ANNUAL REPORT

Fiscal Year 2004

Submitted by

John Sabella, EdD – Interim Director

Southern Coastal Agromedicine Center

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North Carolina

Southern Coastal Agromedicine Center

I. INTRODUCTION & EXECUTIVE SUMMARY

The Southern Coastal Agromedicine Center (SCAC) is based at the North Carolina Agromedicine Institute -- a collaborative initiative of East Carolina University (ECU), North Carolina Agricultural and Technical State University (NCA&TSU), and North Carolina State University (NCSU). The Center's service region includes Alabama, South Carolina, Virginia, Mississippi, Florida, Georgia, Puerto Rico, and the Virgin Islands, states/territories that face many common agromedicine issues related to climate, common crops, strong timber and commercial fishing industries, a common migrant stream, and endemic rural poverty. This is the SCAC's third year of funding.

The 17 projects of the SCAC include participation from ECU, NCA&T, NCSU, Virginia Tech, the University of Florida, the University of Alabama, Mississippi State University, N.C. Extension Service and The Ponce Medical School, Puerto Rico. Projects are listed on the Center Web site: www.ncagromedicine.org/scac. Many products and publications are beginning to emerge from these funded activities and are outlined in the body of this report.

Drs. Sabella & Bernhardt presented preliminary findings from the "Hydration Methods in Preventing Heat Disorders in Fieldworkers" study at the 2004 National Symposium on Agriculture Health and Safety.

Drs. Rose and Hodgson and associates at the NCSU School of Toxicology have presented findings from the RO1 research project "Human Metabolism of New and Emerging Pesticides" at the 43rd Annual Meeting of the Society of Toxicology. Dr. Gary Mirka and Associates from the NCSU Industrial Engineering findings from their ROI study "Ergonomic Interventions in the Agriculture Industry" at the July 2003 ASAE Annual International Meeting in Las Vegas, Nevada. This study has produced seven peer reviewed publications and seven equipment prototypes designed to reduce ergonomic strain and injury.

In 2004 the SCAC funded projects produced a significant number of educational products. The Timber Medic Certification Program produced a Timber Medic Curriculum CD-Rom for distribution of program participants. Additional, Dr. Tony Smith-Jackson, of Virginia Tech University produced a prototype Pesticide Brochure in Both English and Spanish as a product of her study "Cultural Ergonomics to Eliminate Pesticide Exposure".

The SCAC contributed funding and participated in the Southern Region Agricultural Safety and Health Symposium 2, in Nashville Tennessee, September 2004. The purpose of the meeting was to enhance cooperation and collaboration between the Southern Region

NIOSH Centers and Farm Safety Specialist in the Cooperative Extension Service.

In 2004, the SCAC initiated a Farm Equipment Safety Program Feasibility Study to make a needs assessment and costs for the development of a safety program for consumers after purchase of farm equipment. In additional the SCAC funded a pilot study as part of a Master Degree thesis entitled "Recycling and Disposal of Agricultural Chemicals and Waste Chemicals; A Study of the Influences and Attitudes Affecting Private Applicators in Coastal North Carolina".

The National Ag Safety Database team headed by Dr. Carol Lehtola at UF continued to expand upon their data base by adding five additional full length safety videos and numerous safety and health documents in both English and Spanish language.

A. CENTER ACCOMPLISHMENTS FOR FY 2004

1. Four discretionary projects were funded this year:
   - "Child Health Needs of Rural Alabama Latino Families", The University of Alabama, Birmingham, AL - Harrison
   - "Development of a Medical School Curriculum to Provide Knowledge and Training in Treating the Injuries/Illnesses Associated with the Agriculture, Fishing and Forestry Industries of Eastern North Carolina", East Carolina University, Greenville, NC – Malette
   - "Assessment of Minority Health & Safety in Selected Counties of North Carolina", NC A&T State University, Greensboro, NC – Ibriham
   - "The Development of New Tools to Study, Identify, and Prevent Ovarian Cancer", NC State University, Raleigh, NC – Moziak

2. Representatives of the SCAC served as consultants at the Third Annual Central American & Caribbean Congress of Agromedicine, for the establishment of a Central American Agromedicine Institute in San Pedro Sula, Honduras, July, 2004

3. The SCAC established an institutional relationship with the Honduran NGO, Red de Desarrllo Sustenible (RDS) to study and better understand the emotional and psychological effects of isolation from family and community suffered by migrant farm workers from Honduras who labor in North Carolina.

4. The SCAC established an institutional relationship with NCSU's "Center for Environmental Farming Systems" (CEFS) to engage in collaborative research in Health & Safety issues related to Organic/Sustainable Agriculture. Representatives of the SCAC and CEFS participated in the NIOSH funded conference "Cultivating a Sustainable Agricultural Workplace" September 2004 in Troutdale Oregon.

5. The SCAC is a collaborator with the High Plains Intermountain Center for

Agricultural Health and Safety's Tractor Safety proposal to develop a social marketing tool to promote the larger goals of the national initiative.

B. REGIONAL ACTIVITIES

1. States Served by Center:

- Virginia
- North Carolina
- South Carolina
- Georgia
- Florida
- Puerto Rico
- Alabama

2. States & Regions with Center Activity for FY 2004:

- Virginia
- North Carolina
- Florida
- Alabama
- Puerto Rico
- Honduras
- Uruguay
- Mexico

II. REPORT ON THE OUTREACH PROGRAM

In anticipation of the outreach funding for 2004, the SCAC organized on July 27th, 2004 a state wide forum for County Cooperative Extension Directors and Program Leaders to learn about opportunities for outreach activities related to agricultural health and safety between the SCAC and the Cooperative Extension service and its programs. The SCAC is currently accepting proposals from County Extension Directors and program leaders for funding outreach activities germaine to the SCAC mission. Additional, the SCAC has produced, in collaboration with RDS-Honduras, an educational DVD about Migrant farm workers and their alienation from their families and communities, for regional distribution to churches, NGO's and other organizations working with Migrant Farm worker health and safety concerns.

III. CENTER PROJECT REPORT BY CORE / TYPE:

A. PROJECT TITLE

Expansion and Maintenance of the National Agricultural Safety Database (NASD)

B. PROJECT OFFICER(s)

Carol J. Lehtola
Extension Agricultural Engineering Safety Specialist
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C. PROJECT DESCRIPTION

The goals of this project are: 1) to solicit, acquire and review materials for inclusion in the National Agricultural Safety Database (NASD); 2) to review materials in NASD for relevance and accuracy; and 3) to promote the use of NASD.

Editorial Review Board

Oversight of NASD content and review of new materials are provided by an editorial review board composed of agricultural safety specialists from a variety of institutions and from Canada as well as the U.S. These specialists provide a broad range of expertise to the NASD review process. The complete board is as follows:

Dr. Carol J. Lehtola (University of Florida), Chair
Mr. Glen G. Blahey, CSRP (Workplace Safety & Health Division, Manitoba Labour, Canada)
Ms. Sheri Burgus (Farm Safety 4 Just Kids)
Mr. Eric Hallman (Cornell University)
Mr. Murray Madsen (University of Iowa)
Dr. Chip Petrea (University of Illinois)
Ms. Laura A. Powell (Palm Beach Co. Florida Cooperative Extension)
Dr. Risto Rautiainen (University of Iowa)
Dr. Deborah Reed (University of Kentucky)
Dr. Julia Storm (North Carolina State University)
Dr. Roger Tormoehlen (Purdue University)

Statistics about usage of the NASD Web site indicate a significant increase in the number of people using NASD (see Table 1 below). Over the first three and a half years of the current project, unique users of NASD have tripled; perhaps more significantly, the number of repeat users has doubled, suggesting that the number of people who find NASD useful has increased.

The statistics give a limited picture of the users. Certainly, the majority of visitors are one-time visitors who click through to NASD from a search engine. The list of most visited pages reinforces the idea that the majority of these one-time visitors are members of the general public seeking specific information on general safety issues such as stress management, back injuries, and first aid for bee stings.

It is important too that NASD serve its primary audience, educators who deliver agricultural safety programming. The 67,000+ repeat visitors probably include these professionals. We have an indication that they do find NASD very important based on the voluntary user survey conducted in the early months of 2003 (results of this survey are available on the NASD Web site).

Table 1. Comparison of NASD Usage

Measure	1/2000–12/2000	7/2003 – 6/2004	Percent Increase
Total visits	497,572	911,807	83
Average visits per day	1,359	2,491	83
Unique visitors	257,545	751,436	192
One-time visitors	223,148	683,921	207
Repeat visitors	34,397	67,515	96

D. PROJECT START AND END DATES

September 29, 2003 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

F. PROJECT PRODUCTS

2a. Fact Sheets / Brochures / Technical Publications:

During the current year, approximately 190 publications have been reviewed, prepared for submission, and submitted to our technical contractor for addition to the NASD Web site. These publications comprise approximately 900 pages of new material. (See the 'What's New' section on the NASD Web site for a partial listing of new publications.) The technical contractor, Conceptual Arts of Gainesville, Florida, has supplied a complete list in their annual report.

New publications on NASD include a major series of tailgate training publications from Ohio State University; all of these publications are available in English and Spanish. Papers presented at the 2001 ASH-NET (Agricultural Safety and Health Network) Symposium, held in Baltimore, Maryland, have also been included. Total number of publications in the database exceeds 1800.

As the number of submissions to NASD has increased, so has the range of topics. This year, we expanded the topics considered on the NASD Web site in order to accommodate new submissions and to provide additional useful groupings of the NASD publications. Topics added include:

- Aquaculture
- Chemicals and Pesticides – Health Impacts
- Mental Health and Substance Abuse (Emphasis on Rural)
- Rural Health
- Special Populations.

2d. Other Publications:

The first aquaculture publications included a lengthy booklet title "Safety for Fish Farm Workers." It is available in both English and Spanish.

3d. News Letters:

NASD is frequently featured in the monthly newsletter, Safety News & Notes. This newsletter is developed by Dr. Carol Lehtola and is distributed to safety professionals and Extension agents nationwide. NASD materials are referred to in virtually every newsletter and special additions to NASD are usually the subject of feature articles. View Safety News & Notes on the Florida AgSafe Web site: www.flagsafe.ufl.edu.

5. Other:

Marshfield Collaboration

Work continued in 2004 with the National Children's Center for Rural and Agricultural Health and Safety (Marshfield, WI) on a project to evaluate all children's materials in NASD. Project workers used the NIFS Annual Meeting in Keystone, Colorado as an opportunity to meet and finalize the evaluation instrument and electronic review procedures. Materials and software have been assigned to reviewers and were distributed in mid September. Eighty children's resources in NASD will each be reviewed by several reviewers.

- **National Agricultural Safety Database (NASD) website**

Full-Length Videos Added

In 2003, the capability to view full-length videos was added to the NASD Web site along with the first video. In 2004, five more were added:

- "Rhythm of the Seasons: A Journey beyond Loss" (24 min; Florida Cooperative Extension Service);
- "Safety for Fish Farm Workers" (21 min; Catfish Farmers of America and Mississippi Cooperative Extension Service) in English and Spanish;
- "Cattle Handling Safety" (13 min; Oklahoma State University and Southwest Center for Agricultural Health, Injury Prevention, and Education); and
- "Livestock Safety for Kids." (11 min; Oklahoma State University and Southwest Center for Agricultural Health, Injury Prevention, and Education).

G. STATES THE PROJECT WAS ACTIVE IN

Available to all states via the web.

A. **PROJECT TITLE**
Expansion and Maintenance of the National AG Safety Database

B. PROJECT OFFICER(s)
Jeffery S Nelson/ Conceptual Arts, Inc.
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Gainesville, FL 32607
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C. PROJECT DESCRIPTION
AIMS: To maintain and expand the National Ag Safety Database website.

D. PROJECT START AND END DATES
September 29, 2003 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Coordination with NASD Project Director and NIOSH

Conceptual Arts has been communicating regularly with Dr. Carol Lehtola, another sub-grantee who is serving as NASD Project Director/Database Coordinator, and with several NIOSH representatives (Ms. Teri Palermo, Dr. Rick Neimeier, Mr. Chris Gjessing and Mr. Glenn Doyle).

Document Processing

- Abuso de Sustancias y Accidentes
- Agarrado o Atrapado Entre los Objetos de la Finca o "Farm"
- Agricultural Health & Safety Among Racial and Ethnic Minorities: Current Research and Perspectives
- An Overview of Air, Water, and Soil in Agriculture
- Arc Welding Safety
- Atrapado en el Granero o Silo Vertical
- Battery Safety
- Bloque y Cuna (calza)
- Bloquear o Aislar y Marcar con Etiqueta
- Cargadores de Horquillas o Plataforma
- Cargando en la Rampa y el Deposito
- Cattleman Dies Due To Accidental Injection (Nebraska FACE Investigaction # 03NE004)
- Caught-in or Caught-between Objects
- Chain Saw Safety
- Chock and Block
- Choosing Spray Nozzles
- Cold Weather Exposure
- Color Coding

- Colores Codigos
- Combine Fires
- Como Controlar el Estres
- Conocimientos Basicos de Electricidad
- Cortacespedes o Podadoras a Motor
- Descarga Electrica
- Dust and Mold
- Electrical Shock
- Enfermedades respiratorias
- Entender el Comportamiento del Ganado
- Entrada Restringida por Intervalos de Tiempo
- Equipo de Primeros Auxilios
- Equipo Protector de Pesticidas
- Equipos Para Mover Materiales
- Escoger Boquillas para Riego
- Estiercol Liquido
- Estres por Calor
- Estructura protectora de volcamiento (ROPS)
- Exposicion a Pesticidas
- Exposicion al Frio
- Exposicion al Sol
- Extinguidores de Fuego Portatiles
- Farm Family Emergency Response Instructor Tutorial
- Farm Pond Safety
- Farm Safety Issues in Old Order Anabaptist Communities: Unique Aspects and Innovative Intervention Strategies
- Federal Department of Transportation (DOT) Placarding
- First Aid Kits
- First on the Scene
- Fuegos o Incendios Combinados
- Gas Welding Safety
- Golpeado Accidentalmente
- Grain Bin Entrapment
- Grain Bin Hazards
- Grounding Electricity
- Guantes Protectores
- Guia de Materiales Peligrosos (GMP)
- Hand Signals for Agricultural Safety
- Heat Stress
- Helping Health Workers Learn
- Incendio en los Silos
- Introduccion a la Seguridad en la Agricultura
- Introduction to Agricultural Safety
- Irritantes de la Piel
- Lavado de Ropa Contaminada con Pesticidas

- Leer las Etiquetas de los Pesticidas
- Limpiar y Almacenar o Guardar las Mascarillas Apropiadamente
- Liquid Manure
- Loader Safety
- Loading Docks and Warehouses
- Lockout and Tagout
- Manejo seguro de amoniaco liquido (NH3)
- Mascarillas apropiadas
- Material Handling Devices
- Movimiento Repetitivo
- Neighbor Health and Large-scale Swine Production
- No Pasajeros en Podadoras o Equipos de la Finca
- No Riders on Farm and Lawn Equipment
- Older Farmers: Factors Affecting Their Health and Safety
- Orchard Ladder Safety
- Overhead Electrical Hazards
- Pancartas del Departamento Federal de Transportacion (DFT)
- Peligros con Cables de Alta Tension
- Personal Eye Protection
- Pesticide Exposure
- Pesticide Protective Equipment
- Pesticide-Contaminated Clothing Laundering
- Pieces of the Puzzle: Does Atrazine Affect the Risk of Cancer?
- Pieces of the Puzzle: Does Atrazine Affect the Risk of Cancer?
- Polvo y Moho
- Portable Fire Extinguishers
- Power Lawn Mowers
- Power Take-Off (PTO) Shielding
- Prevenir Caidas
- Prevenir Lesiones al Leventar y de Sobre Esfuerzo
- Prevenir Peligros Con Maquinaria
- Preventing Falls
- Preventing Lifting and Overexertion Injuries
- Preventing Machine Hazards
- Primero en la Escena
- Proper Use of Ladders
- Properly Cleaning and Storing Respirators
- Proteccion Contra el Ruido
- Proteccion de las Manos y los Dedos
- Proteccion del Toma Fuerza (PTO)
- Proteccion Personal de los Ojos
- Protecting Against Noise
- Protecting Hands and Fingers
- Protecting the Head
- Protective Clothing in Livestock Facilities

- Protective Gloves
- Proteger la Cabeza
- Que Hacer en Caso de ser Atrapado en el Granero o Silo Vertical
- Reading Pesticide Labels
- Remolcando Tanques con Amoniaco Liquido
- Repetitive Motion
- Respirator Fit
- Respiratory Diseases
- Restricted-Entry Intervals
- Riesgos en los Silos o Almacenadores Verticales de Granos
- Rociar Pintura
- Rollover Protective Structures (ROPS)
- Rotary Agricultural Mower Safety
- Safe Handling of Anhydrous Ammonia
- Safe Operation of Portable Circular Power Saws
- Safe Use of Flammable Liquids
- Safe Use of Hand Held Tools
- Safe Use Of Hand Pallet Trucks
- Safe Use of Harvesting Equipment with Cutterbars
- Safe Use of Hydraulic Systems
- Safe Use of Jacks
- Safe Use of Livestock Medications
- Safe Use of the Power Take Off (PTO)
- Safe Use of Tractors and Self-Propelled Farm Equipment
- Safely Starting and Stopping a Tractor
- Safety for Fish Farm Workers (booklet)
- Safety for Fish Farm Workers (brochure)
- Safety in Livestock Facilities
- Safety Means SMV (Slow Moving Vehicle)
- Saguridad con la Bateria
- Seguridad al Encender y Apagar el Tractor
- Seguridad al Zanjear y Excavar
- Seguridad con el Cargador o Montacargas
- Seguridad con la Escalera en la Plantacion
- Seguridad con la Motosierra de Cadena
- Seguridad con Soldadura Autogena
- Seguridad en Cortacesped Rotativos
- Seguridad en Lagunas o Estanques de la Finca
- Seguridad en los Lugares de Trabajo con Animales
- Seguridad en los Silos
- Seguridad en Soldadura por Arco o Electrica
- Seguridad para Trabajadores en la Producción de Pescado (brochure)
- Seguridad Significa SMV (Vehiculo de Movimiento Lento-VML)
- Señales con las Manos para Seguridad Agrícola
- Silo Fires

- Silo Safety
- Skid-Steer Loaders
- Skin Irritants
- Spraying Paint
- Stress Management
- Struck-By Accidents
- Substance Abuse and Accidents
- Sun Exposure
- The Material Safety Data Sheet (MSDS)
- The Respiratory Inflammatory Response to the Swine Confinement Building Environment
- Towing Anhydrous Ammonia Tanks
- Trabajando con Equipos Grandes de Pacas o Fardos Redondos
- Tractores y Seguridad en las Carreteras o Autopistas
- Tractors and Highway Safety
- Trenching and Excavation Safety
- Understanding Livestock Behavior
- Usando Equipos de Cosechar Heno con Seguridad
- Using Hay Harvesting Equipment Safely
- Using Surveys to Determine Language Needs
- Uso Apropiado de Escaleras
- Uso Seguro de las Carretas Manuales de Paletas
- Uso Seguro de las Herramientas de Mano
- Uso Seguro de Liquidos Inflammables
- Uso Seguro de los Equipos de Cosechar con Barras Cortadoras
- Uso Seguro de los Gatos Hidraulicos
- Uso Seguro de los Medicamentos del Ganado
- Uso Seguro de Motosierras Portatiles de Disco
- Uso seguro de sistemas hidraulicos
- Uso Seguro de Tractores y Equipos Agricolas Con Motor
- Uso Seguro del Toma Fuerza (Eje Rotante- PTO)
- Vestimenta Protectora en los Lugares de Trabajo con Ganado
- What To Do In Case Of Grain Bin Entrapment
- Where There Is No Doctor
- Women in Agriculture: Risks for Occupational Injury within the Contexts of Role, and Haddon's Injury Model
- Working with Large Round Bale Equipment

Online Videos added

- Cattle Handling Safety
- Livestock Safety for Kids
- Rhythm of the Seasons: A Journey Beyond Loss
- Safety for Fish Farm Workers
- Seguridad para Trabajadores en la Producción de Pescado (Safety for Fish Farm Workers)

Videos Abstracts added

- Defending Your Home and Property from Wildfires

Other additions

- 21 author and 13 organization contact pages were created.

G. STATES THE PROJECT WAS ACTIVE IN

Available in all states via the Web.

A. **PROJECT TITLE**
Tractor-related Farm Deaths

B. PROJECT OFFICER(s)
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(252) 744-1000
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C. PROJECT DESCRIPTION
The purpose of this study is to increase knowledge regarding fatal injuries on farms in North Carolina, with particular interest given to those deaths resulting from the occupation of farming. A study of tractor deaths, including those involving both full-time, part-time and non-farmers is included.

A. Specific Aims
The aims of this research project are to examine injury deaths on farm premises from 1998 through 2002 in order to:

- Establish the incidence of injury deaths occurring on farm premises (excluding homicide and suicide)
- Characterize those deaths that occurred in youths ages 16 and younger
- Establish the incidence of occupational agricultural injury deaths
- Characterize occupational agricultural injury deaths
- Establish the incidence of tractor-related injury deaths
- Characterize tractor-related injury deaths

D. PROJECT START AND END DATES
July 1, 2003 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:
A literature review of works related to tractor-related farm deaths published since 1992 was done. The research proposal for this study was submitted to the East Carolina University and Medical Center Institutional Review Board and was approved as UMCIRB #04-0220.

A request was made to the Office of the Chief Medical Examiner (OCME) for the State of North Carolina for a computer file listing cases meeting the broad definition of deaths on farms. Criteria used were:

- PREMISES of injury or death in one of these categories: farm and other rural land; farm utility buildings, farm lake, pond, or other body of water; farm, cultivated land or pasture; livestock pens; farm or logging road, non public

OR

- ICD-9 cause code = E9190

OR

- MEANS of DEATH in one of these categories: animals, farm tractor, other agricultural machinery

AND

- Excluding CAUSE of DEATH as homicide or suicide.

The numbers of cases listed for each year were:

1998- 136
1999- 152
2000- 156
2001- 173
2002- 78 Data entry into the OCME data base is incomplete at this time- Entries are made as coders have time; they are concurrently entering 2003 and 2004.

After receiving the file, deaths due to the following causes were removed without review of the files: alcohol, cocaine, combined alcohol and other, morphine, operative treatment, therapeutic drugs, and multiple drug toxicity and other drugs.

All other files were reviewed by the researcher and a graduate assistant in the OCME in Chapel Hill, North Carolina. (Deaths occurring in Mecklenburg County are handled by the Medical Examiner for that county and stored in county. A trip will be made to Charlotte to view these few files also.) Included in these files were the following causes of death: air transport, animals, asphyxia, bicycle, blunt instrument, carbon monoxide, catastrophic storm, drowning, electrocution, explosion, exposure, fall, falling object, farm tractor, fire/burn, gun, hanging, insect sting, jump, lightning, machinery excluding agricultural, motor vehicles, motorcycles, other, other agricultural equipment, scald, sharp/cutting, train, unknown, and, water transport. Experience in a previous study has shown that while many of these cases would be eliminated from further study, eliminating some of these categories without review would mean missing cases that should be included in the final data set.

Individual case files were pulled, examined, parts copied as needed, and reshelved. It was at this time that the determination was made as to whether a case was excluded from further study because it did not fit the aims of this study or retained as a part of the database for this research. If the fatal injury occurred in North Carolina the case was included even if the victim was not a North Carolina resident. If the death occurred in North Carolina but the injury occurred in another state, the case was not included.

In addition, it was decided that, as the largest category of deaths on farms received from the OCME included motor vehicle accidents (MVA), and that these files were going to be reviewed, consideration should be given to motor vehicle fatalities that potentially were related to the occupation of farming. Criteria were developed to use in determining which cases might have been related to farming from those that occurred to farmers but were not occupationally related or from those that occurred on a farm or in a rural area but were not related to agriculture. For a MVA to be considered as farmer occupational, the injury event must have included a victim who is identified as a full-time farmer, occurred on a rural road (one or two lanes), at a reasonable time of day for farm activities (depending on the month), and there must have been no other apparent reason to think the person was not doing agricultural work (ex. dark hours in winter months, small children in the vehicle, fleeing from police).

Found under the category of motor vehicle accidents were some reports of all terrain vehicle (ATV) deaths. These were included in the database if the injury event appeared to be related to farm work or if the victim could be characterized as a farm family member.

In each file the Report of Investigation by the Medical Examiner (RIME) and the Medical Examiner's Certificate of Death (MECD) were examined. When available, toxicology reports, autopsy reports, newspaper clippings, file correspondence, photographs and any other items in the file were reviewed.

For each case included in the database, the following information was gathered from the file, whenever available:

Case ID number
County of injury code
Premise of injury code
Age
Sex
Race
Hispanic origin
Type of death
Blood alcohol
Witness
Means of death
Job code
Industry code
ICD-9 cause code
Cause type- immediate
Cause type-underlying
Date of injury
Time of injury

Day of injury
Date of death
Time of death
Medical history
Area of body injured
Tractor
ROPS
Seat belt on tractor
Other farm equipment

For each case in the database, the following information was calculated or derived from the file, whenever available:

Survival time
Job category- (farmer full-time; farmer part-time; farmer non occupational; not farmer, occupational; not farmer, not occupational; farm family)
Type of tractor injury-(rollover; run over; road event tractor only; road event with other vehicle; other specific, including PTO)
Weather conditions
Activity at time of injury
Type of place injured
Tractor attachment in place at time of injury
Unsafe acts
Motor vehicle accidents
    Number of road lanes
    Outside/inside municipality
    Driver/passenger
    Valid driver's license
    Other

F. PROJECT PRODUCTS

6. Other
    - As the Principle Investigator became unexpectedly ill in April, 2004 and was able to work very little until October, 2004, the data collected have not been analyzed. It is anticipated that the OCME will complete data entry for 2002 in the next few months and additional cases from that year will be collected. Data analysis, interpretation and a written report of the findings will be completed by September 30, 2005.

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Human Metabolism of New and Emerging Pesticides

B. PROJECT OFFICER(s)

Randy Rose
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C. PROJECT DESCRIPTION

AIMS: To examine the role of specific human xenobiotic metabolizing enzymes in the metabolism of selected pesticides important to agriculture.

The specific aims are to:

1. Establish methods for analytical identification of all test compounds and their metabolites.
2. Determine metabolic pathways and rates of metabolism in human liver microsomes.
3. Determine substrate specificity of recombinant CYP or FMO isoforms relative to the test compounds.
4. Determine the importance of human polymorphisms in identifying populations and/or individuals at increased risk.
5. Examine potential for adverse pesticide interactions by induction of metabolizing enzymes in human hepatocytes using branched DNA signal amplification technology.

D. PROJECT START AND END DATES

September 29, 2003 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

During the course of this year, two manuscripts were accepted for publication. The first concerned the metabolic pathways for several organophosphate compounds and demonstrated the importance of CYP2C family in sulfoxidation reactions. The second characterized the metabolism of fipronil, demonstrating that nearly all the metabolism of this substrate was due to CYP3A4. Details of these studies are in the manuscripts listed below.

Carbofuran related studies were in the final stages at the commencement of this year. Previously, these studies indicated that carbofuran was metabolized primarily by CYP3A4, an enzyme important in metabolism of endogenous hormones including testosterone and estradiol. Our studies demonstrated that CYP3A4-mediated metabolism of carbofuran could be significantly inhibited by chlorpyrifos,

which is also metabolized by CYP3A4. Potential interactions involving CYP3A4-mediated metabolism of testosterone and estradiol were also investigated. Although carbofuran is capable of increasing the rate of testosterone metabolism, no interactions were observed for estradiol. A manuscript on carbofuran metabolism has been accepted for publication.

Previous work with permethrin, one of the most commonly used pyrethroid insecticides, indicated that microsomal and cytosolic esterases played a predominant role in pyrethroid metabolism by human liver homogenates. Since ester hydrolysis is known to be inhibited by substrates that are capable of interaction with acetylcholinesterase enzymes, two known acetylcholinesterase inhibitory pesticides (chlorpyrifos and carbaryl) were selected for further studies. Although chlorpyrifos did not inhibit permethrin hydrolysis, its oxidation product, chlorpyrifos oxon strongly and irreversibly inhibited permethrin hydrolysis at low concentrations. Carbaryl also inhibited permethrin hydrolysis, although concentrations necessary for inhibition were higher than those necessary for chlorpyrifos oxon. These studies have been summarized in a manuscript which is presently under review for publication.

Many efforts to further characterize the possible induction of metabolic enzymes in human hepatocytes have been pursued in the laboratory. Metabolic assays for demonstrating induction of specific isoforms using hepatocyte cultures have been developed for the characterization of CYP1A1, CYP1A2, and CYP3A4. Previously it was demonstrated that human hepatocytes are induced by pesticide concentrations of 50 to 100 µM using the branched DNA (bDNA) technique. Results obtained using CYP-specific substrates and western blotting have, in most cases, confirmed bDNA results. However, there are some cases where bDNA levels indicate significant induction of mRNA, while western blotting results indicate decreased protein levels.
Studies to understand these results are continuing.

Our efforts to explore induction in human hepatocytes are difficult due to the expense and difficulty of acquiring these tissues. We have initiated studies to determine if existent cell lines might be useful for exploration of cytotoxicity and dose responsiveness that can be used to streamline our use of hepatocytes. The THLE-3 cell line and Hep G2 cell lines have been established. Although one study had indicated that the THLE-3 cell line was inducible, we have been unable to replicate the study. Similar difficulties are being experienced with the Hep G2 cell line. However, we have utilized these cell lines to establish a dose response for the cytotoxicity of many of the pesticides we have examined during the course of these studies. In those cases where comparisons have been made to human hepatocytes, it appears that these cell lines have been useful as a guideline for dose responsiveness. Further studies in which transient expression of important CYP enzymes will be initiated.

F. PROJECT PRODUCTS

1. Presentations:

- In vitro metabolism of carbofuran by human, mouse, and rat liver microsomes, and human cytochrome P450 isoforms. K.A. Usmani, E. Hodgson, R.L. Rose. 43rd Annual Meeting of the Society of Toxicology, Baltimore, MD, March 21-25, 2004.
- Study of metabolic interactions of fipronil and some CYP3A4 substrates. J. Tang, A. Usmani, E. Hodgson, R.L. Rose. 43rd Annual Meeting of the Society of Toxicology, Baltimore, MD, March 21-25, 2004.
- Pesticide Metabolism in Humans and the Potential for Metabolic Interactions. R.L. Rose, K.A. Usmani, E.D. Karoly, Y. Cao, N. Cherrington, E. Hodgson. Agricultural Health and Safety Symposium. Keystone, CO, June 21-24, 2004
- In vitro metabolism study of carbofuran and its metabolic interaction with testosterone. K.A. Usmani, E. Hodgson, R.L. Rose. 7th International ISSX meeting, Vancouver, Canada, Aug 29 – Sept 2, 2004

2. Publications

a. Peer Reviewed Journal:

- In vitro sulfoxidation of thioether compounds by human cytochrome P450 and flavin-containing monooxygenase isoforms with particular reference to the CYP2C subfamily. K.A. Usmani, E.D. Karoly, E. Hodgson, and R.L. Rose. Drug Metab. Dispos. 32:333-339.
- In vitro metabolism of fipronil by human and rat cytochrome P450 and its interactions with testosterone and diazepam. J. Tang, K.A. Usmani, E. Hodgson, R.L. Rose. Chemico-Biological Interactions 147:319-329.

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Ergonomic Interventions in the Agriculture Industry

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

SPECIFIC AIM

The specific aim of this project is to develop and test ergonomic interventions for the reduction of the incidence and severity of musculoskeletal disorders among people working in the agriculture industry. The overall process involves 1) identification of high risk jobs/tasks, 2) ergonomic task analysis of these high risk jobs/tasks to identify the specific ergonomic risk factors seen in these jobs/tasks (this includes some basic biomechanical research to better understand the underlying mechanism of injury), 3) prototyping of ergonomic interventions for the reduction of exposure to these ergonomic risk factors, 4) laboratory assessment of the effectiveness of these solutions, 5) fabrication of field-ready ergonomic interventions, and 6) field evaluation of these solutions.

D. PROJECT START AND END DATES

9-29-2003 – 9-29-2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

(linked to journal pub)

- Published (in print, **C.1.a.(1)**) a study exploring the effects of lifting on sloped surfaces (forward-backward slopes).
- Published (in print, **C.1.a.(2)**) the basic biomechanical testing of the stooped posture used in harvesting sweet potatoes.
- Developed and revised a manuscript (in press, **C.1.a.(3)**) that documents the biomechanical risk assessment of commercial crab-pot fishing operations.
- Developed and revised a manuscript (in press, **C.1.a.(4)**) that documents the results of a laboratory study focused on strategies to increase likelihood of worker acceptance of ergonomic solutions.
- Performed a laboratory study to better understand the slip potential risk as farm workers perform repetitive lifting tasks on slippery ground surfaces. Developed a manuscript (in review, **C.1.a.(5)**) that describes this work.
- Performed a laboratory study to better understand the lifting technique employed by farm workers when lifting on laterally slanted ground surfaces (side to side

slanted surfaces, fundamentally different problem than 2 above). Developed a manuscript (in review, **C.1.a.(6)**) that describes this work.

- Performed a laboratory and field evaluation of two prototypes for the process of lifting a newborn calf for weighting and developed two preliminary intervention designs. Developing a manuscript (in preparation, **C.1.a.(8)**) that describes this work.
- On-going development of worker musculoskeletal surveillance systems. Developing a manuscript (in preparation, **C.1.a.(7)**) that describes this work.
- On-going evaluation of ergonomic and productivity data collected during field testing of two different systems for improving the ergonomics of pepper harvesting (both cart-based systems).

Project Tools

(1) Height-adjustable tobacco sorting table (wooden prototype)
(2) Height-adjustable tobacco sorting table (steel prototype)
(3) Tobacco conveyance system (both wet and cured tobacco system design)
(4) Beef calf lifting mechanism – lever system (functional prototype)
(5) Beef calf lifting mechanism – modified handle system (functional prototype)
(6) Pepper harvesting work method / cart mechanism (functional prototype)
(7) Sweet potato harvesting system (laboratory prototype)
(8) Tobacco topping handtool (laboratory prototype)
(9) Tobacco harvesting handtool (laboratory prototype)

F. PROJECT PRODUCTS

1. Presentations:

- Shin, G, T Costello, S Yu, Z Jiang, L Zheng and G Mirka, (2003) "Ergonomics of Harvesting Ground-Level Crops", 2003 International Ergonomics Association Meeting - Seoul, South Korea.
- Costello, T, G Mirka, and S Gustke, (2003) "A Multi-Method Approach to Agricultural Injury and Illness Surveillance" 2003 ASAE ANNUAL INTERNATIONAL MEETING - July 27 - July 30 2003 - Las Vegas, NV.
- Mirka, G, G Shin, Y Shu, Z Li, and T Costello, (2003) "Ergonomics of Harvesting from Ground Level", 2003 ASAE ANNUAL INTERNATIONAL MEETING - July 27 - July 30 2003 - Las Vegas, NV.
- Costello, T., C Mason, J Miranda, and J Sabella, (2003) "Using ergonomics in the prevention and treatment of occupational injuries among farm workers", 16th Annual East Coast Migrant Stream Forum, Westchester, NY, October 23-27, 2003.
- Costello, T. (2003) "Stretching and strengthening activities to prevent and reduce work-related muscular aches and pains", 16th Annual East Coast Migrant Stream Forum, Westchester, NY, October 23-27, 2003.
- Costello, T, G Floyd, and J Sabella, (2004) "Clinic-level Occupational Injury and Illness Surveillance Pilot project" National Symposium on

Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.

- Costello, T and G Mirka, (2004) “Work related musculoskeletal discomfort (WMSD) Prevention and care brochure, ” National Symposium on Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.
- Costello, T and G Mirka, (2004) “Ergonomic benchmarking of North Carolina Field crop production to guide intervention focus and prioritization, ” National Symposium on Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.
- Southard, S, J Freeman, J Drum and G Mirka, (2004) “Ergonomic Interventions for the Handling of Livestock”, 2004 ASAE ANNUAL INTERNATIONAL MEETING, Ottawa CANADA, August 1-4, 2004.

2. Publications

a. Peer Reviewed Journal:

IN PRINT

- Shin, G and GA Mirka, (2004) "The Effects of a Sloped Ground Surface on Trunk Kinematics and L5/S1 Moment during Lifting ", *Ergonomics*, 47(6): 646-659.
- Shin, G., Shu, Y., Li, Z., Jiang, Z. and Mirka, G. (2004) "Influence of Knee Angle and Individual Flexibility on the Flexion-Relaxation Response of the Low Back Musculature", *Journal of Electromyography and Kinesiology*, 14(4): 485-494.

IN PRESS

- Mirka, G, Shin, G, Kucera, K and Loomis, D, (In Press) "Use of the CABS Methodology to Assess Biomechanical Stress in Commercial Crab Fishermen", To Appear in *Applied Ergonomics*.
- Brandenburg, D and G Mirka, (In Press), "Assessing the Effects of Positive Feedback and Reinforcement Throughout the Implementation Phase of an Ergonomic Intervention", To Appear in *Human Factors*.

IN REVIEW

- Shu, Y, Drum, J, Southard, S, Shin, G and Mirka, G (In Review) “The Effect of Low Back Fatigue on Horizontal Ground Reaction Forces During Lifting”, Submitted to *Journal of Applied Biomechanics*.
- Jiang, Z, Shin, G, Freeman, J, Reid, S and Mirka, G (In Review) “A Study of Lifting Tasks Performed on Laterally Slanted Ground Surfaces”, Submitted to *Ergonomics*.

IN PREPARATION

- Southard S, Freeman, J, Drum J and Mirka, G (In Preparation) “Ergonomic Interventions Designed for Obtaining the Birth Weight of Beef Cattle Calves”, To be submitted to *Journal of Agriculture Safety and*

Health.

5. **Other Products**
   - Agricultural Job Task Ergonomic Survey Instrument (Costello)
   - Clinic Intake Form (Costello)
   - Work related musculoskeletal discomfort (WMSD) Prevention and care brochure (Spanish and English versions) (Costello)

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Factors Affecting Youth Decision-Making Concerning Agricultural Tasks

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

AIMS: This project examined the social relations that influence youth decision-making, and in particular their working relationships with agricultural employers, supervisors, and elder farm workers. It was exploratory in nature, designed to set the stage for a longer-term, larger research effort that employs more rigorous data collection and analysis methods across a larger geographical region. Its principal product was to be a larger proposal submitted to NIH; we have since submitted 3 such proposals, none of which were successful, and we will continue to submit more in the future.

D. PROJECT START AND END DATES

September 29, 2003 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

We have completed all research related to this project, including focus groups and interviews

F. PROJECT PRODUCTS

1. Presentations:

- "Immigration and Rural Health" Seminar given at Iowa State University, March 5, 2003.
- "Occupational health among youth in agriculture." ECU Agromedicine Center, NIOSH site visit, July, 2003
- "Work, Occupational Health, and New immigration into small U.S. rural communities." Rural Sociology Meetings, Montreal, Canada, July, 2003 and Metropolis conference, Vienna, Austria, October, 2003.

2d. Publications

- 3 research proposals: one on conditions of children in agriculture (with Aguirre International) and two on the use of alternative health care among rural workers.

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Farm Vehicle Public Road Safety

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

Aims: Understand driver, vehicle and environmental (public road and farm) characteristics that are associated with increased farm vehicle public road crash risk.

D. PROJECT START AND END DATES

September 29, 2004 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Data analysis including basic descriptive statistics completed. Multivariate statistical analysis progressing. Preliminary findings disseminated in reports and professional meeting presentations. Journal articles being drafted.

F. PROJECT PRODUCTS

1. Presentations:

- Costello, T., & Wogalter, M. Driver Attitudes, Beliefs and Reported Behavior Associated with Sharing Public Roads with Farm Vehicles. HFES 47th Annual Meeting, Denver, CO, October 13 – 17, 2003.
- Costello, T., & Schulman, M. Risk Factors for a Farm Vehicle Public Road Crash. 2004 National Symposium on Agricultural Health and Safety. Keystone Resort, Colorado, June 20-24, 2004, 2003.

2a. Publications:

- Costello, T., & Wogalter, M. (2003). Driver Attitudes, Beliefs and Reported Behavior Associated with Sharing Public Roads with Farm Vehicles. Proceedings of the HFES 47th Annual Meeting.
- Schulman, M.D. and Slesinger, D. (2004). "Health Hazards of Rural Extractive Industries and Occupations." Pp 49-60 in N. Glasgow, L. W. Morton, and N.E. Johnson, eds., Critical Issues in Rural Health. Ames, Iowa

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Skin Disorders in Commercial Fishermen

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

SPECIFIC AIM

- To hold educational/screening sessions in North Carolina, Maryland and Gulf Coast (Alabama/Florida) targeting commercial fishermen.
- To conduct a survey of commercial fishermen regarding their skin disorders.
- To develop and disseminate educational materials to educate commercial fishermen about the dangers of working on the water.

D. PROJECT START AND END DATES

September 29, 2003 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

1. Completed survey and analysis of data from survey for commercial fishermen in North Carolina, Virginia and South Carolina.
2. Continued in-person screening/educational sessions in Alabama (May 1-2, 2004).

F. PROJECT PRODUCTS

1. **Presentations**:
   - June 2004 → 2004 National Symposium on Agricultural Safety and Health (Keystone Resort, CO): "Skin Disorders in Commercial Fishermen" presented by Dr. David Griffith.

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Hydration Methods in Preventing Heat Disorders in Field Workers

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

Concerned by the increasing reports of heat related illness, researchers in this project are conducting a study to assess impact of different fluid intake protocols on the physiological health status of farm workers, primarily Hispanic working in produce and tobacco field operations in high heat conditions. The study builds on baseline assessment data collected through a grant funded by the United States Department of Agriculture in 2000-2002.

The research team is comprised of a nurse, a culturally competent bilingual interpreter, and a trained assistant for collecting physiological measures from each subject every two hours during the workday. An Industrial Engineering team member documents data related to heat load obtained from environmental instruments at three locations in the field. Physiological measures of temperature, pulse, respirations, blood pressure (supine and standing), and cognitive function are taken from each study participant at two-hour intervals throughout the workday. Observations regarding appearance (clothing worn, perspiration, etc.) as well as self-reported data such as foods eaten and hydration activities the night and morning before reporting to work are also recorded. Worker productivity is measured by tracking the number of buckets picked over the period of the workday.

Information gained from this study will be useful in identifying and incorporating best management practices in the field aimed at maintaining and/or improving workers' sense of well-being, their cognitive function, and their productivity. In addition, educational programs/materials based on findings of these studies potentially will benefit both farm workers and farm owners by promoting health, preventing heat-related illness, and increasing productivity. Final analysis of data and dissemination of the findings and development of eduational materials will continue occur during the first half of year 2005.

D. PROJECT START AND END DATES

October 1, 2001 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

- Met with potential growers to gain permission to have access to their farms and

field workers for the study

- Developed and prepared all job descriptions for the study field staff
- Calibrated all electronic environmental and medical measuring devices to ensure accuracy in the field
- A data analysis expert has been contracted to perform statistical analysis of current data and to ensure the database is consistant in preparation for 2004 assessments
- Recruited Heat Stress Team members for 2004 assessments
- Trained Heat Stress Team members on all phases of the assessment procedures
- Contacted farmers and gained assess to four farms for conducting 2004 Heat Stress assessments
- Upgraded and improved our study data base with the assistance of representatives of the Bio Statistics Department at ECU
- Completed all 2004 field assessments
- Worked with Bio-Statistical faculty at ECU to assist with the development of the data base

F. PROJECT PRODUCTS

Publications

- Assessing Heat Stress in Agricultural Field Workers, Edge Magazine, East Carolina University, August 1, 2004
- Heat Stress Study to Help Migrant Farm Workers. The East Carolinian, East Carolina University Student Newspaper, July 7, 2004
- Breaking a Sweat; ECU-based researchers near end of 4-year heat stress study. The Daily Reflector, Greenville, NC. August 9, 2004

Presentations

- Assessing Heat Related Illness in Field Crop Workers in North Carolina, Carol Maxwell Ph.D. 2004 National Symposium on Agricultural Health & Safety, Keystone, CO. June 11, 2004

STATES THE PROJECT WAS ACTIVE IN
North Carolina

A. PROJECT TITLE

Educating Agricultural and Health Practitioners about the Agricultural Health Study

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

- Specific Aims:

The Agricultural Health Study (AHS) is a large (90,000 participants), prospective cohort study of farmers and farm families in North Carolina and Iowa and is being directed by investigators from the National Cancer Institute, the National Institute of Environmental Health Science, and the Environmental Protection Agency, in collaboration with the National Institute for Occupational Safety and Health, Battelle Centers for Public Health Research and Evaluation in North Carolina and the College of Public Health at the University of Iowa. It is the largest epidemiological study of agricultural chemical exposures and potential adverse health outcomes conducted to date in the United States, and the only one that is prospective in design. Because the Agricultural Health Study is a landmark study of agricultural exposures and health outcomes, the investigators and collaborators of this education project, as well as the principal investigators of the AHS, think it is paramount that the agricultural community and the health care providers who serve them be fully informed of the findings of the AHS and their implications for work practices and preventive care. This education project (Educating Agricultural and Health Practitioners about the Agricultural Health Study) has received enthusiastic support for and cooperation from the scientists conducting the Agricultural Health Study.

The long term goal of this education and outreach project, Educating Agricultural and Health Practitioners about the Agricultural Health Study, is to increase the awareness, knowledge, and understanding of the Agricultural Health Study among the following primary audiences: the agricultural community, Extension educators, and rural primary health care providers. The overall objective of this project is to develop and disseminate educational materials and training, designed specifically for these audiences, in collaboration with AHS principal investigators, AHS field directors, and collaborating agricultural and health educators.

Specifically, the educational materials to be developed to meet these goals and objectives include:

- Print and on-line publications for the agricultural community and Extension educators summarizing and synthesizing the major findings of the Agricultural Health Study published through 2004,
- Presentations for the 3 major audiences: agricultural community, Extension educators, and rural health providers;
- A "frequently asked questions" document for lay and professional audiences in PDF format for on-line access,
- An interactive, online (web-based) feature called "ask the specialist" to facilitate answers to questions from the public by the AHS investigators, and
- Resources for Spanish-speaking agricultural workers.

The specific delivery and dissemination objectives of the project include:

- Delivering information and educational sessions, continuing professional education, and train-the-trainer sessions to agricultural and health provider audiences, primarily in the Southeast and, to a limited extent, throughout the United States;
- Posting materials for on-line access; and
- Sharing educational materials produced through this project with collaborators in Iowa.

Project tools:
FOR AGRICULTURAL COMMUNITY AND EXTENSION EDUCATORS:
Storm, J.F., W.G. Cope, W.G. Buhler, K. McGinnis. Understanding the Agricultural Health Study. A PowerPoint presentation with speakers notes. September 2004.

FOR HEALTH PROVIDERS:
McGinnis, K. A. Branigan, S. Gustke and J. Storm. Pesticide Related Illness and Health Issues, an on-line health provider continuing education course (funded primarily through other sources, but based on training developed through this grant; development version 8 produced September 2004; scheduled to go online in January 2005)

D. PROJECT START AND END DATES

October 1, 2001 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS

The major project products were reviewed, revised and published during 2004. Agricultural Health Study Executive Committee members were highly involved in the review of educational materials throughout their development and expressed enthusiastic support for these materials. Representatives of all target audiences reviewed educational materials and feedback was incorporated during the development of educational materials. Feedback on all educational materials was positive.

Presentations on the Agricultural Health Study were made on 8 occasions during the project period to audiences including Extension educators, pesticide regulatory

personnel, pesticide applicators (farmers and commercial applicators) and health and safety professionals from the United States and Canada. Overall, project outcome evaluation indicates a significant increase in awareness and knowledge among the members of these target audiences, with an overall increase in awareness of 89% (234 out of 264 training participants evaluated). It is estimated that 600 individuals, including Extension educators, other health and safety professionals, and agricultural community members were reached through Year 3 training sessions and educational presentations. A one-day in-service training for North Carolina Cooperative Extension Field Faculty (agents) responsible for pesticide applicator training in their counties was delivered on May 18, 2004. Educational materials developed through this project were introduced at this training. In addition, Principal Investigators and Study Coordinators for the NC Field Office of the Agricultural Health Study presented scientific findings from the study and served on a discussion panel. Funding acquired competitively from the NC Cooperative Extension Service provided travel funds for Extension agents to attend the training. Workshop evaluation showed that over 80% of attendees found resources beneficial and 87% increased knowledge as a result of the workshop. The PowerPoint presentation and other educational resources for agricultural audiences will continue to be delivered and disseminated to state pesticide safety education coordinators in the United States and to county Extension agents in North Carolina throughout the remainder of 2004 and beyond. In addition, the principal investigator of the project served on the Program Committee for the 1st Professional Development Conference, "Pesticide Toxicology and Risk Assessment" of the American Association of Pesticide Safety Educators (AAPSE) held June 9-10, 2004 in St. Louis, MO. The Agricultural Health Study was featured in this professional development course attended by about 30 Extension educators.

During 2004, grant funds from other sources were used to extend the educational resources for health care providers developed through this project (based on the on-site continuing medical and nursing education course entitled Pesticide Related Illness and Health Issues held in Greenville, NC on November 22, 2002 which offered 5 credit hours of continuing medical education and 6.1 hours of continuing nursing education). Pesticide exposure and chronic health effects findings of the Agricultural Health Study were incorporated into the course content. The one-day, on-site training was used as the basis for the development of a 3 hour on-line health provider continuing education course, with funding from other sources. The on-line course will be offered for at least one year for continuing education credit to health providers throughout the United States for a nominal charge (~$25) through the North Carolina Area Health Education Center (AHEC) Program's AHEConnect service beginning January 2005. Outside funding allowed for the development of a course addressing the full breadth of the pesticide health area, not just the chronic health findings of the Agricultural Health Study, considered the most effective way to meet the continuing education needs of busy health providers. Both courses were designed to fulfill objectives outlined in the National Pesticide Competency Guidelines for Medical & Nursing Education and the National Pesticide Practice Skills Guidelines for Medical & Nursing Practice published by the National Environmental Education and Training Foundation.

F. PROJECT PRODUCTS

1. Presentations

- Pesticide Exposure and Human Health, Julia F. Storm, Pesticide Applicator Recertification Training, Burlington, NC, December 3, 2003. (133 participants)
- Understanding the Agricultural Health Study (1993-2003), Julia F. Storm, Annual Meeting of the N.C. Aerial Applicators Association and Aerial Applicator Recertification Training, Williamston, NC, February 19, 2004. (41 participants; 93% response rate on evaluation; outcomes: 42% increase in awareness, 95% increase in knowledge and understanding)
- Communicating the Agricultural Health Study to the Agricultural Community, Julia F. Storm, Annual Meeting of the Agricultural Health Study National Advisory Panel, Bethesda, MD, February 26-27, 2004 (69 participants)
- Understanding the Agricultural Health Study and the Farm Family Exposure Study, Julia F. Storm, W. G. Cope, W. G. Buhler, R. McRackan, NC Cooperative Extension Long Range Plan Training, Raleigh, NC, May 18, 2004. (50 participants; outcomes: 87% increase in knowledge)
- Understanding the Agricultural Health Study, Julia F. Storm, Annual Meeting of the Southern Region Pesticide Safety Education Program, Asheville, NC, June 13-16, 2004 (40 participants)
- Educating Agricultural and Health Practitioners about the Agricultural Health Study, Julia F. Storm, W.G. Cope, W. G. Buhler, K. McGinnis, 2004 National Symposium on Agricultural Health and Safety, Keystone Resort, Colorado, June 20-24, 2004 (250 participants)
- Overview: Southern Coastal Agromedicine Center and NC Cooperative Extension Farm Safety and Related Projects, Julia F. Storm, Southern Region Extension/NIOSH Centers Joint Farm Safety Symposium, Nashville, TN, May 10-12, 2004 (35 participants)
- Understanding the Agricultural Health Study, Julia F. Storm, Southern Extension Research Activity -19 Rural Health Meeting, New Orleans, LA, October 13-15, 2004 (18 participants)

2c. Publications:

- Storm, J.F., W.G. Cope, W.G. Buhler, K. McGinnis. Understanding the Agricultural Health Study, Part 1: Overview. Publ. No. AG-MED-24. NC State University, North Carolina Cooperative Extension Service, Raleigh, NC. 6pp. September 2004.
- Storm, J.F., W.G. Cope, W.G. Buhler, K. McGinnis. Understanding the Agricultural Health Study, Part 2: Pesticide Exposure. Publ. Nos AG-MED-25. NC State University, North Carolina Cooperative Extension Service, Raleigh, NC, 8 pp. September 2004.
- Storm, J.F., W.G. Cope, W.G. Buhler, K. McGinnis. Understanding the Agricultural Health Study, Part 3: Health Findings Publ. No. AG-MED-26.

NC State University, North Carolina Cooperative Extension Service, Raleigh, NC, 6 pp. September 2004.

- Storm, J.F., W.G. Cope, W.G. Buhler, K. McGinnis. Understanding the Agricultural Health Study, www.extension.tox.ncsu.edu/aghealth

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Timber Medic

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

Aims: Since the inception of the Timber Medic program, safety and training issues were identified. The information confirmed the specific key training objectives to be addressed by the Timber Medic program curriculum. The revisions in presentation, photographs, illustrations and wording have enhanced these objectives in the curriculum. Brochures and flyers were distributed and five courses were presented during October 2003 through May 2004. Numerous community college and rescue-fire agencies have expressed interest in hosting a Timber Medic program. Potential instructors have expressed interest in expanding the course program throughout the State of North Carolina. The final program cycle saw an administration change within the NC Forestry Association, thus leaving a period of time with limited course promotion and delivery. The proposed Trainer-the-Trainer program for potential instructors was discussed but was not able to be completed during this final grant period. The shortage of instructors limited the number of courses that could be presented throughout the State of NC. The expansion of the Timber Medic program may continue with the monitoring of potential instructors and further promotion of the curriculum through the distribution of brochures and flyers to community colleges, fire and rescue agencies, logging firms, forestry agencies, and related conferences.

D. PROJECT START AND END DATES

October 1, 2001 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Final revisions of the curriculum; an educational track over viewing the Timber Medic course program was presented at the NC State EMS conference, EM Today, October 2003; five courses were scheduled and taught (Beaufort Community College, Stanley/Anson Community College, Alamance Community College, Ridgeway VFD and Vance/Granville Community College). A student CD-ROM was developed, reproduced, and mailed to 158 students who have completed the Timber Medic course program since its inception. A course evaluation and an instructor evaluation form was mailed to all course participates (158). Evaluations returned indicate the Timber Medic course program is “generally” to “very” interesting and helpful in increasing safety awareness and patient care.

F. PROJECT PRODUCTS

1. Presentations:

- Meetings Presentations: presented at the NC State EMS conference, EMT Today in October 2003

3e. Education / Traning / Outreach

- Project Products: Timber Medic Curriculum CD-ROM for the student (MS PowerPoint); Evaluations; Flyers (Brochures)

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Cultural Ergonomics to Eliminate Pesticide Exposure

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

AIMS: Specific Aim #1: Psychometric instruments assessing locus of control and self-efficacy will be used to compare risk perception of migrant and seasonal farm workers who are language and ethnic minorities to non-minority farm workers.
Specific Aim #2: To identify user-centered design guidelines for pesticide warning labels based upon the characteristics of ethnic and language minority groups and conduct a heuristic evaluation of the usability and effectiveness of the design guidelines.
Specific Aim #3: To disseminate design guidelines in the form of a warning design specification to employers, safety and training groups, minority-serving agencies, and community-based advocacy and education groups.

D. PROJECT START AND END DATES

October 1, 2001 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Specific Aim 1, all goals, and goal 1 of Specific Aim 2 have been completed. In total, half of specific aim 2 and all of specific aim 3 have yet to be completed.

The Cultural Ergonomics Project has completed Specific Aim 1 and has completed all of Specific Aim 2, with the exception of the Goal 1, which had to be terminated due to the project cycle ending on 9/29. The funds for the project in the initial budget period were allocated 5 months after the contracted time line, causing a loss of participants. Our participant base is highly nomadic, and due to seasonal migrations, we had to postpone data collection until the end of year 1 (when migrant workers returned to this region and we could use our limited travel funds to conduct data collection activities). In Specific Aim 2, due to the seasonal problems, we altered the order of events, such that the comprehension testing and prototype brochures and pesticide labels would be tested for comprehension before the elicitation procedure was done. We were driven by the need to recruit farm workers early in the farming cycle (spring of 2004) so that we would not get behind schedule during the migration season of early fall. Because funding ended in September, we were not able to travel during the harvest month of

October, which would have served as an ideal time for data collection.

With the gracious assistance of travel funds from the Agromedicine Center, we were able to travel to Jacksonville, Florida from March 19 – 21 with 3 additional undergraduate students. This trip supported our urgent need to collect data from Latino farm workers early in the Spring farming season. We collected data from 71 Latino farm workers and 7 African-American farm workers. The African-American farm workers were added to the project in order to at least pilot test the perspectives of a second ethnic minority group. The pilot data will be used to support further studies with African-American and Afro-Caribbean farm workers. In addition, NC State collected data from 48 white farm workers in the Wake and Durham county areas of NC. The data from Specific Aim 2 have not yet been fully analyzed; however, I have attached some of the qualitative data from interviews and some of the guidelines we used to develop test stimuli. Specific Aim 1 results were reported in the 2003 annual report, but are also attached to show the findings thus far. Total number of participants thus far = 136.

1. Completed Specific Aim 1 and analyzed data.
2. Developed test stimuli from SA1 results and guidelines developed from SA1 and literature review.
3. Completed comprehension testing of culturally centered prototype brochures and pesticide labels and usability testing of prototype prevention information.
4. Completed pilot interviews of 7 African-American farm workers.
5. Specific aims 2 and 3 are not completed
6. Searchable ACCESS Database to support culturally centered design of prevention information related to pesticides and label design.
7. Will require a 6 month extension beyond 9/2004 due to initial delays in project funds and data collection.

Initial time table in project proposal follows:

Objective/Aim	Activities	Effort in Months
1. Psychometric instruments assessing locus of control and self-efficacy will be used to compare risk perception of migrant and seasonal farm workers who are language and ethnic minorities to non-minority farm workers.	1. Develop and validate Spanish language versions of psychometric instruments. 2. Assess risk perception, locus of control, self-efficacy in minority and non-minority farm workers. 3. Assess effects on comprehension and intent to comply.	14
2. Identify user-centered guidelines for pesticide	1. Design elicitation instrument. 2. Identify guidelines.	13

warning labels based upon cultural needs and preferences.	3. Assess warning design effectiveness.	
3. Disseminate design guidelines through warning design specifications and educational tools.	1. Design guidelines using heuristic analysis and expert review. 2. Disseminate knowledge products.	9

We are in Objective/Aim #2 and are completing step 1 (steps 2 and 3 have already been completed). Objective/Aim #3 has not begun.
Products include:

1. Culturally centered information brochures in English and Spanish for farm workers. These will be based upon usability testing and are cognitively and socially valid for Latino farm workers.
2. Culturally centered prototypes of pesticide labels in English and Spanish for farm workers. These will be based upon usability testing and are cognitively and socially valid for Latino farm workers.
3. Specifications and guidelines to support further efforts to design culturally centered risk communications.
4. Data in the form of usability problems with existing prevention literature.

A final report identifying the factors associated with culture, hazard exposure prevention, and pesticide warning label design will be disseminated to various groups who impact exposure prevention and education. This report will consist of content explaining the factors, identifying those designs that are likely to have the greatest impact on prevention and knowledge of hazards, recommendations, and information on methods to apply to guidelines to the design of other risk communications. In summary, this research will produce recommendations for format and content of warnings and how to build on existing knowledge and attitudes when designing warnings.

The Cultural Ergonomics research team consists of the following individuals:

PI: Tonya L. Smith-Jackson, Ph.D.
co-PI: Michael S. Wogalter, Ph.D.
Graduate Research Assistant: Yvette Quintela, VT, Psychology
Graduate Research Assistant: Shanna Ward, NC State, Psychology

<u>Specific Aim 1 Summary:</u>
The preliminary research conducted so far includes 40 participants, 23 migrant farm workers and 17 European-American farm workers. The quantitative data so far have shown that migrant workers who work in pesticide usage environments are less likely than European-American to receive protective clothing and equipment from their

bosses. Also, proportionately more migrant workers do not receive training related to pesticide usage, which includes application, field reentry, health hazards, and prevention methods. More migrant workers reported nervous system exposure systems such as dizziness, edginess, and weakness. Surprisingly, migrant workers were aware of the risks associated with pesticide exposure. They reported significantly higher perceptions of risk compared to European-American farm workers. However, migrant workers also reported a significantly lower sense of control over preventing exposures. They reported less confidence in their ability to protect themselves. Significantly more migrant workers reported that they had no control over the level of their exposures and were more likely to believe that exposure was in the hands of their bosses.

We also acquired qualitative data from face-to-face interviews of participants in the same sample. Participants reported issues related to problems encountered in their farm work. Issues were content analyzed to isolate what we call "cultural critical incidents" (CCIs; Smith-Jackson, 2003) or safety-related incidents that arise because of cultural differences, including power relationships, empowerment, differing world views, and communication styles. Here are three examples of CCIs:

Migrant Worker: We work even when the wind is blowing hard and the pesticides are blowing through the air. We aren't told what type of pesticide is being used; usually we recognize it just by smelling it in the air.

Migrant Worker: I can't read the labels even though I would like to--they are all in English. I worry a lot about being exposed to pesticides. I want to be able to protect myself more and I wish the boss would treat us better.

Migrant Worker: Sometimes the wind blows pesticides on us from other areas that are being sprayed, but we do not stop working. My boss doesn't provide us with any protective equipment-- we have to buy it ourselves. It would be nice if my boss treated us better, by giving us some protection and looking out for our safety.

Our follow-up plan is to expand this pilot study by increasing the sample size. We are also designing more usable pesticide labels and educational brochures that will be tested in the field environment against the labels and brochures already available on products and provided by extension agencies and the EPA.

Specific Aim 1 Results Summary:

n = 23 Latinos, n = 17 European-American Farmers

1. Fishers Data
    i. Fewer Latinos can get all of the protective clothing and equipment needed if they ask for it. All EAs said "yes".
    ii. No differences on exposures
    iii. Proportionately more Latinos have not received any training
    iv. More Latinos work in tobacco.

v. More Latinos wear long pants, bathe after spraying,
vi. Fewer Latinos wear masks, goggles, or read pesticide labels
vii. More Latinos report dizziness, weakness, jumpiness, edginess
viii. More EAs report skin rashes, allergic reactions, upset stomach, excessive sweating
ix. More Latinos had more incorrect answers for symbol identification for symbol C (voltage). No other differences.
x. Fewer Latinos knew meaning of pesticide drift. Not other differences.

2. Ratings
   i. Latinos gave significantly higher risk perception ratings on pesticide effects on children, farm workers' experience with health problems due to pesticides, their own experience with health problems due to pesticides, and giving higher priority to work over their own health. Four of the 7 risk perception ratings were significantly different.
   ii. Only two of the locus of control items were significantly different. Latinos expressed lower control over the amount of pesticides they would be exposed to. Latinos expressed more agreement that their exposure depended on the supervisor or farm owner.
   iii. Self-efficacy differed significantly on 4 of the 7 items. Latinos expressed significantly lower self-efficacy for preventing exposures, getting advice on safe handling, using PPE, and using PPE in hot weather conditions.
   iv. Only one significant difference on behavioral intent. Latinos expressed stronger intent to wear gloves if labels tell them to wear gloves.

E. PROJECT PRODUCTS

1. Presentations:

- International Society for Occupational Safety and Health, Houston, TX, May 2004
- NC A & T State University, Greensboro, NC, November 2003
- Society for Risk Analysis, Washington, DC, December 2003
- American Society for Pesticide Safety Educators, June 2002

2a. Publications

- The 3-phases each have components that require comprehensive integration. We have not yet submitted manuscripts because the research is not complete.

2d. Other Publications

- Socially valid interview protocols and questionnaires to assess such variables as locus of control, pesticide-related symptoms, and use of personal protective equipment. These are in both Spanish and English.

5. Other Products:

- Web-based guidelines tool to design pesticide-related risk communications for Latino farm workers and other groups (prototype 1 is completed).
- A prototype (2nd iteration) pesticide brochure in both English and Spanish has been developed.
- Research-based negotiation script have been developed.

G. STATES THE PROJECT WAS ACTIVE IN

Virginia

A. PROJECT TITLE

Arthropod Allergens: Distribution and Mitigation Strategies to Reduce Cockroach Allergens in Swine Farms and Workers' Homes

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

Swine production is an important component of the agricultural economy of several States, including North Carolina. Cockroaches have long been recognized as the most important arthropod pests in swine production and severe infestations may contribute significantly to the maintenance and transmission of swine diseases. However, management of cockroach populations is severely constrained by many factors including cultural and production practices used at the farm, building design, and inadequate sanitation, as well as frequent re-introduction of cockroaches by workers and suppliers. In addition, regulatory restrictions on the types and classes of pesticides that can be used in such facilities frequently result in overuse of several broad- spectrum chemicals, increasing the potential for insecticide resistance to develop in the cockroach population German cockroaches have been shown to carry a number of pathogenic microorganisms, Including multi-drug resistant microbes, and cockroaches are a significant etiological agent in allergic respiratory diseases, especially bronchial asthma.

The overall goal of this project is to elucidate the spatial and temporal distribution of cockroach allergens in the confined swine production system. We also propose to evaluate mitigation strategies to reduce exposure of workers and their families to potentially harmful allergens that are known to cause asthma. The specific objectives are to (1) determine the spatial distribution of a major cockroach allergen, Bla gl, in cockroach-infested confined swine farms and in workers' homes, (2) determine temporal changes in its distribution in relation to animal production practices, and (3) determine the efficacy of German cockroach mitigation efforts on Bla. gl levels. The project will involve the coordinated efforts of entomologists and farm workers. Cockroach allergens will be collected in swab samples from surfaces, vacuum samples, and by air sampling, and an ELISA will be used to quantify Bla gl levels. Cockroach eradication and extensive power washes will be used to reduce Bla gl levels. This project constitutes the most comprehensive application of basic research to gain a thorough understanding of a harmful environmental allergen that contributes significantly to occupational morbidity. The link between occupational and residential exposure is a particularly innovative component of this project. The findings will result in innovative approaches for the control of cockroach infestations, reduction of environmental allergens associated with

them that are responsible for allergies and asthma and lessening the potential for transmission of pathogenic bacteria.

D. PROJECT START AND END DATES

July 1, 2002 - September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Determine the spatial distribution of a major cockroach allergen, Bla g1, in a cockroach-infested confined swine facility and in workers' homes.
Collected numerous samples by vacuuming and swabbing; developed procedures for air monitoring.

Determine the efficacy of German cockroach mitigation efforts on Bla g1 levels in swine farms and workers' homes.
Work is going well in the swine farm. It has been difficult to obtain access to workers' homes.

F. PROJECT PRODUCTS

None: Research Completed

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Development of an Off-Road Vehicle Data Acquisition System for Assessing the Influences of Vehicle Shock and Vibration on Operator Health and Safety

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

A Data Acquisition system will be developed to measure geo-referenced shock and vibration data from an agricultural tractor. Ti-axial accelerometers will be mounted on the front and/or rear axle and on the driver's seat. An ultrasound ground speed sensor will be used to monitor velocity. These sensors will be connected to a National Instruments Modular Signal Conditioning Carrier (MSCC). The carrier is equipped with nine ICP signal conditioners, one per accelerometer channel. A Differential Global Positioning System (DGPS) receiver will be interfaced to the serial port of the MSCC. LabView will provide a graphical users interface (QUI) to the data acquisition system; manage data acquisition and storage of ground speed, accelerometer signals and DGPS data stream.

An obstacle course will be constructed to simulate rough field terrain. The Tractor will be driven through the course at prescribed velocities while data is collected from the accelerometers, ground speed sensor and the DGPS. A position map will be created to mark the obstacles and provide a ground truth of known obstacles. Correlations can then be made between the known obstacles of varying magnitude and the measured shock and vibration events as a function of ground speed.
The development of this data acquisition system will serve two purposes. First, the system will be used as a teaching demonstration tool for undergraduate and graduate level. Secondly, it will be used for monitoring dynamic shock and vibration events and their effects on actual field equipment operation. Specifically, this system will be used in on-going research to evaluate the relationship between travel speed and obstacle magnitude, and their affect on operator safety due to acceleration events.
A. Specific Aims:

Shock and vibration can cause the operator (or passenger) to accidentally actuate controls or fall from an off-road vehicle. Also, long-term exposure to whole-body vibration can affect a person's health. A novel data acquisition system to measure geo-referenced shock and vibration events from an agricultural tractor is proposed. This system will then be used in on-going research to evaluate the effect of such events on operator health and safety. The specific objectives of this project are listed below.

1. Develop data acquisition software and hardware system for acquiring geo-referenced shock and vibration data. National Instruments' Lab View graphical programming language will be used in conjunction with a modular data acquisition and signal conditioning system, and a Differential Geographic Positioning System (DGPS) to geo-reference shock and vibration events.
2. Build a prototype vehicle obstacle course, which will introduce spatially varying shock events to vehicles as they transverse the course. Obstacles will consist of both repetitious and discrete events. The prototype course will use furrow and mound construction of various depths and heights to provide discrete events of varying intensity. A vibration track constructed of landscape timbers will be used to provide a known frequency excitation, which depends on the speed of the vehicle.
3. Conduct preliminary investigation into the shock and vibration relationships between the rear axle and the passenger seat. Additionally, acceleration magnitude levels and primary frequencies will be measured to determine the range of vibrations being experienced by the operator. All preliminary tests will be conducted at moderate speeds.

ABSTRACT
Shock and vibration can cause the operator (or passenger) to unintentionally actuate controls or evenfall from an off-road vehicle. Also, long-term exposure to whole-body vibration can affect a person's health. A novel data acquisition system to measure geo-referenced shock and vibration events from an agricultural tractor is proposed. This system will then be used in on-going research to evaluate the effect of such events on operator health and safety.
The data acquisition system consists of tri-axial accelerometers that are mounted on the rear axle and seat pad. They are connected to a National Instruments Modular Signal Conditioning Carrier (MSCC). The carrier is equipped with six ICP signal conditioners, one per accelerometer channel. It also contains six first order low-pass electrical filters that can cut-off any frequencies above 100 Hz. A Differential Global Positioning System (DGPS) receiver is interfaced to the serial port of a laptop. Lab View provides a graphical users interface (GUI) to the data acquisition system. It is used to manage data acquisition and store accelerometer and DGPS signals.
An obstacle course was constructed to simulate rough field terrain. The tractor was driven through the course at prescribed velocities while data was collected from the accelerometers and the DGPS. A position map was created to mark the obstacles and provide a ground truth of known obstacles. Correlations could be made between the known obstacles of varying magnitude and the measured shock and vibration events as a function of ground speed.

D. PROJECT START AND END DATES

June 1, 2002 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Agricultural machinery is used for a wide variety of road and field conditions. Uneven

road or soil profiles, in combination with driving speed and rotating machine parts, generate a wide variety of unwanted shock and vibrations (Clijmans et. aI, 1998). Off-road vehicles, especially tractors, cause vibrations that reduce the driver's comfort, augment noise level and can result in inefficient control of machinery. Some of these factors have contributed toward tractors being a leading cause of farm fatalities. Tractor-induced shock and vibration are not only a safety concerns, but also affect the health of the operator/passenger. ISO 2631 standard states that:

"Vehicles (air, land and water), machinery (for example, those used in industry and agriculture) exposes people to periodic, random and transient mechanical vibration which can affect with comfort, health and perception.

Vibration exposure can be of two types: whole-body vibration and hand-arm vibration (ISO 2631-1, 1997). ISO 2631 standards further add:

"Exposure to whole-body vibration causes a complex distribution of oscillatory motions and forces within the body. Whole-body vibration may cause sensations (e.g. discomfort or annoyance), influence human performance capability or present a health and safety risk (e.g. pathological or physiological damage)." Therefore, a study on the dynamics of off-road vehicles, especially tractors and their influence on health and safety, become quintessential.

This study addresses the development of a data acquisition system that not only analyzes shock and vibration from agricultural tractors, but also geo-references the shock and vibration data using a Global Positioning System (GPS). The objective of using a GPS system is to create a position map to mark the obstacles and provide a ground truth of the known obstacles. The development of such a data acquisition system will serve two purposes; first, the system will be used as a teaching demonstration tool for undergraduate and graduate students. Secondly, it will be used for monitoring shock and vibration events and their effects on actual field equipment operation. Specifically, this system will be used in on-going research to evaluate the relationship between travel speed and obstacle magnitude, and their effect on operator health and safety, due to acceleration events.

The dynamics of tractors have been studied for years. Two approaches are common: analytical approach and experimental approach. Authors, such as Freeland et aI. (1991), Smith (1997) and Davis (1983) have adopted the analytical method. Lines (1987) and Clijmans (1998) conducted their research on experimental techniques. ISO and SAE standards have studied the effect of shock and vibration on human health and safety. Authors such as Lehtola (1994) have suggested that one of the reasons for off-road vehicle fatalities is vehicular vibration. The works of some of these authors are reviewed in this section.

Freeland et aI., (1991) developed an experimental method and instrumentation system to measure the response of a lawn and garden riding tractor subjected to rear tire impact. One method was developed for non-rolling tires and another for a moving vehicle. For the non-rolling method, the front wheels were removed and replaced with two pillow block assemblies bolted to a concrete surface. The rear of the tractor was suspended above a smooth concrete surface using a woven-steel cable of 21 inches in length. A weight rack containing lead brick ballast weighing 200 lb was mounted on the operator's seat to simulate the combined un-sprung mass of both the seat and operator. The chassis of the test vehicle, outfitted with triaxially aligned accelerometers, was mounted in a laboratory

bump stand. The vibration spectra of individual tire designs were analyzed to determine impact and vibration differences. The energy absorption and deformation characteristics of three tire sets were measured. For the rolling method, the rear axle response was determined by allowing the vehicle to roll over a single curved bump constructed of PVC tubing. An extended bump pole that was loosely attached beneath the tractor dropped into a locked position onto the track surface prior to the arrival of the rear tires. This induced vehicle-frame vibrations whenever the front tires of the forward moving vehicle crossed a bump prior to the rear tires. The results indicate that the impact response of ten replications, of one tire set, in the vertical axis has a very high degree of repeatability. Discriminate analysis of the resultant acceleration curve statistics provided 100% correct classification among three tire models. The ten acceleration curves were averaged by time increments to generate a single curve that was used to identify points not responding to significant events. From this curve, it was concluded that tractor frame deflection and steering assembly free play prevented ideal one degree of motion (Freeland, 1991).
David W. Smith (1977) adopted an analytical method that uses a computer simulation program implementing a mathematical model of a tractor-cab-seat-system to study the effects on ride of a wide variety of design changes. The mathematical model uses Lagrangian dynamics to derive the differential equations of motion corresponding to the thirteen degrees of freedom that the model employs. A modification of the segmented tire model was used to predict the fore-aft and vertical spring forces at the center of each wheel. Models were also created to represent the terrain, the cab mount forces and the seat suspension forces. The computer simulation program implementing the mathematical model has three major sections. The first section requires the input data describing the chassis, front axle assembly, cab, seat and test track. The second section performs several calculations required for transforming input data to the form required by the remainder of the program, to determine the static equilibrium position of the entire tractor and includes a modal analysis that utilizes a linearized version of the mathematical model. The final section of the program performs the numerical integration of the equations of motion. The random terrain profiles represented by the National Institute of Agricultural Engineering (NIAE) smooth and rough test tracks were used as excitation sources for evaluating seat suspensions. The three-dimensional mathematical model implemented in the ride simulation program can thus be used to predict the time history of the fore-aft, lateral and vertical acceleration of any point on a tractor chassis, front axle assembly, cab or seat. Spectral analyses of these acceleration time histories provide the basis for a relative evaluation of the effect on ride due to design changes. The natural frequencies and corresponding mode shapes of the modes of vibration of the tractor-cab system provided insight into the resonances indicated by the spectral analyses (David W. Smith, 1977)

One of the research objectives pursued at the NIAE is to improve the ride characteristics of tractors in order to increase driver comfort and potential working speed. In that research, samples of standard signals, each defined by a series of displacement values, are used to drive an electro hydraulic vibrator for testing tractor seats. The displacement data are converted into analog voltages, which control a hydraulic piston. Different types of terrain and vehicle produce different types of vibration, and at present two such standard signals are used. These are known as the Class 1 and Class 2 signals. P.F. Davis (1983) describes

how the formula used for Class 1 and Class 2 signals were obtained by statistical analysis of a series of displacements used to represent the signals. Compact formulae to define these signals would be more convenient and preferable to particular samples. The aim in fitting a formula was to predict each displacement value as closely as possible in terms of those at earlier sampling instants. The unpredictable parts were then uncorrelated and had Gaussian distributions with zero mean values. Such varieties are sampled "white noise." Examples of the signal can be generated from such a formula by simulating the white noise with the aid of random numbers using a Gaussian distribution. The formula is then used to calculate the power spectra of the displacements and accelerations for Class 1 and Class 2 signals. The accuracy of the results obtained from a time series formula fitted to a sample would depend on the extent of the sample, as this determines the accuracy and statistical significance of the parameters. It is even more important to be able to establish how accurately such a formula applies to any tractor covered by classification 1 or 2. This investigation presumed that a standard track would be used in any investigation of the ride characteristics of a tractor; however, in normal use different types of terrain would be covered. The parameters in a time series formula can be allowed to vary with time according to some stochastic law, and such a variation could take account of variations in terrain (P.F. Davis, 1983).

2.2 Experimental Methods

lA. Lines (1987) describes two experiments in which measurements were made of the transfer function between the ground profile and the motion of an unsprung agricultural tractor by exciting one wheel with a signal that was independent of any signals at other wheels. In the laboratory method, a tractor was placed on a hydraulic test stand, which enabled each of its wheels to be independently vibrated in the vertical direction by a hydraulic actuator. Small diameter rollers covered the surface on which each of the wheels rested so that the wheels could be rotated. The vertical acceleration of the pads on which the wheel rested was measured and the acceleration of the tractor body was measured on the cab floor under the operator's seat in the vertical, longitudinal, lateral, roll, pitch and yaw directions. The results indicated that when the wheels were not rolling, the changes in the amplitude to the input of the wheels caused significant changes in the transfer function. When the wheels were rolling at 6 km/h, the natural frequencies were found to be 25% lower than non-rolling tires. No significant changes could be observed for natural frequencies between 6 km/h and 11 km/h. The transfer functions measured at 6 km/h show that the damping increases in the lateral roll and yaw directions, proportional to the rolling speed. Apparent decrease in damping in the vertical, longitudinal and pitch directions appear to be linked to the change in tire stiffness. In the test track method, a tractor was driven over a standard rough track with one wheel on the rough profile and the other three on relatively smooth concrete. The transfer function was measured between the second differential of the ground elevation under the tire and the acceleration in six directions on the cab floor under the driver's seat. The ground elevation was measured using an optical non-contacting displacement transducer. Measurements of transfer functions indicate results that were consistent with reduction of tire stiffness at the onset of rolling and show only a slow change thereafter. The apparent decrease in damping in the longitudinal and pitch directions in the laboratory method was not shown in these measurements. The

results showed a progressive decrease in damping with increasing rolling speed. The increase in damping for roll, lateral and yaw movements is only apparent in the field experiment results for the front wheel of the tractor (l.A. Lines, 1987).
Clijmans et aI, (1998) aimed to build structural dynamic models based on experimental observations and to apply the models for evaluating possible design changes. These design changes were proposed on the basis of a parameter sensitivity analysis carried out on the experimental models. The information from a sensitivity analysis would be used for the structural modification of the part. This can be done by adding masses or increasing the stiffness of the parts and then predicting their influence on the dynamics of the machine. The hardware components required for the experimental set up consist of an excitation source, generating input forces and response transducers. A vertical hydraulic shaker was constructed for the excitation. Acceleration response was measured by inductive accelerometers. The digital data acquisition system was a DIF A-SCADAS six-channel acquisition system. LMS CADA-X software controls the data acquisition, analysis of measured signals and visualization of mode shapes. The tests were performed on a conventional agricultural tractor with a total mass of 3840 kg that was excited with the vertical hydraulic shaker under the left rear wheel. A total of 35 measurement locations were chosen on the tractor, including the body, frame, cab, axles and the engine hood. The study was limited to a bandwidth of 0 to 50 Hz. The sampling frequency was 100 Hz and a number of samples equal to 1024 resulted in a measurement time period T of 10.24 seconds and a frequency resolution of 0.097 Hz. A set of equations to calculate the sensitivity of the natural frequencies, damping coefficients and mode shape coefficients of the machine to changes in inertia, stiffness and damping distribution was also developed. The summed frequency response function (FRF) of the tractor showed 10 distinct peaks between 0 and 20 Hz, each corresponding to a resonance frequency and a mode shape. A comparison of the synthesized FRF's of the modal model of the tractor for each response DOF with the measured FRF's yielded results that had high correlation coefficients (> 90%). The lowest frequencies were rigid body motions, while the higher frequencies corresponded to local deformations of some parts, including the cab and the motor hood. Results of the sensitivity study of the natural frequencies of the tractor to inertia and stiffness changes revealed that the nodal points are least sensitive for each mode shape. In the anti-nodes, the amplitudes can easily be reduced by structural modification. The results also showed that the modal models can be used to examine possible design changes and hence could be used for application of structural modification predictions (Clijmans, 1998).

2.3 Health Standards

There are two basic types of vibration exposure: whole-body vibration and hand-arm vibration. Whole-body vibrations introduced through the feet, buttocks and lower back are the most common for operators of off-road machinery. Whole-body vibration has been noted to cause permanent physical damage, such as ischemic lumbago, which affects the lower spinal region. Long-term exposure can affect a person's circulatory and/or neurological systems. Adverse symptoms associated with neurological disturbances can be fatigue, insomnia, headaches and "shakiness" (Bruel & Kjaer, 1998).
The International Standards Organization (ISO) recommended that the measure of

vibration in acceleration to be in meters per second or decibels. In addition to acceleration levels, the frequency of vibration and direction of excitation are very important in assessing the impact of shock and vibration on a human operator. The human body acts as a heavily damped system in which each organ has a unique natural frequency. When the body is excited at one part's natural frequency, the body will resonate over a broad range of frequencies. Consequently, a broad range of frequencies needs to be evaluated when determining body response to extended vibration exposure. The frequency ranges from 1 Hz to 80 Hz are most important for whole-body excitation, while the range from 5 Hz to 1500 Hz are of greatest interest for hand-arm vibration studies.

Vibration magnitudes should be measured along the three primary orthogonal axes, with the z-axis being designated as the longitudinal axis, which corresponds to the human head-to-toe axis. This axis is most susceptible to vibration frequencies in the range of 4 to 8 Hz, while lateral directions are most sensitive to the 1 to 2 Hz range frequencies. The ISO Dose System is used to determine the maximum exposure limits for a given acceleration level (weighted to critical frequency ranges) over a given exposure time. Consequently, the operator's repeated daily exposure to vibration in critical frequency ranges has a cumulative effect that can result in short-term fatigue and potential long-term health problems. The Society of Automotive Engineers (SAE) has developed a standard measurement system for measuring whole-body vibrations on equipment operators, consisting of independent orthogonal accelerometers embedded in a seat pad which can be placed on the operator seat or back.

ISO standards have also defined the methods of quantifying whole-body vibration in relation to health, comfort and perception (0.5 Hz to 80 Hz) and incidence to motion sickness (0.1 Hz to 0.5 Hz). Guides to the effects of vibration on health indicate that research has given evidence for an elevated risk of health due to long-term exposure with high intensity whole-body vibration that mainly affects the lumbar spine and the connected nervous system. A health guidance caution zone of 4 hours to 8 hours has been indicated. For exposures below the zone, health effects have not been clearly documented. In the zone, caution with respect to potential health risks is indicated. For exposures above the zone, health risks are likely. The guide to the effects of vibration on comfort indicates the likely reactions to various magnitudes of overall vibration values in public transport. Magnitudes less than 0.315 mls2 are not uncomfortable, 0.315 mls2 to 0.63 m/s2 a little uncomfortable, 0.5 m/s2 to 1m/s2 fairly uncomfortable, 0.8 m/s2 to 1.6 m/s2 uncomfortable, 1.25 mls2 to 2.5 m/s2 very uncomfortable and greater than 2 m/S2 are extremely uncomfortable. The guide to effects of vibration on perception indicates that there is a large variation between individuals in their ability to perceive vibration. When the medium perception threshold is approximately 0.015 m/s2, the interquartile range of responses may extend from about 0.01 m/S2 to 0.02 m/s2. The guide to the effects of vibration on the incidence of motion sickness indicates that there are large differences in susceptibility of individuals to the effects of low frequency oscillation. It has been found that females are more prone to motion sickness than males and that the prevalence of symptoms declines with increasing age (ISO 2631-1, 1997).

2.4 Safety issues

Lehtola et aI, (1994) investigated tractor-related injuries and fatalities in Iowa for a five-year period. The research showed that tractors resulted in 136 fatalities, accounting for 56% of the agriculturally- related deaths. The leading types of tractor incidents resulting in deaths were: overturns (55%), runovers (18%) and motor vehicle and tractor collisions (14%). Of the 24 deaths that resulted due to runovers, 9 deaths were due to operator falling off the tractor and 7 deaths were due to passengers falling off the tractor. All of the 7 tractor passenger runovers were children with an average age of 6.9 years. Also, based on an estimate of the Years of Potential Life Lost (YPLL), the three highest categories of tractor incidents were: overturns (52%), extra riders (13%) and tractor and motor vehicle collisions (11 %). Tractor-related injury analysis speculates that shock and vibrations can cause the operator (or passenger) to unintentionally actuate controls or even fall off the tractor. It is a common practice in farm tractor operations for passengers to ride and stand on the tractor at various locations other than the operator seat. Common sitting locations are on the tractor fender and operator seat armrest, while common standing locations are on the draw bar, PTO cover, three-point hitch, platform steps or even on the operator platform next to the driver. These practices can create a hazard for operation of the vehicle and safety of both operator and passengers. The research recommends installing Rollover Protective Structure (ROPS) on all tractors, using seat belts with ROPS equipped tractors and enforcing the "NO EXTRA RIDER" rule to prevent the tractor-related fatalities (Lehtola et aI., 1994).

2.5 Objectives

1. Develop data acquisition software and hardware system for acquiring geo-referenced shock and vibration data. National Instruments' LabView graphical programming language will be used in conjunction with a modular data acquisition and signal conditioning system, and a Differential Geographic Positioning System (DGPS) to geo-reference shock and vibration events.
2. Build a prototype vehicle obstacle course, which will introduce spatially varying shock events to vehicles as they transverse the course. Obstacles will consist of both repetitious and discrete events. The prototype course will use furrow and mound construction of various depths and heights to provide discrete events of varying intensity. A vibration track constructed of landscape timbers will be used to provide a known frequency excitation, which depends on the speed of the vehicle.
3. Conduct preliminary investigation into the shock and vibration relationships between the rear axle and the passenger seat. Additionally, acceleration magnitude levels and primary frequencies will be measured to determine the range of vibrations being experienced by the operator. All preliminary tests will be conducted at moderate speeds.
4. Development of Data Acquisition System

The Geo-referenced Data Acquisition System (GDAQ) was developed to measure the geo-referenced shock and vibration from an agricultural tractor. This section will describe in detail the various components of the GDAQ system. This will be followed by a discussion on the layout of the GDAQ system used for the laboratory and field tests. Further, a brief description of the obstacle course will be provided. Finally, an overview of the Graphical User Interface (GUI) used to 'capture, analyze and present the data is provided.

3.1 Components of the Data Acquisition System

The GDAQ system consists oftri-axial accelerometers that are mounted on the rear axle and seat pad. They are connected to a National Instruments Modular Signal Conditioning Carrier (MSCC). The carrier was equipped with six ICP signal conditioners, one per accelerometer channel. It also contained six first order low-pass electrical filters that could cut-off any frequencies above 100 Hz. A Differential Global Positioning System (DGPS) receiver was interfaced to the serial port of a laptop. LabView provides a Graphical Users Interface (GUI) to the DAQ system.

3.1.1 Accelerometers

The sensors were mounted to correspond with the operator's primary orthogonal axis. The sensitivities for the x, y and z axes (rear axle and seat pad) are provided in Table 1.

(left) Table 1: Accelerometer Sensitivity

Axis	Sensitivity-Rear Axle (mv/g)	Sensitivity-Seat Pad (mv/g)
X	99.8	102.3
Y	95.8	109.1
Z	98.8	96.8

3.1.2 Modular Signal Conditioning Carrier (MSCC)

National Instruments MSCC provides portable, modular signal conditioning to the GDAQ system. The SCC Data Acquisition system consists of an SC-2345 Series shielded carrier, SCC modules, a DAQCard-6024E device and a cable. The SC-2345 shielded carriers are shielded enclosures for the SCC signal conditioning modules that connect directly to 68-pin E Series DAQ devices. The carrier also contained six first order low pass electrical filters. The SCC signal conditioning modules are dual-channel modules that condition analog or digital channels. The DAQ-6024E is a PCMCIA card which has 16 analog inputs, 2 analog outputs at 12 bit accuracy, and is capable of 200 kS/s. The cable that connected the SCC carrier and the DAQ card was a SHC68-68-EP cable 0.5 meters in length.

3.1.3 Filters

Frequency ranges from 1 Hz to 80 Hz are the most important for whole-body excitation (1S0-2631-1, 1997). Hence, low pass electrical filter modules with a cut-off frequency of 100 Hz were custom built for the MSCC.

3.1.4 Differential Global Positioning System

The type of receiver used for obtaining the ground truth of known obstacles is a Trimble differential AgGPS receiver. It has a sub-meter accuracy « 3.28 feet) and 0.1 mile-per-hour velocity accuracy through NMEA0183 and TSIP (Trimble Standard Interface Protocol) messages. The data from the GPS is projected onto Arc View to

mark and provide the ground truth of known obstacles. Correlations can then be made between the known obstacles of varying magnitudes and the measured shock and vibration events as a function of ground speed.

Acquisition System

The layout of the GDAQ system shows that the rear axle accelerometer and the seat pad accelerometer are connected to the MSCC. The MSCC was connected to the DAQ card using the SHC68-68-EP

Experiments were conducted in the laboratory and in the field to analyze the shock and vibration data from an agricultural tractor. The type of tractor used in all the experiments was a John Deere 6410. All of the tests were performed three times to ensure repeatability. In the laboratory tests, vibration analysis was run on a stationary tractor idling at the maximum rpm (2500 rpm). Separate tests were performed for the rear axle accelerometer and the seat pad accelerometer. During the tests conducted with the seat pad accelerometer, a human subject was asked to sit on the seat pad to simulate real-time situations. The subjects used in this study had approximately the same weight to ensure seat pad accuracy.

The laboratory tests also included experiments on a tractor rolling at 2500 rpm on an asphalt pavement.

Low, medium, and high speeds were used to understand the significance of speed on tractor vibration. The time taken for the tractor to roll a distance of 100 feet was noted using a stop watch.

Field tests were conducted on an obstacle course (described in the previous section) that was constructed on an agricultural field at the University of Florida. Similar to the rolling tests, all of the field tests were conducted for three different speeds (low, medium and high). The traverse of the tractor over the various tracks and berms were treated as a single test run with a continuous data stream being collected for the entire run. Specific data segments were isolated in the record using the GPS position as related to the physical obstacle locations on the test track. Three repetitions were performed at each speed to ensure repeatability.

4.2 Results and Discussion

Stationary Tests: The sampling information used to perform the analysis is provided in Table 2.

Table 2: Input data for the stationary tests

Input	Rear Axle	Seat Pad
Sample Rate (Hz)	3000	3000
No of Samples	1024	1024
Frequency Resolution (Hz)	2.92985	2.92985
Time Record (ms)	341.33	341.33

It can be seen from the rear axle plot that one of the main frequency components of engine-induced vibration is at 40 Hz. It is interesting to note that in the seat pad plot a harmonic appears at 80 Hz, which is likely a result of the seat mounting system.

Rolling Tests: The tests were conducted for three speeds (low (A2), medium (A4), high (B2)). The sampling information used to obtain the data for the rolling tests is shown in Table 3. The small percentage of error in the time observed can be attributed to the perception-coordination error that occurs in human beings when operating a stop watch. Table 3:

Input	Rear Axle	Seat Pad
Sample Rate (Hz)	3000	3000
No of Samples	1024	1024
Frequency Resolution (Hz)	2.92985	2.92985
Time Record (ms)	341.33	341.33
Distance driven (ft)	100	100
Time taken (s) (A2)	34	33
Time taken (s) (A4)	24	23

The power spectrum plots between the rear axle accelerometer and seat pad accelerometer for a tractor in the rolling position at A2 speed (2500 rpm). When comparing the spectrum plots of the stationary tractor to the rolling tractor, it is seen that the vibration data has similar frequency components, but the magnitudes have changed significantly. With respect to the rear axle, the most significant changes are seen in the z-axis (vertical) magnitude at 40 Hz. When operating at speeds A2 and B2, the z-axis magnitude is approximately twice that of the stationary tractor, while the magnitude at speed A4 is four times that of the stationary vehicle. There may be a resonance that occurs at speed A4 that results in this unexpected jump in magnitude. When observing the spectrum plots of the seat pad, it is seen that the y-axis (front to rear) vibration significantly reduces at 80 Hz as the vehicle begins to move, while the x-axis (side to side) magnitude significantly increases at 40 Hz.

A single test run was constituted by having the agricultural tractor traverse both the vibration tracks and the berms. The data was acquired from the accelerometers (seat pad and rear axle) and the Trimble GPS. The data from the GPS was used to create an actual position map using Arc View 3.0. Fixed and known landmarks present in the vicinity of the test location are identified.

The data from the GPS can be used to isolate track and berm vibration. The magnitudes obtained from the isolated vibration track 1 can be compared to the magnitudes obtained from the isolated vibration track 2.

When comparing the spectrum plots between the field test on track 1 (24-inch spacing) and the rolling test on pavement, it is seen that the magnitudes and frequencies on the various accelerometer channels for both speed A2 and B2 were in the same order of magnitude at the principle frequencies. There were obvious minor changes, but the range was similar. However, when the tractor drove over the I8-inch track, the magnitude at the low frequency (below 10Hz) increased by an order of magnitude. It is

believed that the tire lug and track spacing interaction created a significant resonance at both A2 and B2 speeds with a more severe increase at speed B2. At these frequencies, the operator would be exposed to significant whole-body vibration, which, if sustained over a long period, could present health problems.
Through the use of the GPS position data, the data records for the two berm shock events were retrieved from a continuous data stream by identifying the geographic position of the event and then isolating that particular data segment. Since these excitations were not periodic in nature, the data must be examined in the time domain to observe the magnitudes. It can be observed in the z-axis plot that there is a low frequency excitation of approximately 2 Hz, which likely corresponds to the vehicle's impact with the successive beams. These magnitudes are significantly higher than that of the rolling vehicle test on pavement, confirming that farm impacts are being recorded by the data acquisition system. It is clear from the y-axis plots that a periodic shock has been introduced, since there is randomness to the time domain magnitude.

Summary and Conclusions
A data acquisition software and hardware system was developed for acquiring geo-referenced shock and vibration data using National Instrument's Lab View graphical programming language in conjunction with a modular data acquisition and signal conditioning system, and a Differential Geographic Positioning System (DGPS) to geo-reference shock and vibration events. A prototype vehicle obstacle course was constructed, which introduced spatially varying shock events to vehicles as they transverse the course. Obstacles consisted of both repetitious and discrete events. A series of preliminary investigations were conducted into the shock and vibration relationships between the rear axle and the passenger seat. Experiments were conducted under various operating conditions to insure system robustness under various conditions.
The GDAQ system has demonstrated significant potential, allowing for the acquisition of geo-referenced acceleration data from six accelerometer channels simultaneously. Spectral and time-domain plots of the data demonstrated expected results and gave confidence that accurate accelerometer readings were being acquired. The use of geo-referenced data records proved to be beneficial in isolating and extracting significant data segments from a continuous record. However, the original goal of using the GIS plot to isolate major shock and vibration events is somewhat elusive and will require additional research to perfect. Data filtering or other geospatial techniques may be needed to develop a methodology for locating major shock events from the GIS plots.

F. PROJECT PRODUCTS

1. Presentations

- Balasubramanian, K.*, T. Burks, C. Lehtola, and W. Lee. 2004. Development of an Off-Road Vehicle Data Acquisition System for Assessing the Influences of Vehicle Shock and Vibration on Operator Health and Safety. 2004. National Symposium on Agricultural Health and Safety. Keystone, CO. June 21-23,2004

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

- A data acquisition software and hardware system for acquiring geo-referenced shock and vibration data was developed using National Instruments' LabView in conjunction with a modular data acquisition and signal conditioning system, and a Differential Geographic Positioning System (DGPS).

G. STATES THE PROJECT WAS ACTIVE IN

Florida

A. PROJECT TITLE

A Dynamic System for Monitoring and Predicting Occurrence and Spread of West Nile Virus in Mississippi

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

West Nile Virus (WNV) represents an emerging infectious disease in the United States and has the potential to impact the entire country. The disease has already had severe impacts on birds and other wildlife as it has moved westward from its point of introduction in New York. Because WNV is apparently carried by migrating birds, there are growing concerns over its impact on wildlife populations and the ripple effects on recreational activities like camping, fishing, and hunting.

Outbreaks of the virus in temperate regions generally occur during late summer or early fall, coinciding with the arrival of large concentrations of migratory birds (and mosquitoes); these outbreaks often occur among humans living in or near wetlands where high concentrations of birds come into contact with large numbers of ornithophilic mosquitoes (primarily Culex sp.)

Fears of a West Nile Virus 'epidemic' have frightened people into staying indoors or using copious quantities of mosquito repellant when they venture outside. As pesticides are applied to kill a particular target insect, many other non-target insects and other wildlife are exposed to chemicals in the process. Aggressive spraying campaigns raise important health issues for humans and wildlife.

Development of a system for predicting, monitoring, and responding to outbreaks of mosquito and tick vectored diseases is a critical need for community well-being including; public health and water management, disaster management, and agricultural competitiveness. Creation of a geospatially-based dynamic monitoring and prediction system that is sensitive to changing environmental, social, and political variables is the ultimate goal of this project. A coordinated team effort is needed among organizations and agencies that share data and/or are end users of the system. Robust 'Regression-tree' modeling techniques will be used that optimize the input of continuous and categorical variables. Interpretability of models is an advantage over 'Neural Network' modeling techniques.

D. PROJECT START AND END DATES

July 1, 2003 – September 29, 2004

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Developed a risk prediction system that indicates where natural resource managers, field crews, and the public are at increased risk for West Nile Virus infections. Assessed the usefulness of ecosystem variables and climatic data for modeling risk of West Nile Virus Infections A Dynamic GIS-based system has been created that updates risk with each monthly precipitation minus evaporation update.

F. PROJECT PRODUCTS

1. Presentations:

- **2004 National Symposium on Agricultural Health & Safety**, Title: A Dynamic System for Monitoring and Predicting Occurrence and Spread of West Nile Virus in Mississippi. June 20-24, 2004, Keystone, Colorado.
- **Final Report and Presentation to Mississippi State Department of Health.** Title: GIS as an Analytical Tool to Assess the Significance of Environmental Variables for 2002-2003 West Nile Virus Human Occurrences. August 11, 2004, Jackson, Mississippi.
- **Invited Presentation.** Geospatial Technologies for Health (West Nile Virus*)*, Association of Southern Region Extension Directors and Association of Extension Administrators, Fall Meeting, University of Arkansas Cooperative Extension Service, August 27 – 29, 2003, Little Rock, AR

2d. Publications:

- Internet GIS News Article, Mississippi University researcher uses GIS to examine dangers of West Nile Virus. GIS Development, The Geospatial Resource Portal, www.GISdevelopment.net http://www.gisdevelopment.net/news/viewn.asp?id=GIS:N_hwqteobdli&cat=Industry%20Application&sub=Health
- University Relations Publication: MSU Studying Environmental Causes of Deadly West Nile Virus. May 10, 2004. Syndicated releases: Merck Source, Picayune Item.com

5. Other Products:

- An M.S. thesis will be presented this semester to the MSU Department of Geosciences by Robert Wallis detailing his work on the West Nile Virus project.

G. STATES THE PROJECT WAS ACTIVE IN

Mississippi

A. PROJECT TITLE

North Carolina Farmscape Interactive Modeling

B. PROJECT OFFICER(s)

Kofi Boone
NC State University
College of Landscape Architecture
North Carolina State University
Raleigh, NC 27695
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kofi_boone@ncsu.edu

C. PROJECT DESCRIPTION

AIMS:

This project provides a theme-learning package of materials that broadens current definitions of farm safety from solely avoidance of human hazard, to raising awareness of farm impacts of local ecology, to broader trends of agricultural land use changes in the mountains. The project is focused on providing educational materials, including a hands-on model, for use in ongoing farm safety education efforts targeting elementary and middle school children.

Project Tools:

- Farm Safety context:
  Features a series of diagrams and images identifying the scope of the problems, the affects they have on farm children, and the project study area.
- Farmscape evolution:
  Follows the changes over time on a prototypical North Carolina mountain farmscape, ranging from pre-settlement to a sustainable "future farm" highlighting best management practices.
- Farmscape model:
  A physical model of the sustainable farm to be used as an orientation and teaching tool for safety educators.

D. PROJECT START AND END DATES

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

Research of historic cultural and environmental trends affecting the North Carolina mountain farm landscape

Development of materials to be used in coordination with ongoing youth-oriented farm safety programs. These materials include presentations of farm safety issues at the scale human safety (hazard and exposure), farm safety (ecological impacts of farming on the land), and broader regional safety (impacts of broader trends of declining agriculture).

- Review of these materials with farm safety educators was postponed due to hurricane related flooding in the project area, and the crisis needs of key project

participants in the project area.

- Refining the materials per feedback will not occur until farm safety educators become available.
- Delivery a prototypical “kit” for use by farm safety educators will not occur until review and refining per feedback.

F. PROJECT PRODUCTS

2a. Publications:

- Abstract accepted by Council of Educators in Landscape Architecture (CELA) Conference 2004

G. STATES THE PROJECT WAS ACTIVE IN

North Carolina

A. PROJECT TITLE

Mountain Pesticide Education and Safety Outreach – A Pilot program for Christmas Tree Worker Safety in Western North Carolina

B. PROJECT OFFICER(s)

James Hamilton
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C. PROJECT DESCRIPTION

The specific goal of the Mountain Pesticide Education and Safety Outreach (PESO) pilot initiative was to develop and execute appropriate pesticide and safety training approaches relevant to the Christmas tree industry for Hispanic workers to reduce pesticide exposure and farm injury risks of (primarily) non-English speaking workers in Watauga County by:

1. *Providing direct safety training for farm workers in the field on pesticide and farm safety concerns specific to the Christmas tree industry.*
2. *Developing appropriate bilingual training to facilitate worker-grower communication regarding work related tasks and commonly used work site terminology.*

D. PROJECT START AND END DATES

July 1, 2003 – September 29, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

In early 2004, the PI advertised the program in local newspapers, the quarterly Watauga County Extension Newsletter, and among Christmas tree growers through the Watauga Nurserymen's Association Newsletter. By early April, five Watauga County Christmas tree growers had indicated interest in participating.

The 'tailgate training' program was developed by the PI, Watauga County's Extension Agent and Pesticide Education Coordinator, with input from two leader Christmas tree growers in the community, and the past president of High Country Amigos (a former Christmas tree worker) and was based on conclusions and recommendations in Hamilton's 2004 study of the labor dynamics in the Christmas tree industry. Input from growers indicated that training emphasis be placed on communicating the importance of proper safety equipment use for specific chemicals and application procedures commonly used in the production of Christmas trees. These growers and interview participants in Hamilton's 2004 study indicated that while personal protective equipment is issued to workers before fieldwork, many farm-workers remove equipment such as masks and protective eyewear before work is completed. The

principal investigator collaborated with the North Carolina Department of Agriculture's Pesticide Section Bilingual Coordinator for baseline bilingual educational materials available for the training of Hispanic farm-workers with an emphasis on exposure routes, proper use of personal protective equipment, and other aspects of pesticide safety relevant to the Christmas tree industry.

There is one restricted-use pesticide that is applied by large numbers of workers. Growers who were interviewed mentioned that workers apply Di-Syston, a granular organophosphate pesticide, during late spring to combat the 'twig-aphid' for harvest year trees. For more specialized insecticide spraying, with high-pressure sprayers, growers mentioned that few workers participate in this type of application and that workers who do more specialized spraying get more training on site. Herbicide treatments with Round-up, a non-restricted herbicide, are also applied by large numbers of workers on the majority of farms during the summer months to eliminate weed competition. Emphasis was therefore placed on training farm-workers on proper safety equipment use and application practices with granular, high-pressure, and 'backpack' pesticide applications with these common Christmas tree chemicals.

Training events were coordinated with each grower to maintain rapport and avoid work schedule conflicts. Each training took place in early morning before fieldwork began and lasted for approximately 1 hour followed by equipment distribution and questions/answers. The "Tailgate Training" program was delivered at 5 Christmas tree farms to 55 workers in Watauga County. Each training covered the following items and was followed with a 'Q&A' session where workers voiced their questions and concerns about pesticide application:

Exposure routes of pesticides, acute toxicity vs. potential long-term health effects of improper safety/application practices.

Chemicals used in Christmas trees and PPE required for each type of application (granular, high pressure, backpack).

Handling, mixing, and re-entry intervals

Hand-washing in the field and proper clothing protocol for post-application.

At the end of each training event, each worker was provided their own pair of gloves, safety goggles, respirators, rubber boots, and 2 Tyvek suits to encourage their proper use in the field. Handouts in Spanish were also distributed as supplemental materials that outlined proper hand-washing and handling of contaminated clothing. Posters from the North Carolina Department of Agriculture on pesticide safety were provided to the participating employers to post at their offices and areas where workers congregate before work.

Feedback from the PESO project has been overwhelmingly positive. Growers who participated in the project have indicated that their workers properly utilized their safety equipment during pesticide applications. Use of safety goggles and respirators was noticeably improved from past years-especially with Di-Syston and Roundup application. Seven workers interviewed a month after the safety program indicated that

they felt more knowledgeable about proper application practices after the training sessions and were more conscientious about proper use of safety equipment. Workers and growers appreciated the informal atmosphere of the training that allowed for interaction and questions. Providing free equipment to workers was seen as a positive incentive for grower participation in the program. While growers/employers are required to provide this type of equipment anyway, free equipment offset any perceived loss of productivity by having their workers in training for part of a workday.

Leg-guards and first-aid kits ordered for the proposed 'shearing-safety' component of the PESO program did not arrive in time for 2004 training, so this element of the program will be conducted during the 2005 production season.

55 Hispanic Christmas tree workers were trained on five farms and provided personal protective equipment for pesticide application.
Improved communication and rapport established with Watauga County Christmas tree grower community concerning pesticide safety issues with their farm-workers.
Increased public awareness of pesticide safety issues through two articles in local newspapers increased availability of pesticide safety information in High Country Amigos office for Hispanic farm-workers and their families. Several hundred copies of pesticide safety materials were produced for workshops, field days, and safety programs offered to the Hispanic community by High Country Amigos.
Increased interest in opportunities for future pesticide safety classes to Christmas tree farm-workers expressed by growers in Watauga County.

F. PROJECT PRODUCTS

1. Presentations:

Results and impacts of the Mountain PESO project were presented at the 2004 Summer Meeting of the North Carolina Christmas Tree Association (NCCTA) and will be updated and presented at the 2005 Winter Meeting of the NCCTA.

2. Publications

a. Peer Reviewed Journal:

2004. Hamilton, J.Y. Extension's Role in Hispanic Farm worker Pesticide Safety. Journal of Extension. In progress.

b. Other Publications:

- “Uso de Pesticidas Agrico1as de Manera Segura". A publication (handout) on pesticide safety published by the CropLife Foundation.
- “Los Pesticidas y La Sa1ud Humana". A publication of North Carolina Cooperative Extension.
- "Protejase de 10s Pesticidas" (Protect Yourself from Pesticides). A poster from the North Carolina Department of Agriculture and Consumer Services.

3. Education / Training / Outreach Training Seminars:

a. Other:
Project received coverage in local media to promote program and then to report results.

G. STATES THE PROJECT WAS ACTIVE IN
North Carolina

IV. PROGRESS REPORT ON FEASIBILITY PROJECTS (AS APPROPRIATE)

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

VI. COLLABORATION

NC Cooperative Extension Service
NC, VA and SC Forestry Association
NC Fisheries Association
Department of Health and Human Services
North Carolina Strawberry Association
Greene County Migrant Health Clinic
Roberson Migrant Health Clinic
Southern Rural Development Center
Southern Region Sustainable Agriculture Research and Education Center
Southeast Center, Lexington, Kentucky
North Carolina State University
North Carolina A&T University
University of Alabama, Birmingham
NC Office of the Chief Medical Examiner
East Carolina School of Medicine
Ponce School of Medicine, Ponce, PR
UNC Office of the President

APPENDIX

I. TOTAL CENTER BUDGET FOR FY 2004

1. **Total NIOSH Expenditures: $824,499**

2. **In-Kind Contributions: $142,962**

3. **Other Outside Funding: $0**

II. CENTER PROJECTS / ACTIVITIES FOR FY 2004

1. **Ongoing Projects: 18**

2. **Projects Completed:**
   - Arthropod Allergens: Distribution and Mitigation Strategies to Reduce Cockroach Allergens in Swine Farms and Workers' Homes – Schal
   - Development of an Off-Road Vehicle Data Acquisition System for Assessing the Influences of Vehicle Shock and Vibration on Operator Health and Safety. – Burks
   - Mountain Pesticide Education and Safety Outreach – A Pilot program for Christmas Tree Worker Safety in Western North Carolina. – Hamilton

3. **New Projects:**
   - "Child Health Needs of Rural Alabama Latino Families", The University of Alabama, Birmingham, AL - Harrison
   - "Development of a Medical School Curriculum to Provide Knowledge and Training in Treating the Injuries/Illnesses Associated with the Agriculture, Fishing and Forestry Industries of Eastern North Carolina", East Carolina University, Greenville, NC – Malette
   - "Assessment of Minority Health & Safety in Selected Counties of North Carolina", NC A&T State University, Greensboro, NC – Ibriham
   - "The Development of New Tools to Study, Identify, and Prevent Ovarian Cancer", NC State University, Raleigh, NC – Moziak

4. **Feasibility Projects:**
   - "Farm Equipment Safety Program"

III. CENTER INVESTIGATORS

1. **Scientific Investigators:** 17

2. **Program Support Staff:** 4

IV. CENTER PRODUCTS

1. **Presentations:**

- In vitro metabolism of carbofuran by human, mouse, and rat liver microsomes, and human cytochrome P450 isoforms. K.A. Usmani, E. Hodgson, R.L. Rose. 43rd Annual Meeting of the Society of Toxicology, Baltimore, MD, March 21-25, 2004.
- Study of metabolic interactions of fipronil and some CYP3A4 substrates. J. Tang, A. Usmani, E. Hodgson, R.L. Rose. 43rd Annual Meeting of the
- Society of Toxicology, Baltimore, MD, March 21-25, 2004.
- Pesticide Metabolism in Humans and the Potential for Metabolic Interactions. R.L. Rose, K.A. Usmani, E.D. Karoly, Y. Cao, N. Cherrington, E. Hodgson. Agricultural Health and Safety Symposium. Keystone, CO, June 21-24, 2004
- In vitro metabolism study of carbofuran and its metabolic interaction with testosterone. K.A. Usmani, E. Hodgson, R.L. Rose. 7th International ISSX meeting, Vancouver, Canada, Aug 29 – Sept 2, 2004
- Shin, G, T Costello, S Yu, Z Jiang, L Zheng and G Mirka, (2003) "Ergonomics of Harvesting Ground-Level Crops", 2003 International Ergonomics Association Meeting - Seoul, South Korea.
- Costello, T, G Mirka, and S Gustke, (2003) "A Multi-Method Approach to Agricultural Injury and Illness Surveillance" 2003 ASAE ANNUAL INTERNATIONAL MEETING - July 27 - July 30 2003 - Las Vegas, NV.
- Mirka, G, G Shin, Y Shu, Z Li, and T Costello, (2003) "Ergonomics of Harvesting from Ground Level", 2003 ASAE ANNUAL INTERNATIONAL MEETING - July 27 - July 30 2003 - Las Vegas, NV.
- Costello, T., C Mason, J Miranda, and J Sabella, (2003) "Using ergonomics in the prevention and treatment of occupational injuries among farm workers", 16th Annual East Coast Migrant Stream Forum, Westchester, NY, October 23-27, 2003.
- Costello, T. (2003) "Stretching and strengthening activities to prevent and reduce work-related muscular aches and pains", 16th Annual East Coast Migrant Stream Forum, Westchester, NY, October 23-27, 2003.
- Costello, T, G Floyd, and J Sabella, (2004) "Clinic-level Occupational Injury and Illness Surveillance Pilot project" National Symposium on Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.
- Costello, T and G Mirka, (2004) "Work related musculoskeletal discomfort (WMSD) Prevention and care brochure, " National Symposium on Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.
- Costello, T and G Mirka, (2004) "Ergonomic benchmarking of North Carolina Field crop production to guide intervention focus and prioritization," National Symposium on Agricultural Health and Safety, Keystone, Colorado, June 20-24, 2004.

- Southard, S, J Freeman, J Drum and G Mirka, (2004) "Ergonomic Interventions for the Handling of Livestock", 2004 ASAE ANNUAL INTERNATIONAL MEETING, Ottawa CANADA, August 1-4, 2004.
- "Immigration and Rural Health" Seminar given at Iowa State University, March 5, 2003.
- "Occupational health among youth in agriculture." ECU Agromedicine Center, NIOSH site visit, July, 2003
- "Work, Occupational Health, and New immigration into small U.S. rural communities." Rural Sociology Meetings, Montreal, Canada, July, 2003 and Metropolis conference, Vienna, Austria, October, 2003.
- Costello, T., & Wogalter, M. Driver Attitudes, Beliefs and Reported Behavior Associated with Sharing Public Roads with Farm Vehicles. HFES 47th Annual Meeting, Denver, CO, October 13 – 17, 2003.
- Costello, T., & Schulman, M. Risk Factors for a Farm Vehicle Public Road Crash. 2004 National Symposium on Agricultural Health and Safety. Keystone Resort, Colorado, June 20-24, 2004, 2003.
- June 2004 → 2004 National Symposium on Agricultural Safety and Health (Keystone Resort, CO): "Skin Disorders in Commercial Fishermen" presented by Dr. David Griffith.
- Pesticide Exposure and Human Health, Julia F. Storm, Pesticide Applicator Recertification Training, Burlington, NC, December 3, 2003. (133 participants)
- Understanding the Agricultural Health Study (1993-2003), Julia F. Storm, Annual Meeting of the N.C. Aerial Applicators Association and Aerial Applicator Recertification Training, Williamston, NC, February 19, 2004. (41 participants; 93% response rate on evaluation; outcomes: 42% increase in awareness, 95% increase in knowledge and understanding)
- Communicating the Agricultural Health Study to the Agricultural Community, Julia F. Storm, Annual Meeting of the Agricultural Health Study National Advisory Panel, Bethesda, MD, February 26-27, 2004 (69 participants)
- Understanding the Agricultural Health Study and the Farm Family Exposure Study, Julia F. Storm, W. G. Cope, W. G. Buhler, R. McRackan, NC Cooperative Extension Long Range Plan Training, Raleigh, NC, May 18, 2004. (50 participants; outcomes: 87% increase in knowledge)
- Understanding the Agricultural Health Study, Julia F. Storm, Annual Meeting of the Southern Region Pesticide Safety Education Program, Asheville, NC, June 13-16, 2004 (40 participants)
- Educating Agricultural and Health Practitioners about the Agricultural Health Study, Julia F. Storm, W.G. Cope, W. G. Buhler, K. McGinnis, 2004 National Symposium on Agricultural Health and Safety, Keystone Resort, Colorado, June 20-24, 2004 (250 participants)
- Overview: Southern Coastal Agromedicine Center and NC Cooperative Extension Farm Safety and Related Projects, Julia F. Storm, Southern Region

Extension/NIOSH Centers Joint Farm Safety Symposium, Nashville, TN, May 10-12, 2004 (35 participants)

- Understanding the Agricultural Health Study, Julia F. Storm, Southern Extension Research Activity -19 Rural Health Meeting, New Orleans, LA, October 13-15, 2004 (18 participants)
- Meetings Presentations: presented at the NC State EMS conference, EMT Today in October 2003
- International Society for Occupational Safety and Health, Houston, TX, May 2004
- NC A & T State University, Greensboro, NC, November 2003
- Society for Risk Analysis, Washington, DC, December 2003
- American Society for Pesticide Safety Educators, June 2002
- 2004 National Symposium on Agricultural Health & Safety, Title: A Dynamic System for Monitoring and Predicting Occurrence and Spread of West Nile Virus in Mississippi. June 20-24, 2004, Keystone, Colorado.
- Final Report and Presentation to Mississippi State Department of Health. Title: GIS as an Analytical Tool to Assess the Significance of Environmental Variables for 2002-2003 West Nile Virus Human Occurrences. August 11, 2004, Jackson, Mississippi.
- Invited Presentation. Geospatial Technologies for Health (West Nile Virus), Association of Southern Region Extension Directors and Association of Extension Administrators, Fall Meeting, University of Arkansas Cooperative Extension Service, August 27 – 29, 2003, Little Rock, AR
- Results and impacts of the Mountain PESO project were presented at the 2004 Summer Meeting of the North Carolina Christmas Tree Association (NCCTA) and will be updated and presented at the 2005 Winter Meeting of the NCCTA.
- Balasubramanian, K.*, T. Burks, C. Lehtola, and W. Lee. 2004. Development of an Off-Road Vehicle Data Acquisition System for Assessing the Influences of Vehicle Shock and Vibration on Operator Health and Safety. 2004 National Symposium on Agricultural Health and Safety, Keystone, CO, June 21-23, 2004
- 16th Annual East Coast Migrant Stream Forum - Terry Town, NY
- Assessing Heat Related Illness in Field Crop Workers in North Carolina, Carol Maxwell Ph.D. 2004 National Symposium on Agricultural Health & Safety, Keystone, CO. June 11, 2004

2. Publications

a. Peer Reviewed Journal: 10

b. Trade Journals: 4

c. Fact Sheets / Brochures / Technical Publications: 7

d. Other Publications:

- Alliance signed with Uruguayan research Institute - The East Carolinian – 6/9/04
- Agromedicine Institute at ECU establishes institutional relationship with BIO Uruguay - The Daily Reflector – 5/31/04
- Understanding and Addressing Agricultural Work-RMusculoskeletalkeletal Disorders – AgConnections – Autumn 2003
- Assessing Heat Stress in Agricultural Field Workers, Edge Magazine, East Carolina University, August 1, 2004
- Heat Stress Study to Help Migrant Farm Workers. The East Carolinian, East Carolina University Student Newspaper, July 7, 2004
- Breaking a Sweat; ECU-based researchers near end of 4-year heat stress study. The Daily Reflector, Greenville, NC. August 9, 2004

3. Education / Training / Outreach

c. Hazard Surveys / Consultations: 2

d. **Academic Training:** 1

e. News Letters: 1

f. CD-ROMs or other Computer Based Training Programs: 7

4. Conferences / Meetings Sponsored:

- NIOSH Director's meeting – Saskatoon – 10/19/03
- Sponsored & Organized: Agricultural Emerging Issues session – Saskatoon – 10/20/03
- NC Association of Cooperative Extension Specialist – 10/3/03
- Kanaph at Walstonburg – 8/20/03
- Dr. Betsy Brown from the UNC System office at the ECU International Office, Dr. Charles Lyons office – 4/29/04
- Nancy McGillicuddy - ECU, Howard House – 4/30/04
- Paul Skillicorn, Green Natural Fibers, Snow Hill – 5/3/04
- NCSU Luncheon - NCSU, Raleigh, NC -4/27/04
- Goldsboro CEFS – 5/5/04
- NIOSH Directors' Meeting - Davis, CA – 5/13-17/04

- Southeast Strawberry EXPO - Sheraton Imperial Hotel, Raleigh – 11/10-11/03
- NC Commercial Fishing Show - New Bern, NC – 2/28-29/04
- Southern Farm Show - Raleigh, NC – 2/4-6/04
- 28th Annual Mid-Atlantic Farm Show - Williamston, NC – 12/9/03
- Greene County Migrant Health Fair - Snow Hill, NC – 9/22/03

- Vass Log n Show - Vass, NC – 10/25-26/03

V. ADMINISTRATIVE REPORT

Dr. Susan Gustke retired from East Carolina University and from her position as Director of the North Carolina Agromedicine Institute and the Southern Coastal Agromedicine Center effective June 31, 2004. Since that date, John Sabella, Associate Director for the SCAC has assumed the position of Interim Director. The North Carolina Agromedicine Institute Board of Directors has initiated the search process for the Directors position and a new Director is expected to be named by no later than July, 2005.