NIOSH AGRICULTURAL CENTERS

ANNUAL REPORT

FISCAL YEAR 2005*

(*October, 2004 to September 30, 2005)

STATE

Colorado

CENTER NAME

High Plains Center for Agricultural Health and Safety

I. INTRODUCTION & EXECUTIVE SUMMARY OF THE PROGRAM

[Open to the Center for comment on the past fiscal year.]

HICAHS continued with a very productive second year of this three year funding cycle. Even though the starting date for the initial year was September 15, 2003, funds were not received from CDC/NIOSH until November 19, 2003. These initial funds were for the Administrative Core and only projects that did not include Human Subjects. Final release of funds for research projects involving human subjects occurred on March 3, 2004. The large number of projects involving human subjects and the need to secure IRB approval from many collaborating institutions contributed to this delay. Although the delay in funding inhibited hiring of staff and project implementation, we have been able to keep most projects on schedule. We have engaged a wide network of partners throughout Region VIII and nationally to collaborate on the research, intervention, education and outreach activities funded. New partnerships with agricultural producer organizations and workers compensation insurance carriers have been particularly exciting, with HICAHS serving to connect these groups. In addition HICAHS has played a lead role in a number of important national initiatives, including the National Agricultural Tractor Safety Initiative. We are now continuing to build and foster partnerships, emphasizing Tribal Nations this year, and look forward to an eventful third year of this project.

A. CENTER ACCOMPLISHMENTS FOR FY 2005

[This would include approximately 3 to 8 of the Center's major accomplishments for FY 2005.]

1. **National Tractor Safety Initiative.** Dr. Reynolds led the development of a grant proposal to NIOSH involving collaboration of all of the NIOSH Agricultural Centers to fund a National Agricultural Tractor Safety Initiative. The project was awarded by NIOSH in September 2005 and in addition to the Lead Center (HICAHS) includes projects on: Costs of Tractor Operator Injuries from Overturns and Highway Collisions; Impact of Changes in ROPS Standards, Regulations, and Technology on Future Tractor ROPS availability; Documentation of Acceptability and Procedures for Financial Incentives for Rollover Protective Structures (ROPS) Retrofitting; Designing Community-Based Social Marketing Programs for Tractor Safety. An important component of this project is engagement of key community partners.

2. Regionalization Project

Our established regional partners include the following Extension programs: Colorado State University Extension, Utah State University Extension, Montana State University Extension, South Dakota State University Extension, North Dakota State University Extension, and University of Wyoming Extension. Each Extension program was eligible to receive up to $4,000 in seed money from HICAHS to develop and conduct health and safety projects in their respective region. The regional Cooperative Extension specialists and other agricultural stakeholders also provide a key route of dissemination of HICAHS educational materials such as articles and fact sheets. The projects conducted by the Regional Extension offices included enhancement of a Youth Farm Safety operator certification curriculum, hearing conservation education, conducting tractor safety school programs, improved methods to control dust exposures in livestock areas, and ATV safety courses to Native Americans.

3. Endotoxin Exposure and Genetic Factors in Organic Dust Lung Disease Research questionnaires developed for this project (in English and Spanish) were shared with the Western Center for Agricultural Health and Safety and with the Southwest Center for Agricultural Health, Injury Prevention, and Education. Dr. Reynolds consulted with both centers on research protocols and HICAHS provided endotoxin analysis of samples for pilot studies in California.

4. Children's Supplement
Supplement funds were received in Year 02 to enhance R2P activities related to children in two specific areas. A portion of these funds are being used to expand the development and testing of the 4-H CD curriculum for grade school age children. These funds allow us to include a third state, Montana, in the development and testing phase. The product will be an interactive CD-based curriculum for children. Funds also allowed us to work on creating a "Children's Corner" on our website. The products will include downloadable information sheets based on the 4H and the High School curricula projects.

5. Development of Novel Biomarkers for Pesticides in EPA Region VIII
We have developed novel analytical methods in blood, brain and urine for atrazine and its three chlorinated metabolites. All methods involve either liquid/liquid extraction or mixed mode cation exchange solid phase cleanup. Based on current limits of detection for atrazine and its chlorinated metabolites in each matrix, we anticipate considerable improvements in limits of quantitation after integration of a stable isotope of atrazine as internal standard

6. ROPS Design and Testing for Agricultural Vehicles
The results of the tests (described below) have been reported to the ROPS manufacturing industry as described in the presentations and meetings listed in Section F. Five presentations, three committee reports and a Webinar were presented this past year. To date, no known front drive mower ROPS has been designed using the original ASAE S547 continuous roll model. Companies present at meetings include: Deere and Co., CNH, AGCO, Toro, Kuboto, AEM, FEMCO, Woods Equipment, Grasshopper, Excel Industries, Weasler Engineering, Scag Power Equipment, Exmark Mfg., Custom Products

of Litchfield, Full Vision, Inc., Moridge Manufacturing, MTD, Hustler.

A website describing 1) the test slope construction details for the S547 lateral field upset test, 2) the existing ASAE S547 continuous roll prediction model, 3) the modifications made in the model, 3) test results and 4) a location to download the revised model. The website is at the HICAHS Agricultural Center website - http://www.hicahs.colostate.edu/rops_design.asp.

The initial draft of the ROPS design engineering booklet has been developed. The sections include 1) description of the original ASAE S547 lateral upset test and limitations, 2) lateral upset test site construction, 3) description of critical ROPS height, 4) model modifications, and 5) model validation. An internal review has been conducted on the booklet material.

The revised continuous roll model is currently in Matlab code. Modifications are underway to provide user input of mower dimensions. Also, an executable version is being developed.

B. REGIONAL ACTIVITIES

1. **States Served by Center:** Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

2. **States with Center Activity for FY 2005:** California, Colorado, Florida, Georgia, Hawaii, Iowa, Kentucky, Minnesota, Montana, Nebraska, Nevada, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, Wyoming; the countries of Mexico, Canada, and other international contacts.

II. REPORT ON THE OUTREACH PROGRAM

HICAHS did not receive funding for Outreach activities in this first year, other than for the project “Regionalization “ which is described below as part of the Outreach and Education Core. Funds targeted for Outreach were received for Year 02. These funds were used to develop materials such as “barn door fliers” requested by Cooperative Extension and for outreach collaboration with producer organizations, for updating and maintaining the HICAHS Website and Newsletter for information dissemination, and for travel to participate in regional agricultural meetings (e.g. presentations at Colorado Livestock Association meeting, demonstration and booth at Farm Safety Day Camp). Particular effort went into expanding partnerships with organizations such as Agribility, producer organizations, and Tribal Nations (Colleges, Associations).

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Administrative Core

1. PROJECT OFFICER(s)

Stephen J. Reynolds, Ph.D., CIH – Center Director
Environmental & Radiological Health Sciences
1681 Campus Delivery
Colorado State University
Fort Collins, CO 80523
(970) 491-3141
stephen.reynolds@colostate.edu

Victoria Buchan, Ph.D. – Center Deputy Director

Dennis Lamm, Ph.D. – Extension Education and Co-Director for Outreach/Education Core

John Rosecrance, Ph.D., PE, - Intervention/Prevention Core Director and Outreach/Education Core Co-Director

John Tessari, Ph.D. – Research Core Director

2. PROJECT DESCRIPTION

The Specific Aims of the Administrative Core are to:

1. Provide Center Administration and Leadership.
2. Provide coordination of research, outreach, and prevention activities within the Center, with other related programs at Colorado State University, with other NIOSH Agricultural Health and Safety Centers, and with other US and international colleagues active in agricultural health and safety.
3. Utilize a strategic plan to guide the Center's development and growth.
4. Conduct evaluation (internal) of Center progress and products.
5. Provide professional education and/or training related to agricultural health and safety.

The Center is governed by the Administrative and Planning Core through an Internal Advisory Committee that is composed of the Center Director (Steve Reynolds), Center Deputy Director (Vicky Buchan), the Directors of the Prevention/Intervention (John Rosecrance), Education and Outreach (Rosecrance and Lamm), Multidisciplinary Research Cores (John Tessari), the Director of the Master of Agriculture Program in Extension Education (Dennis Lamm), and the Administrative Assistant (Angi Buchanan). The Regional Advisory Committee represents a

broad constituency including: scientists, agricultural producers, Farm Bureau, health and veterinary care providers, church, agricultural business, migrant advocates, Cooperative Extension, and government. A list of Advisory Board members is included below under collaborators. In addition to building an infrastructure for collaborations, these advisors provide critical consultation on the needs of constituents and potential mechanisms for meeting those needs.

3. PROJECT START AND END DATES

September 15, 2003 to September 14, 2006

4. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Funds for this project were released from CDC/NIOSH on November 19, 2003. Even with the delay in funding, the project is on schedule. Activities and results are described for each specific aim, relative to objectives laid out in the grant proposal.

1. **HICAHS Center Leadership**

The Internal Advisory Committee meets at least monthly to coordinate projects within the Center and between the Center and other organizations/programs. All of the members proposed for the External Regional Advisory Board have continued to participate. The External Regional Advisory Board met in person on November 17, 2004, and has communicated by email and telephone approximately quarterly since then. An external Scientific Advisory Board was proposed to be developed in Year 01 – since our Regional Advisory Board does contain a number of prominent Scientists this was not developed further as a separate entity.

2. **Coordination of Research, Outreach, Prevention**

Dr. Reynolds led the development of a grant proposal to NIOSH involving collaboration of all of the NIOSH Agricultural Centers to fund a National Agricultural Tractor Safety Initiative. The project was awarded by NIOSH in September 2005 and in addition to the Lead Center (HICAHS) includes projects on: Costs of Tractor Operator Injuries from Overturns and Highway Collisions; Impact of Changes in ROPS Standards, Regulations, and Technology on Future Tractor ROPS availability; Documentation of Acceptability and Procedures for Financial Incentives for Rollover Protective Structures (ROPS) Retrofitting; Designing Community-Based Social Marketing Programs for Tractor Safety. An important component of this project is engagement of key community partners. Dr. Reynolds was invited to talk about this initiative at the 2005 CDC National Injury Prevention and Control Conference, May 19, Denver, CO.

HICAHS personnel and students have participated in seminars in various departments and Centers at CSU to foster interactions. Dr. Reynolds made invited presentations at the American Industrial Hygiene Conference and Exhibition in Los Angeles, CA, at the University of Wyoming, and for the NIOSH Agricultural Centers Webinar Series.

Requests for Proposals for Feasibility Projects were distributed via the External Regional Advisory Board, to Health Departments, migrant health organizations, academic institutions and other organizations in Region VIII. Four awards were made in FY 2005 (see below). As described in the Outreach section, HICAHS has also worked specifically with the Extension Safety specialists in each state to develop additional targeted Feasibility projects.

The section on **Regionalization** also describes in more detail the significant expansion of our partnerships this past year.

3. Strategic Plan

The HICAHS Regional Advisory meeting on November 17, 2005 focused on setting priorities and strategic planning. The Administrative Core continues to work with the Regional Advisors on updating and implementing strategic plans.

4. HICAHS Center Evaluation

Center Program Monitoring

Center evaluation includes both an overall Center ACCESS Database that documents the activities and products of Center Investigators and personnel; and individual project evaluations documenting completion of project objectives as reported by Center investigators in year end reports. In the last fiscal year, HICAHS personnel have had over 100,000 contacts in 24 states and Mexico. Table 1 below, illustrates the contact counts by type of activity. The majority, of course, is distribution of materials such as HICAHS articles in the All Agricultural Center Newsletter, and materials developed for distribution in PHS Region VIII. Center personnel have both attended and presented at a number of Professional conferences, in addition to arranging workshops and exhibits.

Table 1: Counts by Activity

ACTIVITY TYPE	CONTACT COUNTS
Material distribution	100548
Resource cultivation	16520
Professional presentation	1786
Workshop-arrange/attend/present	1160
Conference-Arrange or present	273
Material development	254
Consultations	171
Conference-Attend	171
Exhibit	135
Project development/planning	99
Data collection	82
Academic lecture / education	64
Testing/screening	44
Response to stakeholder	4
Media interview	2

Table 2 below, provides an overview of the number and types of Center projects that have resulted in moving from research to practice (r2p). We are pleased to see that multiple categories within the r2p definition have been addressed this year. The Center has been working on approaches to improve surveillance with migrant farm workers; a project that will benefit future researchers as well as hopefully the farm workers in developing more targeted projects. The Regional Cooperative Extension Project is an extremely beneficial method to disseminate the results of research and publications, as an already existing network is in place that can quickly and efficiently move information to our target population, those involved in agricultural production.

Table 2: Research 2 Practice

	PROJECT TITLE	CATEGORIES OF R2P
1	Endotoxin and Genetics in Organic Dust Lung Disease	Research to Research
2	Ag Health and Safety Curriculum Evaluation	Research to Evaluation
3	Professional Education	Research to Academia
4	Theses/Dissertations	Research to Academia
5	Previous Publications	Research to Academia
6	ROPS Design and Testing for Tractors and other Agricultural Vehicles	Research to Research
7	Regional Cooperative Extension Project	Research to Intervention and Education
8	Develop Biomarkers for Pesticides in EPA Region VIII	Research to Research
9	Improving Injury Information for Migrant Farmworkers	Research to Surveillance and Intervention
10	Reduction of Exposures from Dairies and Cattle Feedlots	Research to Surveillance and Intervention
11	Ag Center Tractor Initiative	Research to Policy
12	Evaluation of a Bacteriophage Cocktail to Reduce Escherichia coli 0157:H7 Shedding in Beef Cattle	Research to Research

Administrative Core Objectives:

The Administrative Core objectives included five major categories including: administration & leadership, coordination of activities, utilization of a strategic plan, center evaluation and professional education and training. Table 3 below lists the

objectives and sub objectives and a checklist of accomplishments during the last fiscal year.

1.1 Prepare annual Center reports regarding progress on individual project objectives within each core.

Process measures: Center monitoring database reports (see Center Evaluation for description).

OBJECTIVE	Completed	
	Yes	**No**
1. Provide Center Administration and Leadership:		
1.1 Hold monthly meetings of Internal Advisory Committee Process measure: meeting minutes	√	
1.2 Hold annual meetings of External Regional Advisory Committee Process measures: minutes and presentations	√	
1.3 Establish an external Scientific Advisory * Committee composed of recognized leaders in agricultural health and safety Outcome measures: List of recruited members; synopsis of advice as requested.		
1.4 Prepare annual Center reports regarding progress on individual project objectives within each core. Process measures: Center monitoring database reports (see Center Evaluation for description).		
2. Provide coordination of research, outreach, and prevention activities within the Center with other related programs at Colorado State University, with other NIOSH Agricultural Health and Safety Centers, and with other US and international colleagues active in agricultural health and safety.		
2.1 Hold bimonthly research seminars for Center investigators, other Colorado State University faculty and students, and other community partners in PHS Region VIII. Outcome measure: Provide annual schedule of seminars presented, topic and presenter.	√	

*Utilized professional Advisory Committee members

	OBJECTIVE	Completed	
		Yes	No
	Hold an annual regional conference for Center investigators, other Colorado State University faculty and students and regional stakeholders and partners in PHS Region VIII. Process and outcome measures: Copies of Request for abstracts, Meeting agenda and topics, list of presenters and attendees. Evaluation report based upon attendee feedback.	√	
2.2	Disseminate HI-CAHS products (research papers, technical documents, etc.) to other NIOSH Centers and other US and international investigators via internet and peer reviewed journals. Outcome measures: Center monitoring database provides lists of products by category, and numbers & targets of dissemination efforts.	√	
2.3	Promote research, outreach/education and prevention/intervention through facilitation of feasibility projects and other funding opportunities with regional and other partners. Process and outcome measures: Feasibility projects will be reviewed by NIOSH and External Scientific Advisory Committee with summary report included in annual report.	√	
2.4	Participate in Agricultural Centers Coordinating Committee to facilitate multi-center collaboration and maximize agricultural centers program national resources (e.g. Tractor initiative). Process measures: Center monitoring database, Tractor Initiative records.	√	

OBJECTIVE	Completed	
	Yes	No
3. Utilize a strategic plan to guide the Center's development and growth.		
3.1 Provide external and internal advisory committee members with strategic planning materials from NIOSH and other organizations involved in agricultural health and safety.	√	
3.2 Develop strategic plan for HI-CAHS based upon suggestions of both external and internal advisory committees. Outcome measure: Strategic plan forwarded to NIOSH for program review and included in Year I report	√	
3.3 Update strategic plan with input from both external and internal advisory committees annually. Outcome measures: Updates reported in year end reports Years 2 and 3.		√
4. Center evaluation (internal) of progress and products.		
4.1 Train all project personnel to complete documentation (project overview form and logs) on all activities related to their projects for entry into Center monitoring database. (See Evaluation section for description and appendices for examples of forms).	√	
4.2 Utilize Center database to monitor progress on individual project objectives. Outcome measure: Year-end summary report documenting progress on objectives by project by Core (table format).	√	

OBJECTIVE	Completed	
	Yes	No
4.3 Utilize Center database to provide a yearend overview of additional Center accomplishments and activities. Outcome measures: The database provides reports on Center products, professionals trained, Center collaborative efforts, educational presentations, and descriptive information regarding contacts and the target audiences of the various projects. (See Evaluation section for more specific information re measures included).	√	
4.4 Conduct formative evaluation on products developed by the Center (e.g. instruments, publications, laboratory methods etc.) by peer review process and/or pilot testing as appropriate. Formative evaluation measures: Written statements re formative feedback in individual project reports; reports on feedback from External Scientific Advisory Committee as consulted.	√	
5. Provide professional education and/or training related to agricultural health and safety.		
5.1 Provide graduate education in multiple disciplines at CSU Outcome measures: numbers of students graduating per grant year and the discipline from which they graduate. Copies of theses, dissertations and publications will be forwarded to NIOSH.	√	
5.2 Provide continuing education or training to professionals in issues related to agricultural health and safety. Outcome measures: the database provides numbers and types of education or training efforts delivered by HICAHS staff. Also categorized are types of target groups who attend.	√	

5. Professional Education/Training

A number of MS, MSW, and PhD students are working on HICAHS projects and will produce reports, theses and dissertations. Students are enrolled in programs in the College of Veterinary Medicine and Biomedical Sciences (industrial hygienists, epidemiologist, veterinarian), College of Agricultural Sciences, College of Engineering and College of Applied Human Sciences, at CSU. A graduate student at the University of Utah, Rocky Mountain Center for Occupational and Environmental Health (ERC) was also supported on a HICAHS project. The Administrative Core has also been working to develop relationships with additional producer organizations and insurers. We are in the initial stages of collaboration on continuing education/training programs for the Colorado Corn Growers, Colorado Livestock Association and others, as well as collaborating on research and outreach dissemination.

6. National Agricultural Centers Evaluation Project

HICAHS staff V. Buchan and H. Holmquist-Johnson received funding late in 2004, for providing leadership to an evaluation of the NIOSH Agricultural Center Initiative. During the first year of this project, each Center assigned a representative to the Agricultural Center Evaluation team. Two workshops were held in Fort Collins (Jan. 21 & 22nd, and June 20th & 21st, 2005) during which an all Center database (developed under previous funding) was revised and a five month pilot was agreed upon. All Centers have utilized the ACCESS database to document Center activities, products and projects for the period from May 1, 2005 through September 30, 2005. This information has been forwarded to HICAHS to be cumulated into an Initiative database; the information will then address evaluation questions agreed upon in an Initiative Report. In addition ground work was laid to test the feasibility of inter-Center outcomes assessment during fiscal year 2005-2006. Two topic areas were selected for this experiment: High School Agricultural Health and Safety Curriculums (5 Centers) and Professional Development (6 Centers).

Conclusion

In Year 03 the Administrative Core will continue to provide leadership and direction to the Center members and will continue to foster collaboration between HICAHS and regional and national partners. Working with the External Regional Advisory Committee on strategic planning will continue to be a priority. We will also work closely with the Cooperative Extension Safety Specialists and Feasibility Grant awardees to ensure that their projects are successful and that findings are shared. We will continue to play a leadership role in activities such as the NIOSH Agricultural Centers Tractor Safety Initiative and the NIOSH Agricultural Centers evaluation. Finally, an exciting new initiative – development of a Colorado School of Public Health offers new opportunities for HICAHS collaboration. Dr. Reynolds is a member of the lead team at CSU.

5. PROJECT PRODUCTS

[Please report the major project products for the fiscal year. Please delete category if nothing to report.]

1. Presentations: *[Please list]*

Invited Presentations

AIHA International Affairs Committee Response to the Tsunami. Reynolds. AIHCE 2005, May 23, Los Angeles, CA.

Colorado Injury Control Research Center, Ft Collins, CO. Rosecrance. "Colorado Dairy Injuries." November, 2005.

Connections with the High Plains Intermountain Center for Agricultural Health and Safety, Cooperative Extension Forum, 9/19-9/23, 2005. Colorado State University, Fort Collins, CO.

NIOSH Agricultural Centers' National Agricultural Tractor Safety Initiative. Reynolds. 2005 CDC National Injury Prevention and Control Conference, May 19, Denver, CO.

Overview of the High Plains Intermountain Center for Agricultural Health and Safety. Reynolds. University of Wyoming, Department of Animal Science Seminar, February 25, 2005, Laramie, WY.

ERHS graduate Seminar Series "Overview of the High Plains Intermountain Center for Agricultural Health and Safety," Reynolds. February 28, 2005.

High Plains Intermountain Center for Agricultural Health and Safety. Reynolds. NIOSH Agricultural Centers Webinar (Internet) Series, February 16, 2005.

Presentations

Particle Bounce and Endotoxin Levels in a Marple Cascade Sampler with PVC Filters. Kirychuk S, Koehncke N, Reynolds S, Nakatsu J, Mehaffy J. AIHCE 2005, May, Los Angeles, CA.

Gravimetric and Endotoxin Evaluation of Size-Selective Sampling Methods Using Swine Dust in a Wind Tunnel. Reynolds SJ, Nakatsu J, Mehaffy J, Tillery M, Keefe T, Thorne P, O'Neill M, Metwali N, O'Shaughnessy P. AIHCE 2005, May, Los Angeles, CA.

Urinary pesticide levels in Iowa farm spouses and children. Curwin BD, Hein MJ, Sanderson WT, Striley C, Heederik D, Reynolds SJ, Ward EM, Alavanja MC. Presented at the National Advisory Panel Meeting for the Agricultural Health Study, March 3-4, 2005.

Evaluation of New and Traditional Methods in Measuring Agricultural Dust Particulates, student poster. Nakatsu J, Reynolds SJ, Tillery M, Keefe T, Thate R, O'Shaughnessy P. AIHA-Rocky Mountain Section 11th Annual OEH&S Conference, October 19-20, 2004, Golden, CO.

2. Publications *[Only if applicable]*

a. Peer Reviewed Journal: *[Please list]*

Buchan, V. and Holmquist-Johnson, H. (in press). Summary Proceedings: 2004 National Symposium on Agricultural Health and Safety. *Journal of Agromedicine.*

Reynolds SJ, Mehaffy J, Ragan JV, Tessari J, Keefe T, Milton D, Alwis U, Larsson L, Chen L. Evaluation and Optimization of a new rFC Endotoxin Assay using Agricultural Dusts. AJIM (submitted 2004) Reynolds, Dosman, Koehncke editors special edition.

Rautiainen RH, Ledolter J, Sprince NL, Donham KJ, Burmeister LF, Ohsfeldt R, Reynolds SJ, Phillips K, Zwerling C. 2005. Effects of premium discount on worker's compensation claims in agriculture in Finland. Am J Ind Med 48:100-109.

Curwin BD, Hein MJ, Sanderson WT, Barr DB, Heederik D, Reynolds SJ, Ward EM, Alavanja MC. 2005. Urinary and handwipe pesticide levels among farmers and non-farmers in Iowa. J Expo Anal Environ Epidemiol 1-9.

Curwin B, Hein MJ, Sanderson WT, Nishioka MG, Reynolds SJ, Ward WM, Alavanja MC. 2005. Pesticide contamination inside farm and non-farm homes. J Occup Environ Hyg 2(7):357-367.

Groves WA, Agarwal D, Chandra MJ, Reynolds SJ. 2005. Evaluation of a fluorometric method for measuring low concentrations of ammonia in ambient air. J Environ Monit *Journal of Environmental Monitoring. 7(2):163-8, 2005 Feb*.

Groves WA, Agarwal D, Chandra MJ, Reynolds SJ. Evaluation of a fluorometric method for measuring low concentrations of ammonia in ambient air. J Environ Monit DOI:10.1039/B411109E (online version).

Merchant JA, Naleway AL, Svendsen ER, Kelley KM, Burmeister LF, Stromquist AM, Taylor CD, Thorne PS, Reynolds SJ, Sanderson WT, Chrischilles EA. 2004. Asthma and farm exposures – a cohort of rural Iowa children. Environ Health Perspect DOI:10.1289/ehp.7240 December 7 (online version).

Flamme GA, Mudipalli R, Reynolds SJ, Kelly K, Stromquist A, Zwerling C, Burmeister LF, Peng SC, Merchant J. 2004. Prevalence of hearing impairment in a rural midwestern cohort: estimates from the Keokuk County Rural Health Study, 1994-1998. Ear Hear 26(3):350-60.

c. Fact Sheets / Brochures / Technical Publications: *[Please list]*

Liu, J., P. Ayers., S. Reynolds. 2004. Feasibility Study to Mount Cost effective ROPS (CROPS) on Older Tractors. Research report submitted to James Harris, NIOSH Division of Safety Research, Morgantown, WV.

b. Other Publications: *[Please list]*

NIOSH Agricultural Safety and Health Centers – National Tractor Safety Initiative, January 2004. [Co-Authors with primary responsibility for section on Research.]

ASAE PM 23/2/2 ROPS Committee report on ASAE S547 field upset test evaluation. 2005 Agricultural Equipment Technology Conference, Louisville KY. February 13.

ASAE PM 23/2/2 ROPS Committee report on Revised Continuous Roll Model Evaluation. 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL. July 18

Liu J, Ayers P, Reynolds SJ. 2004. Feasibility Study to Mount Cost effective ROPS (CROPS) on Older Tractors. Research report submitted to James Harris, NIOSH Division of Safety Research, Morgantown, WV.

NIFS Tractor and Machinery Issues Committee report on ROPS Updates. 2005 National Symposium of Agricultural Health and Safety, Wintergreen, VA June 27

4. Education / Training / Outreach *[Only if applicable]*

a. Training Seminars: *[Please list]*

Reynolds, Endotoxin and Organic Dust Lung Disease, Seminar Department of Environmental and Radiological Health Sciences, Colorado State University, October 11, 2004.

g. Other: *[Please list]*

Reynolds – Lecture in CSU Department of Agriculture Class A300, Issues in Agriculture – "Health and Safety in Agriculture" September 2005, 65 students.

IOWA State Fair Webinar Presentation. ROPS Design and Testing for Agricultural Vehicles. August 16, 2005.

Pre/posttests used for evaluation of Pesticide Risk Reduction Program in Colorado.

Reynolds SJ. 2004. Interview for article "Invest in Manure Safety Use this Checklist to learn how to keep employees safe when working around manure" in Dairy Herd Management.

1. Conferences / Meetings Sponsored: *[Please list]*

Co-Organizer (Reynolds): Advanced Perspectives in Mold Prevention & Control. AIHA and ISIAQC. Las Vegas, Nevada, November 2004.

Co-Organizer (Reynolds): Colorado Asthma Coalition – Bringing Together Medial and Environmental Practitioners for Collaborative Solutions, to be held April, 2006.

4. Other Products: *[Please list]*

Stanton TL, Wailes WR, Reynolds SJ, Johnson D, Davis J. The effect of algae and bacterial additions to a CAFO lagoon on the conversion from anaerobic to aerobic fermentation. CSU, Department of Animal Sciences Website, 2004

G. STATES THE PROJECT WAS ACTIVE IN

Colorado, Wyoming, North Dakota, South Dakota, Utah, Montana

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

ROPS Design and Testing for Agricultural Vehicles

B. PROJECT OFFICER(s)

Dr. Paul Ayers, Ph.D., P.E.
Department of Biosystems Engineering and Environmental Science
2506 E.J. Chapman Drive
The University of Tennessee
K3noxville, TN 37996-4531

Phone: 865-974-4942
E-mail: ayers@utk.edu

C. PROJECT DESCRIPTION

The overall objective of this project is to investigate, develop, evaluate and disseminate information regarding rollover protective structure (ROPS) designs for agricultural vehicles in the United States to provide and ensure operator protection on vehicles not currently available. The specific objectives include:

1) Evaluation of the continuous roll prediction accuracy of the model described in the newly approved (December 2002) ASAE Standard S547 “Tip-Over Protective Structure (TOPS) Protective Structure for Front Wheel Drive Turf and Landscape Equipment”. The evaluation

includes:

- Field upset test verification (roll behavior and angular velocities) using Deere F 925 front drive mower
- Determination of measured and calculated critical ROPS height (CRH) for the Deere F925 front mower
- Model sensitivity analysis and parameter estimation on model factors including moment of inertia, mower deck size, ROPS and test slope deflection, center of gravity location, coefficient of elasticity of slope,

2) Determination of the required critical ROPS height (CRH) for the 17 previously examined agricultural vehicles (lawn tractors, lawnmowers, off-road utility vehicles and ATV's), utilizing the continuous roll prediction model described in ASAE S547. A comparison of the calculated (CRH) to the actual ROPS height for the available ROPS will be conducted,

3) Dissemination of information addressing ROPS design and testing will be presented to the Agricultural Vehicle Industry (including tractor, lawnmower, off-road utility vehicle and ATV). Dissemination will occur in the form of technical presentations and literature distribution at national meetings, individual site visits (vehicle and ROPS manufactures), specialty meeting (i.e., PM 52 and the OPEI EXPO). The topic areas will include general ROPS design and testing, ASAE S547 test slope construction, ASAE S547 model validation and utilization. A website presenting 1) the test slope construction details for the S547 lateral field test and 2) the OECD Code 6 continuous roll prediction model accuracy evaluation and limitations will be developed,

4) Conducting lateral field upset tests in accordance with ASAE S547 of prototype or commercially available ROPS and non-ROPS frames designed for non-traditional agricultural vehicles including lawnmowers, off-road utility vehicles and ATV's to evaluate operator protection characteristics.

D. PROJECT START AND END DATES

Start - 9/15/2004
End - 9/14/2005

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

The previous project report (9/03 to 9/04) covered:

1) ASAE S547 Lateral Upset Test Model Evaluation, Sensitivity Analysis and Dissemination and
2) Critical ROPS Height Determination for 17 Vehicles.

This project report will include the modification and evaluation of ASAE S547 continuous roll prediction model, and intervention activities.

In order to evaluate the accuracy of the ASAE S547 continuous roll model a 4.05 meters long and 3.42 meters wide slope of 35 degrees was constructed at the University of Tennessee. Lateral upset tests for Deere F925 front drive mower with a ROPS of 1.9 m and 2.22 m were conducted. These tests indicated the mower deck influenced the rollover behavior. In addition, the mower yaw (rotation) and slide downhill were also observed. The original model described in ASAE S547 did not accurately predict the roll behavior of the mower. Therefore, the activities of this project involved modifying the original continuous roll model to include the mower deck size, yaw and slide downhill evaluating, and evaluating the accuracy of the revised model.

MODIFICATION OF ORIGINAL MODEL

The original model was revised to include 1) the deck size, 2) yaw and 3) slide down the slope. This revision included the tipping axes rotation and mass moment of inertia transformation.

Three parameters were added into the model to include the size of the mower deck. These are: 1) the horizontal distance between the contact point of the deck and the center of gravity (L3), 2) the height of the contact point of the deck (D3), and 3) the extended width of the deck measured from the center line of the front tire to the left end of the mower deck (B_m) (see figure 1).

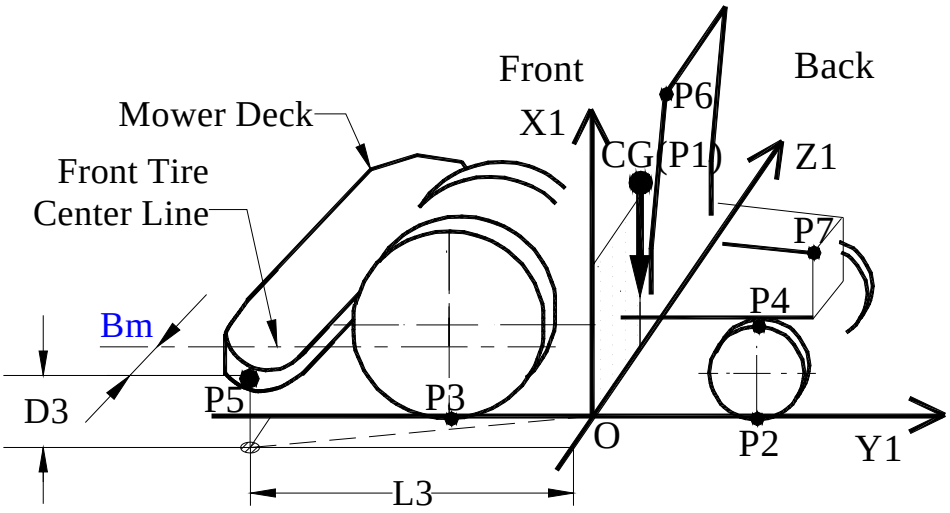


Figure 1. Definition of (X1, Y1, Z1) coordinates and seven contact points.

Because adding the deck size to the model, the tipping axes changed, therefore, the moment of inertia, the equivalent slope angle, the potential and kinetic energy changed. These factors affected the mower roll behavior. The modified tipping axes are described below first.

REVISED TIPPING AXES

The modified tipping axes are described below (Three versions are defined in order to distinguish the roll behaviors):

1. If the leading point of intersection of ROPS is in front of the longitudinal unstable equilibrium point, the mower rolls towards the back. This is defined as B1 version (see figure 2). Tipping axes 1 and 2 change from dashed lines to solid lines by adding the mower deck. The longitudinally unstable equilibrium point (EQ) is the intersecting point between the rotation plane 2 and the line passing through the ROPS/slope contact point and parallel to the tipping axis 2.
2. If the leading point of intersection of ROPS is near the longitudinal unstable equilibrium point, the mower directly rolls over the top of ROPS. This is defined as B2 version (see figure 3). Tipping axes 1 and 2 also change from dashed lines to solid lines by adding the mower deck.
3. If the leading point of intersection of ROPS is behind the longitudinal unstable equilibrium point, the mower will roll towards the front. This is defined as B3 version (see figure 4). Tipping axes 1, 2 and 3 change from dashed lines to solid lines by adding the mower deck. Tipping axes 1, 2 and 3 change from dashed lines to solid lines by adding the mower deck.

From the field test, only the B3 version (the mower rolling towards the front) was observed. The other two situations did not occur. However, in order to cover all possible situations, the versions B1 and B2 were also included in the Matlab code.

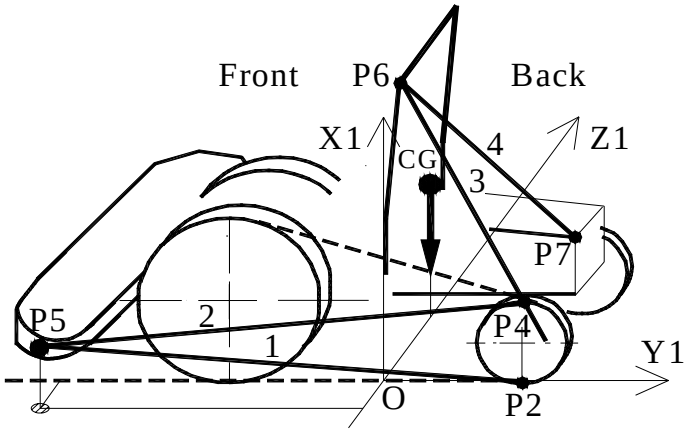


Figure 2. The tipping axes of B1 version (mower rolls back).

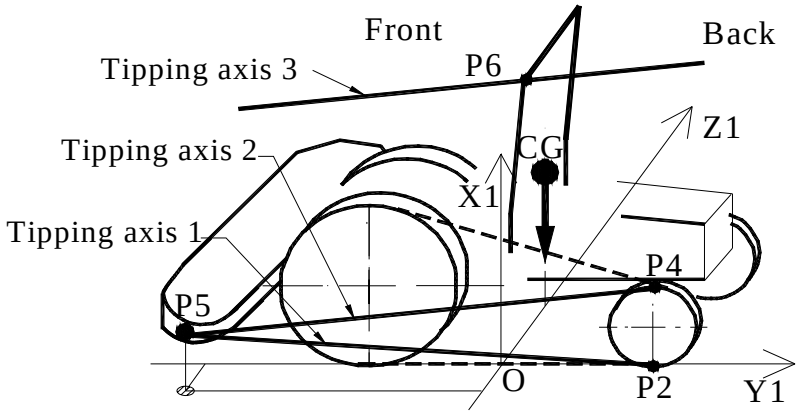


Figure 3. The tipping axes of B2 version (mower rolls over the top of ROPS).

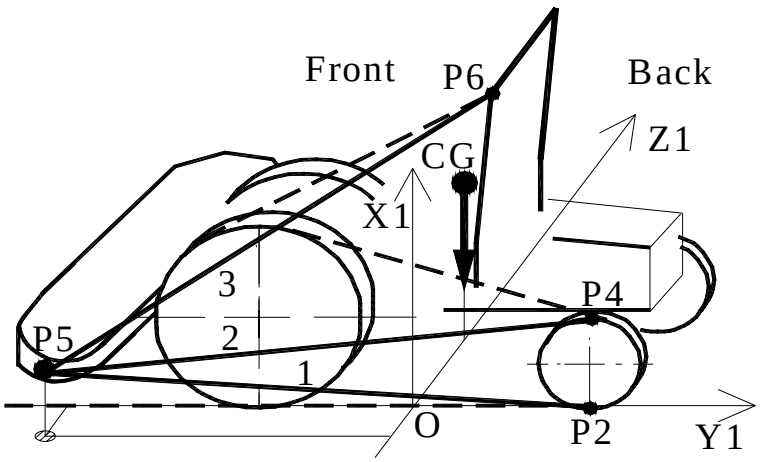


Figure 4. The tipping axes of B3 version (mower rolls front).

REVISED POTENTIAL AND KINETIC ENERGY DUE TO DECK SIZE

The three situations that were addressed in the revised potential energy calculations were: 1) change of the tipping axis due to mower deck size, 2) the slide of mower down the slope, and 3) the yaw of mower on the slope. The revised potential and kinetic energy calculations due to deck size were developed.

Finally, the influence of deck size on the equivalent slope angle (A1) is discussed. The equivalent slope angle is different than the original slope angle. The equivalent slope angle (A1) is defined as the angle of the line (OT), an intersection of rotation plane and the slope, with respect to the horizontal plane (see figure 5). It affects the mower roll behavior. By adding the mower deck size, the tipping axis 1 changes the angle by θ_1 degrees from the longitudinal direction; therefore, the direction of the rotation plane 1 also changes an angle of θ_1 degrees. The relationship between A1, θ_1 and the original slope angle (A0) is shown below:

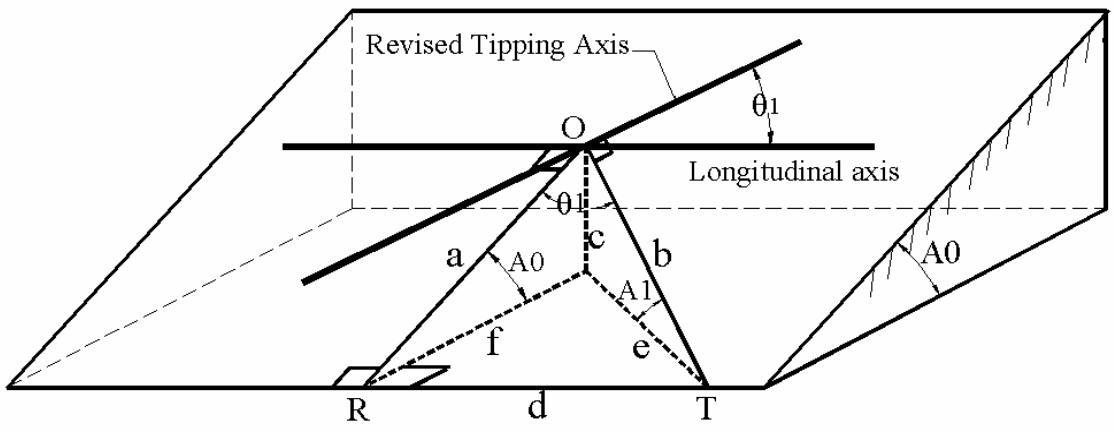


Figure 5. Relationship between the original slope angle and revised equivalent slope angle.

REVISED MOMENT OF INERTIA

Because the tipping axes change, the moment of inertia around the tipping axis changes. The modified moment of inertia is described below (see figure 6).

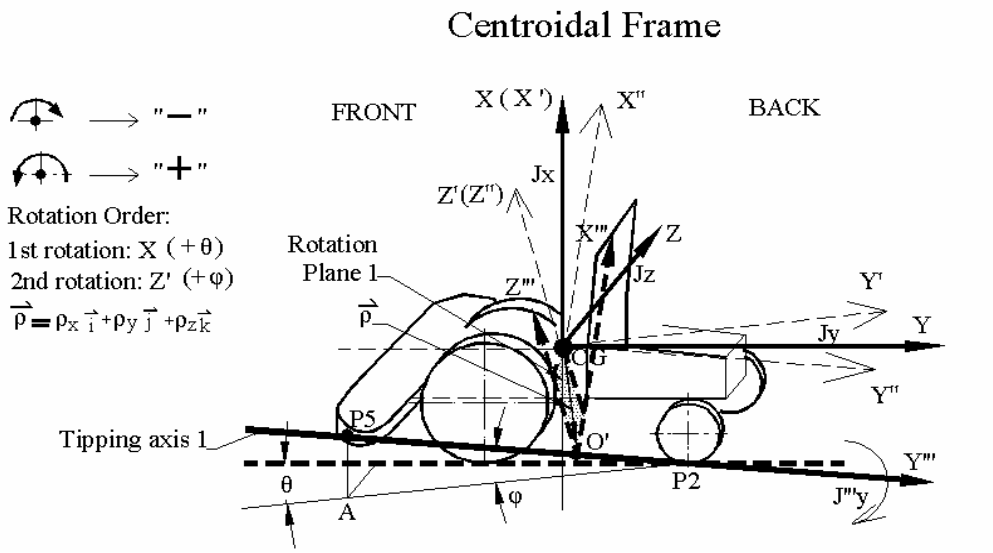


Figure 6. Transfer the moment of inertia from old coordinates to new coordinates.

The moment of inertia around the tipping axis 1 can be obtained by the transformation and translation of the moment of inertia around the (X, Y, Z). In sequence, these rotations are θ with respect to the X-axis, φ with respect to the Z'-axis, therefore, the moment of inertia about the system (X'', Y'', Z'') is determined. Finally, the moment of inertia around the system (X''', Y''', Z''') is obtained by using the parallel-axis theorem (Wang, 2005).

REVISED KINETIC ENERGY DUE TO THE YAW ANGLE AND SLIDE

Due to the deck size, the front tires of the mower are suspended, therefore, the weight shifts to the rear tire, and the rear tire receives greater friction force than front deck. This causes the front deck move faster than the rear tire. This situation results in the yaw of the mower. Due to the yaw, the angle between the longitudinal direction and the tipping axis connecting the ROPS impact point to deck/slope contact point further decreased, therefore, the equivalent slope became steeper; finally, the roll tendency increased. The mower undergoes a combination of three motions including slide, roll and yaw down the slope. Figure 7 shows that the mower moves from position 5 to position 6 after yaw and slide. At position 6, the mower will roll around the tipping axis 3 with the angular velocity O_5 .

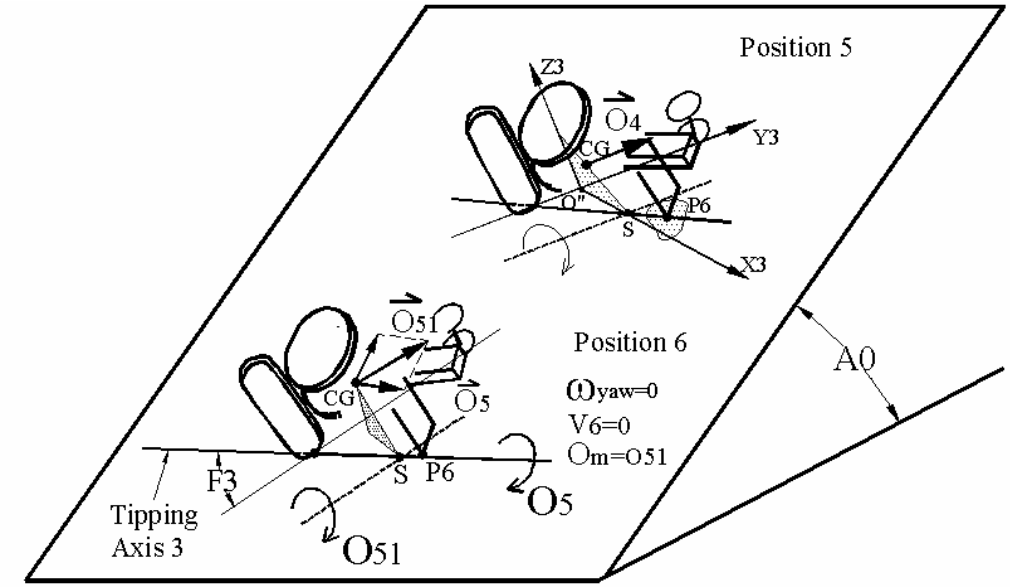


Figure 7. Adding the roll, yaw and slide into the model.

Figure 8 shows the potential energy changes due to the slide and yaw of the mower downhill in two dimensions. Because of the work due to the friction force, the conservation of energy equation is modified.

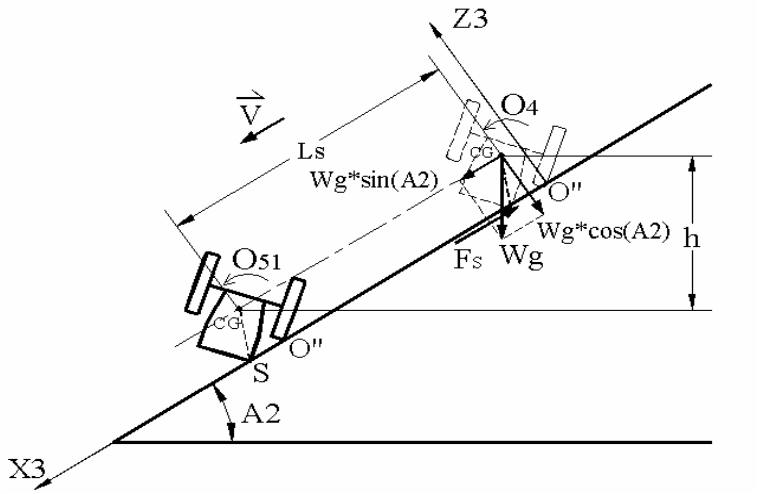


Figure 8. Potential energy change due to slide and yaw.

EVALUATION OF THE REVISED MODEL

In order to evaluate the accuracy of the revised model, the yaw angle, and the slide distance need to be measured. One-meter grid marks are put on the slope to measure them (see figures 9 and 10). Field tests were conducted for Deere F925 mower.

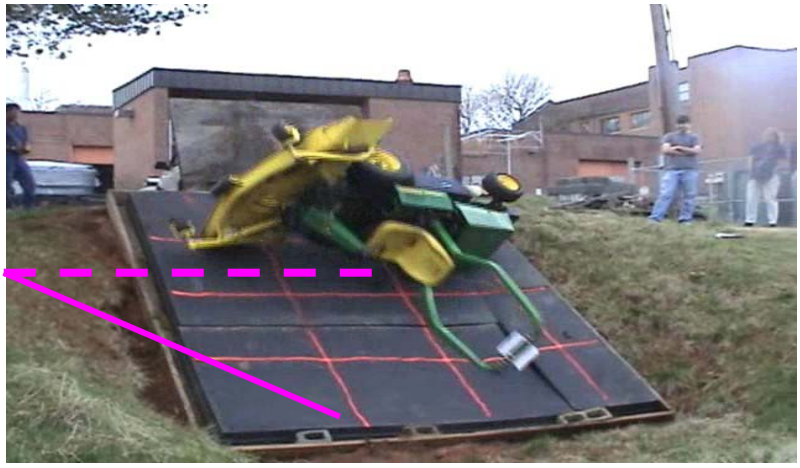


Figure 9. ROPS just hits the slope.

Figure 10. The angle when the mower continues to roll about the tipping axis 3.

Nine field tests were conducted on the slope for the F925 mower (see table 1).

Table 1: Field tests on polyethylene pad with regular ROPS

ROPS Position	ROPS Height (m)	No of Tests
Regular	1.90	3
Regular	2.22	1
Regular	2.42	1
Regular	2.55	2
Regular	2.67	2

The average slide distance on the polyethylene pad is approximately one-meter. The angle between the tipping axis 3 and the longitudinal direction after the mower undertakes a yaw and when

the mower continues to roll was estimated from video footage. The angle between the tipping axis 3 and the longitudinal axis change because the mower yaws. The average value of this angle is about 15 degrees (see figure 10). This angle can be dependent on mower and slope conditions. It directly affects the equivalent slope angle.

The measured CRH are 2.55 m and 2.67 m with deck in the transportation (up) and the working position (down) respectively. The CRH predicted by the original model is 2.17 m. The CRH predicted by the revised model is 2.50 m, and 2.63 m with the deck in the transportation (up) and the working position (down) respectively. Field tests show that the revised model result is much closer to the field test result for Deere F925 mower with the regular ROPS (see figure 11).

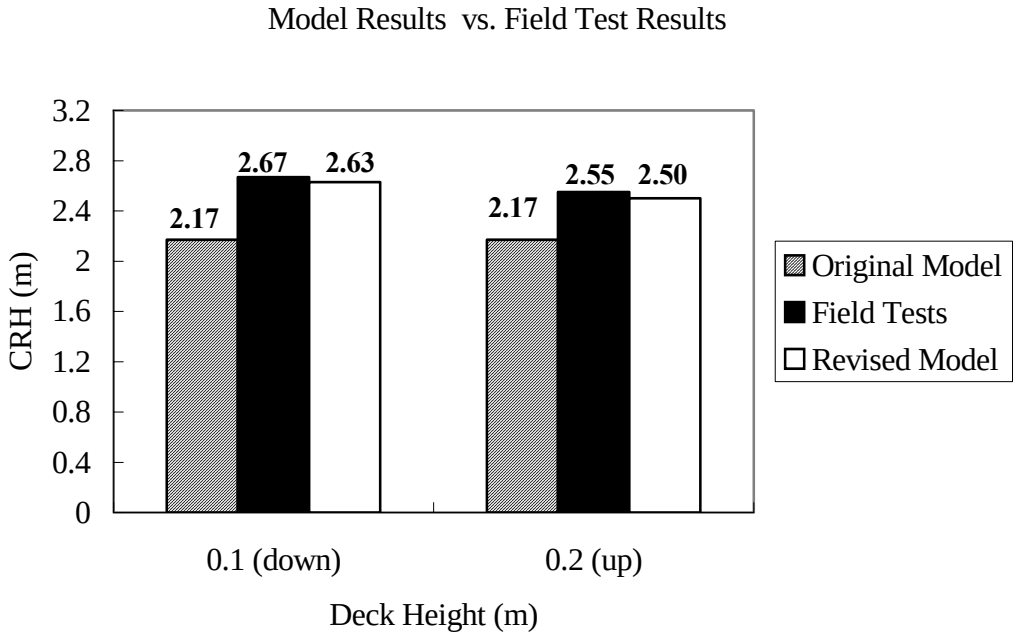


Figure 11. Comparison between model results and field test results.

Intervention Activities

The results of the tests described above have been reported to the ROPS manufacturing industry as described in the presentations and meetings listed in Section F. Five presentations, three committee reports and a Webinar were presented this past year. To date, no known front drive mower ROPS has been designed using the original ASAE S547 continuous roll model. Companies present at meetings include: Deere and Co., CNH, AGCO, Toro, Kuboto, AEM, FEMCO, Woods Equipment, Grasshopper, Excel Industries, Weasler Engineering, Scag Power Equipment, Exmark Mfg., Custom Products of Litchfield, Full Vision, Inc., Moridge Manufacturing, MTD, Hustler.

A website describing 1) the test slope construction details for the S547 lateral field upset

test, 2) the existing ASAE S547 continuous roll prediction model, 3) the modifications made in the model, 3) test results and 4) a location to download the revised model. The website is at the HICAHS Agricultural Center website - http://www.hicahs.colostate.edu/rops_design.asp.

The initial draft of the ROPS design engineering booklet has been developed. The sections include 1) description of the original ASAE S547 lateral upset test and limitations, 2) lateral upset test site construction, 3) description of critical ROPS height, 4) model modifications, and 5) model validation. An internal review has been conducted on the booklet material.

The revised continuous roll model is currently in Matlab code. Modifications are underway to provide user input of mower dimensions. Also, an executable version is being developed.

F. PROJECT PRODUCTS

1. Presentations:

Ayers, P., X. Wang, R. Comer. 2004. Agricultural Vehicle ROPS Activities. Presented at the NIOSH Ag Centers and USDA Cooperative Extension Southern Region Farm Safety Symposium 2, Nashville, TN September 20-21.

Ayers, P. 2005. S547 TOPS for Front Drive Mowers. Presented at the 2005 Agricultural Equipment Technology Conference, Louisville KY, ASAE PM-52 Turf and Landscape Equipment Committee meeting February 15.

Ayers, P. 2004. Continuous roll model evaluation for front drive mowers. Presented at the 2004 Outdoor Power and Equipment Institute (OPEI), Louisville KY, ASAE PM-52 Turf and Landscape Equipment Committee meeting September 25.

X. Wang, Ayers, P. and R. Comer. 2005. Modification and Evaluation of Continuous Roll Prediction Model for Front Drive Mowers. Presented at the 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL.

Comer, R, Ayers, P. and X. Wang. 2005. Evaluation of Engineering Plastic for Rollover Protective Structures (ROPS) mounting. Presented at the 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL.

2. Publications

c. Fact Sheets / Brochures / Technical Publications

X. Wang, Ayers, P. and R. Comer. 2005. Modification and Evaluation of Continuous Roll Prediction Model for Front Drive Mowers. ASAE Paper No. 05-5003.

Comer, R, Ayers, P. and X. Wang. 2005. Evaluation of Engineering Plastic for Rollover Protective Structures (ROPS) mounting. ASAE Paper No. 05-5007.

d. Other

Wang, X. 2005. Modification and Evaluation of Continuous Roll Prediction Model for Front Drive Mowers. PH.D. Dissertation. The University of Tennessee.

3. Education / Training / Outreach

f. Other:

NIFS Tractor and Machinery Issues Committee report on ROPS Updates. 2005 National Symposium of Agricultural Health and Safety, Wintergreen, VA June 27

ASAE PM 23/2/2 ROPS Committee report on ASAE S547 field upset test evaluation. 2005 Agricultural Equipment Technology Conference, Louisville KY. February 13.

ASAE PM 23/2/2 ROPS Committee report on Revised Continuous Roll Model Evaluation. 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL. July 18

IOWA State Fair Webinar Presentation. ROPS Design and Testing for Agricultural Vehicles. August 16, 2005.

4. Conferences / Meetings Sponsored:

Meeting Organizer - Coordination Meeting for Collaborative NIOSH/Tractor Industry Research Activities to be held 12/07/05, Hyatt Hotel Pittsburgh Airport.

G. STATES THE PROJECT WAS ACTIVE IN

Tennessee, Kentucky, Georgia and Colorado

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Reduction of Exposures from Dairies and Cattle Feedlots

B. PROJECT OFFICER(s)

Stephen J. Reynolds, Ph.D., CIH – PI
Environmental & Radiological Health Sciences
1681 Campus Delivery
Colorado State University
Fort Collins, CO 80523
(970) 491-3141
stephen.reynolds@colostate.edu

Dr. Tim Stanton	Colorado State University	Co-Investigator
Brad Lester	Colorado State University	Co-Investigator/ PhD Candidate

C. PROJECT DESCRIPTION

Colorado's dairy industry makes a significant contribution to the state's agricultural economy. In 2001, Colorado ranked 18th in the nation with approximately 80,000 cows (mostly Holstein) on 500 dairy farms which produced approximately 1.97 billion pounds of milk annually. Workers on dairies and feedlots are exposed to excessive levels of airborne hydrogen sulfide, ammonia, other gases, and aerosols including bacterial endotoxins. A novel intervention, using an assemblage of algae to create aerobic conditions in manure holds promise for reducing exposure to these gases and aerosols. The algae system will be introduced into manure lagoons at two local dairies, and occupational exposure analysis will be performed to measure reduction in exposures. A unique aspect of this study is the evaluation of the Cyranose 320 electronic nose as a qualitative and quantitative sampling device, and the comparison of the Cyranose to a scentometer and gas chromatography methods for odor assessment. This project will build on and expand current work in collaboration with the CSU Center for Animal Agriculture and Community Enhancement, local dairy producers, and the producer of the algae intervention. The goals of this project are to: 1) develop community-based partnerships to implement this project and disseminate results; 2) implement an algae manure intervention and evaluate its effectiveness in reducing emissions and occupational exposures of workers to particulates, bioaerosols, and gases from dairies and eventually feedlots, 3) evaluate the utility of the Cyranose 320 electronic nose (a simple direct reading tool for field use) for detection, identification, and quantification of gaseous emissions from diaries and feedlots as an alternative to a scentometer and gas chromatography methods, and 4) disseminate information on intervention technology, costs, and results in coordination with producers, agribusinesses, regulators, and communities via HICAHS outreach core and Cooperative Extension. This project addresses key NIOSH agriculture initiative objectives of developing, evaluating, and disseminating cost-effective interventions to reduce occupational exposure in the livestock production industry.

D. PROJECT START AND END DATES

September 15, 2003 to September 14, 2006

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Funds for this project were released from CDC/NIOSH on November 19, 2003. Two dairies were recruited, and the algal intervention is in place at one. Methods development and pilot testing was completed in year 02. Twenty-seven (27) field sampling visits have been completed at the intervention dairy (in addition to methods development and pilot testing). Participant consent at the control dairy has been granted and data collection has just begun. Marcus Cusannelli completed his work on calibration and adaptation of the electronic nose and will use this for his M.S. thesis (expected Spring 2006). He is currently working at US EPA in Washington, D.C.

Seventeen (17) participants have been recruited from Morwai Dairy (Hudson, CO). Fourteen (14) participants have been recruited from La Luna Dairy (Wellington, CO). The participants range in age from 18 to 55+ years. All of the participants except for three (3) are Hispanic. Ninety-four percent (94%) are male (29 out of 31). One male worker has been removed from the study after losing his job for undisclosed reasons. Personal sampling data has been collected for 9 individuals from La Luna Dairy who agreed to participate. Personal sampling has focused on characterizing occupational exposures for various tasks including milking, feeding, maintenance, working sick cows, and driving tractors. Area samples have characterized environmental exposures to gases and odors downwind of the lagoon. The following results were obtained for the first 27 visits to the intervention dairy. Environmental and meteorological results were as follows: temperatures ranged from -9.9 to 36 °C with a mean of 11.5 °C. Relative humidity ranged from 0.6 to 90.3% with a mean of 29.4%. Hydrogen sulfide ranged from 0 – 670 ppb with a mean of 31.8 ppb. Ammonia ranged from 0 – 10 ppm. Carbon dioxide ranged from 270 – 841 ppm with a mean of 426 ppm. Scentometer readings ranged from 0 – 15 dilutions to threshold (D/T) with a mean of 7 D/T. The mean concentration of culturable mesophilic bacteria downwind of the lagoon was $5.6x10^9$ CFU/m^3. Total particulate and endotoxin levels were 0.85 mg/m^3 and 41.4 EU/m^3 at the lagoon, respectively. Inhalable particulate and endotoxin levels were 1.1 mg/m^3 and 9.2 EU/m^3 at the lagoon, respectively. Occupational exposure results were as follows: the mean concentration of culturable mesophilic bacteria in a barn was $2.6x10^8$ CFU/m^3. Total particulate and endotoxin levels were 0.54 and 1.56 mg/m^3, and 352.0 and 577.6 EU/m^3 for maintenance and milkers, respectively. Inhalable particulate and endotoxin levels were 1.96, 0.77, 0.68, and 1.5 mg/m^3, and 494.4, 360.1, 206.6, and 728.1 EU/m^3 for working calves, working sick cows, feed mixing tractor, and feed loading tractor, respectively.

Exposures vary with job tasks and job description. Surprisingly, exposures to endotoxins are highest in the milking parlor, which was thought to be the cleanest area. The levels of hydrogen sulfide, endotoxin, and mesophilic bacteria exceed recommended occupational and environmental levels and could create significant health concerns.

During the coming year we plan on completing sampling and data analysis. The current schedule includes two to three field trips per week.

F. PROJECT PRODUCTS

[Please report the major project products for the fiscal year. Please delete category if nothing to report.]

2. Publications:

c. Trade Journals: *[Please list]*

"Exercise Caution When Inoculating Livestock" Colorado Dairy News, September/October 2004, Helen Schledowitz.

Interview (Reynolds, Schledowitz) and text for article "**Invest in manure safety** Use this checklist to learn how to keep employees safe when working around manure." By Shirley Roenfeldt, Managing Editor, Dairy Herd Management

"Teach Clients Proper Inoculations Procedures" in Bovine Veterinary Magazine. Fall 2004. Reformatted from Colorado Dairy News, September/October 2004, Helen Schledewitz.

d. Other Publications: *[Please list]*

Stanton TL, Wailes WR, Reynolds SJ, Johnson D, Davis J. 2004. The effect of algae and bacterial additions to a CAFO lagoon on the conversion from anaerobic to aerobic fermentation. CSU, Department of Animal Sciences Website.

3. Education / Training / Outreach *[Only if applicable]*

f. Other: *[Please list]*

MS Student – Noa Roman Muniz, Thesis - *Worker Safety Training and Future Needs of the Colorado Dairy Industry*. Summer 2004. Reynolds – Thesis Committee.

5. Other Products: *[Please list]*

An SOP for operation of the Cyranose 320 for agricultural applications has been developed and is currently being refined.

G. STATES THE PROJECT WAS ACTIVE IN

Colorado, Nebraska, Kansas, Wisconsin, California, Ohio and New York

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Agricultural Health and Safety Curriculum Evaluation

B. PROJECT OFFICER(s): R. Seiz, P.I.; V. Buchan, Co-P.I.; & T. Keefe

Robert C. Seiz, Ph.D.
School of Social Work
127 Education Building
Colorado State University
Fort Collins, CO 80523-1586
(970) 491-4810
seiz@cahs.colostate.edu

C. PROJECT DESCRIPTION

The purpose of this project is to evaluate an innovative computer-based [CD] agriculture health and safety curriculum being taught to youth aged 15 to 17 enrolled in rural Colorado and Wyoming high school agriculture classes. Farmers and ranchers are among the highest risk groups for occupational injuries and illnesses. The agriculture industry annually employs about 667,000 young workers. In addition, many more young people are conducting agricultural work for their farming/ranching parents and/or are exposed in varying degrees to one of the most hazardous occupational environments in the United States. Credible knowledge about the environmental and occupational hazards encountered on America's farms and ranches is critical to the safety and health of these youth.

The technology-driven curriculum was based upon the developmental stage of the target youth and a needs assessment of agricultural educators in Colorado and Wyoming. It provides information on hazard and safety issues involved in the use of tractors, ATV's, and garden machinery; the handling of horses, livestock, agricultural chemical and volatile organic compounds; being around stored grain, organic dusts, electrical conduits and power lines; and emergency rescue. This 5-year study was undertaken to evaluate changes in student's knowledge, attitudes and safety behavior due to the inclusion of the curriculum into existing school curricula and to tack changes in incidences of agriculture-related injuries and illnesses. The study utilizes repeat measures and semi-structured family interviews with random-assignment to study and standard curriculum groups. The development of the multiple instruments and interview schedule used in the study were completed earlier in the project's history.

D. PROJECT START AND END DATES:

10/15/01 – 9/30/06

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Between October 1, 2004 and September 30, 2005 the collection of quantitative and qualitative data in Colorado was completed in accord with the project's timeline. The final post-posttest instrument measuring the retention of prevention knowledge was administered and collected, and the final administration of the self-reporting instrument of the incidences of agricultural injury and illness was accomplished and collected. In addition, of the 32 families in the study group who agreed to participate in the interview process, 29 participating students (response rate of 91%) and 28 parents (response rate of 88%) completed the interview process. Of the 19 families in the control group who agreed to participate in the interview process, 15 parents (response rate of 79%) participated in the interview process. In Wyoming, quantitative data on the incidences of agricultural injury and illness continued to be collected in accord with the project's timeline. At the same time, statistical and thematic analysis of collected data continued.

F. PROJECT PRODUCTS

None

G. STATES THE PROJECT WAS ACTIVE IN:

Colorado and Wyoming

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE:

Interactive Agricultural Health and Safety CD: 4-H Youth

B. PROJECT OFFICER(s):

V. Buchan, P.I.; R. Seiz and J. Liu Co-PIs.
Victoria V. Buchan, Ph.D.
School of Social Work
134 Education Building
Colorado State University
Fort Collins, CO 80523
(970) 491-5211
buchan@cahs.colostate.edu

C. PROJECT DESCRIPTION

Today there are many youth living and working on farms and ranches. Because agriculture is one of the most dangerous occupational environments in the U.S., statistics show there are increased injuries and fatalities each year to these youth. There is an urgent need to decrease this

phenomenon. The objectives of this project are to: 1) Develop an interactive CD for delivery of agricultural health and safety information to youths in 4-H youth grades 3-5. 2) Evaluate and revise the prototype CD using both formative and process evaluation methods

D. PROJECT START AND END DATES:

10/15 /03 – 9/30/06

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

We have now completed formative evaluation of the CD in two different Colorado counties under the direction of two Cooperative Extension agents. Based upon the evaluation feedback from over 150 children in the targeted grades, from parents, and Cooperative Extension agents, many revisions have been made to the CD, additional characters have been created and additional video clips have been added.

The prototype CD has been forwarded to an I.H. specialist at the South West Center for review. In addition, IRB approval was applied for and received for the process evaluation to be completed in Phase II.

The following objectives were set and have been completed for Project Year II.

1. Pre-testing of evaluation instruments for Phase II
2. Submission of instruments and protocol to CSU IRB for approval.
3. Revise the CD based upon pilot feedback.

Two new objectives were added to Year II due to collaborative opportunities that have arisen that provide the opportunity to enhance testing the CD.

1. Test the quiz components of the five CD modules with approximately 100 students in the target grades in an eastern county in Colorado.

2. Present 4-H CD project to the Colorado Cooperative Extension Forum in the Fall of 2005. This step will assist, we hope, in recruitment of additional counties and 4-H personnel for the process evaluation included in Phase II.

We are currently working on the objectives related to Project Year III which include:

1. Selection of 10-12 4-H groups from Colorado and 2-3 regional states to use CD and participate in process evaluation.

   We are working with both Montana and South Dakota at this point. Each state group will be divided into treatment and control groups to test if knowledge is gained through use of the CD versus no use. Both groups will then have access to the final version of the CD once all evaluation steps are completed.

2. Train Cooperative Extension agents associated with treatment and control groups re evaluation protocol & data collection.

   Training is scheduled in Montana for December 20th, with the assistance of Dr. Douglas Steele, Vice Provost and Director of Extension, Montana State University.

F. PROJECT PRODUCTS

1. Presentations: 2 formal presentations have been made:

Seiz, R., Buchan, V. *The Interactive Agricultural Health and Safety CD: 4-H Youth.* September 22, 2005. Cooperative Extension Forum, 9/19-9/23, 2005. Colorado State University, Fort Collins, CO.

Buchan, V. *The Interactive Agricultural Health and Safety CD: 4-H Youth.* August 2, 2005. Western Regional 4-H Directors Conference, 8/1/05-8/3/05. Jackson, Wyoming.

3. Education / Training / Outreach

e. CD-ROMs or other Computer Based Training Programs:

*Agricultural Health and Safety CD fo*r 4-H Youth. (approximately 15 revisions have been undertaken to this point)

5. Other Products:

A draft Instruction manual for the next evaluation phase has been developed to be tested by the process evaluation.

G. STATES THE PROJECT WAS ACTIVE IN:

Colorado, Montana, Texas and Wyoming

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Regional Education Through State Extension Safety Agents

B. PROJECT OFFICER(s)

John Rosecrance, PT, PhD, CPE
Environmental & Radiological Health Sciences
1681 Campus Delivery
Colorado State University
Fort Collins, CO 80523
(970) 491-1405
john.rosecrance@colostate.edu

C. PROJECT DESCRIPTION

The goal of this project is to determine the feasibility of utilizing the existing structure of cooperative extension services and other agricultural stakeholders to improve agricultural health and safety education throughout PHS Region VIII (Colorado, Utah, Montana, Wyoming, South Dakota, North Dakota).
The specific objectives include:

1) Provide finical support to enhance agriculture health and safety education in PHR VIII region.
2) Deliver education programs that meet unique agriculture H&S needs in PHR VIII.
3) Facilitate effective communication between HICAHS personnel and state extension specialists in each state.
4) Facilitate collaboration between HICAHS personnel and state Extension Specialists by providing opportunities to meet.
5) Evaluate HICAHS devolved educational materials as used in Regionalization project.
6) Evaluate Region VIII extension safety programs in relation to objectives set for each regional state as part of contract.
7) Disseminate HICAHS health and safety materials where appropriate in Region VIII.
8) Provide access to agriculture health and safety expertise from HICAHS personnel to regional initiative and others as appropriate.

D. PROJECT START AND END DATES

September 15, 2003 to September 14, 2006

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

A major challenge to agricultural health and safety outreach in the high plains intermountain region is the diversity of operations and the long distances between communities. Regionalized education utilizing state extension agents and other agricultural stakeholders addresses these issues by increasing communication and collaboration between HICAHS and established networks of extension safety specialists and other agricultural stakeholders in the six state region. The agricultural extension model is one of the most successful in securing user's adoption of research results (Rogers, 1995). This integrated system consisting of university researchers, county extension

agents who work as change agents with rural populations, and extension specialists who link researchers to the county agents is instrumental in the innovation-development process.

Partnerships

Our established regional partners include the following Extension programs: Colorado State University Extension, Utah State University Extension, Montana State University Extension, South Dakota State University Extension, North Dakota State University Extension, and University of Wyoming Extension.
Each Extension program was eligible to receive up to $4,000 in seed money from HICAHS to develop and conduct health and safety projects in their respective region. The regional Cooperative Extension specialists and other agricultural stakeholders also provide a key route of dissemination of HICAHS educational materials such as articles and fact sheets. The projects conducted by the Regional Extension offices included enhancement of a Youth Farm Safety operator certification curriculum, hearing conservation education, conducting tractor safety school programs, improved methods to control dust exposures in livestock areas, and ATV safety courses to Native Americans. Based on feedback from the Extension Specialists and Agents, we have refined the project proposals and report summaries used by the Extension Programs. The refinements simplified the proposal process for the Extension programs and provided HICAHS better information to evaluate the proposals and project outcomes.

During the past year, we expanded our partnership base in order to provide greater dissemination of existing and new agricultural related health and safety information. Thus, we established new partnerships with agricultural associations, private enterprises, and insurance carriers in the state of Colorado. We have enhanced our research to practice efforts with presentations to our new partners which are listed below.

F. PROJECT PRODUCTS

[Please report the major project products for the fiscal year. Please delete category if nothing to report.]

1. Presentations: *[Please list]*

Small Group Presentations of Research Findings

1. Colorado Corn Growers Association and Colorado Association of Wheat Growers, Greeley, CO
2. Agland, Inc., Eaton, CO
3. Colorado Livestock Association, Ft Collins, CO
4. Pinnacol Assurance (Worker's Compensation Insurance), Denver, CO
5. Colorado Cattlemen's Association & Colorado Wool Growers Association, Aurora, CO
6. Colorado Agribility, Denver, CO
7. Flood and Peterson Insurance, Inc.

Conference Presentations

1. Brouha Physiology Symposium, Keystone, CO, Platform Presentation
2. Preister National Extension Health Conference, Lexington, KY (Poster presentation with conference proceedings).
3. Professional Conference on Industrial Hygiene, Denver, CO (Poster presentation with conference proceedings).
4. Colorado Injury Control Research Center, Ft Collins, CO (Invited presentation)

4. Conferences / Meetings Sponsored: *[Please list]*

Meetings with Operators and Farm Workers

1. Dairy Specialists, Inc., Evans, CO
2. Morwai Dairy, Hudson, CO
3. La Luna Dairy, Wellington CO

G. STATES THE PROJECT WAS ACTIVE IN

Colorado, Wyoming, North Dakota, South Dakota, Utah, Montana, and Kentucky

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE:

Development of Novel Biomarkers for Pesticides in EPA Region VIII

B. PRINCIPAL INVESTIGATOR:

John D. Tessari, PhD
Associate Professor
Department of Environmental & Radiological
Health Sciences
College of Veterinary Medicine & Biomedical Sciences

C. PROJECT DESCRIPTION:

The proposed research is intended to develop critically needed tools to develop novel biomarkers of exposure and address the following issues: (1) What is the relationship of biomarker concentrations with the intensity and duration of exposure in the receptor population? (2) What time domains of exposure are confidently assessed by specific biomarkers of the parent chemical, metabolites, or adducts. We intend that the results of this research could be used for future risk assessment model-building frameworks following standard methods that rely on current US EPA applications of mode of action for assigning the shape of the dose response curves and dosimetry (i.e. PBPK models)to support low-dose and interspecies extrapolation.
Specific Aims-

Aim 1: We will develop analytical methods for biomarkers of exposure (using

rodent hair and blood samples) to determine specific bound protein adducts of atrazine, and chlorpyrifos and their major metabolites to hemoglobin.

Aim 2: We will develop analytical methods for biomarkers of exposure (using rodent and human samples) to determine free residues of atrazine, chlorpyrifos and their metabolites in blood, brain, hair, saliva, and urine.

Aim 3: We will identify and characterize biomarkers of exposure to atrazine and chlorpyrifos by utilizing in-vivo techniques and laboratory studies in rodents.

D. PROJECT START AND END DATES:

Project Start Date: 09/15/03
Project End Date: 09/14/06

E. PROJECT ACTIVITIES/ACCOMPLISHMENTS:

During this time period our research focused on Aim 1 and 2 of the project. The only significant issues with conducting the proposed research was the graduated student that had been hired for this project made a decision to leave graduate school. Since we only review new graduate students once per year we were short handed in accomplishing the laboratory work. There were no other issues associated with the quality control/assurance and there were no changes in the scope or objectives of the stated project.

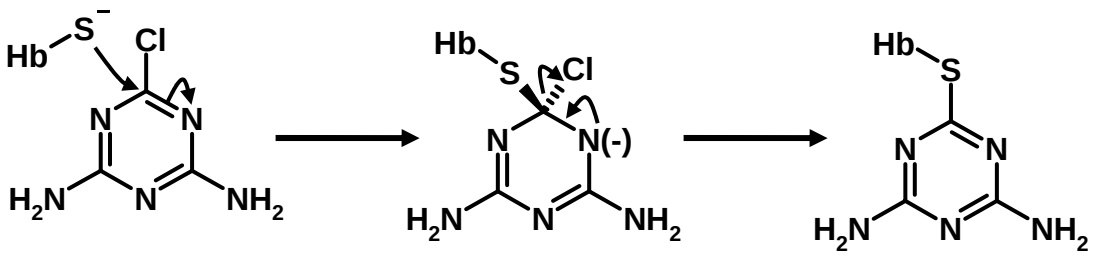
AIM 1 Hemoglobin Adducts:

In our experiments, we exposed SD rats to 0, 10,30, 100, and 300 mg Atrazine/kg/day for 3 days and blood drawn at 1h, 24h,72h, 20 d, 1m, and 2m. Globin was purified from red blood cells and the alpha and beta chains were separated with high performance liquid chromatography. HPLC analysis of globin samples from rats exposed to Atrazine showed a peak (B1) that eluted earlier than the two B peaks (B2 and B3) seen in control animals . This B1 peak was not seen in controls and was not seen at 0h or 2m for the exposed animals. The peak presented itself in a dose dependent increase that coincided with a dose dependent decrease in the B3 peak. This relationship was also seen over the course of the experiment. After 48h, the B1 peak was significantly increased from 0h, reaching a maximum at 10d and decreasing back to 0h levels after 2m.The B3 peak showed a significant decrease to 10d and returned to 0h levels at 2m. These data indicate the B1 peak is a modified version of the B3 peak where the modification caused a shift in chromatographic behavior that decreased the area of the B3 peak. The decrease in the first eluting B1 peak from 10d to 2m is likely due to red blood cell turnover (lifespan of 60d in rats) causing the modified B peak to be replaced, and subsequent increase in the B3 peak from 10d to 2m.

Mass spectrometry analysis of the B1 fraction showed a peak of 15,993 Da consistent with mass addition modification of the 15,869 Da B3 subunit. Tryptic digestion of the B1 and B3 HPLC fractions from rats exposed to 300 mg/kg were analyzed by mass spectrometry (MS and MS/MS)

followed by a MASCOT protein database search. Both fractions were identified as *Rattus norvegicus* hemoglobin B chain major form, with a protein sequence coverage of 83% and 91% for B1 and B3, respectively. However, the B1 digest was missing the peptide corresponding to amino acids 121-132 of this B chain. This peptide has a mass of 1340 Da and contains Cys-125, which has been shown by other investigators, to form a covalent adduct with xenobiotic chemicals. Others also showed that Cys-125 in hemoglobin from Sprague-Dawley rats was approximately 4000 times more reactive towards DTNB (5,5-dithio-bis-2-nitrobenzoic acid) than glutathione. Examination of the B1 digest spectrum in the region of 1400 Da to 1500 Da revealed a large peak at 1449.9 Da that was not present in B3 digest spectrum and is suggestive of the 1340 Da peptide with a 110 Da modification. This was consistent with our MS data for the whole globin that showed a peak 110 Da greater than the B subunits. Analysis of the MS/MS spectrum of the 1449.9 Da peak showed a fragmentation pattern which matched that of the known sequence for amino acids 121-132 with a 110 Da adduct on Cys-125. These results are very strong evidence that the B1 peak is a modified B3 peak with a 110 Da adduct from the Atrazine exposures. The B1 digests from all time points and doses indicate that the 1449.9 Da peak is readily detected with 30 mg/kg exposures at 72h and 10 days, and the highest adduct levels are seen in the 300 mg/kg dose group. This peak was also seen in one rat with 10 mg/kg exposure at 48h- 10 d, but this may be due to variability in the dosing regime or metabolic variability. The lowest reliable dose that produced the Atrazine adduct in this experiment was 30 mg/kg.

Phase I metabolism of Atrazine is cytochrome P-450 mediated with n-dealkylation at the ethyl or the isopropyl group to desethylatrazine or desisopropylatrazine. Additional n-dealkylation removes the remaining alky group forming DACT. Phase II metabolism is via glutathione conjugation resulting in nonchlorinated metabolites. The principal metabolite DACT is thought to be responsible for the *in vivo* hemoglobin adduct seen in this study. The absence of Atrazine adducts and adducts of desethylatrazine or desisopropylatrazine is likely due to rapid metabolism to DACT. McMullin et al. showed complete metabolism of Atrazine to DACT within 48h of a single 90 mg/kg/body weight Atrazine dose in SD rats. This adduct formation was confirmed with *in vitro* incubation of globin obtained from control rats and 90 ppm DACT. Tryptic digestion and MS/MS analysis of this globin indicated that Cys-125 is modified with a 110 Da mass addition following DACT incubation. The MS/MS fragmentation of the peak at 1449.6 Da seen in the DACT exposed globin was identical to that of the 1449.9 Da peak of the modified B subunit seen in the *in vivo* Atrazine exposures. This result clearly indicates the Cys-125-triazine adduct that forms *in vivo* with exposure to DACT. The proposed mechanism of the triazine adduct formation is via nucleophilic aromatic substitution. Only the chlorinated metabolites would provide a carbon center with partial positive charge favoring this nucleophilic displacement. Since a dechlorinated diaminoatrazine has a mass of 110 Da, the modified Cys-125 is hypothesized to have the structure shown below.



Although the chemical structure of this adduct was not positively identified, this is the most realistic option for an adduct of this size from Atrazine metabolism. This adduct research indicates exposure to Atrazine results in chemical interactions with cellular macromolecules and provides analytical model for detection of Atrazine adducts in other macromolecules with sulfhydryl function groups.

AIM 2: Free Residues for Atrazine and Chlorpyrifos:

Atrazine and 3 chlorinated metabolites:

We have developed novel analytical methods in blood, brain and urine for atrazine and its three chlorinated metabolites. All methods involve either liquid/liquid extraction or mixed mode cation exchange solid phase cleanup.

Blood: This analytical method for individual quantitative analysis of parent compound and chlorinated metabolites in plasma has a limit of quantitation (LOQ) < 100 ppb.

Brain: An analytical method for the determination of parent compound (atrazine) and its three chlorinated metabolites in rodent brain has been developed. Estimated limits of quantitation (LOQ) for each analyte are below 40 ppb.

Urine: Atrazine and its three chlorinated metabolites are eliminated in the urine. DACT is the major chlorinated metabolite eliminated in urine 24 hours after a single dose of atrazine. We have developed an analytical method using 1.0 ml urine, cleanup on polymeric mixed mode cation exchange solid phase extraction, and derivatization for gas chromatography/ mass spectrometry. Estimated method quantitation limits are 10 ppb for all metabolites.

Based on current limits of detection for atrazine and its chlorinated metabolites in each matrix, we anticipate considerable improvements in limits of quantitation after integration of a stable isotope of atrazine as internal standard

Chlorpyrifos (CPF) and 3,5,6-trichloro-2-pyridinol (TCPyr):

Our research focuses on the metabolic pathway of chlorpyrifos. We have developed new methods or modified existing techniques for cpf and TCPyr in human substrates of saliva, urine and whole blood. Cpf and TCPyr use dimethyl chlorpyrifos and 3,5-dibromo-2-pyridinol, respectively, as surrogates for quality control purposes.

Saliva: 0.5 ml saliva is acidified, salted and extracted with dichloromethane. Analytes are extracted simultaneously, and TCPyr is derivatized with BSTFA. At 1.0 ppb fortification, CPF is recovered at 86% efficiency with coefficient of variation 0.13 and TCPyr, at 10 ppb fortification is recovered at 90% efficiency with coefficient of variation of 0.18.

Urine: CPF and TCPyr are extracted separately in this method. Cpf is extracted from acidified urine using mixed mode cation exchange solid phase extraction. Recovery efficiency of 10 ppb fortified samples average 99% with a coefficient of variation of 0.12. TCPyr is recovered from acidified urine with a combination of initial extraction with 1-chlorobutane followed by cleanup on Phenomenex StrataX solid phase extraction and, and derivatization with BSTFA. Recovery of 1.0 ppb fortification was 80% with a coefficient of variation of 0.11.

Blood: As with urine samples, CPF and TCPyr are extracted separately from whole blood. CPF is under development and there is insufficient data to report at this point. TCPyr is extracted from acidified blood with 1-chlorobutane and further cleaned up on Phenomenex StrataX solid phase extraction followed by BSTFA derivatization. Recovery of 10 ppb TCPyr fortification is 72% with a coefficient of variation of 0.089.

Beyond these matrices, we plan research to recover free residues of CPF and TCPyr from human and rat hair.

F. PROJECT PRODUCTS

None

G. STATES THE PROJECT WAS ACTIVE IN

Colorado

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Endotoxin and Genetics in Organic Dust Lung Disease

B. PROJECT OFFICER(s)

Stephen J. Reynolds, Ph.D., CIH – PI
Environmental & Radiological Health Sciences
1681 Campus Delivery
Colorado State University
Fort Collins, CO 80523
(970) 491-3141
stephen.reynolds@colostate.edu

Dr. James Burch	Colorado State University	Co-Investigator
Dr. Thomas Keefe	Colorado State University	Co-Investigator
Dr. Niels Koehncke	University of Saskatchewan	Co-Investigator
Dr. David Schwartz	NIEHS	Co-Investigator
Dr. John Tessari	Colorado State University	Co-Investigator

C. PROJECT DESCRIPTION

More than 1,000,000 U.S. farm workers are at risk for occupational lung disease related to organic dust exposures. It is clear that Gram-negative bacterial endotoxin plays an important role, however key aspects of exposures and genetic susceptibility remain unknown. This project, building on current HICAHS research, will use a novel Recombinant Factor C (rFC) endotoxin assay in concert with mass spectrometry (MS) chemical methods to explore the role of endotoxin exposure and genetic factors in lung disease among corn dust workers. The specific aims of this project are to 1) characterize worker exposure to endotoxin-containing corn dust aerosols; 2) evaluate respiratory outcomes including symptoms, cross shift changes in pulmonary function, (PFT) and cellular/immune markers (cytokines); 3) survey genetic markers related to lung disease and endotoxin etiology (TLR4 gene mutations, and polymorphisms of IL1-RN, and TNF-alpha); 4) explore whether endotoxin assay or GC/MS is best predictor of biomarkers; 5) explore whether cellular/immune responses and PFT differ among those with different genetic status.

A unique aspect of this project is the ability to study endotoxin exposure, respiratory outcomes and genetic factors in a concerted multidisciplinary approach. This project involves close collaboration with the University of Utah ERC, Duke University, University of Saskatchewan (Institute of Agricultural, Rural, and Environmental Health), and NIOSH.

D. PROJECT START AND END DATES

September 15, 2003 to September 14, 200**6**

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Funds for this project were released from CDC/NIOSH on March 3, 2004 after the final IRB approval was received from the University of Utah. Significant delays were caused when the farm managers at the LDS Church declined to participate. In addition Dr. Lillquist left the University of Utah. A new faculty member who took over for Dr. Lillquist was unable to recruit any participants using alternative strategies. Kurt Church , research assistant on the project also left Utah. Since no subjects were recruited in Utah we plan on recruiting the majority of subjects from Colorado, but will also collaborate with Dr. Susanna Von Essen at the University of Nebraska to reach our goal. Recruiting in Colorado has been conducted with the assistance of the Colorado Corn Growers Association, Pinnacol Assurance, Colorado Livestock Association, and the Colorado Grain and Feed Handlers Association. 55 participants had been recruited in Colorado, when a key member of our team, Angelica Maria Serrano Martinez, M.D. had to return to Colombia for health reasons. We have hired staff to replace her, but this process also was delayed while waiting for CSU Office of Equal Opportunity compliance.

Results from the first 55 participants are reported here. Overall inhalable dust levels ranged from 0.59 to 76 mg/m3, while endotoxins ranged from 62 to 34,808 EU/m3. Exposures and respiratory outcomes differed by type of operation. At grain elevators (n = 20) inhalable dust and endotoxin exposures averaged 12 mg/m3 and 2,803 EU/m3 respectively. Exposures averaged 4.9 mg/m3 and 5,646 EU/m3 at cattle feedlots (n = 24), and 2.7 mg/m3 and 1,807 EU/m3 at dairies (n = 11). The rank order of endotoxin content per gram of dust was feedlots > dairies > grain elevators. In addition the make up of the endotoxins varied by operation. 3-hydroxy fatty acid content of endotoxins was dominated by C14 for grain elevators, C14 and C18 for feedlots, and C8 and C18 for dairies. Baseline FEV1 was lowest for dairy and grain workers. The mean cross shift change in FEV1 was - 3.1% to - 3.8% for all three groups. The cross shift change in FVC was greatest for diary workers (-3.8), followed by grain workers (-2.1%) and feedlots (-1.8). The most common symptoms reported included eye irritation (18 - 42%), nose irritation (18 - 50%), mucous (18 - 42%), and cough (16 - 30%). Symptom rates were higher among grain workers, and lowest among diary workers. While dust was correlated with endotoxin exposures, and symptoms were correlated with each other, exposures were not correlated with symptoms, FVC or FEV1. IL-8 in nasal lavage samples ranged from 24 to738 pg/ml. TNF alpha and IL-4 were non-detectable. Myleoperoxidase ranged from 4 to 88 pg/ml. Exposures did correlate with albumin. Most participants were homozygous for TLR4 299 and 399. Exposure, cross shift changes in pulmonary function, and symptoms differed by type of operation. Exposures to dust and endotoxin were extremely high in some cases.

We have now hired staff to replace Dr. Serrano Martinez, and have established collaboration with Dr. Von Essen in Nebraska to move forward on the remaining data collection for an additional 195 workers.

F. PROJECT PRODUCTS

[Please report the major project products for the fiscal year. Please delete category if nothing to report.]

1. Presentations: *[Please list]*

2004 Endotoxin and Organic Dust Lung Disease seminar. Department of Environmental and Radiological Health Sciences, Colorado State University, October 11, Fort Collins, CO.

2. Publications *[Only if applicable]*

a. Peer Reviewed Journal: *[Please list]*

Merchant JA, Naleway AL, Svendsen ER, Kelley KM, Burmeister LF, Stromquist AM, Taylor CD, Thorne PS, Reynolds SJ, Sanderson WT, Chrischilles EA. 2004. Asthma and farm exposures – a cohort of rural Iowa children. Environ Health Perspect DOI:10.1289/ehp.7240 December 7 (online version).

Reynolds SJ, Milton DK, Heederik D, Thorne PS, Donham KJ, Croteau EA, Kelly, KM, Douwes J, Lewis D, Whitmer M, Connaughton I, Koch S, Malmberg P, Larsson BM, Dedden J, Saral A, Larsson L. 2005. Interlaboratory Evaluation of Endotoxin Analyses in Agricultural Dusts – Comparison of LAL assays and mass spectrometry. JEM: 7, 1371-1377.

Reynolds SJ, Mehaffy J, Ragan JV, Tessari J, Keefe T, Milton D, Alwis U, Larsson L, Chen L. Evaluation and Optimization of a new rFC Endotoxin Assay using Agricultural Dusts. AJIM (submitted 2004) Reynolds, Dosman, Koehncke editors special edition.

d. Other Publications: ***[Please list]***

Reynolds, Dosman, Koehncke - Editors special edition of AJIM on Exposure to Endotoxin and the Lung. In press.

5. Other Products: *[Please list]*

Research protocol and questionnaires in English and Spanish shared with UC Davis and Tyler Texas Centers to plan related research.

As a result of interactions with producer organizations on this project the HICAHS outreach core is also now working with the Associations and with Pinnacol Assurance on a number of collaborative projects.

G. STATES THE PROJECT WAS ACTIVE IN

Colorado, Utah, Nebraska, North Carolina, West Virginia, Saskatoon Saskatchewan, California and Texas

III. CENTER PROJECT REPORT BY CORE / TYPE:

[Please provide the following information for each Center Project / Activity.]

A. PROJECT TITLE

Improving Injury Information from Migrant Farmworkers

B. PROJECT OFFICER(s)

Lorann Stallones
Department of Psychology
Colorado State University
Fort Collins, CO 80523-1876
Phone: 970 491-6156
e-mail: lorann@colostate.edu

Martha Soledad Vela-Acosta, M.D., M.S., Ph.D.

Ed Hendrikson, M.D.
Salud Clinics

C. PROJECT DESCRIPTION

Migrant agricultural farm workers experience increased injury and pesticide exposure compared to other farm workers. They are also less likely to report hazardous conditions or receive medical care when injured due to cultural and economic reasons. Because of these problems, culturally sensitive research adapted to this underserved population is needed which includes exposures, risk factors for injuries/illness and to gain more accurate information regarding the true rates of occupational injury/illness. The goal of this project is to improve collection methods of migrant farm workers work history including occupational hazards as well as occupational and motor vehicle related injuries. Studies are being conducted with Colorado migrant farm workers and non-migrating farm workers in Guanajato, MX to obtain in depth information about their cultural, social and health beliefs. Theories of disease, injury and health beliefs influence how people respond to interview questions and differences between migrant farm workers in Colorado and native Mexican farm workers will provide important information in understanding the best way to collect this data.

Specific Aim 1: To conduct ethnographic studies of migrant farmworkers in Colorado and

resident farmworkers in Guanajuato, México to uncover similarities and differences in theories of disease, injury, injury etiology, and prevention so that such information can be used to adapt interview techniques to ensure items are both culturally appropriate but also address the underlying socio-cultural factors. Guanajuato is selected because a majority of migrant farmworkers in Colorado originate from this state, thus differences in health and injury beliefs have important implications in designing programs whose goals are to improve the health and safety of this underserved population.

Specific Aim 2: To adapt an existing icon-calendar interview method based on information from ethnographic studies to obtain more detailed histories of acute occupational risks and injury experiences, as well as related socio-cultural factors, in Hispanic migrant farmworkers. Additional areas of enquiry will include motor vehicle travel, acute pesticide exposures and effects, injury risks at home, safety risk perception, and other factors influencing the adoption of protective behaviors.

Specific Aim 3: To conduct a cross sectional survey of 150 migrant farmworkers in Colorado and in Guanajuato, México using the modified icon-calendar technique to assess potential occupational exposures, injury risks, occupational diseases and injuries.

Specific Aim 4: To disseminate the research findings so that they may be incorporated in existing prevention and occupational health surveillance programs. This work will focus on partnering with the Center Education and Outreach Core, the Colorado Injury Control Research Center, and the Salud Family Health Centers as they have existing prevention programs in both Colorado and in Guanajuato that address migrant farmworker health needs.

D. PROJECT START AND END DATES

9/15/03-9/14/06

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

During the previous project period, pilot ethnographic interviews were conducted among 10 migrant farm workers in Colorado and 5 farm workers in Guanajuato Mexico. All interviews were conducted in Spanish and tape recorded. The interviews were transcribed and translated into English. The results were presented at a national conference in Denver in May, 2005. Based on the experience with the pilot study, we developed a qualitative approach to using a calendar to provide help with the ethnographic interview as a modification of the more traditional Icon-Life Events calendar approach.

Using the modified approach developed with the calendar and after creating a new list of prompting questions, we have completed a total of 94 interviews in Colorado and 25 interviews in Guanajuato Mexico. A total of 34 interviews have been transcribed in Spanish from audiotapes and the completed transcriptions are being translated into English.

F. PROJECT PRODUCTS

1. Presentations

Stallones, Lorann, Soledad Vela-Acosta, Martha, Bigelow, Philip. IMPROVED METHODS OF OBTAINING INJURY INFORMATION FROM MIGRANT FARMWORKERS. National Injury and Violence Prevention Conference. Denver, CO. May 2005.

Stallones, Lorann, Soledad Vela-Acosta, Martha, Bigelow, Philip. IMPROVED METHODS OF OBTAINING INJURY INFORMATION FROM MIGRANT FARMWORKERS. **To be presented at the Universidad Nacional Autónoma de Heredia, Costa Rica, February, 2006.**

2. Publications

a. Peer Reviewed Journal

Soledad Vela-Acosta, Martha, M.D., M.S., Ph.D., Chapman, Phillip, Ph.D., Bigelow, Philip L., Ph.D., C.I.H., Kennedy, Catherine, Ph.D., Buchan, Roy M., P.H., C.I.H. MEASURING SUCCESS IN A PESTICIDE RISK REDUCTION PROGRAM AMONG MIGRANT FARMWORKERS IN COLORADO

3. Education/Training/Outreach

f. Other

Pre/posttests used for evaluation of Pesticide Risk Reduction Program in Colorado.

G. STATES THE PROJECT WAS ACTIVE IN

Colorado, Texas, and Guanajuato Mexico.

IV. PROGRESS REPORT ON FEASIBILITY PROJECTS (AS APPROPRIATE)

Limited funds for Feasibility Projects were awarded only for the first year, but we used carry-forward funds for additional Feasibility Projects in Year 02. Request for Proposals for Feasibility Projects were distributed via the External Regional Advisory Board, to Health Departments, migrant health organizations, academic institutions and other organizations in Region VIII. Only a few external applications were received, possibly because of the small amount of dollars involved. It is also possible that lack of familiarity with the grants process played a role. The need to work intimately with the Extension Safety Specialists in each state to develop suitable proposals underscored this observation. Dr. Goodridge at the University of Wyoming used results from his Year 01 feasibility project to secure a major grant. Dr. Goodridge and Dr. Rosecrance are using results of Year 01 feasibility projects to prepare additional RO1 type grant submissions. Projects funded this year include: Exposure Injury Analysis: The effects of Atrazine on Luteinizing Hormone; Menstrual Cycles and Reproductive Patterns in Women Exposed to Atrazine'; High Speed Tractor Safety and Impact on Applicable ROPS; and

Validation of a Predictive Model for West Nile Virus Using Weather and Climate Data.

V. REPORT ON SPECIFIC IMPROVEMENTS IN AGRICULTURAL SAFETY AND HEALTH THAT RESULTED FROM CENTER ACTIVITIES (RESEARCH TO PRACTICE).

See Table 2 above.

VI. COLLABORATION

[Please list project collaborators, including other Centers, NOSH, other State or Federal Government Agencies, or other major project collaborators. Please list the names of any NIOSH collaborators directly involved in the conduct of the project.]

Agricultural Media organizations:
Ragan Adams, Publisher Colorado Dairy News (Article on needle sticks)
Shirley Roenfeldt, Managing Editor, Dairy Herd Management (article on manure safety)
Geni Wren, Editor, Bovine Veterinarian Magazine, Lenexa, KS (article on needle sticks)

Agricultural producer organizations:
Colorado Corn Growers Association
Colorado Livestock Association
Colorado Grain and Feed Handlers
Colorado Homestead Ranchers
Colorado Potato Growers
Colorado Wine Growers Association
The National Pork Board
Routt Country Woolens
Utah Grain and Feed Handlers Association
Church of Latter Day Saints, Salt Lake City, Utah
Jon Slutsky, La Luna Dairy, Wellington, CO

Agricultural Service/manufacturing
AgLand Incorporated
Gary Mills, Deere and Company
Monsanto Corporation
Pioneer Hy-bred International
SKC West Incorporated

Colorado State University:
Colorado State Bookstore
Colorado State Cooperative Extension
Colorado State University Alumni Association
Jessica Davis, Department of Animal Sciences
Peter Dorhout. Vice Provost for Graduate Studies
Robert Fetch, Extension, Agribility

Frank Garry, DVM, Professor, Director Integrated Training Program for Vet Medicine
Don Johnson, Department of Animal Sciences
Kathleen Kelley, College of Business
Kathleen Lynn, Policy Center (Organic Farming Study)
Noa Roman Muniz, DVM, Department of Clinical Sciences
Tracy Nelson, Department of Health and Exercise Science
Jeff Goodwin – Director of Colorado 4-H
David Van Meter, DVM, Department of Clinical Sciences
Bill Wailes, Extension Specialist and Department of Animal Sciences

University of Colorado (Boulder):

Kathy Mueller, MD
Lee Newman, MD (National Jewish Medical Research Center)
Jim Ruttenber

Farm Safety Organizations:
Marylin Adams, Farm Safety for Just Kids
Agricultural Safety & Health Network (ASHNET)
Tom Karsky, President National Institute for Farm Safety
Sheryl Skjolas, National Institute for Farm Safety
Bruce Stone, National Institute for Farm Safety

Institute for Agricultural Medicine, University of Saskatchewan
Dr. James Dosman, University of Saskatchewan and Director Institute for Agricultural Medicine
Shelley Kirychuck, MS, MBA, RN, University of Saskatchewan and Institute for Agricultural Medicine, Saskatoon Saskatchewan
Dr. Niels Koehncke, University of Saskatchewan and Institute for Agricultural Medicine

NIOSH
John Etherton, Morgantown
James Harris, Division of Safety Research, Morgantown, WV.
Greg Kullman, Morgantown
Max Lum, Washington, DC
John Meyers, Morgantown
Melissa Van Orman, Washington, DC
Teri Palermo, Morgantown
Paul Siegel, Morgantown

NIOSH Agricultural Centers:
Great Plains Center:
Dr. Wayne Sanderson, Director GPCAH
Dr. Kelley Donham, University of Iowa, IA, GPCAH
Murray Madsen, University of Iowa, IA, GPCAH
Dr. Patrick O'Shaughnessy, University of Iowa, IA, GPCAH
Dr. Risto Rautiainen, University of Iowa, IA, GPCAH
Dr. Peter Thorne, University of Iowa, IA, GPCAH

Northeast Center
John May, MD, Director NE Ag Center
Eric Hallman, PhD, Cornell University, Extension, NY

Western Center
Marc Schenker, MD, Director Western Ag Center
Paul Leigh, University of California Davis
Steve McCurdy, MD, Western Ag Center

Southeast Center
Robert McKnight, DrPH, Director SE Ag Center
Chike Anyaegbunam, University of Kentucky
Hank Cole, PhD, SE Ag Center
Alyssa Eckman, University of Kentucky
Susan Westneat, University of Kentucky

Great Lakes Center
Thomas Bean, EdD, Director, Great Lakes Ag Center
Jay Wilkens, PhD, OH NIOSH Ag Center (Micotil needle sticks issue)

Southern Coastal Center
Susan Gustke, MD, Director Southern Coast Ag Center
Judy Bernheart, North Carolina State University
Carrel Maxwell, East Carolina University
John Sabella, PhD, Director Southern Coast Ag Center
Michael Schulman, North Carolina State University
Julia Storm, North Carolina State University

Southwest Center
Jeffrey Levin, MD, Director SW Ag Center
Karen Gilmore, SW Ag Center
Torey Nalbone, PhD, SW Ag Center

Northwest Center
Richard Fenske, PhD, Director Pacific NW Ag Center
Marcy Harrington, NW Center
Helen Murphy, University of Washington
Eric Swenson, Pacific NW Ag Center

National Farm Medicine and National Children's Centers
Barbara Lee, RN, PhD, National Children's Ag Center
Steve Kirkhorn, MD, National Farm Medicine Center, Wisconsin (Micotil needle sticks issue)
Mark Purschwitz, PhD, National Children's Ag Center

United States Department of Agriculture
Brad Rein

Regional Cooperative Extension Agents
Mike Cavey, Extension Specialist, Montana
Jerry Langbehn, Extension Service, University of Wyoming
George Maher, Ag Safety Specialist, North Dakota State University Extension Service
Rhonda Miller, Ag Systems Technology & Education, Utah State University
Dick Nicolai, Farm Machinery & Safety Specialist, South Dakota State University

External Advisory Board
Greg Baxter, U.S. Dept. of Labor, OSHA
Del Chase, Lamar Community College
Jill Daily, Colorado Livestock Association
Kevin Dalsted, OSHA Consultation Director, South Dakota State University
Dan Fahrenholtz, MD, MBA, Northern Colorado Family Medicine
Paul Gunderson, PhD., Former NIOSH Ag Center Director
Bill Hammerich, Colorado Livestock Association
Ed Hendrikson, MD, SALUD Clinics
Kimi Jackson, Esq., Migrant Farmworker Legal Services
Burton Kross, PhD., Faculty Affiliate Environmental Health, Colorado State University
John Martyny, PhD, CIH, National Jewish Medical Research Center
Sherry Nestor, Cargill, Inc.
Del Sandfort, CIH, Director, Colorado OSHA Consultation
Doug Steele, PhD, Cooperative Extension Director, Montana State University
Mike Taylor, Manager, Health Safety, LDS Church, Utah
Mary Thoman, Cattle Rancher, Wyoming
Dianne Tobias, Director, Loss Prevention Services, Pinnacol Assurance
Joan Waldoch, Colorado Farm Bureau

Other:
Bill Hetzler, Nebraska DOL, FACE (Micotil needle sticks issue)
Dr. Lennart Larsson, Lund, Sweden
Dr. Dean Lillquist, University of Utah-ERC

Scott Matthews, Colorado Asthma Coalition
Mike Richer, Rocky Mountain AIHA
Scott Philips, MD, CO Poison Control Center (Micotil issue)
Pinnacol Assurance (Workers Compensation Carrier), Denver, CO
Dr. Susanna Von Essen, Omaha, NE

APPENDIX

I. TOTAL CENTER BUDGET FOR FY 2005

[Include as dollar amounts, by category, as listed below, for FY 2005.]

1. **Total NIOSH Expenditures: $850,468**

2. **In-Kind Contributions: $ 50,000 Salary and fringe, $ 13,104 indirect**

2. **Other Outside Funding: None**

II. CENTER PROJECTS / ACTIVITIES FOR FY 2005

1. **Ongoing Projects: 8** *# [Number only]*

2. **Projects Completed: 0** *[Please list by project title]*

3. **New Projects: 0** *[Please list by project title]*

4. **Feasibility Projects:** *[Please list by project title]*

Exposure Injury Analysis: The effects of Atrazine on Luteinizing Hormone

Menstrual Cycles and Reproductive Patterns in Women Exposed to Atrazine

High Speed Tractor Safety and Impact on Applicable ROPS

Validation of a Predictive Model for West Nile Virus Using Weather and Climate Data

III. CENTER INVESTIGATORS *[Number(s) only]*

1. **Scientific Investigators:** 15 *#*

2. **Program Support Staff:** 2 *#*

IV. CENTER PRODUCTS

[This would include tabulation of all products presented in Section II of this report, plus any more general Center products not listed as a part of a specific project in Section II.]

1. Presentations: *[Please list]*

Ayers, P. 2004. Continuous roll model evaluation for front drive mowers. Presented at the 2004 Outdoor Power and Equipment Institute (OPEI), Louisville KY, ASAE PM-52 Turf and Landscape Equipment Committee meeting September 25.

Ayers, P., X. Wang, R. Comer. 2004. Agricultural Vehicle ROPS Activities. Presented at the NIOSH Ag Centers and USDA Cooperative Extension Southern Region Farm Safety Symposium 2, Nashville, TN September 20-21.

Ayers, P. 2005. S547 TOPS for Front Drive Mowers. Presented at the 2005 Agricultural Equipment Technology Conference, Louisville KY, ASAE PM-52 Turf and Landscape Equipment Committee meeting February 15.

Buchan, V. *The Interactive Agricultural Health and Safety CD: 4-H Youth.* August 2, 2005. Western Regional 4-H Directors Conference, 8/1/05-8/3/05. Jackson, Wyoming.

Comer, R, Ayers, P. and X. Wang. 2005. Evaluation of Engineering Plastic for Rollover Protective Structures (ROPS) mounting. Presented at the 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL.

2004 Endotoxin and Organic Dust Lung Disease seminar. Department of Environmental and Radiological Health Sciences, Colorado State University, October 11, Fort Collins, CO.

2004 Evaluation of New and Traditional Methods in Measuring Agricultural Dust Particulates, student poster. Nakatsu J, Reynolds SJ, Tillery M, Keefe T, Thate R, O'Shaughnessy P. AIHA-Rocky Mountain Section 11th Annual OEH&S Conference, October 19-20, Golden, CO.

2005 Gravimetric and Endotoxin Evaluation of Size-Selective Sampling Methods Using Swine Dust in a Wind Tunnel. Reynolds SJ, Nakatsu J, Mehaffy J, Tillery M, Keefe T, Thorne P, O'Neill M, Metwali N, O'Shaughnessy P. AIHCE 2005, May, Los Angeles, CA.

2005 Particle Bounce and Endotoxin Levels in a Marple Cascade Sampler with PVC Filters. Kirychuk S, Koehncke N, Reynolds S, Nakatsu J, Mehaffy J. AIHCE 2005, May, Los Angeles, CA.

Seiz, R., Buchan, V. *The Interactive Agricultural Health and Safety CD: 4-H Youth.* September 22, 2005. Cooperative Extension Forum, 9/19-9/23, 2005. Colorado State University, Fort Collins, CO.

2005 Urinary pesticide levels in Iowa farm spouses and children. Curwin BD, Hein MJ,

Sanderson WT, Striley C, Heederik D, Reynolds SJ, Ward EM, Alavanja MC. Presented at the National Advisory Panel Meeting for the Agricultural Health Study, March 3-4.

X. Wang, Ayers, P. and R. Comer. 2005. Modification and Evaluation of Continuous Roll Prediction Model for Front Drive Mowers. Presented at the 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL.

Conference Presentations

Brouha Physiology Symposium, Keystone, CO, Platform Presentation

Preister National Extension Health Conference, Lexington, KY (Poster presentation with conference proceedings).

Professional Conference on Industrial Hygiene, Denver, CO (Poster presentation with conference proceedings).

Stallones, Lorann, Soledad Vela-Acosta, Martha, Bigelow, Philip. IMPROVED METHODS OF OBTAINING INJURY INFORMATION FROM MIGRANT FARMWORKERS. National Injury and Violence Prevention Conference. Denver, CO. May 2005.

Stallones, Lorann, Soledad Vela-Acosta, Martha, Bigelow, Philip. IMPROVED METHODS OF OBTAINING INJURY INFORMATION FROM MIGRANT FARMWORKERS. **To be presented at the Universidad Nacional Autónoma de Heredia, Costa Rica, February, 2006.**

Invited Presentations

2005 AIHA International Affairs Committee Response to the Tsunami. AIHCE 2005, May 23, Los Angeles, CA.

Colorado Injury Control Research Center, Ft Collins, CO. Rosecrance. "Colorado Dairy Injuries". November, 2005.

Connections with the High Plains Intermountain Center for Agricultural Health and Safety, Cooperative Extension Forum, 9/19-9/23, 2005. Colorado State University, Fort Collins, CO.

2005 ERHS graduate Seminar Series "Overview of the High Plains Intermountain Center for Agricultural Health and Safety," February 28.

2005 High Plains Intermountain Center for Agricultural Health and Safety. NIOSH Agricultural Centers Webinar (Internet) Series, February 16.

2005 NIOSH Agricultural Centers' National Agricultural Tractor Safety Initiative. 2005 CDC National Injury Prevention and Control Conference, May 19, Denver, CO.

2005 Overview of the High Plains Intermountain Center for Agricultural Health and Safety. University of Wyoming, Department of Animal Science Seminar, February 25, Laramie, WY.

Small Group Presentations of Research Findings

Agland, Inc., Eaton, CO
Colorado Agribility, Denver, CO
Colorado Cattlemen's Association & Colorado Wool Growers Association, Aurora, CO
Colorado Corn Growers Association and Colorado Association of Wheat Growers, Greeley, CO
Colorado Livestock Association, Ft Collins, CO
Flood and Peterson Insurance, Inc.
Pinnacol Assurance (Worker's Compensation Insurance), Denver, CO

2. **Publications** *[Break down as following]*

   a. **Peer Reviewed Journal: 13** *[Number(s) only]*

   b. **Trade Journals: 3** *[Number(s) only]*

   c. **Fact Sheets / Brochures / Technical Publications: 2** *[Number(s) only]*

   d. **Other Publications: 3** *[Number(s) only]*

3. **Education / Training / Outreach** *[Break down as following]*

   a. **Training Seminars**: 1 *[Number(s) only]*

   b. **Short Courses:** 0 *[Number(s) only]*

   c. **Hazard Surveys / Consultations:** 0 *[Number(s) only]*

   d. **Academic Training:** 0 *[Number of Students sponsored in Academic Degree Programs (Undergraduate & Graduate levels) and Number of Students graduated from Academic Degree Programs (Undergraduate & Graduate levels) during FY 2005.]*

   e. **News Letters:** 0 *[Number(s) generated]*

   f. **CD-ROMs or other Computer Based Training Programs: 1** *[Number(s) only]*

   g. **Other:** *[Please list]*

Agricultural Equipment Technology Conference, Louisville KY. February 13.

ASAE PM 23/2/2 ROPS Committee report on Revised Continuous Roll Model Evaluation. 2005 ASAE/CSAE ANNUAL INTERNATIONAL MEETING Tampa, FL. July 18

IOWA State Fair Webinar Presentation. ROPS Design and Testing for Agricultural Vehicles. August 16, 2005.

Liu J, Ayers P, Reynolds SJ. 2004. Feasibility Study to Mount Cost effective ROPS (CROPS) on Older Tractors. Research report submitted to James Harris, NIOSH Division of Safety Research, Morgantown, WV.

NIFS Tractor and Machinery Issues Committee report on ROPS Updates. 2005 National Symposium of Agricultural Health and Safety, Wintergreen, VA June 27

NIOSH Agricultural Safety and Health Centers – National Tractor Safety Initiative, January 2004. Co-Author with primary responsibility for section on Research.

Pre/posttests used for evaluation of Pesticide Risk Reduction Program in Colorado.

Reynolds SJ. 2004. Interview for article "Invest in Manure Safety Use this Checklist to learn how to keep employees safe when working around manure" in Dairy Herd Management.

4. Conferences / Meetings Sponsored: *[Please list]*

Meeting Organizer - Coordination Meeting for Collaborative NIOSH/Tractor Industry Research Activities to be held 12/07/05, Hyatt Hotel Pittsburgh Airport.

2004 Co-Organizer: Advanced Perspectives in Mold Prevention & Control. AIHA and ISIAQC. Las Vegas, Nevada, November.

Meetings with Operators and Farm Workers

Dairy Specialists, Inc., Evans, CO
La Luna Dairy, Wellington CO
Morwai Dairy, Hudson, CO

5. Other Products:

A draft Instruction manual for the next evaluation phase has been developed to be tested by the process evaluation.