

2003

National Land Grant Research and Extension Agenda for Agricultural Safety and Health

NCR-197 Committee on Agricultural Safety and Health Research and Extension

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National Land Grant Research and Extension Agenda for Agricultural Safety and Health

Abstract

In 2000, The North Central Regional Administrators (NCRA) approved the establishment of the NCR-197 Committee on Agricultural Safety and Health Research and Extension. The goal of the committee was to more effectively use the land grant system's research and extension capacity in cooperation with the expertise of those who live and work in agriculture to reduce work-related injuries, illness, death, and property loss. The committee's work was intended to develop a structure for gathering stakeholder input and identifying and coordinating priorities for the agricultural experiment stations and cooperative extension systems in areas such as:

- Improving sensors and systems for the detection of toxic atmospheres in confined spaces, human presence protection in hazardous locations, and guarding and shielding of agricultural equipment;
- Applying ergonomic approaches to the safe design of agricultural equipment, workplaces and hand tools to reduce cumulative trauma disorders caused by vibration, repetitive motion, and over exertion;
- Understanding developmental characteristics of children as applied to task selection, risk-taking, parental decision-making, and injuries;
- Developing appropriate large animal handling systems which minimize risk of injury to humans and animals;
- Reducing exposure to dusts, microtoxins, pesticides and other agricultural chemicals, noise, sun, and other environmental hazards that present an occupational health hazard in the agricultural workplace;
- Understanding the limiting economic and social factors that impact agricultural producer and worker risk-taking and decision-making; and
- Preparing for, responding to, and recovering from agricultural-related emergencies and disasters.

The committee was comprised of representatives from 18 land grant institutions, United States Department of Agriculture (USDA), and National Institute for Occupational Safety and Health (NIOSH). Over the course of two years, a set of specific committee objectives and corresponding action plans were developed using a consensus process. It was determined that the first objective to be undertaken would be to "Establish a national land grant research and extension agenda for agricultural safety and health." 23 Statement

Disciplines

Agriculture | Bioresource and Agricultural Engineering

National Agenda for Action

National Land Grant Research and Extension Agenda for Agricultural Safety and Health

2003

*Prepared by NCR-197
Committee on Agricultural
Safety and Health Research
and Extension*

Introduction

In 2000, The North Central Regional Administrators (NCRA) approved the establishment of the NCR-197 Committee on Agricultural Safety and Health Research and Extension. The goal of the committee was to more effectively use the land grant system's research and extension capacity in cooperation with the expertise of those who live and work in agriculture to reduce work-related injuries, illness, death, and property loss. The committee's work was intended to develop a structure for gathering stakeholder input and identifying and coordinating priorities for the agricultural experiment stations and cooperative extension systems in areas such as:

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The action plan for achieving this objective consisted of the following:

1. Design and implement a mechanism for stakeholder inputs to the national agenda.
2. Survey and assess national agricultural research and extension safety and health resource investments, staffing, projects, and programs.
3. Identify and articulate the highest priority agricultural research and extension needs that could be addressed by drawing upon the strengths of land grant institutions.
4. Develop and distribute study papers on high priority needs and opportunities.
5. Develop, publish, and disseminate a "National Agenda for Action."
6. Implement both technical and public reviews and assessments across the nation of the "National Agenda for Action."

A subcommittee of NCR-197 was selected and assigned the task of developing a draft of research and extension priorities. Members of the subcommittee were: Robert Aherin, Ph.D., professor, University of Illinois; Thomas Bean, Ed.D., professor, The Ohio State University; William Field, Ed.D., professor, Purdue University; and Dennis Murphy, Ph.D., professor, The Pennsylvania State University.

The subcommittee met at The Ohio State University on May 13-15, 2002, to initiate the process of developing a draft document. A series of three drafts were prepared and reviewed by the subcommittee with versions circulated to the full committee and selected administrators for review and comment. A second meeting of the subcommittee was held October 15-16, 2002, in Indianapolis, Indiana to address unresolved comments and issues related to the document. A revised version of the document was distributed to the full NCR-197 committee and reviewed at a meeting of the committee held in St. Louis, Missouri, November 6-7, 2002.

A draft of the document was circulated to all land grant institutions for review and comments from the experiment station directors. The final document, including the recommendations, was approved by the directors listed on the back cover of this booklet for distribution and implementation as resources allow.

Statement of the Problem

Agricultural production in the U.S. has been historically recognized as one of the most hazardous of all industrial categories (NSC, 2001). As most other industries have benefited from increased expectations from workers for enhanced workplace safety and expanded workplace safety regulations, farms and ranches have experienced little reduction in the rate of workplace deaths and injuries over the past decade. The fatality rate for agricultural workers is estimated to be six times higher than the average rate for all industries (22.5/100,000 vs. 3.8/100,000) (NSC, 2001). Currently an average of 740 people lose their lives and another 130,000 workers are temporarily or permanently disabled as the result of farm-and ranch-related injuries.

Approximately 75 percent of all farm-related fatalities involve tractors and machinery, with the single most significant cause of death being tractor overturns. The remaining workplace fatalities are distributed over a wide variety of causes ranging from livestock-related injuries to suffocation in flowing material. In addition, farm and ranch families are impacted by the increased hazards of rural transportation and the intersection of work, recreation, and home that results in broad exposure to workplace hazards that don't exist in most other industries

Non-fatal injuries, though not as well documented as fatal injuries, have both a significant economic and human effect on all those involved in agricultural production. There are an estimated 4-16 injuries per 100 workers annually based upon the statistical source being referenced (NSC, NIOSH, BLS, 2001). Non-fatal injuries can, however, be the most economically devastating to the farm or ranch business due to the long-term costs associated with medical care and rehabilitatio

Work-related illnesses are the least understood component of the agricultural safety and health problem. Since most farmers, ranchers, and agricultural workers are not covered by worker compensation programs or not required to report injuries or illnesses to Occupational Safety and Health Administration (OSHA, 2001), there is little data to estimate the economic losses associated with workplace illnesses. This would include loss of hearing, musculoskeletal disorders, respiratory diseases, skin disease, infections, and work-related cancers caused by exposure to workplace hazards.

Property losses due to fires, storm damage, chemical spills, contamination of ground water, and vandalism are also significant within the agricultural community. These losses impact profitability, public image of producers, and the quality of life for both producers and rural residents. From an economic perspective, fires remain the most costly of farm-related disasters.

Even conservative estimates of the cost of farm-related fatalities, injuries, and disease suggests that the agricultural safety and health problem is a \$4.5 billion issue (NSC, 2001) with substantial potential for large returns on investments made to reduce or eliminate the losses. These returns on intervention investments have been well documented in other industries and could be realized in agriculture if implemented. The land grant system is in an ideal position to provide effective stewardship of these investments to ensure the greatest returns possible.

Identification of research and extension needs relating to the safety and health of farmers, ranchers, and agricultural workers is not a new undertaking. One of the best early benchmarks involving agricultural safety and health research needs was the 1972 American Society of Agricultural Engineers Safety Research Needs Survey. Over 30 years ago, the American Society of Agricultural Engineers (ASAE) solicited input from professionals working in agricultural safety and health, equipment manufacturers, and groups such as National Institute for Farm Safety, Inc. (NIFS), the Farm Equipment Institute (FEI), the National Safety Council (NSC), and the USDA to identify the most pressing research needs. The activity resulted in establishing a goal of reducing agricultural fatalities by 50% during the 1970s. The report identified 22 broad areas needing additional research and provided specific research questions that needed attention.

In 1980, ASAE undertook a follow-up initiative to assess progress towards meeting the safety research goals established in 1972 and to develop a strategic plan for the 1980s. Three workgroups were established and broad research needs were identified. The results were published in a special report entitled *Engineering A Safer Food Machine* (ASAE, 1980). The final report, however, did not provide a clearly defined set of unmet or future research needs.

The National Committee on Agricultural Safety and Health (NCASH), an ad hoc self-appointed research group, coordinated an effort that produced, *Agriculture At Risk: A Report to the Nation – Agricultural Occupational and Environmental Health: Policy Strategies for the Future* (Merchant et al., 1989). This report summarized a conference and related activities held in 1988 to explore agricultural safety and health issues and develop public policy strategies. Specific problems were identified along with agencies considered best positioned to facilitate potential solutions. There was little mention of the potential role of land grant institutions in addressing the problems identified. The influence of this effort on the U.S. Congress resulted in a new funding stream for agricultural safety and health research through the National Institute for Occupational Safety and Health (NIOSH), the U.S. Department of Health and Human Services agency responsible for occupational safety and health research. This was a significant shift away from the land grant system, the historical home for publicly supported agricultural safety research and education efforts.

Over the years, other organizations and governmental agencies have also developed agricultural safety and health

research agendas and priorities as a means of focusing limited resources. Some of these efforts were organizational specific, such as those formulated by NSC and NIFS. Other efforts have been broader and overlapping, allowing for topics to be identified by multiple stakeholders. This included, for example, the need for health care research related to migrant and seasonal farm workers identified by USDA, the U.S. Public Health Service (PHS), the U.S. Environmental Protection Agency (EPA), and United Farmers Workers (UFW).

The land grant institutions are well positioned to provide much of the research expertise and means to effectively address agricultural safety and health issues at all levels of the agricultural industry. The land grant system possesses unique expertise particularly in areas such as engineering, control of environmental containments, animal handling, agricultural chemicals, and evaluation of agricultural-related educational programs. This coupled with the fact that extension services provide the most comprehensive public agricultural education system in the country, places these groups in a prominent position to have a major impact on injury and illness risk reduction in agriculture.

Procedures

The strategy adopted by the NCR-197 subcommittee to accomplish its task of developing research and extension priorities was to: (a) build upon the earlier efforts of organizations and agencies in identifying and establishing research agendas and priorities; (b) consider contemporary concerns and issues; and (c) develop a new research and extension agenda that articulated the highest priorities, drawing on the historical strengths of the land grant system. Consideration was also given to the substantial amount of NIOSH sponsored research and engagement activities in the field of agricultural safety and health and the need to compliment rather than duplicate these on-going efforts.

The first step of the NCR-197 subcommittee was to complete a review of prior research agendas and priorities in order to establish a benchmark and to identify needs that had not been addressed. Documents prepared by ASAE, NIFS, NSC, NIOSH, and NCASH were summarized, focusing on what each group or document reported concerning future research needs. The summary was

distributed to the entire NCR-197 committee for review and comment. A list of relevant on-going research sponsored by NIOSH was also compiled as a means of gaining insight into present-day NIOSH priorities for agricultural safety and health research.

The subcommittee then met on two occasions to categorize and prioritize the topic areas identified by the various stakeholders and explore contemporary and future issues that will require attention. The subcommittee began with a list of research priorities identified by the full NCR-197 committee at a prior meeting. An expert panel approach was used to first categorize the dozens of identified research needs into manageable groupings. Terminology was refined and the individual categories of research needs prioritized. The process included voting by the members of the subcommittee to categorize critical topic areas and to rank them. A ballot was developed and used in the voting process that included five criteria which were evaluated on a scale of 1 to 7. The criteria used were:

- Potential for future funding.

- Potential for significant impact (short term results 5 years or less, reduction of high incident rates).
- Has significant future relevance.
- Research is not being duplicated elsewhere.
- Transferability/broad application of research results.

The ballot was also used to rank each of the broader research areas identified by the subcommittee. The scores were tabulated and averaged using all of the individual scores and then again without the high and low scores. The two scoring methods showed little difference in the final rankings. The subcommittee then refined, combined, and rearranged the more specific research topics under each of the broad research areas. This process resulted in 12 priority research areas with 115 individual research topics.

Drafts of the research and extension agenda based upon the prioritized research topics was prepared and circulated to the full NCR-197 committee for comment. It was also distributed to selected land grant administrators for comments. Follow-up meetings of the subcommittee and full committee were held to resolve comments and concerns. The following section summarizes the research and extension priorities developed through this process.

The following prioritized list of research and extension areas, as ranked by the subcommittee and approved by the full committee, includes a brief narrative of the problem and an alphabetized listing of potential research topics that fall within the prioritized areas.

The research and extension priorities are not intended to be all inclusive of every potentially significant topic that could be addressed by the land grant system. Nor should the list of topics be used to restrict ongoing or future research and extension initiatives of individual land grant institutions and their staffs. The list does, however, reflect an effort to identify broad areas of needed research and a modest attempt to prioritize them. It is recognized that additional topics may surface due to the introduction of new production and processing practices and pressure from public opinion.

1. Sensors and guarding systems

Injuries and fatalities associated with tractor overturns, machinery and equipment entanglements, and exposure to toxic environments account for the largest proportion of

documented cases. The expanded use of sensors, including sensors incorporated into enhanced guarding systems, could play an important future role in reducing injury rates. There have been significant advancements in recent years in sensor technology applicable to agricultural settings, and land grant institutions have been at the forefront of this technology transfer. Additional research is needed on how sensor technology could be applied to specific agricultural workplace hazards as a means of identifying, monitoring, and providing adequate warnings about specific hazards. In addition, research is needed on developing alternative guarding systems that provide more effective operator protection and are sustainable under harsh environmental conditions. Specific research and extension topic areas that may be included in this priority area are:

- Enhanced rollover protection systems
- Equipment stability indicators
- Human presence detection
- Interlock and lockout systems
- Machine guarding characteristics
- Machine guarding standards
- Toxic environment monitors
- Use of global-positioning systems (GPS) for worker location

2. Operating agricultural equipment on public roads

The rapid urbanization of traditional agricultural production areas has led to a substantial increase in the mix of agricultural equipment and licensed motor vehicles on public roads. With the expanded use of heavier, wider, and higher speed equipment, the potential for more serious public road crashes increases. Research is needed on the broad array of issues relating to this problem including:

- High-speed agricultural vehicles (marking, braking, controls)
- Licensing of operators (age, skill level)
- Lighting and marking of agricultural equipment
- Motor/agricultural vehicle operator training
- Operational procedures (nighttime travel)
- Rural road design (bridges, signs, lighting)
- Specialized vehicles (all-terrain vehicles, snow-mobiles, horse drawn buggies)
- Transporting hazardous material (NH₃, pesticides, fuel)
- Use of sensors and enhanced vision systems

3. Agricultural confined spaces

Agricultural production units continue to increase in size, scale, and specificity of enterprises, and there has been a corresponding increase in the number and size of confined spaces found with these operations. These include crop storage structures, manure storage and handling facilities, and bulk chemical and fuel storage containers. The likelihood that eventually all agricultural confined spaces will be regulated, as those in industrial workplaces are currently, further supports the need for research and extension efforts on topics such as:

- Confined space rescue procedures
- Economic impact of confined space entry regulations on agricultural producers
- Facility design for minimal entry
- Fall protection systems
 - Fires and explosions
 - Practices that minimize toxic gas production
 - Safe entry procedures
 - Toxic gas monitoring and warning systems
 - Ventilation systems

4. Emerging technologies

Technology has contributed significantly to improving the safety and health of agricultural workers through reduced exposure to recognized risks and enhanced worker comfort. Agricultural production methods and processes will continue to change and adapt as new technology is introduced. This technology will not only enhance productivity and efficiency, but may also introduce new hazards that will need to be addressed. Research topics that focus on both the attributes and harmful effects of the technology may include:

- Automatic steering, auto pilot, and computer operated processing equipment
- Bio-sensors
- Exposure to high-pressure hydraulic systems
- Exposure to genetically modified organisms (GMOs)
- High-speed equipment (vibration, jarring, reaction time)
- Irradiation of food
- Land application of sludge
- Managing safety in on-farm, value-added processing operations
- Operatorless/remote control tractors and machinery
- Power transmission lines and communication towers (exposure to EMF, RF)

- Using GMOs to develop safer production methods
- Using GPS to monitor worker activities

5. Human factors engineering and design

The standard for acceptable work practices with respect to safety, health, and comfort continues to be raised. Workers have higher expectations for safety and health and are less willing to perform jobs that are painful, stressful, noisy, or make them uncomfortable. Recently enacted regulations have also placed greater demands on employers to protect their workers from the harmful effects of work. Smaller agricultural workplaces may eventually be covered by these regulations and all agricultural workplaces will have to become more sensitive to worker production if they are to recruit and maintain a stable workforce. Potential research areas that need further attention include:

- Accommodating disabilities in the workplace
- Anthropometric data for agricultural tasks
- Controls and control layout
- Developmental-and age-related issues (child, elderly)
- Gender issues
- Guarding design
- Effects of long-term exposure to vibration, noise, sun, dust, etc.
- Human behavior (risk perception and acceptance)
- Lifting and back protection
- Musculoskeletal disorders
- Prevention of secondary injuries
- Operator warnings/instructions (literacy, clarity, language)
- Shift work
- Stress and behavior management
- Walking and working surfaces

6. Management of agricultural emergencies

Land grant institutions have historically taken a lead role in the development of resources and facilitation of training for emergency preparedness in rural communities. Even with the recent development of strong local emergency management agencies in most rural communities, extension has continued to be a key source of information, networking, and training related to agricultural-related injuries and emergencies, catastrophic events caused by severe weather and the potential for nuclear, chemical, or biological disaster. The events of September 11, 2001, have caused the land grant system to further explore the contributions it could make to enhanced preparedness and

appropriate responses in the event of catastrophic activities. Research areas needing further attention include:

- Decontamination processes
- Enhanced systems of rural communication
- Identification of vulnerability to bio-terrorism within agricultural production
- Impacts of disasters on livestock
- Preparation for severe weather
- Responding to agro-terrorism
- Responding to chemical spills
- Responding to farm-related entrapments and entanglements
- Rural fire prevention and response (structures, machinery, woodlands)
- Sustaining rural emergency response capability

7. Livestock handling and housing systems

Livestock remains an essential component of agricultural production. Researchers presently know considerably more about the impact of production practices on livestock than is known about the impact these practices have on workers. As livestock operations become larger, more concentrated, less diversified, and more animal specific, additional research will be needed to ensure that both the production processes and facilities are safe and healthy for both workers and livestock. This includes exploration of:

- Enhanced ventilation systems/air quality
- Fire detection and suppression
- Human/animal behavior
- Livestock handling equipment
- Personal protective devices
- Sanitation
- Working surfaces
- Zoonotic diseases/long-term exposure

8. Public policy issues

Public policy on agricultural worker safety and health has led to the majority of farms in the U.S. not being covered by regulations that apply to most other workplaces. As this public policy is revisited, especially for youth and uninsured farm workers, and agricultural production units become larger and employ larger numbers of workers, attention needs to be given to how new public policy will impact agriculture. This includes:

- Economics of safety (cheap food policy)
- Funding of safety initiatives

- Impact of increased enforcement of occupational safety and health regulations
- Liability issues (statute of limitations)
- Licensing for particular practices (machinery operation, chemical and manure application and storage)
- Risk acceptance/role of family
- Role of family members as employees
- Rural/urban interface issues (pesticides, water quality, public roadways, noise, dust)
- Worker compensation benefits

9. Capital and management intensive vs. family labor intensive operations

The rapidly growing dichotomy between the traditional family farm where labor is supplied largely by family members, and industrialized operations where labor is supplied largely by a hired workforce, has generated a need for customized research and delivery mechanisms for agricultural safety and health information and training. Land grant institutions can provide a unique pathway to deliver research-based resources that meet the needs of both types of clientele. Exploration is needed, however, to identify and use the criteria for selecting the most appropriate delivery tools and ensuring that the right information is being disseminated. Areas needing more research include:

- Computer-based vs. traditional forms of instruction
- Design of small-scale equipment
- Effective channels of delivery for target audiences
- Impact of legislative exemptions on application of OSHA standards
- Long-term effects of safety management practices on profitability
- Risks associated with sustainable agriculture
- Seasonal and migrant labor issues
- Upgrading older equipment to current safety standards
- Worker health care and disability benefits

10. Fire detection and suppression

Fire losses in agriculture are significant due to type of construction, presence of valuable livestock, minimal fire prevention standards, and isolation from fire protection services. Long delays in detection of fires and lack of cost-effective extinguishing systems commonly found in industrial settings often result in total structure losses. In addition to the potential for loss of life and injuries, fire can result in the loss of structures, crops, livestock,

machinery, and supplies that may have a serious, negative psychological and economic impact on the producer. In many cases, the losses are not well insured with little or no potential for recovery. Areas that need additional research include:

- Chemical storage fires and cleanup
- Crop storage fires
- Electrical standards (National Fire Protection Association, local codes)
- Emergency communication systems
- Extinguishing agents appropriate for agricultural settings
- Fire detection and monitoring systems
- Fire suppression systems for buildings and machinery
- Machinery and equipment fires
- Safer fuel storage and handling procedures
- Training of rural firefighters

11. Agricultural safety education and training

Land grant institutions have been the primary provider and facilitator of safety and health education and training for agricultural producers, families and employees. This experience, along with its nationwide network of county-level extension educators, is the most effective mechanism available for delivery of research-based information and training on preventing agricultural workplace-related injuries and illnesses. Land grant institutions are also well equipped to provide on-going evaluation of safety and health education programs, delivery strategies, impacts and outcomes, and to train future agricultural safety and health professionals.

Potential future research topics include:

- Developing more effective operator manuals and instructions
- Development and testing of risk assessment tools
- Development of agricultural equipment operator testing strategies

- Evaluating effectiveness of unique safety education and training curriculum (literacy, cultural acceptance, clarity)
- Evaluation of teaching methodologies
- Evaluation of the use of graphics and pictorials to communicate worker instructions and warnings
- Evaluation of computer-based and Web-based (broadband Internet access) delivery formats
- Meeting mandatory training and certification requirements
- Meeting the needs of special populations

12. Special populations and enterprises

Agricultural production workers have become much more diverse with respect to their educational, cultural, and ethnic backgrounds. A single approach is no longer suitable to meet the workplace safety and health needs of every group, especially for those individuals who are required to meet certification and licensing requirements. The land grant system has been in the process of retooling itself to be more responsive to the unique needs of the increasingly diverse workforce and to ensure full access to resources. To ensure that this trend continues, additional research is needed in areas such as:

- Development and testing of culturally sensitive safety and health resources for groups such as Latinos and the Old-Order Anabaptists (Amish, Mennonite, Hutterites)
- Effects of aging on agricultural workplace safety
- Gender influences on worker safety
- Hazards of logging, fishing, specialty crops, and exotics
- Injuries to children and youth
- Low literacy issues
- Secondary injuries to persons with disabilities
- Unique safety and health needs of those in transition from migrant to permanent agricultural employment

Recommendations

In order to fully use the outcomes of this process of developing a national land grant research and extension agenda for agricultural safety and health, the NCR-197 Committee recommends the following actions to be taken:

1. NCR administrators should adopt the agricultural safety and health research and extension priorities as proposed by NCR-197 and facilitate implementation throughout the land grant system.
2. Through broad distribution of this research and extension agenda, NCR-197 should attempt to increase the awareness of faculty and administrators of all land grant institutions concerning potential opportunities for research and extension activities relating to agricultural safety and health.
3. Land grant administrators should encourage the incorporation of agricultural safety and health research priorities within the USDA national research and extension agendas.
4. Incentives should be established for multi-institutional research and extension efforts to better use the existing strengths of the land grant system in more effectively addressing agricultural safety and health priorities.
5. Establish incentives within land grant institutions to encourage multi-disciplinary research and extension efforts to address statewide and regional agricultural safety and health priorities.
6. Land grant administrators need to encourage and support agricultural safety and health programs that reflect all three mission areas of their institutions: research, teaching, and extension.
7. USDA should provide within the Challenge Grants Program opportunities for the development, enhancement, and delivery of appropriate agricultural safety and health courses at both undergraduate and graduate levels.
8. USDA should establish a competitive research grants program for addressing agricultural safety and health priorities with a minimum of \$15 million of annual funding.
9. USDA should increase the extension competitive grants program for agricultural safety and health to \$15 million annually.

List of NCT-177/NCR-197 Committee Members

Participants	Institution	Area
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Keith Tinsey, M.Sc. ¹	Michigan State University	Agricultural Safety
Dale Vanderholm, Ph.D. ^{3**}	University of Nebraska-Lincoln	Administrative Advisor
Michael F. Walter, Ph.D. ³	Cornell University	Animal and Human Physiology

¹ Member of NCR 197 Committee, Agriculture Safety and Health Research and Extension (www.tnvc.iastate.edu/NCR197/)

² Member of NCT 177 Committee, NCT 177 Committee was established by North Central Region to prepare justification and a proposal for the information of the current NCR 197 Committee. This committee formed in 1999 and its membership was moved to NCR 197 in 2000.

³ Member of both NCR 197 Agriculture Safety and Health Research Committee and Extension and NCT 177 Agriculture Safety Research

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Approving Institutions as of 4/10/02
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The Pennsylvania State University
University of Nebraska - Lincoln
Purdue University
University of Missouri
University of Minnesota

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... and justice for all

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