping populations, segregating populations, cytogenetic lines, and developed varieties. Additionally, tissue culture lines, cell lines, and even molecular genetic libraries of genes and gene constructs are part of the genetic germplasm pool that plant improvement scientists can use for genetic diversity. Biotech modification of germplasm includes the development of transgenic plants, identifying molecular markers for specific genes, chromosomal and molecular cytogenetic mapping, and other applications for capitalizing on an ever-increasing knowledge of molecular biology. More conventional germplasm modifications include introgression of genes from wild relatives and unadapted lines into adapted genotypes, generation and selection of novel genetic mutations, and development of breeding lines with specific trait

Figure 1. COMPONENTS OF A SUCCESSFUL PLANT IMPROVEMENT PROGRAM



polymorphisms. Scientists involved in germplasm modification and development should include molecular biologists, cytogeneticists, and basic science-oriented chemists, physiologists, pathologists, and entomologists. Screening germplasm is a continuation of germplasm development, and focuses on incorporating specifically identified traits into genetically stable plant material that can be readily hybridized with adapted varieties and breeding lines. Besides discipline-oriented scientists (pathologists, entomologists, etc.), plant geneticists and plant breeders are involved in these screening procedures. The modified and developed germplasm typically result in cellular, tissue, or whole-plant genetic materials altered in one or more of five broad categories.

- Yield and test weight – Fundamental changes in the ability to produce increased biomass and/or grain quantity or volume.
- Physiologic traits – Modifying characteristics such as height, winter hardiness, maturity, drought tolerance, heat tolerance, tillering capacity, and photosynthetic rate.
- Disease resistance – Developing germplasm with fundamental improvements in resistance and tolerance to pathogens or pathogenesis-related processes.
- Insect resistance – Developing germplasm with fundamental improvements in resistance and tolerance to insects and other arthropods.
- End-use traits – Modifying biochemical and metabolic pathways related to grain and biomass quality.

b. Crossing Block & Segregating Generations – Crossing is developing of F_1 hybrids using the gene pool of adapted varieties and lines hybridized with the gene pool of trait-specific germplasm. It typically involves effort of the plant breeder or geneticist. Breeding strategies used in crossing, hybrid F_1 production, and segregating generations (F_2 – F_5) include the pedigree method, bulk method, single seed descent, and backcross method. Screening procedures for segregating generations are many and varied, and differ with individual traits and desired population outcomes. Typically, small grain segregating populations are grown as bulks from the F_2 to F_4 or F_5 generations, with or without selection (screening procedures). Sometimes, populations are developed for use in linkage-based mapping populations (primarily for molecular mapping). Lines that are deficient in one or more traits are put back in the germplasm pool for crossing. Single heads may be selected in segregating generations, grown as head rows, and subsequently tested in the field beginning at about the F_5 generation. Essentially all scientists involved in the plant improvement team have input into segregating generations and selection.

c. Field Evaluations – Most plant breeders and plant improvement scientists are involved in evaluating in the field for numerous agronomic, pathological, and entomological traits. The material is tested under a wide range of environments to determine the relative strengths and weaknesses of each line, and to determine area of adaptation. Biotech modification, such as the insertion of a gene for herbicide tolerance, is typically carried out on genetic material that is homozygous or nearly so.

d. Purity, Multiplication, and Variety Release – Promising lines that the plant breeder has identified as potential varieties are typically head-rowed and selected for uniformity of plant type. Seed from selected head rows or from head row derived plots are typically bulked together to serve as initial breeder seed. Because purity and multiplication (P&M) efforts can take several years to get adequate quantities of pure seed, these activities are conducted concurrently with field testing. Thus, many lines originally put into P&M activities are never released as varieties but are recycled into the breeding program as breeding lines. After deciding that a line becomes a variety, pure breeder seed is provided for foundation seed production by the Texas Foundation Seed Service or a private seed company and also provided to Extension crop testing personnel.

2. Breeding

Plant breeding is the science and art of the genetic improvement of plants. Plant breeders in the Texas A&M small grains improvement team are familiar with all steps necessary for developing improved varieties (see Figure 1). Specifically, the plant breeders recognize phenotypes of genetic traits, and also the physiological, pathological, and entomological responses of small grains important for adaptation, yield, and quality of the crops. Techniques are designed and implemented for evaluating genetic potential for all traits of interest. The plant breeder works with other members of the small grains improvement team to develop and combine new and improved traits into adapted varieties.

3. Biotechnology and its application to the Texas Small Grains Improvement Program

The Texas small grains improvement program must position itself to access the latest technologies in crop improvement, including development and release of transgenic cultivars. Assuming that wheat and other small grains follow trends set by other commodities (i.e., corn, cotton, soybeans, etc.), much of the wheat acreage in the U.S., Canada, Australia, etc. will ultimately be planted to transgenic cultivars. Since many desired gene(s) and gene constructs will not be owned by the Agriculture Program, new partnerships with the private sector will be developed to provide access to privately owned gene(s) for use in TAES germplasm at early stages of varietal development. This must be accomplished through public-private partnerships as commercial large-scale transformation of crop germplasm is beyond the scope of the Agriculture Program.

Besides gaining access to new genes, the small grain improvement program must initiate a vigorous program in fundamental genetic research to support its applied germplasm development programs. The application of molecular tools to small grain improvement has lagged behind that of other crops, due in part to the large genome size exhibited by commercially grown small grains, to a lack of variation (polymorphism) exhibited within segregating populations for many marker systems (RFLP, etc.), and until recently, to a lack of large federally funded programs to support research on crops with large, complex genomes such as wheat.

By 2005, the Texas small grains improvement program should establish research in the following areas related to biotechnology.

a) Use of genetic markers to "tag" traits of interest and to facilitate their incorporation (marker-assisted selection) into commercial varieties. This effort at College Station will consist of both molecular markers (MAS) to pyramid desirable gene(s) and marker development to ensure rapid integration of new marker technology by breeding programs. It is anticipated that the future wheat molecular position based at College Station will develop new marker systems and insure that all small grain improvement programs have access to the latest marker technology.

b) Use molecular tools to better understand factors associated with grain development and quality. This effort will consist of a team of researchers that includes molecular biologists, food scientists, cereal chemists, and plant breeders all focused on developing small grains with improved quality and processing traits. The anticipated wheat molecular position at College Station will collaborate with wheat researchers and other scientists in the Agriculture Program to enhance the food quality and value of Texas small grains.

c) Better understand plant responses (gene expression, etc.) to abiotic and biotic stresses to facilitate the developing new plant genetic mechanisms that reduce plant stress on grain and forage yield. A new micro-array based DNA diagnostics project is currently being developed by the Crop Biotechnology Center. Linking field based screening programs with micro-array technology will permit identifying genes and gene families involved in regulating complex plant responses to abiotic and biotic stress.

d) Use molecular tools to better understand genetic variability and strategies of pathogens and insects to overcome plant genetic resistance mechanisms. New partnerships between field-based pathology and entomology programs and campus based molecular genetic programs are needed to understand the population structure of insects and pathogens.

e) Use molecular tools to better understand genome organization, gene expression and gene silencing in polyploid species. Germplasm development and the integration of genes from “wild” species are important for long-term crop improvement. The small grains improvement program must insure a long-term strategy for understanding complex interactions among wheat genomes. Such an effort would include wide hybridization, molecular cytogenetics, functional and structural genomics, etc.

4. Entomology and its role in the Texas Small Grains Improvement Program

Major areas to be addressed in wheat entomology research include greenbugs, Hessian fly, vectors of barley yellow dwarf virus, vectors of wheat streak mosaic virus, armyworms, other minor pests, and multifaceted ecological evaluations. These challenges can be met with multidisciplinary teams, enhanced coordination of research conducted by faculty at research and extension centers, and basic research concentrated in the Department of Entomology and the Crop Biotechnology Center on the Texas A&M campus. The major obstacle is stable, dependable funding for long-term research. However, significant strides have been made in understanding the basic biology of many entomological pests of wheat important to Texas, but additional research is needed in biology and epidemiology. Long term solutions can be achieved by combining traditional approaches with new technologies. For example, resistance in wheat to Russian wheat aphid is difficult to track in wheat breeding populations naturally or artificially infested with aphids. Currently identified resistance is multigenic. A collaborative program could result in developing a marker assisted selection process to facilitate identifying multigenic inheritance in segregating populations without infesting with aphids. Substantial evidence suggests that commonality exists between wheat and sorghum genomes for collaborative research between commodities on related pests such as greenbugs.

Revision of the economic threshold and economic injury levels is a pressing need in greenbug research. Producers need to know when to treat greenbug infestations, and how to choose appropriate compounds and techniques. We need to ensure that chemical applications are incorporated into a true integrated pest management (IPM) program that considers the presence and impact of biological control agents.

Host plant resistance to greenbugs in wheat has yielded significant results, but additional research is needed in host plant resistance, synthesis of new biotypes and the impact of resistant cultivars on predators and parasitoids (tritrophic relationships).

Hessian fly annually limits wheat production in some part of Texas. Biotype shifts may occur since varieties that were resistant are now infested. USDA-ARS in Kansas has periodically sampled the Texas population of Hessian fly and may continue cooperative projects on biotypes. Host plant resistance may be the best approach for control, but Texas needs an active program to collect and rear Hessian flies, or to identify and track resistance in wheat germplasm and varieties.

Texas needs a means to forecast pending outbreaks of armyworms. This includes an organized network of pheromone traps to warn of moth flights moving from south into central and north Texas.

Other minor pests of wheat need to be examined for their impact and control. Russian wheat aphid remains an occasional pest, and host plant resistance and biological control may be the best tools for its control. The impact of Banks grass mite, brown wheat mite, and winter grain mite are virtually unknown and basic ecological research is needed. Finally, the impact of other aphids in wheat, such as the rice water aphid, are not known. The rice water aphid feeds on wheat in the top inch or two of the soil, and is totally overlooked as a source of stress on the plant or a potential disease vector.

Finally, we must recognize that wheat and other small grain crops are part of a larger ecosystem. Pests in wheat are likely dependent on multiple interacting factors. To improve IPM, long-term research that addresses seasonal abundance of all aphids, predators, and parasitoids in wheat, other small grains and wild hosts (i.e., native grasses and other refugia) are needed to build a useable database and develop predictive models.

To address these problems, we suggest the following:

a. Begin an aggressive program to revise and update insect and mite economic thresholds and economic injury levels regularly.
b. Organize and fund a trapping network for wheat pests.
c. Fund research on a long-term basis to collect annual data on small grain aphids, Hessian fly, wheat curl mites, and minor insect and mite pests.
d. Recognize and support IPM as the cornerstone of insect and mite control in wheat.
e. Develop and support collaborative multidisciplinary research teams involving off-campus and campus-based faculty.

5. Plant Pathology and its role in the Texas Small Grains Improvement Program

Diseases are major limiting factors in producing small grains in Texas. In traditionally lower rainfall areas (principally High Plains and Rolling Plains), virus diseases and diseases that affect the roots tend to be more common and severe than other diseases. Small grains produced in those areas that have greater amounts of rainfall (Cross Timbers, Blacklands, East Texas, Central Texas, South Texas, and the Gulf Coast) tend to suffer more from fungal diseases, but viruses are also quite common. The Table below lists major wheat producing areas and their most important disease problems.

Texas Region	*Diseases of Primary Importance*
High Plains	Barley Yellow Dwarf Virus (BYDV) Wheat Streak Mosaic Virus (WSMV) High Plains Disease Virus (HPDV) Common Root Rot Fusarium root rot Take-All
Rolling Plains	Leaf Rust Barley Yellow Dwarf Virus Common Root Rot Soilborne Mosaic Virus
Blacklands	Leaf Rust Barley Yellow Dwarf Virus Soil borne Mosaic Virus (SBMV) Septoria Diseases Powdery Mildew
East Texas	Leaf Rust Septoria Diseases Barley Yellow Dwarf Virus Powdery Mildew
Central Texas	Leaf Rust Barley Yellow Dwarf Virus Powdery Mildew Common foot rot
South Texas	Leaf Rust Stem Rust Barley Yellow Dwarf Virus Common foot rot

On oat, the primary disease problems are crown rust, stem rust and barley yellow dwarf virus. On barley, barley yellow dwarf virus is the most widespread and damaging disease. Smuts and bunts occur on small grains in Texas. Because small grains are relatively low value crops, the use of disease resistance and cultural methods for managing diseases are widely practiced.

Resources for genetic management of the major small grain diseases are a major objective of the small grains improvement team. A major thrust in breeding for resistance to the leaf rusts and major viral diseases (BYDV, WSMV, SBMV) of small grains will result in cultivars with durable resistance to these diseases. Right now, sources of resistance do not exist for HPDV. For genetic improvement in disease resistance to succeed, the program must join modern techniques such as molecular markers, and transgenic technology, with traditional resistance breeding, and be guided by the application of epidemiological principles.

The small grains improvement program should have expertise in breeding for disease resistance, epidemiology, virology, and mycology. Research into the basic and applied aspects of small grain diseases; a service component for screening germplasm, and an education component for technology transfer are all elements of a successful pathology program.

An Extension Small Grains Pathology Specialist with statewide responsibility is key to success and development of a recognized small grains program in Texas. Extension Associate positions at key locations (such as the High Plains, Rolling Plains, and Blacklands) should be developed as part of the statewide effort in Extension Pathology.

J. PRODUCTION AND MANAGEMENT OF SMALL GRAINS

Introduction

While TAES breeding efforts in grain production have been extensive and coordinated, research and education programs in management have been uncoordinated. Research and extension faculty have individually addressed planting variables such as planting date and seeding rate, soil fertility, irrigation, soil compaction, tillage, and pest management including disease, insect and weed control. However, these efforts have lacked adequate coordination and interdisciplinary planning. Noticeably lacking has been evaluation of grazing and forage management practices, especially in dual-purpose wheat systems.

Key problems that reduce yields and increase risk including foliar fungal diseases such as leaf rust, powdery mildew and septoria; viral diseases vectored by aphids and mites including barley yellow dwarf, wheat streak mosaic and the High Plains virus; weather variables that damage small grains including drought, heat, winter kill and spring freeze injury from extreme shifts in temperature; improper grazing management, inadequate or improper fertilizer management; post maturity damage from excessive rainfall; crop damage from aphids (greenbug and Russian wheat aphid), Hessian fly and mites; and yield and quality damage from weeds.

Dual Purpose Small Grains

Small grain cereals grown in the U.S. Great Plains from Mexico to Canada are used primarily for grain production. However, the southern Great Plains including Oklahoma, Texas, New Mexico and southern Kansas, graze wheat and other small grains as a forage crop for 90 to 110 days during late fall and winter. In spring, grazing is terminated before the crop enters the reproductive stage and it produces a grain crop -- thus the term, dual-purpose small grains.

Dual-purpose small grains are extremely important in Texas with wheat being planted on about 6 million acres. More than 50% of the Texas wheat crop is grazed as a forage, and about 40% of the wheat acreage is grazed through maturity as a forage crop. The dual-purpose aspect of small grains is important because it increases management flexibility and helps stabilize economic income in areas with highly fluctuating climate, yield, and income. Small grains are key because they are excellent rotational crops that add more organic matter to the soil than most row crops. They also reduce soil erosion by providing complete groundcover during the growing season and after harvest. Small grains are among the most dependable crops grown in the Southern Great Plains, largely because of their adaption to a wide range of soil and climatic conditions. Their wide adaptation and dependability are widely recognized as a source of winter grazing for stocker cattle that later go to High Plains feedlots for further finishing.

Cattle grazing Texas small grains typically gain 150 to 200 pounds per head by early spring, thereby increasing their value by $100 to $150 each. Allocating two acres per animal, the small grains acreage in Texas accommodates 1.5 million animals on 50% of the acreage. These figures show a gross return of $125 to $225 million to Texas from grazing small grains before grain production. The Texas Agricultural Statistics Service shows the annual value of grain from all small grain crops ranging from $238 to $503 million during the 1990's.

Dual-purpose of small grain crops require different growth characteristics, therefore different genetics and management practices from crops grown strictly for grain production. Successful dual-purpose cereals produce maximum early vegetative growth in the fall, continue vegetative growth as weather permits during the winter, have a high recovery rate from mechanical grazing damage and have high grain yield potential. Breeding and selection goals must include forage yield, palatability, and quality that relate to animal production.

Grazing management has a significant influence on quantity of remaining forage and effective leaf area, and these directly influence grain yield. Research is needed on the impact of grazing management practices and crop inputs on grain yield and quality. The impacts of rotational vs. uncontrolled grazing, planting date, management of stocking rates, date and crop growth stage on livestock removal, and other factors contribute directly to returns in dual purpose wheat, and may impact grain quality.

Tillage practices and soil fertility management also influence forage yield and seasonal distribution, and these are different for dual-purpose cereals than for cereals produced only for grain. Soil fertility effects on dual-purpose production systems have not been adequately evaluated for grain yield, grain quality, animal productivity, and economic returns from grazed systems. Nutrient management practices must be evaluated from both economic and environmental perspectives. Information is needed to relate grazing termination dates to grain yields, and influence of grazing on grain quality. To obtain maximum benefits from dual-purpose small grains, Texas needs a well-organized, coordinated, statewide research and education program that develops adapted varieties and cultural management practices for the unique requirements of small grains grown for both grazing and grain production.

The Small Grains External Assessment Panel that evaluated the Texas A&M Small Grains Program in 1999 identified dual-purpose small grains production for increasing the small grains profit potential in Texas. They recommended that a multi-disciplinary research and extension team be formed at the Amarillo and Vernon Centers to provide appropriate dual-purpose management technology. The SGAC strongly supports the Panel's recommendation and identifies the following disciplinary expertise and coordination process to ensure efficient use of resources. A key faculty member of each team would be an agroecologist with expertise in both crops and soils, and an interest in developing forage and grain cropping systems. An animal scientist/animal nutritionist and an agricultural economist would also be essential to each team. Each team should include a mix of research and extension faculty and where both are available within a discipline, both should be involved in the research and educational programs to develop and deliver dual-purpose technology. Research teams will select a scientist leader to coordinate activities within and among Centers, including Centers other than Vernon and Amarillo as appropriate. The leader would be responsible for calling timely meetings of statewide wheat workers to assess needs and review results relating to all management aspects of dual-purpose wheat systems.

Grain quality of Texas wheat is an issue with end users. Environmental stresses are known to affect wheat grain quality, but research is limited on best management practices to reduce this environmental impact. Little is known about the impacts or interaction of various management practices for dual purpose wheat production and grain quality parameters.

<u>Structure</u>

The strategic plan for small grains in Texas recognizes the importance of crop management research and extension, and the need to integrate small grain crop management aspects into TAES and TAEX planning. Planning efforts must involve more disciplines, and must more closely tie research of agronomists, entomologists, pathologists and animal scientists to efforts in grain quality, cereal breeding and biotechnology.

The concept of two "Centers of Excellence" (Amarillo and College Station) lends itself to development, coordination and cooperation in small grain crop management research and education. Each center should provide unique staffing, laboratory facilities and equipment to handle research and educational needs in their respective regions.

The Amarillo Center

The Amarillo Center will address small grain production in traditionally dry regions of the state, but will focus on both rain-fed and irrigated production systems and problems inherent to crop production and grazing management under low rainfall, low humidity, high stress environment. This team will include TAES research scientists at Amarillo, Lubbock and Vernon; extension specialists at Amarillo, Vernon, Lubbock, San Angelo, Ft. Stockton and College Station, and county extension agents from Extension Districts 1, 2, 3, 6, and 7 with possible input from districts 8 and 10. Key positions for this team are discussed elsewhere in the strategic plan.

This team should seek strong input and buy-in from a steering committee composed of representatives from the wheat grain and forage industry, i.e., farmers (presumably the Texas Wheat Producers Board), cattlemen involved in the beef stocker industry, bakers, the agrochemical industry, news media, extension agents, specialists, research scientists and appropriate administrative liaisons. Input should be solicited from Texas Tech, the USDA-ARS at Bushland West Texas A&M. Research focus will probably include projects to identify germplasm, production practices and management inputs that enhance water use efficiency, reduce the impact of weather related stress on the crop and livestock, and reduce the impact of soil borne fungal pathogens, aphids, and wheat curl mite and viral diseases vectored by these pests. Input and participation by pathology specialists will be key to this mission.

While the Amarillo center is charged to develop efficient, productive and profitable management systems for grain, forage and livestock production for drier regions of the state, we recognize that great diversity exists in soils and climate within that western region. It is paramount that research and educational programming have an extensive outreach to adapt research findings to resource niches, and to extend information throughout the applicable production regions in the state. We further recognize that coordination with the College Station Center is vital. Many research and education activities have common themes, goals and objectives, and resources will be allocated with close coordination.

The College Station Center

The Center of Excellence at College Station will serve the entire state, but research and educational programs will emphasize problems associated with grain and forage production in the more humid and higher rainfall regions of the state. This will include most of Extension Districts 4, 5, 8, 9, 10, 11 and 12. The role of this center will be substantially different from that of the Amarillo center as part of the faculty will have teaching responsibilities in addition to activities described for the Amarillo center. This center will, due to the presence of the Crop Improvement Center, the anticipated position in molecular biology of wheat, and the full time availability of graduate students, have much more responsibility in the identification and development of wheat biotechnology applications. Other positions associated with the College Station center are described elsewhere in the Strategic Plan.

A second steering committee, consisting of individuals of the same interests, but with economic ties to the eastern, central and southern regions of the state will help focus activities of this center (i.e., representatives from the TAMU Departments of Soil and Crop Science, Entomology, Plant Pathology and Microbiology, and TAMU Commerce serve along with industry, county extension agents, and others). Representatives from the two steering committees will meet periodically with the Small Grains Advisory Committee and with each respective steering committee to enhance communication among the groups.

We anticipate that research and educational interests of the College Station Center will be divergent from those of the Amarillo Center. Major focus would include management of foliar fungal diseases including leaf rust, crown rust, septoria, powdery mildew and insect pests including greenbug, winter grain mites, Hessian fly, and the aphid- vectored barley yellow dwarf virus (BYDV). BYDV and its vectors may deserve special attention due to its widespread destructiveness. Plant virologists in the Plant Pathology Department will be encouraged to participate in this small grains research and education program. Grain and forage yields in this region are often limited by drought in the spring and summer and excess water during the winter. Efficient production technologies and grazing strategies in this environment will vary significantly from those in the drier climates.

K. ANALYSIS CAPABILITIES FOR INTRINSIC QUALITY

Texas has a rich history of releasing hard red winter wheat cultivars that have been productive, stress resistant and possessed adequate quality for leavened pan bread production. In a market dominated by foreign government grain buyers who make purchase decisions primarily on price, there has been little need to emphasize improvement of intrinsic grain quality during the breeding process. Over the past decade, however, both domestic and foreign buyers have altered the way in which they do business. Foreign government grain purchasing teams now are the exception, and private millers and bakers in foreign countries now purchase their own grain. They are becoming increasingly specific in their demands for end-use quality. Concurrently, domestic wheat buyers are demanding higher intrinsic quality and consistently demand cultivars with more uniform quality across a range of environments. There also is a domestic movement to rapidly increase amounts of identity preserved (IP) grain. In the IP system, varietal identity of grain is preserved from the farm gate to the final processor. Many larger baking companies in the United States are already involved in IP programs or are developing IP capabilities, and Texas is unprepared for this change. We have neither the storage nor data base on genotype/environment interaction to attract large IP opportunities.

The Cereal Quality Laboratory (CQL) at Texas A&M University has done an outstanding job of evaluating the intrinsic quality of experimental lines of wheat from the various Texas wheat breeding programs. They have done this with very limited funding and labor. This is the only university laboratory in the United States that processes up to two thousand preliminary line samples each year and, somehow, manages to get data to the breeders early enough for use in selection decisions before fall planting. Analyses include standard mixogram, protein, flour extraction and grain hardness. Very little baking is currently done at the CQL without a specific request. Advanced experimental lines generally are grown in regional performance nurseries before commercial release. Each entry in these uniform regional trials is milled and baked by the USDA Wheat Quality Laboratory in Manhattan KS, and those data shared publicly. Also, breeders can enter their pending releases in milling and baking trials conducted by the Wheat Quality Council. In these trials, commercial milling and baking companies analyze the intrinsic quality of wheats under their specific processing procedures, and data are reported annually at a public meeting in Kansas City.

If Texas A&M University and the Texas Agricultural Experiment Station are to remain competitive in wheat germplasm enhancement and wheat cultivar development, we need increased emphasis on enhancing the intrinsic quality of Texas wheat. Texas is challenged in this regard in several ways. First, Texas is the only state that annually grows significant acreages of all major market classes of wheat. Largest acreages are dedicated to hard red winter wheat and soft red winter wheat, but there also are measurable acreages of hard red spring wheat, hard white winter wheat and durum wheat. This diversity causes potential for intermingling market classes and a consequent discount in quality. Secondly, proteins largely responsible for intrinsic quality are deposited in the grain late in the grain-filling process. These proteins are highly heat sensitive. The temperature load in Texas wheat fields during grain filling are high and result in lower basic quality than identical varieties grown farther north. Third, Texas' highly diverse growing environments compliment one another, but also can make it very difficult to produce uniform intrinsic quality in any given year statewide.

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<u>Current Resources</u>

Listed below are the current resources in the Cereal Quality Laboratory dedicated to wheat improvement. This typifies the resources required to adequately service a relatively large wheat breeding effort but is insufficient to conduct research on the many nuances affecting the intrinsic quality of wheat.

Personnel	
Project Leader:	
Dr. Lloyd Rooney 10% effort	$ 13,000
Senior Research Assoc.	
Dr. Elly Suhendro 50% effort	$ 23,000
Part time Labor	
S&CS Dept. Funding	$ 3,000
TWPB Funding	$ 6,500
Equipment Cost	
NIR	$ 42,500
SKHT	$ 25,000
Computerized Mixogram	$ 25,000
Small Scale Mill	$100,000
Baking Ovens	$ 30,000

<u>Future Needs</u>

To maintain current programs (screening breeding germplasm) and also expand capacities to meet the increasingly complex needs of the industry, substantial additions are required to the Cereal Quality Laboratory. A full time senior research associate is needed to work under the direction of Dr. Rooney. This person would supervise the daily research (milling, baking and data analysis) conducted on wheat in the CQL. Working under the supervision of the senior research associate would be a baking technologist (B.S. level) who would be trained in basic baking techniques and thereby facilitate expansion of activities to include actual baking analysis of commercial and experimental wheats. This added capacity would facilitate the establishment of a database relating the effects of environment on end use quality and systematized bake analyses of appropriate experimental cultivars. Also under the daily supervision of the senior research associate should be a 0.33 effort from faculty directly associated with the CQL but with multicrop responsibilities. This person would serve as the interface with molecular geneticists in the Crop Biotechnology Center and would provide an enhanced capability to identify issues and solve problems of intrinsic quality that are more basic than those currently being investigated in the CQL. Estimated additional resources for new personnel are:

Senior Research Associate (I FTE)	$50,000
Baking Technologist (I FTE)	$30,000
1.0 Faculty Position	$60,000

Each of these individuals will require part time labor with a total estimated annual cost of $16,000 annually. Additionally, current milling equipment in the CQL is 35 years old and has been in continuous use during those years. Estimated replacement cost is $150,000.

While these additions may seem excessive, they are minimal for a modern, program directed at current and future needs. These resources do not include the significant resources that will be required to conduct the molecular analyses critical to a well-rounded program. In order for Texas A&M to move to the forefront of wheat technology, these recommended additions are only skeletal. Additional resources will need to be gleaned from collaborative research with other departments/units within the System, through cooperative research with other institutions and through sponsored research efforts.

L. EXTENSION SMALL GRAINS PROGRAM - POSITIONS, ACTIVITIES AND SUPPORT

As the Agriculture Program re-evaluates priorities and sets about restructuring the Small Grains Program, the Extension educational component must be critically reexamined. The model of focusing small grains research at centers at Amarillo and College Station is not necessarily appropriate for aligning educational programming efforts. In the current scenario, the center-based specialists carry the brunt of contacts with county agents and the public with small grains education. This is appropriate now and in the future due to their close affiliation with the county agent and their geographical distribution, which puts them within reasonable driving distance of most of the small grains producing regions that they serve. An effective educational program in small grains will truly involve many forms of media, but personal contact and direct service will continue to be important.

A vital element in extension education in small grains today is the component of applied, on farm trials and demonstrations of new and developing technology. Such field trials are vital to exhibit new technology to Texas farmers and ranchers on their own farms and ranches, and to become centerpieces of educational programs such as field days and tours. The credibility and adaptability of new research findings are established by these diverse field trials and the educational programs which showcase them. Of the many field trials in place today, topics of applied research include fungicidal and insecticidal seed treatments, weed control, tillage, forage and grazing management, comparisons between varieties and species, foliar fungicides, herbicide resistant wheats and agronomic management practices such as planting dates, seeding rates, etc. The subject and content of these applied trials are dynamic, with a focus on addressing real world problems identified by industry, county agents, farmers, TAES scientists, or the specialists themselves.

One of the needed roles of the extension specialist in small grains is the comprehensive evaluation of small grain varieties for yield and quality of grain and forage, diseases and insect resistance, winter hardiness, and other agronomic characteristics across the diverse environments in which they are grown. TAES does and has historically conducted variety testing, at least that part related to grain yield and agronomic components. This testing is often a component of breeding programs, comparing commercial varieties to advanced lines. The variety testing concept is directly related to the mission of extension, or the transfer of technology into the field for education and adaptation by farmers and ranchers. A 2000 survey by the TDA shows that 52 per cent of all wheat is grazed, and 26 per cent of all wheat is planted only for forage. These figures document the need for increased effort in identifying superior varieties and production practices for wheat and other small grains as both forage and grain crops.

Extension specialists have varying access to suitable equipment for the establishment and harvest of small grains trials, such as cone or tray type planters and plot combines and they have no available hard funds to acquire new equipment. In Extension Districts 1 and 3, county clusters represent farms on which wheat and other small grain varieties are planted to serve a dual function as replicated research trials and as focus for educational programs in the surrounding counties. In Extension District 4, four trials are typically planted which serve much this same purpose. In Extension Districts 7 and 8, specialists assist agents in acquiring seed for strip trials from which results are pooled. Little organized testing of varieties occurs in Districts 2, 6, 10, 11 or 12 despite a significant acreage of small grains in parts of each region.

With approximately 7 million acres planted annually, small grains are planted on more acreage and are geographically more widespread than any other crop. Management of small grains is complicated by the fact that most of the crop is managed as a forage and a grain crop, and by the widespread problems with fungal and viral diseases common to wheat and other small grains. Despite the extent of the acreage and complexity of the production systems, the Extension Agronomist- Small Grains must apportion time with responsibilities in soybeans, minor oilseed crops and drought related issues. Little support in extension pathology of wheat and other small grains is available in disease management due to other priorities in the Department of Plant Pathology and Microbiology.

To enhance efforts in Extension education and applied research of small grains, the following steps are proposed:

1. Convert Extension Agronomist- Small Grains to 100 percent small grains effort.

2. Create Crop Testing Unit in small grains to address significant needs in forage and variety testing across state. Testing will be accomplished by Extension Associate with Extension Agronomist-Small Grains acting in advisory and coordinating roles between Associate, breeders and center-based agronomists. Support in rating of small grain tests will come from center-based specialists and scientists at Centers of Excellence. The Associate may work in tandem with existing Crop Testing program. Funding should come in part from royalty income derived from sale of

small grains and from fees generated from entries in trials. Equipment is to be derived in part from existing small grains inventory, as is available.

Equipment needs:	Combine	$100,000- or from inventory
	Plot drill	$24,000- or from inventory
	Truck	$25,000
	Trailer for combine and drill	$4,000- or from inventory
	Forage harvesting equipment	$4,000- or from inventory
	Computer and hardware	$5,000
	Supplies	$3,000
	Travel budget	$5,000
Staff needs:	0.5 time secretary	$10,000/year
	Technician/assistant	$22,000/year
	Extension Associate	$30,000/year

3. Extension Small Grains Pathologist position in the humid region of the state where known solutions for disease problems exist. Individual needs at least 50% (preferably 75- or 100%) appointment in small grains to address many and diverse disease problems in the crop.

4. Operating funds and equipment. Center based specialists struggle with acquiring and maintaining equipment for establishing fertility, weed control, and agronomic trials and demonstrations. It is estimated that $5,000/year each at Amarillo, Vernon and San Angelo would be needed to acquire and maintain adequate equipment and to fund travel for enhanced small grain activities.

5. County/multi-county demonstration aides. Programs in place in the High Plains indicate that demonstration aides (i.e.. Agri-Partners) working directly with county agents and farmers with center- based specialists advising and directing educational efforts can have a great impact on development and adaptation of new technologies. If funding could be identified to employ 5 people on a part- time basis in the High Plains, Rolling Plains and Edwards Plateau, great advances could be made in technology transfer and improving profitability in dual purpose wheats. These individuals could be of great assistance to the Crop Testing Unit activities.

M. TEXAS FOUNDATION SEED SERVICE (TFSS) AND SMALL GRAINS BREEDING PROGRAMS.

An objective of the Texas Agricultural Experiment Station (TAES) is to develop and release new, improved small grain varieties that possess good quality characteristics and also high yield potential and diverse pest resistance. Adequate supplies of seed with excellent varietal purity must be maintained for the farmers and the commercial seed industry in Texas. Careful supervision of seed production through all generations is a continuous process to protect new small grain varieties released under the Plant Variety Protection Act.

There are five major objectives of the TFSS in relation to the Small Grains Breeding Programs:

1. Work with plant scientists to develop “entrance strategies” for the orderly purification and multiplication of potential new varieties, and “exit strategies” for the commercial release and long term (17 year) maintenance of varieties.
2. Increase seed of the controlled generation classes (Breeder, Foundation, Registered, and Certified) of new small grain varieties as rapidly as possible.
3. Keep seed pure by variety during increase and through the certification process.
4. Have pure seed of new varieties available to commercial growers on an equitable basis and at a reasonable price.
5. Maintain adequate supplies of pure seed of previously released TAM varieties, and increase as necessary.

Specifically, TFSS either serves as or finds exclusive or semi-exclusive agents for all Breeder Seed and other parental material distributed through TAES. TFSS contracts with individual growers for the production of

Foundation Seed from Breeder Seed. A key activity of TFSS is to rogue, harvest, and condition the seed stocks without mixing or genetically altering a variety. Besides handling new varieties, TFSS should also maintain pure seed stock of varieties previously released from TAES. TFSS may also increase and distribute varieties from other organizations, which are adapted to Texas.

Seed Classes:

Breeder Seed – Seed which is directly controlled by the originating scientist, who supplies the initial source and recurring increases of foundation seed.

Foundation Seed – Produced from Breeder or Foundation Seed under the control of TFSS and the originating scientist.

Registered Seed – Produced from Foundation Seed. This class of seed shall be of a quality suitable for the production of Certified seed. This seed is typically one generation from Foundation Seed.

Certified Seed – Produced from Foundation, Registered, or Certified Seed stocks. Must be state certified to produce additional Certified Seed.

Plant breeders are responsible for the basic research and early-generation testing and selection of homozygous lines (typically F_1 through F_4 generations). In addition, the breeder first evaluates lines for yield in the F_5 generation, followed by one or more years of testing before being "purified" or "head-rowed" for possible seed increase (see table below).

Homozygous line evaluation	***Seed purification and multiplication***
1st Year (F_5)	none
2nd Year (F_6)	none
3rd Year (F_7)	Heads selected
4th Year (F_8)	Head rows grown; discard off-types; bulk similar rows (pedigree seed)
5th Year (F_9)	Plant pedigree seed; rogue off-types; harvest breeder seed
6th Year (F_{10})	Plant breeder seed; rogue off-types; harvest foundation seed
7th Year (F_{11})	Plant foundation seed; rogue off-types; harvest registered seed
8th Year (F_{12})	Plant registered seed; harvest certified seed

The plant breeder is typically responsible for the production and maintenance of breeder seed. The foundation seed and subsequent generations of seed production on a large scale are done by TFSS in cooperation with the breeder.

Seed purification and multiplication (P & M) is begun by the breeder after one or two years of yield testing, well before any decision is made concerning possible release of a line. This requires significant additional effort by the breeder because seed of the lines not released (the majority) must be discarded. However, with simultaneous evaluation and P & M of lines, the time required to have seed of a new variety available to farmers is greatly reduced. The sooner P & M activities are initiated; the sooner large quantities of seed can be made available to farmers. Nevertheless, early P & M activities significantly increase the time, space, and resources required of the plant breeder (thereby decreasing the time spent by the breeder on basic research, parent development, crossing, selection, etc.). Besides the production and maintenance of breeder seed, the plant breeder is also responsible for the preparation and completion of all information and forms relating to Plant Variety Protection (PVP), and also the preparation of information and advertisements that relate to a new variety. P & M activities should be a cooperative effort between the breeder and TFSS, with responsibility for purity gradually moving away from the breeder and toward TFSS as generations of selfing increase.

N. COMMERCIALIZATION OF IMPROVED CULTIVARS

The Texas Agricultural Experiment Station (TAES) seeks to develop strong relationships with private companies that can promote a Texas small grains industry that is sustainable and competitive in world markets. Primary goals of these relationships are production and sale of high quality and pure seed, support of the Texas certified seed industry, and delivering to Texas farmers the benefits of biotechnology and new varieties. To facilitate these goals, TAES will work with the commercial seed industry to release improved cultivars and grant commercial licenses to private companies that can maximize availability and benefits of quality seed. Moreover, TAES looks to these relationships for generating some of the revenue needed to sustain Texas small grains research and education programs (e.g., purchase and maintenance of equipment and instrumentation, maintenance of Texas Foundation Seed Service, and marketing varieties with limited utility or distribution).

TAES recognizes that free-release of small grain varieties to independent seedsmen does not effectively promote proper business principles or a healthy certified seed industry for small grains. To facilitate needed business principles, TAES will file appropriate protection instruments in the United States for licensing new varieties, including patents, plant patents, or certificates of protection. Private sector partnerships will be pursued that develop appropriate business mechanisms, assure proper seed distribution, confirm quality controls for seed production, and protect and enforce intellectual property. Partnerships will include elements described below.

- Performance-testing services for licensed varieties, to identify and promote regional adoption of licensed varieties.
- Evaluation of quality of licensed varieties using industry protocols and standards.
- Assurance that sublicensees, distributors and associates have valid contracts for production and sale of licensed varieties.
- Effective monitoring of seed sales and usage.
- Audits that assure accurate reporting of sales of licensed varieties.
- Enforcement of intellectual property rights in Texas and in other states that protects licensed varieties from infringement and abuse.
- A program for seed increase and production for licensed varieties that effectively meets public and market demand.
- Pricing of licensed variety seed similar to pricing of other proprietary varieties that have similar demand and have been released for equivalent periods.
- Working with TAES scientists on release of new varieties, developing needed marketing and production plans for these varieties.
- Maintaining all certification standards as required by certifying agencies for jurisdictions where production takes place.
- Using care in all aspects of production, conditioning, distribution and sale of licensed products to insure quality and purity of all products sold.
- Selling licensed products to the public under a commercial name that identifies the variety as originating from the Texas A&M University System, and only using a variety name and not selling as Variety Not Stated ("VNS").

O. UNIVERSITY/INDUSTRY INTERACTIONS

Background:

In 1987, the Texas legislature recognized the dawning of a new day in commercialization of the products of agricultural research at Texas A&M University. This was the year the Texas Agricultural Experiment Station was directed to use available legal protections for plant cultivars and develop procedures to capture a return on the State's research investment through licensing fees, royalties and other forms of partnerships with industry cooperators. Without this directive, partnerships between TAES and industry would have been unlikely, particularly with wheat and other small grains. In the years since the legislative directive, life sciences have gone through an amazing metamorphosis. Biotechnological processes that were considered very basic in 1987 are now routine. The concept of gene ownership, which was controversial in 1987, is now generally accepted and genes are primarily privately owned. Genetically modified organisms, while not yet totally accepted by the general public, are planted on most of the country's soybean and cotton acreage and approximately one-third of the U.S. corn acreage. The benefits of biotechnology are being rapidly realized and Texas is poised to assume a leadership position in development of a new sector of the state's economy based on life science research and collaborative arrangements with industrial partners. The 1999 Texas summit entitled "Life Science Technologies: From Potential to Product" stressed in its conclusions the importance of enhanced industrial partnerships. In its final report to TAES, the October 1999 small grains External Assessment Panel also encouraged TAES to rapidly explore avenues of collaboration with industry.

Collaboration Examples:

Wheat and other small grains lag behind other crops concerning the contributions of biotechnology to cultivar and product development. This is largely due to the enormity of the wheat genome and the complexities inherent when dealing with a polyploid species. This delay, however, may be a blessing since it is possible to watch the mistakes made in other crops and not allow them to be repeated in wheat.

Wheat is grown on more acres than any other crop in the world. It is used primarily as a food and products made from wheat are consumed by an increasingly health conscious public. Wheat plants and wheat flour could serve as delivery systems for the myriad of healthful products now known as nutriceuticals. Manipulation of specific constituents in the wheat grain could lead to development of novel industrial products. Wheat starch, for example, may have as many potential uses as corn or potato starch. The unique proteins of wheat offer many novel potential uses other than just serving as a balloon for the entrapment of gases during the baking process.

Texas and Oklahoma are unique in the United States in that wheat is grown as a dual purpose crop for grazing and for grain production. This duality offers great potential for expanded research and commercialization of new products. Could wheat be modified in a way to produce more healthful beef? Could cattle health products be delivered through wheat plants rather than by injection or as a feed additive? Are perennial wheats a possibility?

Although today it may sound low tech to mention agronomics, there is tremendous potential to develop new agronomic products that are both profitable and beneficial to all end users of wheat. For example, herbicide resistant wheats already are being designed and have the potential to decrease chemical use thereby benefitting the environment. New cultivars that are more input efficient may be possible, particularly genotypes that more efficiently use solar radiation for enhanced photosynthesis. Will a wheat cultivar ever exist which fixes nitrogen? Can cultivars be developed which naturally resist all forms of fungi, bacteria or viruses? Will it be possible to develop cultivars that exude compounds which prevent the growth of non-target plants?

Finally, the manner in which wheat is marketed is rapidly changing from a commodity-based system relatively void of quality incentives to an added value, identity preserved system in which high quality is rewarded. It is unlikely that any university system can effectively capitalize on this new system without industrial partners.

Approach:

1. Inventory existing programs to determine focal points that may lead to partnerships.
2. Develop interdisciplinary teams to share ideas and assist in project focus. Teams should be different than the teams of the past. Today, plant breeders need to work with food scientists, molecular biologists and agricultural engineers as much as they need to work with pathologists and entomologists.
3. Invite key leaders in industry to visioning meetings with TAES faculty.
4. Follow up on visioning meetings by exploring opportunities with key people in the private sector.
5. Develop long range plans for industrial partnerships that focus on a few key issues and includes a prospectus for resource acquisition, product development and technology transfer.

P. VARIETY SURVEYS

A variety survey was taken in 1990 and 2000. Much more frequent surveys, preferably taken in alternate years, are needed to identify the approximate acreage of each wheat variety grown in the State, document its use, (for grain, grazing, or both), and provide a history of its rate of adoption and decline. The survey could be financed from sources such as the Texas Wheat Producers Board, Texas Agriculture Statistical Service, industry and government grants. The survey should be conducted and the results widely distributed by TDA.

Q. IMPLEMENTATION PLAN

The envisioned small grains research and education program described in Section H will be implemented by the Vice Chancellor and Dean, Agriculture and Life Sciences, and Director, Texas Agricultural Experiment Station and Texas Agriculture Extension Service, using the Strategic Plan for Small Grains and other forthcoming recommendations of the Small Grains Advisory Committee as guidelines. The SGAC will meet at least annually, review new and ongoing issues in small grains, make additional recommendations to the Vice Chancellor, and modify as needed the Small Grains Strategic Plan for the purpose of maintaining a truly statewide perspective to the small grains program and to enhance the procurement and efficient use of resources.

To bring stability and assure adequate resources for the small grains program, there must be continued sources of income, consistent with the program requirements. The following two sections describe the resources needed to keep the program productive and current and a financial plan to provide for the required resources.

1. Capital Asset Management

Every facet of research and education in small grains and other commodities is dependent upon capital equipment. Capital equipment is subject to wear, tear and depreciation, and to keep active and viable programs ongoing, a careful and thoughtful approach to equipment replacement must be developed. Many capital equipment items used by small grain scientists are expensive to the degree that they cannot be purchased from operating budgets of principal investigators. Many granting sources specifically prohibit the use of grant funds for the purchase of capital equipment, leaving scientists with limited options to replace worn and failing equipment.

Capital equipment in small grains research varies with position. In small grains breeding, standard equipment needs would include:

Item	Approximate cost/unit	Life expectancy
plot combine(s)	$100,000	10 years
plot tractors (2)	$15,000	15 years
plot drills (2)	$24,000	10 years
3/4 or one ton pickup	$25,000	5 years
½ ton pickup	$18,000	7 years
gooseneck trailer	$7,500	10 years
plot threshers(2)	$2,500	15 years
head threshers (2)	$2000	10 years
forage harvester	$7500	10 years
tillage equipment (disc, harrow)	$5000	15 years
alley shredder	$1000	15 years
electronic balances (2)	$2,000	10 years
plot sprayer	$1500	15 years
bar code reader	$1000	10 years
fertilizer applicator	$2000	10 years
processing/lab space	$?	25 years
greenhouse space	unit purchase	Varies
vernalization chamber	$5000	10 years

office equipment (computer, laptop, printer software, etc.)	$7000	Varies, 3 to 5 years
TOTAL	$226,000	

In addition to the initial cost of capital equipment, annual repair and maintenance will cost approximately $10,000. The number of units of capital equipment varies with each breeding program. With the initiation of the "Centers of Excellence" concept, they perceive that due to the large size of each region covered, multiple units may be required to cover needs. New capital equipment cost for each position will exceed $250,000. Annual maintenance and upkeep on the above equipment would approximate $10,000. Breeders will have 2, or perhaps 3 combines, using older and reconditioned machines for less demanding uses. As with any agricultural application, rapid harvest is required to prevent serious weather loss to field trials. With the thousands of individual plots harvested annually in each program, plot combines log many hours annually. Periodic reconditioning of combines can greatly extend useful life, and should be planned. Planting and maintenance equipment such as sprayers, shredders and fertilizer applicators are no less important than are combines, but have much lower unit costs. The annual depreciation cost of the above equipment is what should be targeted by a capital asset management plan, so that equipment can be replaced before it limits the scientific program.

Greenhouse space and associated equipment may or may not be shared space, with costs shared by various projects. Functional greenhouses are an important asset to a breeding program and maintenance should be a planned activity. Greenhouse needs should be analyzed by the requirements of each individual program. As the breeding programs at Amarillo and College Station are currently open, a plan for greenhouse management might best be delayed.

The Small Grains Strategic plan will shift the current small grains variety testing program to the Extension Service. The equipment required for this variety testing program will be:

Item	**Approximate Cost/Unit**	**Life Expectancy**
Plot combine	$ 100,000	10 years
Plot drill	$ 24,000	10 years
Plot tractor	$ 15,000	15 years
Tillage equipment	$ 5,000	15 years
Fertilizer applicator	$ 2,000	10 years
3/4 ton truck	$ 25,000	5 years
Gooseneck trailer	$ 7,500	10 years
Forage harvester	$ 7,500	10 years
Office equipment	$ 7,000	3- to 5 years
	$193,000	

Due to the small number of seed companies that currently sell seed wheat in Texas, it is unlikely that a significant part of the revenue from variety testing can be captured from variety testing fees. As the variety testing program is an integral part of the strategic plan, it will rely on revenues listed in section Q. 2. to purchase and maintain equipment.

Each of the existing small grains breeding programs have a significant inventory of capital equipment, much of which is in fair to poor condition due to the lack of funding and an organized capital asset management strategy and funding dedicated to capital assets.

The field of molecular genetics requires a large inventory of equipment that changes rapidly with the technology. The CBC on campus has a significant inventory of equipment, but project leaders will need to assess and define needs in this area.

Purchase and Replacement of Equipment:

Each investigator in small grains has a working knowledge of the condition of capital assets in inventory and any additional equipment requirements of his or her project. Investigators should be encouraged to seek outside funding for capital assets as they are available. It is the intent of the Small Grains Advisory Committee to coordinate funds available from state initiatives, redirected TAES, TAEX and unit funds, and funds from the Texas Wheat Producers Board, as well as monies from royalties, contracts, and grants. The ultimate objective will be to prevent the lack of capital assets from limiting the scope of small grain research and education programs. The Small Grains program and its two proposed centers of excellence will be a statewide, multi disciplinary effort to improve production and profitability of the largest crop in the state. The success of this strategic plan will hinge on the buy-in from the leadership of the departments and units involved. If a truly successful *statewide* program is to be accomplished, it needs statewide coordination by scientists, administrators and representatives of the wheat industry. It is proposed that the SGAC serve in this function concerning capital asset management, annually reviewing equipment condition and needs, and also making recommendations regarding allocation of pooled resources listed in Q.2. for the purchase of capital assets dedicated to small grains research and education.

2. Funding the Statewide Strategic Plan

Full funding for implementing the Statewide Small Grains Strategic Plan as recommended herein will require new resources. Sources of funding should include but are not limited to:

(a) Proposed new 2001 State Legislative Initiative, "Wheat: A Golden Opportunity" (Appendix II);

(b) Redirected resources within TAES, TAEX, and/or specific Units thereof;

(c) Partnerships with other institutions or agencies (e.g. USDA-ARS, TTU, etc.);

(d) Industry including the Texas Wheat Producers Board;

(e) Royalties from wheat varietal development and sales; and

(f) Contracts and grants.

The potential for large new funding in the short term (5 years) is probably greatest through the Legislative Initiative/Exceptional Item route. It will require more time for the other mechanisms to gather momentum and reach their full potential, but eventually they may become the more sustainable sources.

The SGAC believes that the distribution of any new state resources that may become available will be most effective if allocated and committed on a 2- to 4-year basis (except large, non-recurrent expenditures such as capital equipment items). Funds distribution should be made according to stated program goals recommended in this Strategic Plan (see an earlier section) and according to opportunities to develop the two designated Centers of Excellence.

Moreover, we recommend that sufficient funding from the statewide Wheat Legislative Initiative and other sources be earmarked for priorities related to:

- Equipment and infrastructure needs;
- Critically-needed funding to specific units for support staff and operating costs, which are below threshold levels for realizing nationally-prominent, highly productive programs;
- Competitive grants available to Agriculture Program scientists in concert with close partnering agencies; and
- Strategic partnering, accountability, and appropriate visibility.

The Small Grains Advisory Committee through several meetings took these resource allocation factors into account. The recommended resource allocations, assuming full funding of the 2001 Legislative Initiative, "Wheat: A Golden Opportunity", are shown in Table 6, with initial 2-year funding allocations to address the most urgent needs in relation to the requested $2.8 million total requested funding. The values in Table 6 represent an initial SGAC consensus approximation as to levels for addressing present base needs for Centers of Excellence/locations/units and stated goal attainment.

While the Legislative Initiative, if funded, can probably supply an initial infusion of capital and operating costs, additional resource development and allocation measures will be needed to fully fund the "Strategic Plan for Small Grains Research & Extension, TAMUS." The SGAC should be assigned a strong role in the development and allocation process of new resources to assure fulfillment of the Strategic Plan.

Moreover, because funds will be needed to implement the recommended elements and precepts of this "SMALL GRAINS STRATEGIC PLAN FOR TEXAS," it is hereby recommended that all TAES royalties (excluding payments to inventing scientists and TLO) (i.e., 42.5% of total allocated by TAMUS-TLO) from small grain varietal development henceforth received by the TAES Administration and administrative units be set aside for use solely for the statewide small grains program.

Specifically, the SGAC recommends that TAES royalty funds be placed in a special account for recommendations on allocations by the SGAC toward implementing this Strategic Plan. This redirection of funds does not include the distributions to scientists or to the TAMU Technology Licensing Office. The recommended revised policy should be reevaluated by the SGAC at 5-year intervals to assure the appropriate development and delivery of small grain varieties and management practices.

Table 1. Texas Small Grains Improvement Program Inventory of Texas Agricultural Experiment Station Faculty Positions, July 2000.

Location		Breed Germ.	Breed Var.	Physiol.	Path.	Prod/ Mgmt	Var. Test	Lvstk/ Graze	Entom.	Econ.	Qual/ End-Use	Total
Overton	Y	0.1	0.2		0.1		0.1					0.5
	$	8.0	16.0		8.0		8.0					40.0
Dallas	Y	0.2	0.3		0.5							1.0
	$	17.0	25.5		42.5							85.0
Vernon	Y					0.3		0.3				0.7
	$					22.0		20.0				48.0
						0.1						
						6.0						
Amarillo	Y	0.4	0.6	0.25	0.25	0.08		0.15	0.25			2.3
	$	24.1	36.1	17.2	23.3	5.5		13.6	19.1			165.6
						0.32						
						26.7						
Soil/Crop Sciences	Y		0.5				0.3				0.1	0.9
	$		29.0				26.8				9.0	64.8
Corpus Christi	Y					0.05						0.05
	$					3.4						3.4
Ag Econ	Y									0.1		0.1
	$									7.5		7.5
Uvalde	Y		0.05	0.1		0.1						0.25
	$		2.9	5.8		5.8						14.5
TOTAL	Y	1.0	1.35	0.35	0.85	0.95	0.40	0.45	0.25	0.10	0.10	5.8
	$	74.6	84.0	23.0	73.8	69.4	34.8	33.6	19.1	7.5	9.0	428.8

Table 2. **Texas Small Grains Improvement Program Inventory of Texas Agricultural Extension Service Faculty Positions, July 2000.**

Location		Prod/ Mgmt	Entom.*	Path.	Econ.	Lvstk/ Graze	Var. Test	Irrig.	Total
Vernon	Y	0.3	0.3		0.3				0.9
	$	18.0	20.0		18.0				56.0
Amarillo	Y	0.23	0.2	0.08	0.1	0.2		0.15	1.04
	$	16.4	11.0	1.3	5.7	13.3		11.5	65.9
	Y	0.08							
	$	6.7							
Soil/Crop Sci.	Y	0.5					0.35		0.85
	$	38.0					31.2		69.2
Ag. Econ.	Y				0.25 mkt 0.20 Mgt				0.45
	$				18.0 14.0				32.0
Plant Pathology	Y			0.2					0.2
	$			11.5					11.5
San Angelo	Y	0.20	0.05		0.15		0.05		0.45
	$	12.0	2.0		7.8		3.0		24.8
TOTAL	Y	1.31	0.55	0.28	1.0	0.2	0.40	0.15	3.9
	$	91.1	33.0	12.8	63.5	13.3	34.2	11.5	259.4

Entom.* (0.5 and $30.0 total estimated for 4 locations; Amarillo, Lubbock, Vernon, Dallas)

Table 3. Texas Small Grains Improvement Program Inventory of Texas Agricultural Experiment Station (TAES) and Texas Agricultural Extension Service Technical Support Positions, July 2000.

Location		Breed Germ.	Breed Var.	Path.	Mol. Gen.	Prod/ Mgmt	Irrig.	Var. Test	Lvstk/ Graze	Entom	Qual/ End-Use	Total
		TAES										
Overton	Y	0.2[1]	0.4[1]	0.2[2]				0.3[2]				1.1
	$	5.0	10.0	5.0				8.0				28.0
Dallas	Y	0.2[3]	0.3	0.5[3]								2.0
	$	8.0	12.0	20.0								66.0
	Y	0.5[2]		0.5[2]								
	$	13.0		13.0								
Amarillo	Y	1.0[3]	1.0[1]			0.3[2]	0.15[1]		0.3[2]	0.15[3]		3.3
	$	31.2	36.5			7.7	7.8		7.0	4.5		104.5
	Y		0.3[2]							0.1[2]		
	$		7.0							2.8		
Soil/Crop Sciences	Y	0.5[1]	0.5[1]		0.75[1]						.15[1]	1.9
	$	13.0	TAES/ Grant		19.0 Grant						5.0	50.0
Corpus Christi	Y					0.05[2]						0.05
	$					1.2						1.2
Vernon-All Prod/Mgmt Positions	Y	0.35[1]	0.35[2]	0.2P.D.[4]	0.3[1]	0.4[4]	0.7[2]		1.0[1]			3.3
	$	10.5	9.2	6.2	8.7	13.6	14.0		32.0 Vacant			94.2
TOTAL		2.7	1.9	1.2	0.75	3.65	0.15	0.3	0.3	0.15	.15	11.25
		82.2	59.5	38.0	19.0	103.1	7.8	8.0	7.0	4.5	5.0	343.9

[1] Research Associate [2] Technician [3] Research Scientist [4] Post-doc

	TAEX Y	$	
Soil/Crop Sciences	0.55	15.0	Extension Assistant in Production/Management
	1.0	42.0	Extension Assistant/Research Associate in Variety Testing (TAEX/TAES)
Amarillo (Ext. Asst.)	0.25	7.9	Extension Assistant in Production/Management (TAEX/TAES)

Table 4. Small Grains Program Inventory of Texas Agricultural Experiment Station Operating Budget, Dollars

Location		Breed Gen.	Breed Var.	Physiol	Prod/ Mgmt	Entom.	Path.	Lvstk	Irrig.	Var. Test	Qual/ End-Use	Mol. Gen.	Econ	Total
Dallas	$	4.0	4.0											8.0
Vernon	$				7.0 5.0									12.0
Amarillo	$	2.9	4.3		5.5	0.5	0.5	2.5	5.0					21.2
Soil/Crop Sciences	$	7.0	15.0							8.0	4.0	10.0		44.0
Corpus Christi	$				0.5									0.5
Ag Econ	$												2.5	2.5
Uvalde	$	1.0		2.0	2.0									5.0
TOTAL														$93.2

Table 5. TAES and TAEX Small Grains Faculty Position
July 2000

Unit	**TAES**	**TAEX**	**Total**
	-----FTE-----		
Overton	0.5	—	0.5
Dallas	1.0	—	1.0
Vernon	0.7	0.9	1.6
Amarillo	2.3	1.0	3.3
Soil/Crop Sciences	0.9	0.85	1.75
Ag. Economics	0.1	0.45	0.55
Uvalde	0.25	—	0.25
San Angelo	—	0.45	0.45
Plant Pathology	—	0.2	0.20
Corpus Christi	0.05	—	0.05
Total	5.8	3.9	9.7

Table 6.

Budget Model

"FUNDING THE STATEWIDE WHEAT/SMALL GRAINS STRATEGIC PLAN"

(Proposed Totals for FY2002 and FY2003)

Leg. Init. "WHEAT--A GOLDEN OPPORTUNITY" (2-yr Totals)

Strategic Plan Goals	%	Total for Legislative Initiative $	Centers of Excellence Concept: Ama/Bush and Vern/Chill.	Centers of Excellence Concept: Coll.Sta. and Dallas E. & S. TX	Flexible	Other New Funding for Small Grains: TAES	Other New Funding for Small Grains: TAEX	Other New Funding for Small Grains: Royalties	Other New Funding for Small Grains: Industry	TOTAL FUNDING $$
		$	$	$	$	$	$	$	$	
TAES Administrative Reserve, unassigned	20	560,000	0	0	560,000					
Goal 1. Breeding/Genetics	17.6	492,800								0
* Equipment/Infrastructure Items		180,000	120,000	60,000	0			160,000		340,000
* Base Allocation/Regional ++		252,800	168,000	84,800	0			0		252,800
* Competitive Grants		60,000	0	0	60,000			0		60,000
*Subtotal………………………………………		492,800	288,000	144,800	60,000			160,000		652,800
Goal 2. Mgmt/Cropping Systems)	22	616,000								0
* Equipment/Infrastructure Items		240,000	160,000	80,000	0			0		240,000
* Base Allocation/Regional		240,000	160,000	80,000	0			0		240,000
* Competitive Grants		136,000	0	0	136,000			0		136,000
*Subtotal………………………………………		616,000	320,000	160,000	136,000			0		616,000
Goal 3. Biotic/Abiotic Stresses	10	280,000								0
* Equipment/Infrastructure Items		72,000	36,000	36,000	0			0		72,000
* Base Allocation/Regional		136,000	68,000	68,000	0			0		136,000
* Competitive Grants		72,000	0	0	72,000			0		72,000
*Subtotal………………………………………		280,000	104,000	104,000	72,000			0		280,000
Goal 4. Quality/Marketability	11.2	313,600								0
* Equipment/Infrastructure Items		160,000	8,000	152,000	0			0		160,000
* Base Allocation/Regional		132,000	20,000	112,000	0			0		132,000
* Competitive Grants		21,600	0	0	21,600			0		21,600
*Subtotal………………………………………		313,600	28,000	264,000	21,600			0		313,600
Goal 5. Integrate Biotech w/Breeding	11.2	313,600								0
* Equipment/Infrastructure Items		121,800	45,000	76,800	0			0		121,800
* Base Allocation/Regional		121,800	45,000	76,800	0			0		121,800
* Competitive Grants		70,000	0	0	70,000			0		70,000
*Subtotal………………………………………		313,600	90,000	153,600	70,000			0		313,600
Goal 6. Tech Transfer/Info Dissem.	8	224,000								0
* Equipment/Infrastructure Items		112,000	56,000	56,000	0			0		112,000
* Base Allocation/Regional		72,000	36,000	36,000	0			0		72,000
* Competitive Grants		40,000	0	0	40,000			0		40,000
*Subtotal………………………………………		224,000	92,000	92,000	40,000			0		224,000
Total allocated/targeted funds =	80	2,240,000	922,000	918,400	399,600	0	0	160,000	0	2,400,000
Unallocated estimated funding =		0	0	0	0	100,000	50,000	0	200,000	350,000
Total, allocated + unallocated funds, 2-yr =		2,240,000	922,000	918,400	399,600	100,000	50,000	160,000	200,000	2,750,000
Summary, Wheat Initiative Funding:		2,800,000								
* Equipment/Infrastructure Items	31.64	885,800	425,000	460,800	0	0	0	0	0	885,800
* Base Allocation/Regional ++	34.09	954,600	497,000	457,600	0	0	0	0	0	954,600
* Competitive Grants	14.27	399,600	0	0	399,600	0	0	0	0	399,600
* TAES Administrative Reserve, unassigned	20	560,000			560,000					
*Subtotal………………………………………	100	2,800,000	922,000	918,400	959,600	0	0	0	0	2,800,000

++ Base Allocation includes: (a) critically needed support staff, in addition to present staff levels devoted to small grains; and (b) essential operating costs beyond present base levels.

Appendix 1

Survey Results of Equipment / Facility / Personnel Needs of the Statewide Small Grains Improvement Project 1999

System-Wide Present Status and Future Needs

Program	***Present Status***		***Future Needs***	
	TAMUS	Private	TAMUS	Private
Bushland/Amarillo	Bushland - 30 acre dryland; 20 acre irrigated	Washburn – 2 acre Stinnett – 1 acre	Bushland – 10 acre irrigated Etter – 20 acre (dry+irr)	? Location – 1 acre ? Location – 1 acre
Chillicothe/Vernon	Chillicothe – 75 acre Lockett – 25 acre (irr)	Location* 1 – 1 acre Location 2 – 1 acre Location 3 – 1 acre Location 4 – 1 acre Location 5 – 1 acre Location 6 – 1 acre	Chillicothe – 25 acre (irr)	
Prosper/Dallas	Prosper – 80 acre Dallas – 12 acre Beeville – 3 acre	Location 1 – 2 acre Location 2 – 2 acre Location 3 – 2 acre Location 4 – 2 acre	Dallas – 3 acre (irr)	? Location – 2 acre ? Location – 2 acre
Overton	Overton – 7 acre	Mt. Pleasant – 1 acre Dekalb – 1 acre		
College Station	CS – 15 acre McGregor – 20 acre Beaumont – 5 acre Temple – 10 acre Beeville – 10 acre	Brady – 3 acre Hondo – 3.5 acre	CS – 15 acre Temple – 3 acre	
Total	352 acre**	24.5 acre	56 acre	6 acre

*Location refers to producer-owned fields that change geographic locations from year to year.
**In a given year, approximately half of this figure (175 acre) is in small grains research, with the other half being fallow.

Field Equipment

David Worrall, TAES-Vernon

Description	*Age*	*Condition*
2 Hege Plot Combines	10 & 6	Good
3 Kubota Plot Tractors	5, 15, 25	Good
2 Vogel Threshers	15, 30	Only 1 functional
1 Gooseneck Trailer	23	Fair
1 Bumper-pull Trailer	10	Good
2 Kincaid Plot Drills	16, 23	Fair

1 H&N Planter	23	Fair
2 Vogel – Type Single Plant Threshers	18	Fair
1 Flail-type Forage Harvester	5	Good
2 Rotary Mowers for Alleys	2	Good
1 ¾ Ton Dodge Pickup	New	Excellent
1 1993 Suburban (130K miles)	5	Fair
1 Carter Dockage Tester	2	Good

Future needs:
Plot combine $ 70K
Plot Planter $ 30K
Gooseneck Trailer $12K
Dockage Tester $8K
Suburban $25K

Mark Lazar, TAES-Amarillo

Description	Age	Condition
1 Hege Plot Combine*	24	Fair
1 Wintersteiger Combine*	12	Fair
1 Kubota Plot Tractor	25	Good
2 Vogel Threshers	20, 30	Good
1 Kem 6-row cone planter	25	Fair
1 Kem 4-row cone planter, w/headrow dispenser	23	Fair
3 Pickup trucks*	New,11, 16	Excellent, Fair, Poor
1 small sedan*	14	Poor
1 Vogel – Type Single Plant Threshers	21	Good
1 Gas powered headrow thresher	16	Good
2 Disc plot markers	20, 25	Poor
1 5-section drag harrow	23	Good

*Total annual repair costs approximately $6,000

Other equipment used, but not owned by project
1 110 Hp Tractor
2 15-ft. sweep plows
1 Laser plane
2 Gooseneck utility trailers
1 Bumper-pull utility trailer
1 Front loader
1 One-ton truck w/gooseneck attachment
1 Irrigation-pipe trailer
1 Carter forage harvester
1 Dry fertilizer spreader
1 Anhydrous injector rig
1 Irrigation dike disc
1 5-foot flail mower
1 5-foot rotary shredder
1 spray rig
various plows

Immediate Future Needs:
One New Truck $20K
Plot Combine $65-100K
Protein Analyzer $5K
Single-row Binder $7K

Dave Marshall, TAES-Dallas

Description	*Age*	*Condition*
1 Small JD Tractor	7	Good
1 H&N Plot Planter	13	Fair
1 Hege Headrow Planter	12	Fair
1 Dodge Van	9	Fair
1 Chevy 0.5 ton pickup	5	Good
1 Spray Rig	2	Good
1 Trailer	10	Good
1 Hege 125C Combine	13	Fair
1 Wintersteiger Combine	9	Good
1 Vogel Thresher	50	Poor
2 Bundle Threshers	10 and 8	Good
1 FieldAir Compressor	2	Good
1 Grain Wagon	5	Fair
1 Alley Mower	10	Poor
1 Granular Fertilizer Applicator	5	Good
1 Rototiller	7	Poor

Immediate Future Needs

- Plot Combine - $70,000
- 0.75 ton pickup - $25,000
- Small Plot Tractor - $15,000

Allan Fritz, College Station

Description	*Age*	*Condition*
1 Hege 125B Plot Combine	11	Good (Technically still assigned to Vernon station)
1 Gooseneck Trailer	New	New
1 Hege Plot Drill	New	New
1 1999 Dodge ¾ ton Pickup truck	New	New
1 1985 Chevy Celebrity Station Wagon	14	Fair
1 Tractor-mount sprayer	New	New
1 bundle thresher		Good

Other field equipment needs and projected cost:

Description	Est. cost	Notes
1 small plot tractor	$14,000	Currently on order
1 fertilizer spreader	$2000	Currently use the oat project's spreader
1 small plot combine	$70,000	Need not immediate, but approaching
Alley cutter/mower		Currently use oat project's
storage for equipment	?	Currently a major problem

Milton McDaniel, College Station

Description	*Condition*
1 Hege 125C Plot Combine	Good
1 Gooseneck Trailer	Fair
1 Plot Drill	Fair
Round-up Alley Cutter	Good
Vicon Fertilizer Spreader	Good
1971 Tractor	Fair
1994 Kubota Tractor	Good
1982 Chevy ¾ ton truck	Poor
1991 GMC ¾ ton truck	Fair
1 Vogel thresher	Fair
1 bundle thresher	Fair

Lloyd Nelson, TAES-Overton

Description	*Age*	*Condition*
1 Hege Plot Combines	15	Poor
1 Bundle thresher	25	Poor
1 Plot Drill	15	Poor
1 half-ton Pickup truck	10	Poor
1 Fertilizer spreader	10	Good
1 Plot tractor	5	Good
1 Forage harvester	12	Good
1 Headrow planter	25	Poor
1 Spray rig	3	Good

Greenhouse & Growth Chamber Facilities (Present Status and Needs)

Mark Lazar, TAES-Amarillo

Two greenhouses are available, about 3,000 total sq. ft. of bench space w/ heat and evaporative cooling. These are each over 40 years old w/faulty wiring, inadequate lighting and small headhouse (about 750 sq. ft. total). Main headhouse in need of roof repair. Glass-doored double refrigerator in greenhouse is used for vernalization, in fair condition. 9 Growth Chambers are available, but only 5 functional. These are used for insect and disease screening, for cool-season simulation in summer and specialized lighting/temperature studies. Need space to locate these chambers (see greenhouse space below) and maintenance funding for them (about $3K per year). New facility needed w/sections for variable lighting and pest screening, space and electrical capacity in headhouse for growth chambers, soil sterilizer. Total cost $100K. We are currently raising private donations for this facility and have raised about 1/3 of the needed funds.

David Marshall, TAES – Dallas/Prosper

Presently have approximately 5,000 sq. ft. of greenhouse space that is heated well, but which has inadequate cooling. We have one dew deposition chamber for rust work. The chamber is 13 years old and in poor shape. A new dew deposition chamber is needed at an approximate cost of $35,000. Air conditioned greenhouse needed ~ $ 50,000.

Allan Fritz and M.E. McDaniel, Soil and Crop Sci. Dept., College Station

The greenhouse facilities are shared between the wheat and oat projects. We are currently vernalizing plants in Petri dishes in the refrigerator. New CBC growth chambers could be used in this capacity, but will have to be rented.

Facility	Area	Heating/Cooling or notes	Condition
2 Greenhouses	800 sq. ft each	reznor heaters/evaporative cooling pads	fair (cooling system is poor)
Headhouse	700 sq. ft.	shared	very poor
CBC greenhouses	available for rent	only one air cooled house/competition is intense for that space	

Needs include: Revamping of the cooling system--$4000. Head house facilities--Extensive remodeling or building would be required. No screening facilities available. For leaf rust screening, $2500, would provide minimally adequate set up.

David Worrall, TAES-Vernon

8,000 ft^2 of greenhouses – 17 years old – in good condition. Greenhouses have heat and evaporative cooling. Remodeled beer cooler is used for vernalization. Need 10 sheets of polycarbonate sheeting for $7500, new cooling pads $10K. Need vernalization chamber with lights, $25K.

Lloyd Nelson, TAES-Overton

We have good greenhouse facilities, although electronic controls are in need of maintenance and upgrading. Approximate cost, $ 3,000. Cold room for vernalization chamber is adequate. Incubation chamber for growing fungal cultures is in need of replacement, at a cost of $3,000. Growth chambers are adequate.

Seed Handling & Storage Facilities (Present Status & Needs)

Mark Lazar, TAES-Amarillo

Description	Age	Condition
2 Single Head Threshers	15 and 20	Good
2 Weighing Scales	15 and 20	Good
1 Seed counter	20	Fair
1 De-awner	20	Fair
2 Shaker Seed Cleaners	20	Good
1 Barcode Reader	New	New
2 Desktop Computers, 1 Laptop	Laptop new, 1 desktop newly renovated, second 6-yrs. old.	New, Semi-new, fair
1 10x8 Cold Room	25	Very Poor

We are currently moving from the two buildings used for this purpose, into a new seed processing and storage building that has been built, using mostly private funding, at a cost of about $225K. This building is to include a new cold room and 2 plant/seed drying rooms. One new computer is needed, as well as seed separators and a test weight analyzer. It is unlikely that all equipment needs can be met using the funds raised.

David Marshall, TAES-Dallas

Description	Age	Condition
3 Single Head Threshers	13, 12, and 8	Fair, Fair, and Good
3 Weighing Scales	13,10, and 5	Good
1 Test weight machine	40	Fair
1 Seed counter	10	Fair
3 Seed Distributors	13, 10, and 5	Good
2 De-awners	13 and 10	Fair
1 Shaker Seed Cleaner	9	Good
1 Barcode Reader	7	Good
1 Data Down-Link Computer	7	Fair
1 6x8 Cold Room	8	Good
1 Seed Treater	10	Fair

Allan Fritz, Soil and Crop Sci. Dept., College Station

Description	Condition
2 Single Head Threshers	Fair
2 Weighing Scales	Good
4 Computers	1 Poor, 3 Good
1 Seed distributor	Fair
2 Seed cleaners	

We currently have four individual rooms, each approximately 400 sq. ft. , for seed handling and processing, small equipment storage, technician office space and seed storage. The primary needs are long term seed storage (no cold storage available), a bar-code system and a test weight machine. We could use an additional single head thresher

Milton McDaniel, Soil and Crop Sci. Dept., College Station

1 deawner	Fair
1 Hege seed treater	Good
1 cryogenic freezer	Not functional
1 dryer	Good

David Worrall, TAES-Vernon

Have a 1500 ft^2 building for seed storage and processing at Chillicothe in good condition.
We have one barcode reader $700 – new, one electronic scale $3000 – being repaired and a Napco drying oven – good condition. We need a 750 ft^2 receiving room, as we have no space to clean seed, and an additional barcode reader and electronic scale. We have two walk-in cold chambers.

Lloyd Nelson, TAES-Overton

Description	Age	Condition
1 Gravity Table	10	Good
1 Incubation Chamber	12	Poor
1 Barcode Reader	5	Good

Seed Cleaners		Fair
Computer	3	Fair
Cold Room Space, 12x24	12	Fair

We need a new bar-code reader. Approximate cost would be $800. We do not have any seed treating equipment, and use laboratory or hoods for treating seed.

Laboratory & Office Facilities (Present Status & Needs)

Allan Fritz, Soil and Crop Sci. Dept., College Station

Have a 750 ft2 lab in the CBC, with access to various common use equipment (centrifuges, autoclave, etc) and services. We are generally in good shape here. We need to be set up for the use of radioisotope. It will cost about $1500 to get this done. There used to be a common use facility in the CBC, but user misuse cause the closure of that service. We could use additional staff office space, especially for field technician and for grad students. We can make technician an office at the seed lab and I believe we can find grad student desk space at the CBC.

David Worrall, TAES-Vernon

Have no current lab space. Project Leader has an office at Lockett. Technicians share an office at Lockett. If our RIF position is ever restored, the new employee will need an office and desk.

Mark Lazar, TAES-Amarillo

Have 1,500 sq. ft. in good condition, but located in Amarillo, not Bushland. Facilities are too small to accommodate more users, including graduate students. Ideally, the lab should be located closer to the greenhouses and other facilities, preferably at Bushland. New building would cost at least $350K. Some new equipment, such as a scintillation counter, is desirable. Project leader has an office at Amarillo, Research associate has an office at Bushland, shared by other technicians, Assistant Research Scientist offices in Amarillo, and Graduate students office in laboratory. We need grad student office space outside of lab. This may be accommodated by a center expansion that has been funded. New lab facilities at Bushland would require office space for project leader and Assistant Research Scientist.

Lloyd Nelson, TAES-Overton

Laboratory Facilities are adequate. Office facilities are adequate. Computer and data handling software is adequate.

David Marshall, TAES-Dallas

Presently have a 1,200 sq.ft lab which has inadequate heating and cooling. Need one microplate reader for the lab ($10,000). Presently have office space for project leader and assistant research scientist, but none for Technician. All together, there are 6 computer systems on the project, with 5 printers and one scanner. Computer equipment is upgraded about every three years at a cost of about $3,000 per upgrade.

APPENDIX II

FY 2002-03 Texas Agricultural Experiment Station Initiative

Wheat: A Golden Opportunity

The Texas wheat industry has a nearly $2 billion annual impact on the state's economy, with more than 6 million acres grown from from the High Plains to Central Texas. Texas leads the nation in producing dual-purpose wheat — that is, wheat that can be used as grain for human consumption and forage for livestock. But growing this type of wheat cost effectively is becoming harder to do because of droughts, insects, diseases, and late freezes. More resources are needed for Texas A&M research and education experts to develop hardier varieties and new management techniques to ensure a golden economic outlook for Texas wheat farmers and the rural communities in which they reside.

Partners

Texas Agricultural Experiment Station
•
Texas Agricultural Extension Service
•
West Texas A&M University
•
Texas A&M University - Commerce

USDA - Agricultural Research Service

Budget Requested

FY 2002: $1.4 million
FY 2003: $1.4 million

Texas Agricultural Experiment Station
The Texas A&M University System

Texas Wheat Farmers Face Unique Challenges

Because most Texas wheat farmers grow wheat for both grain and forage, they need solutions that only Texas-based research and education can address. Over the past couple of years, the state's wheat industry has suffered significant losses due to drought and other stresses, as well as ongoing low commodity prices.

This picture could have been more bleak, but thanks to Texas A&M and USDA research and extension efforts, the industry has seen these successes:

- Because pathogens and insect pests can adapt to resistant plant varieties, it's important to continually develop new varieties. Texas A&M's wheat breeding program has done this, recently developing the nation's first hard winter wheat variety resistant to three known biotypes of greenbug. The variety, TAM 110 is expected to save Texas producers up to $30 million annually, with as much as one-third of this savings due to reduced pesticide applications. In 2000, this breeding program released a hard winter wheat (TAM 302) resistant to leaf rust, powdery mildew, and barley yellow dwarf virus and out-yielded other varieties by up to nine bushels per acre. Other varietal releases are planned for the next two year.

- In 1990, Texas A&M scientists developed a program to help wheat farmers cost effectively control Russian wheat aphids. As a result, the use of insecticides in wheat farming has dropped 60 percent — a cost savings of $10 million to $15 million to the wheat industry.

New Wheat Varieties and Management Practices Key to Future Successes

The key to sustaining any agricultural industry is to continuously develop superior varieties, develop and implement sustainable and profitable production systems, rapidly transfer new technologies to the farm, and widen public understanding of agriculture's impact on the economy. With this blueprint in mind, Texas A&M and USDA experts plan to:

- Coordinate molecular biology and traditional breeding methods to develop superior single-and dual-purpose wheat varieties.

- Develop drought-tolerant wheat varieties with insect and disease resistance and higher yields of grain and forage.

- Create dual-purpose grazing management and cropping systems to maximize profits and sustain land and water resources through optimum combinations of grain and livestock production.

- Develop breeding and management practices for high levels of grain quality that satisfy specific markets and demand premium prices.

- Rapidly disseminate science-based information on wheat production, management, and marketing to help wheat producers maximize profits and help rural communities thrive.

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