September 2004

Resource

Engineering & Technology for a Sustainable World

Focus on Ergonomics, Safety, and Health

Tampa to Host 2005 ASAE Meeting

PUBLISHED BY ASAE - THE SOCIETY FOR ENGINEERING IN AGRICULTURAL, FOOD, AND BIOLOGICAL SYSTEMS

Events Calendar

ASAE Conferences and International Meetings

To receive more information about ASAE conferences and meetings, contact ASAE at 800-371-2723 or mcknight@asae.org. For the complete list, see www.asae.org/resource/asaevents.html.

2004

Sept. 12-15 **Self-Sustaining Solutions for Streams, Wetlands, and Watersheds.** Radisson Riverfront Hotel, St. Paul, Minnesota, USA.

Oct. 7-8 **Automation Technology for Off-road Equipment (ATOE 2004).** Kyoto, Japan.

2005

Feb. 14-16 **Agricultural Equipment Technology Conference (AETC).** Louisville, Kentucky, USA.

May 18-20 **International Livestock Environment Symposium (2005 ILES)**. Beijing, China.

July 17-20 **ASAE Annual International Meeting.** Tampa, Florida, USA.

2006

July 10-13 **ASAE Annual International Meeting.** Portland, Oregon, USA.

ASAE Section and Community Events

For more information, contact the person identified in each listing. For the complete list, see www.asae.org/resource/community.html.

2004

Sept. 10 **Wisconsin Section Meeting**. University of Wisconsin, Madison Campus, Madison, Wisconsin, USA. Contact Damion Babler, damion.babler@kuhnknight.com.

Sept. 23-25 **Pacific Northwest Section Meeting**. Sunridge Inn, Baker City, Oregon, USA. Contact John Busch, 541-523-7121, ext. 211, john.busch@or.usda.gov.

Sept. 24-25 **Red River Valley Section Meeting** and **North Central Intersectional Conference** – Hosted by Manitoba Section. Winnipeg, Manitoba, Canada. Contact Danny Mann, danny_mann@umanitoba.ca.

ASAE Endorsed Events

For more information, contact the person identified in each listing. For the complete list, see www.asae.org/resource/endorsevents.html.

2004

Oct 27-29 **International Conference on Pesticide Application for Drift Management**. Waikoloa, Hawaii, USA. Contact http://pep.wsu.edu /Drift04.

2005

Jan. 5-7 **State of the Science of Animal Manure and Waste Management.** San Antonio, Texas, USA. Sponsored by the National Center for Manure and Animal Waste Management. Contact www.cals.ncsu.edu/waste_mgt/natlcenter/center.htm.

April 25-27 **International Salinity Conference.** Riverside, California, USA. Sponsored by USDA-NRCS, Bureau of Reclamation, and USDA-ARS. Contact www.waterresources.ucr.edu/index.php?content=news_Events /intisf_meeting/SF05pageDW.htm.

Other Events

For more information, contact the person identified in each listing.

2004

Sept. 19-22 **Joint meeting of the American Association of Cereal Chemists and Tortilla Industry Association**. San Diego, California, USA. Contact www.aaccnet.org/meetings/2004, www.tortilla-info.com.

Sept. 20-24 **2nd WASAE International Conference on Agricultural Engineering**. Kumasi, Ghana. Sponsored by the West Africa Society of Agricultural Engineering and the Ghana Society of Agricultural Engineering. Contact Emmanuel Bobobee, +233 51 60242, fax: +233 51 60137, ebobobee@yahoo.com, wasae2004@yahoo.co.uk.

Sept. 26-29 **Annual Conference of the Association of State Dam Safety Officials**. Phoenix, Arizona, USA. Contact 859-257-5140, info@damsafety.org, www.damsafety.org.

Sept. 26-Oct. 1 **4th International Crop Science Congress**. Queensland, Australia. Contact 61-7-3858-5554, 4icsc04@im.com.au, www.cropscience2004.com.

Oct. 6-8 **5th International Conference on Performance-Based Codes and Fire Safety Design Methods**. Luxembourg. Sponsored by the Society of Fire Protection Engineers. Contact www.sfpe.org.

Oct. 10-13 **Conference on Tailings and Waste '04**. Vail, Colorado, USA. Sponsored by the Department of Civil Engineering, Colorado State University. Contact Linda Hinshaw, 970-491-6081, lhinshaw@engr .colostate.edu.

Oct. 11-14 **2004 CIGR International Conference, Olympics of Agricultural Engineering**. Beijing, China. www.2004cigr.org.

Oct. 13-16 **Conference on Water Rights and Related Water Supply Issues**. Salt Lake City, Utah, USA. Sponsored by the USCID. Contact www.uscid.org/04idcall.html.

Oct. 25-29 **RETA 95th Annual National Convention.** Reno/Sparks, Nevada, USA. Sponsored by the Refrigerating Engineers and Technicians Association. Contact 847-375-4738, www.reta.com.

Oct. 28-29 **ABET 2004 Annual Meeting, Competing in a Diverse World.** Nashville, Tennessee, USA. Contact 410-347-7727, eandis@abet.org, www.abet.org/annual_meeting_cover.html.

Nov. 1-4 **Annual Water Resources Conference**. Orlando, Florida, USA. Sponsored by American Water Resources Association. Contact Harriette Bayse, 540-687-8390, harriette@awra.org, www.awra.org.

Nov. 13-19 **2004 ASME International Mechanical Engineering Congress and RD&D Conference**. Anaheim, California, USA. Sponsored by the American Society of Mechanical Engineers. Contact June Leach-Barnaby, 212-591-7795, www.asme.org.

Nov. 14-16 **International Irrigation Show**. Tampa Bay, Florida, USA. Sponsored by the Irrigation Association. Contact 703-536-7080, www.irrigation.org.

2005

Jan 24-27 **Third International Conference on Remediation of Contaminated Sediments.** New Orleans, Louisiana, USA. Sponsored by Battelle. Contact 800-783-6338, info@confgroupinc.com.

To have an event listed here, send information to Suzanne Howard, 2950 Niles Road, St. Joseph, MI 49085, USA; fax 269-429-3852, howard@asae.org. Information must reach us *at least* two months before the event.

Resource

Engineering and Technology for a Sustainable World

Vol. 11 No. 7 September 2004

FOCUS ON ERGONOMICS, SAFETY, AND HEALTH

Features

ON THE COVER

Our cover reflects various facets of this month's special focus: ergonomics, safety, and health. From bio-sensing milk components to light-activated DNA, from surgically implanted telemetry devices to clean "green" plant systems – researchers and engineers link modern high-tech ingenuity with old-fashioned common sense, thinking in and out of many boxes, and bringing us a safer, healthier world.

Tampa to Host 2005 ASAE Meeting

17 Make plans now for the ASAE Annual International Meeting in Tampa, Fla., July 17-21, 2005. One of Florida's most invigorating travel destinations, the Tampa Bay area is a perfect choice for the ASAE Annual International Meeting and also doubles as an exciting family vacation venue.

Departments

Personnel Service

POSITIONS OPEN

The deadline for copy to be received at ASAE is the first day of the month preceding the month of publication (October 1 for the November issue). Each issue mails on the first day of the month.

Advertisements are $110 per column (3.5-inch wide) inch, which includes placement on *Resource's* Personnel Service Web page at www.asae.org/resource/persads.html. Ads are posted on the Web site within three business days of final approval and remain there until the last day of the issue month (November 30 for the November issue). If the insertion order is for two months, the cost is $99 per column inch per insertion.

For more details on this service, contact Pam Bakken, ASAE Personnel Service, 2950 Niles Road, St. Joseph, MI 49085-9659 USA; 269-428-6337, fax 269-429-3852, bakken@asae.org, www.asae.org/resource/persads.html.

ASSISTANT PROFESSOR – HYDROLOGY

University of Florida, Tropical Research & Education Center, Homestead, FL. This 12-month tenure-track position involves 60% research and 40% Extension in the area of surface and groundwater hydrology emphasizing the southern Everglades. A Ph.D. in Soil Science, Hydrology, Agricultural Engineering, or closely related discipline is required. A strong understanding of basic hydrologic and transport processes and knowledge of irrigation, drainage, and water management systems is necessary. More detailed information can be found at: http://trec.ifas.ufl.edu/job1.htm. Formal review of applications will begin on September 15, 2004 and will continue until a suitable candidate is found. Applicants should submit a letter of application, curriculum vitae, and four letters of recommendation directly to: Dr. Bruce Schaffer, Chairperson, Hydrology Search and Screen Committee, University of Florida, Tropical Research and Education Center, 18905 S.W. 280 Street, Homestead, FL 33031-3314. The University of Florida is an equal opportunity, equal access, affirmative action employer. Women and minorities are encouraged to apply.

Tenure Track Assistant Professor Biological Engineering

The Dept. of Biological and Environmental Engineering at Cornell University invites applications for a tenure track faculty position in Biological Engineering. We are primarily interested in applicants at the Assistant Professor level. This individual will establish a research program in an emerging area of biological engineering with nanobiotechnology applications. Research could include molecular recognition and sensing, nanoscale analysis of biomolecules, metabolic engineering, biomimetics, biomaterials or biosystem-based electronics. Applications of research can be for biological, environmental, agricultural, or food systems. The successful candidate will complement ongoing departmental programs in biological engineering, particularly at the molecular level, activities at the Cornell Nanobiotechnology Center and also the new university-wide $600 million Life Sciences Initiative. Securing external funding to support research program is expected. This position is 50% research and 50% teaching. Typical teaching responsibilities will be two courses in biological engineering, including one of the core departmental courses, and the development of an upper level undergraduate or graduate course that reflects the candidate's areas of expertise. Mentoring and advising of undergraduate and graduate students is expected.

Applicants should have a Ph.D. in an appropriate discipline with demonstrated expertise of integration of engineering and biological sciences. A letter of application, vita, transcripts and names of three references (including telephone numbers and email addresses) should be submitted to:

CORNELL

Michael F. Walter, Chair
Department of Biological and Environmental Engineering
104 Riley-Robb Hall
Cornell University
Ithaca, NY, 14853-5701

Closing date is October 15th, 2004 or until a suitable candidate is located.

For more details: http://www.bee.cornell.edu/ABOUT/Position.html

Cornell University is an affirmative action, equal opportunity employer. Applications from women and minorities are encouraged.

http://chronicle.com/jobs/profiles/2377.htm

POSITIONS WANTED

ASAE members are entitled to a two-month listing free of charge. Nonmembers are charged $55 for a one-month listing. Includes placement on *Resource's* Personnel Service Web page at www.asae.org/resource/persads.html. For further information about an ad or for more details on this service, contact Pam Bakken, ASAE Personnel Service, 2950 Niles Road, St. Joseph, MI 49085-9659 USA; 269-428-6337, fax 269-429-3852, bakken@asae.org.

AGRICULTURAL ENGINEER (Ph.D., P.E.) seeking position in structures and environment area. Prefer part-time and/or temporary. Experience: 5 years extension (waste management/livestock housing); 25 years teaching/research at university; and two years consulting. Available July 2004. Willing to relocate. W-1049

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Resource

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hq@asae.org, www.asae.org

PRINTED WITH SOY INK

Fresh fruit with fizz makes debut

Imagine biting into a juicy apple or pear and experiencing a zinging, fizzy sensation. "Fizzy Fruit," a carbonated fruit, should be commercialized soon.

Fizzy fruit was discovered by accident. Galen Kaufman, a Texas neurobiologist and Fizzy Fruit's inventor, discovered it while he was on a sailing trip. Biting into a pear that had been in a cooler chilled with dry ice, he sensed an unusual fizziness in the fruit. He found the carbonation delightful.

Kaufman quickly figured out that some of the dry ice in the cooler had sublimated, changing from a solid directly into carbon dioxide gas, entering the fruit. Kaufman's pear had thus become carbonated by the dry ice used to chill the sailboat's cooler.

Kaufman decided to try to develop it into a commercial product. He applied for a U.S. patent for the intellectual concept of carbonated fruit. He contacted ASAE member and Oregon State University (OSU) professor John Henry Wells, an expert in food packaging and storage at the Food Innovation Center in Portland. Kaufman wanted the Center's help to develop a patentable process of carbonating fruit on a commercial scale.

ASAE member Qingyue Ling, OSU's product development engineer for the Food Innovation Center, came up with designs for the manufacture of fizzy fruit, including computerized-controlled techniques. Patents are pending with OSU and Kaufman's company, "Fizzy Fruit, North America," as co-owners.

Kaufman and the OSU researchers envision that the fizzy fruit may encourage people to eat healthier diets by consuming more fruit. Ling foresees fizzy fruit as becoming a big hit with school children.

Farmedic training program saves lives

Two years ago a 14-year-old boy in Genoa, N.Y., stood atop a mound of corn while unloading a tractor-trailer on the family farm. Suddenly the truck's unloading trough opened, and he was engulfed by grain and sank as if in quicksand.

John Ducey, chief of the Genoa Fire Department, recalls that the boy "had swallowed and breathed in corn," and it appeared that "his time was about done." But Ducey's fire department had received specialized agricultural rescue training from Cornell University's Farmedic program. It is the only training course in the country designed for agricultural rescue.

Farmedic is a training course designed for agricultural rescue. ***(Graphic courtesy of Cornell University)***

Rescuers from the Genoa Fire Department arrived within minutes and started shoveling the corn to one side. The boy was pulled out, harnessed, placed in a Stokes basket, and sped by ambulance to the nearest hospital. Thanks to the firefighters' fast response, the boy lived.

"When people see a farm, it's an idyllic scene with a barn and silo," says Ted Halpin, director of Farmedic, and former fire chief in Canandaigua, N.Y. But, he says, "These structures house livestock and provide storage for machinery, grain, feed, and manure – and many potential hazards."

Farm fatalities and accidents can result from electrocutions, silo fires and explosions, falls from heights, and entrapment in grain, feed, animal waste, and machinery, Ducey says.

Four out of 10,000 agricultural workers in the United States are killed each year, while 140,000 accidents happen during the planting and harvest seasons, according to University of Iowa statistics. Augers (for moving grain) rank among the most dangerous agricultural equipment, while farm tractors cause the most deaths.

The Farmedic program teaches specific techniques on handling dozens of different accident situations. For example, silo fires can turn into silo explosions if firefighters open a silo air-hatch to pour in water or foam. "It's imperative for firefighters to know what kind of fire they are fighting," says Halpin.

As a fire chief, Halpin noticed that many fire and rescue people died while conducting poorly executed rescues. In 1981, the Henrietta, N.Y., Fire District and Halpin's father's John Deere dealership near Rochester, N.Y., hosted the first program to train fire, rescue, and emergency medical technicians. From this, Halpin, who grew up on a farm, started Farmedic and developed a training manual and course. The program moved to Cornell University in 2002. Over 23,000 fire and rescue personnel in the United States and Canada have been trained since 1981.

Halpin's program works. Around the country, firefighter deaths from agricultural emergencies are down from several years ago. "This type of call can be extremely challenging. Instead of a working in a kitchen, we find ourselves in a silo. Instead of on a highway, we're in a muddy field carrying tools to the scene," says Halpin. "We not only need to concern ourselves with the patient, but we must consider hazards that have injured and killed rescuers."

For more information, contact Halpin, 800-437-6010, twh9@cornell.edu.

For more information, contact Ling, 503-872-6652.

Purdue to expand crop of engineers

Purdue University will create a new engineering education department that will beef up the study of engineering among K-12 students. Under the plan approved by its board of directors, the school eventually will offer graduate and undergraduate degrees in engineering education and certify high school teachers in the field.

Officials at Purdue, West Lafayette, Ind., say the move is a first step to counter reduced interest in engineering in lower grades at a time when demand is growing.

"Our program will infuse engineering into the K-12 curriculum and put more engineering content into classrooms," says Kamyar Haghighi, a Purdue agricultural and biological engineering professor who will head the new education unit. He says Purdue is the first to create such a department. Virginia Polytechnic Institute and State University, Blacksburg, are also forming similar units.

For more information, contact Haghighi, 317-494-1182.

Research aimed at improving turfgrass

The Agricultural Research Service and the National Turfgrass Federation recently signed an agreement to begin a long-term research program aimed at improving turfgrass. The research will be conducted as part of a national turfgrass initiative, a cooperative effort between the turfgrass industry, universities, and the ARS.

Turfgrass is a major agricultural crop that covers almost as many acres as wheat and supports a $40 billion-a-year business. ARS Acting Administrator Edward Knipling of the ARS notes that turfgrass is the only crop industry that increases with urban development.

The new initiative will support research in six priority areas identified by the industry as their top research needs: improvement of water management; germplasm collection and enhancement; pest management; improving turfgrass's role in the environment; soil enhancement; and integrated turf management systems.

For more information, contact Don Comis, 301-504-1625, comis@ars.usda.gov.

Cows corralled in bovine bubbles to study air emissions

For the next two years Frank Mitloehner, a UC-Davis Cooperative Extension specialist in the Department of Animal Science, will monitor several dozen Holstein heifers in airtight bovine bio-bubbles. Housing the cows in these greenhouse-like structures will enable scientists to quantify airborne emissions of ammonia, particulate matter or "fugitive dust," and volatile organic compounds that give rise to ozone.

"We will be measuring nutrients fed to and excreted from cows and all the related emissions released into a closely monitored atmosphere." Mitloehner said.

What prompted this unusual research project is concern over air quality in the San Joaquin Valley, which ranks among the worst in the country. The valley also has a high concentration of dairy farms that add dust and air emissions to the atmosphere. Detailed data about the dairy industry's role in air quality are needed to give the industry and state agencies current information for regulatory decisions.

Looking much like Quonset huts, Mitloehner's four covered corrals each measure 21 by 12 meters (70 by 40 feet) and arch 4.6 meters (15 feet) high. Each pen will house 10 heifers (young cows that have never given birth) or 10 non-lactating adult cows, which typically make up more than half of a dairy's herd.

Cows enter the air-pollution barn, known as the bovine bio-bubble. ***(Photo courtesy of UC-Davis)***

In addition to emissions, animal scientists will monitor ambient air and surface temperature, surface moisture, relative humidity, static pressure, and the volume of air moving through the bio-bubbles.

In the first year of the project, Mitloehner's team will be investigating several methods to reduce dust, ammonia, and volatile organic compounds. Rice straw bedding, for instance, is believed to reduce ammonia emissions and could have other benefits, too – keeping livestock pens dry in winter and dust-free in summer while creating a new use for an agricultural waste product.

Ammonia is of concern because it combines with nitrogen or sulfur oxides to create irritating, fine dust particles that pose health risks. Dust kicked up by the trampling of dried dairy or feedlot manure is another health concern because tiny particles known as PM 10 or PM 2.5 (a reference to particle size in microns) are a human respiratory hazard.

In the second year of the project, Mitloehner's team will examine how various feed rations affect what wafts into the atmosphere.

For more information, contact Mitloehner, 530-752-3936, fmmitloehner@ucdavis.edu.

High-Tech Safety in Fields and Orchards

NIOSH advances innovative roll-over guard

Tony McKenzie, NIOSH Division of Safety Research, Morgantown, West Virginia, elm6@cdc.gov

The National Institute for Occupational Safety and Health (NIOSH) is advancing the development and commercialization of a high-tech system to protect tractor operators from serious injury or death in a tractor rollover, the leading cause of occupational fatalities in agriculture.

The system, called AutoROPS (**Auto**matically deployable **R**oll-**o**ver **P**rotective **S**tructure), consists of a roll sensor, a fixed metal structure, and a deployable metal structure shaped like a squared, upside-down U. The AutoROPS is mounted behind the tractor seat. In normal circumstances, the AutoROPS bar sits no higher than the operator's head. However, it has a telescoping ability powered by compression springs when unlatched.

When the sensor detects that a tractor is tilting on uneven terrain or in a fast turn in a way likely to result in a turnover, the sensor signals the latches to release. This release deploys the roll-over bar to a level higher than the operator's head. Deployed in approximately 0.3 seconds, the bar prevents the operator's head from fatally striking the ground or bearing the impact of the rollover.

Shown above is the AutoROPS, retracted on the left and deployed on the right.

Rollovers account for more than 100 deaths in farming every year. Rollover fatalities can be prevented with the use of a ROPS and a seat belt.

"ROPS are fundamental protective equipment for tractors, but the two traditional versions – fixed ROPS and manually adjustable ROPS – both pose complications that AutoROPS is designed to overcome," noted NIOSH Director John Howard, M.D.

"For example, farmers may find fixed ROPS, which remain elevated above the level of the operator's head, physically impossible to use in orchards and other settings where clearance is low," Howard said. "A manually adjustable ROPS provides some flexibility in that it can be lowered in such settings, then raised when the tractor moves onto open ground, but the farmer still needs to remember to raise it and to take time to do so. The new AutoROPS prototype, which NIOSH developed in close partnership with the farming community and equipment manufacturers, represents an ingenious use of high tech to meet those challenges."

NIOSH evaluated the prototype earlier this year in successful field tests that compared it with traditional ROPS. The tests involved simulations in which remotely controlled tractors without drivers were overturned in ways that could occur in actual operations. The tests showed that the sensors operated reliably, that the bars deployed to levels higher than those where most operators' heads would be positioned, and that the bars met industry standards for withstanding the impact and weight of overturns.

NIOSH also asked a group of farmers to compare the AutoROPS with a manually adjustable ROPS system. The farmers said they believed that the AutoROPS was more effective than the manually adjustable version, and that it provided better protection. NIOSH and FEMCO, a McPherson, Kan., ROPS manufacturer, are working with tractor and power equipment manufacturers to determine ways to bring the technology to commercial use in the agricultural industry. The landscape and horticultural services sector of agriculture is a likely first area of use.

Vibration Aspects

Operator safety defined by new directives

ASAE member Roberto Deboli, IMAMOTER (CNR) Institute, r.deboli@imamoter.cnr.it, Torino, Italy, and Angela Calvo, University of Turin, Italy, angela.calvo@unito.it

In Europe occupational diseases caused by vibration exposure involve about 5 percent of workers in all sectors with high economic and social costs. Concerning hand-arm vibration, the main effect to their exposure is the Vibration White Finger (VWF), a disorder of the blood supply to fingers and hand which can be caused by regular use of vibrating hand-held tools. Sufferers from VWF may have a permanent loss of sensation in their fingers. In each European country about 3,000 yearly new cases of VWF are reported. To face this problem, specific directives have been introduced in Europe since the CE 1989/392 (Machine Directive).

Today, a specific European directive – the CE 2002/44,

gives guidelines to employers for determining the daily vibration exposure A(8). In this document vibration categories are defined as daily exposure value:

- under the action level of 2.5 m/s^2: no action necessary;
- between 2.5 and 5 m/s^2: various actions necessary;
- above 5 m/s^2: power tool not suitable for professional application.

Field research on the daily use of chain saws and workers' exposure to hand-transmitted vibration provides important data on safe and unsafe exposure vibration levels.

To determine the daily vibration exposure, employers should know both the exposure time (the duration of time the hand is in direct contact with the vibrating transmission point) and vibration levels transmitted to workers' hands. Typical exposure times are furnished by the directive (for example, professional chain saws are declared for a daily exposure time of 3.7 hours) and vibration level data can be obtained by the tool instruction manual. Unfortunately, such data may not correspond to the real values.

Woodcutters are among the workers at higher risk of occupational diseases caused by vibration exposure, and an incorrect evaluation can seriously damage them.

For this reason field research has been done in a public forestry yard. A survey, one year long, on the daily use of 20 chain saws of the same manufacturer and same model (70.8 cm^3, 3.8 kW) furnished the utilization and exposure time, as well as fuel and oil consumption, during the wood operation of felling, de-limbing, and bucking. This survey focused on an exposure time of 3.0 hours/day for the full load, 0.2 for racing, and 0.2 for the idling, against the theoretical values of 1.23 hours/day for the full load, 1.23 for racing, and 1.23 for idling.

To really evaluate the worker's exposure to hand-transmitted vibration, a second survey over the same machines and the same operators has been executed to acquire the exposure vibration level using a triad of mono axial accelerometers over each chain saw handle. On the rear handle, the exposure vibration levels measured in the field (8.8 m/s^2) are over the indication provided by chain saw manufacturers (8.4 m/s^2). Normalized daily exposure values A(8) are different in the three cases:

Case 1: vibration level declared by manufacturers and time exposure obtained by directive (5.76 m/s^2);

Case 2: vibration level measured in field and time exposure obtained by directive (5.91 m/s^2);

Case 3: vibration level and time exposure obtained in the field (6.02 m/s^2).

Rear handle values A(8) are always over the daily limit exposure vibration level of 5 m/s^2. Power tools are not professionally suitable, and employers must take into account different work solutions as well as reduced exposure times.

Safety of Pesticide Sprayers

ASAE member Theodor Friedrich, Agricultural and Food Technologies Engineering Service (AGST FAO), Rome, Italy, theodor.friedrich@fao.org

Pesticide sprayers are probably some of the most critical implements when it comes to safety issues in agricultural production. Sprayer safety is not only of concern for the operator but also for the environment, the general public, and the consumer of agricultural produce. Worldwide there is an increasing concern about the environmental and food safety implications of pesticides used in agricultural production.

While legislation is focusing mainly at the chemical products, the subject of pesticide sprayers is often neglected by policy makers. Particularly critical is the situation with operator carried sprayers, such as knapsack sprayers, which are the most common tool for pesticide application in most of the developing world. Nevertheless, very few national safety standards exist for this kind of equipment. The work on internationally agreed ISO standards for operator carried sprayers has yet to be concluded. Unsafe, bad quality, or badly maintained and adjusted sprayers, regardless whether operator carried, tractor- or airplane-mounted do not only present a risk for the operator but also for the environment, the rural population, and the consumers. They contribute to wastage of

Shown above is a lever-operated knapsack sprayer with no safety features and signs of emergency repairs made to retain and detain leakage.

pesticides and with this, partly to the problems caused by agricultural pesticide, (mis)-use.

Internationally accepted safety standards for spray equipment are still scarce or missing completely, and very few countries consider these in their legislation. Therefore the Food and Agriculture Organization of the United Nations (FAO) has been actively working in this area, producing standards for spray equipment as guidance for member countries as well as related policy guidelines. The organization is giving advice to member countries and is also actively collaborating with the international standard organization (ISO) in the development of international standards for spray equipment.

Unsafe and badly maintained sprayers are also common with the motorized versions.

In order to improve the safety of pesticide use, it is not only important to look at equipment safety standards. Regulations also have to consider the maintenance conditions of the equipment and the operator proficiency. Policy guidance and technical assistance is therefore provided in three areas:

• organization of certification schemes for spray equipment based on safety standards,

• organization of training schemes for spray operators which might lead into licensing of operators, and

• organization of inspection schemes for sprayer in use to improve the maintenance and actual working conditions of sprayers.

Of the few countries considering these areas in their legislation most are European. The European Commission is now planning to harmonize the legislation and introduce these three areas as part of the pesticide legislation for all member countries. In a recent regional project on pesticide safety and application equipment between FAO and the Interafrican Phytosanitary Council of the African Union, these concepts were introduced on a pilot scale in Cameroon for the adoption by other African countries. As a direct result the pesticide use in the project intervention areas could be reduced significantly in a very short time period.

Instruction of trainers for knapsack spray operators is the first step to establish an operator licensing program.

Study Finds Trellis Height Influences MSD Risks in Vineyards

ASAE member Fadi A. Fathallah, University of California-Davis, fathallah@ucdavis.edu

A study of five different trellises used in California vineyards has shown that one trellis — the popular vertical shoot positioning (VSP) — best protects workers against developing musculoskeletal disorders (MSD) of the wrist and lower back while pruning. Center investigators in the Agricultural Ergonomics Research Center at University of California-Davis evaluated five trellis systems commonly used in the Napa and Sonoma Valleys to learn which, if any, would minimize MSD risk factors such as repetitive forceful hand and shoulder motion, sustained forward bending, overextension, and other awkward body postures. In the first study ever to quantitatively measure trunk posture and wrist motion during simulated pruning activities, the movements of skilled vineyard workers were tracked as they pruned actual branches embedded in foam at heights where the branches would be cut during actual pruning.

The workers wore a Motion Analysis System, which captured information about wrist motion, and a Lumbar Motion Monitor that tracked their body motion on three planes including forward bending. They pruned branches attached to five standard trellis systems that ranged in height from 0.6 to 1.2 meters (2 to 4 feet) off the ground. In addition to measuring the workers' wrist and trunk movement, the researchers asked them to rank the trellis systems for bodily discomfort. Their subjective response — a clear preference for the VSP system — corroborated the quantitative findings. Workers in California's burgeoning wine industry suffer from a high prevalence of work-related MSDs — 80 cases per 1,000 workers. The most common and most costly injuries involve the lower back and upper extremities. Pruning requires long periods of physically demanding, highly repetitive work. With a grant from the National Institute for Occupational Safety and

Health, the research was undertaken to help the industry select trellis systems that might improve worker health.

Height dictates the difference in risk levels and comfort: only a few centimeters (less than an inch) can be significant. It's tricky, because of the small difference, and it's hard to pick up visually, which is why gathering quantitative data is so important. One might think intuitively that the highest system would work best, because it requires the least bending, but quantitative results showed that the workers were extending their back while pruning branches using the highest system, which isn't good either. They corroborated these findings indicating they were most uncomfortable with the systems at the extreme — the very lowest and the very highest.

A worker picks simulated grape clusters (0.45-kilogram/1-pound rice bags) from a low-trellis system, while devices on his back and hand capture his trunk and wrist motions.

VSP system

At a height of 1.1 meter (42 inches), the VSP system required the least bending or extension of the left wrist and the least forward bending, helping workers maintain an upright, neutral body position to a greater extent than the other systems. It is fortunate that the VSP is the most widely used system in the Napa and Sonoma Valleys, and researchers hope to get the word out to the industry that, when the time comes to replant old vineyards, using the VSP is a good choice for worker health and safety. Researchers recently also found similar results after analyzing data on harvesting grape clusters (as noted with the photo above); the VSP was best in terms of maintaining the most upright posture.

Research on Safety Levels in Tractors and Agricultural Machinery

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Since the 1960s, the University of Bologna Department of Agricultural Economics and Engineering (DEIAGRA) has carried out research on safety levels in tractors and agricultural machinery.

The official Bologna OECD Tractor Testing Station is also part of DEIAGRA, which tests tractor performance and the strength of the protective structures. Related to this activity, the research staff at DEIAGRA are involved in the development of new safety systems for agricultural operators and the definition of testing procedures.

Research has been done on the dynamic aspects of narrow-track tractors evaluating the effect of tire characteristics on tractor lateral stability and non-continuous rolling behavior. Tests were carried out according to OECD, EC, and ISO Standards. A proposal has been submitted for revising the field of application of the Standards in order to better define the tire types which can be fitted on a narrow-track tractor.

Other research has led to the development of a new static method for determining the tractor's center of gravity height, which is an important parameter for stability and rolling behavior. This method has several advantages over the dynamic method, particularly in terms of its operation and precision. Taking into account the results of these tests, studies are now in progress for a statistical approach in determining the center of gravity height and momentum of inertia.

Seat belt anchorage performance on tractors has been also tested according to different international standards. A test procedure for seat belt anchorages was proposed at the 2004 OECD Annual Meeting, to be included as an optional test in the codes for the strength of protective structures.

Research is now in progress for studying the stability index on agricultural machinery to define the risk of overturning.

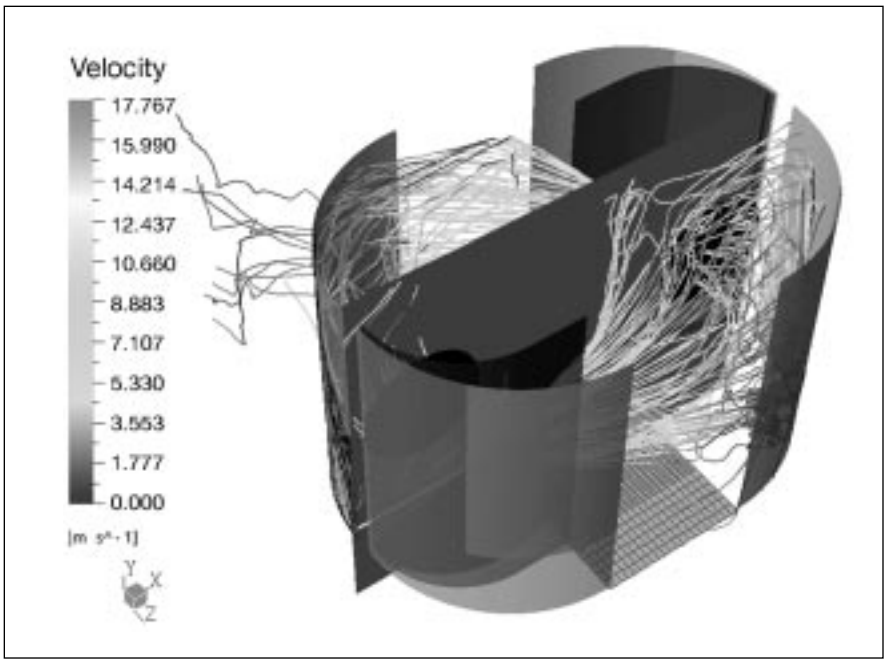
A drawbar power test is executed on the ring of the Bologna OECD Testing Station.

A strength test is administered on the protective structure of a ride-on rotary mower.

Attention is focused on this category of machines because it is recognized that there is a real risk of overturning for some types, therefore safety systems to protect the operator must be studied.

A field in which the DEIAGRA has been working for many years is crop protection, with the aim of improving sprayer performance and reducing environmental pesticide losses. Methods based on colored tracers have been developed to determine the spray deposit on the canopy and losses to the ground and into the environment.

A tunnel sprayer has recently been designed and built using a Computational Fluid Dynamics simulation. Field tests on the prototype showed high performance in terms of spray application quality, reduced environmental drift, and operator contamination.



In a test administered by the Department of Agricultural Economics and Engineerings, University of Bologna, Italy, the results are rendered into a 3D computerized drawing for further study. Diagrammed above are the trajectories and velocity of the droplets ejected by the nozzles in a tunnel sprayer.

Risks Caused by Bioaerosols of Livestock Houses

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The air in farm animal housing contains a large variety of different pollutants: gases, odors, dust particles, microorganisms, others like endotoxins, and even antibiotics. The totals of these air pollutants are also called bioaerosols because of their complex natures. (Bioaerosols are not only the antibiotics; they are the sum of all air pollutants.)

Bioaerosols remain suspended in the air for longer periods because of their minute dimensions — between 10-4 and approximately 102 µm. They give concern for several reasons.

There is epidemiological evidence that the health of farmers and farm workers may be harmed by regular exposure to these air pollutants. It has been reported that about 20 percent of pig farmers investigated in a survey taken in northern Germany complained about respiratory disorders in relation to work in animal houses.

Equally, animal respiratory health may be compromised by air pollutants. Up to 40 percent of slaughter pigs show signs of older or recent lung lesions at meat inspection.

A third reason of concern is that bioaerosols, which are emitted from buildings, are supposed to play a role in respiratory afflictions in people living in the vicinity of animal enterprises. The concentration of airborne microorganisms in livestock buildings is between some 100 and several 1,000 per liter. *Staphylococcae, stretococcae,* coli-like bacteria, fungi, molds, and yeasts are regularly found. The 24-hour average concentrations of dust in animal barns vary considerably. In poultry houses the highest inhalable respirable dust concentrations were found (up to 10 mg/m^3 resp. 1.2 mg/m^3), followed by pig houses (5.5 mg/m^3 resp. 0.46 mg/m^3) and cattle barns (1.22 mg/m^3 resp. 0.17 mg/m^3). The threshold at the workplace is 4.0 mg/m^3 for inhalable dust and 1.5 mg/m^3 for respirable dust. Endotoxins in airborne dust can range from 0.6 ng/m^3 (cattle respirable dust) to 860 ng/m^3 (laying hens, inhalable dust). There is presently no occupational health threshold at the workplace for endotoxin or for microorganisms. The emission rates for respirable dust are from piggeries (about 60 mg/hr), from poultry houses (nearly 300 mg/hr), and from cattle barns at 20 mg/hr, related to 500 kilograms live weight of the animals.

Liberty Tube™ Prototype

Plastic grain rescue tube

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Each year incidents of engulfment in flowing grain in on-farm and commercial grain storage structures are documented. Findings from studies of engulfment incidents have shown that individuals have become fully and partially engulfed in grain while unloading concrete silos, corrugated bins, and transport vehicles. It has also been reported that rescue attempts of partially engulfed victims — those mostly covered by grain with head and mouth above the grain surface — were complicated, lasted for several hours, and sometimes resulted in the death of the victim and even the rescue workers.

In some cases, cofferdams were constructed to facilitate the extrication process and were made from plastic trash cans, plywood, rigid stretchers, fence posts, and even a circular portion of a hog feeder. Although an all-metal prototype grain rescue tube was built in the 1980s, it was determined that a single section of the tube could not pass through the oval- or round-shaped entryways typically found on corrugated grain bins. Because a viable rescue device was not identified, an effort was initiated to develop a portable, inexpensive, and functional tube to facilitate the extrication of a partially engulfed individual.

Extraction exercise (above and below) in process at West Liberty, Ohio: Tube sections were placed around the mock victim and forced down into the grain mass. After inserting the tube, with the pressure exerted from the grain mass on the victim transferred to the tube sections, the mannequin was lifted out of the grain mass and removed from the bin. Participants were then asked to make recommendations for improving the handling and insertion of the tube.

Several versions of a plastic rescue tube device were constructed and tested. Testing included the extrication of a mannequin that was engulfed in the outflow of grain while unloading equipment was operated. Rescue workers extricated the mannequin while using the interlocking, plastic tube sections. The device, which was inserted around the mannequin, thus eliminating the pressure exerted by the grain, was named the Liberty Tube™ after an extrication exercise was conducted in West Liberty, Ohio. Recently, five workshops were conducted in Ohio with the assistance of a jointly funded project by The Ohio State University, Grady Memorial Hospital (Delaware, Ohio), and Illinois State University.

Is Driving as Simple as Going Up and Down the Field?

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For decades, North American farmers have been driving up and down their fields. It is a skill that has been passed from one generation to the next. Within the last few years, however, engineering advancements have caused substantial changes to this task. The global positioning system has made it possible to display accurate guidance information right in front of the driver using a light bar. Even more unbelievably, tractors are now able to drive themselves up and down the field. Where does all this technology leave the driver?

The simple answer is that the role of the driver has changed. When guidance aids are used, the source of the guidance information changes. With the more advanced driverless system, the driver no longer needs guidance information. The "driver" has been relegated to a supervisory role. However, lessons from industry teach us that automation must be approached cautiously. Automation often only changes the workload rather than reducing it.

If it is accepted that the role of the driver has changed, the next question to be answered is "How has the role changed?" To begin to answer this question, a driving simulator was developed at the University of Manitoba. Within a realistic environment of a salvaged tractor cab, the simulator can be used to study guidance systems from an ergonomic perspective.

Originally, the simulator was used to evaluate several innovative light bar designs. Light bars made with blue light emitting didoes (LEDs) resulted in less guidance error than light bars made using the traditional red and green colors. Driver mental workload was also lower with the blue-LED light bar.

Currently, the simulator is being used to characterize the

eye-glance behavior for day and night conditions. It is hypothesized that more reliance will be placed on the light bar during night conditions when external field cues are not visible. In the future, the simulator will permit study of the driver's supervisory role.

Shown above is an interior view of the simulator used to study guidance systems from an ergonomic perspective.

For some time, the importance of ergonomics in the design of tractor cabs has been recognized. With the increasing use of automated guidance systems, ergonomics will become even more important to ensure the safety of these systems when problems arise and the human driver must regain control of the tractor.

Back Injury Intervention

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Work-related musculoskeletal disorders are rising in incidence and account for a majority of workers' compensation dollars. A first-time back injury can total costs as high as $10,000, with costs for repeated back injuries reaching as much as $300,000. Agricultural work is no exception to this with highest costs associated with back injuries. While no one has put a figure on the cost of work-related back injuries in agriculture, researchers report that a study of more than 110,000 workers' compensation claims from 45 states showed the average overall cost per back injury case to be approximately $8,300 in the 1990s. With 3,350 being reported each year in California agriculture, that yields a conservative cost estimate of over $27 million per year for back injuries alone.

Hand harvest work in winegrape vineyards is physically demanding and exposes workers to a variety of ergonomic risk factors. The University of California Agricultural Ergonomics Research Center research in winegrape vineyards has shown the presence of serious risk exposures for a variety of types of musculoskeletal disorders (MSD). More than 200 workers formally participated in this study. Cooperators' injury records representing 194 permanent workers were reviewed for evidence of MSD incidence. Twenty-nine MSDs were defined for 28 employees. These MSDs represented 435 lost workdays. Back injuries predominated at 69 percent, with lifting and carrying of filled tubs of grapes as the predominate reported cause. The primary intervention consisted of providing smaller plastic tubs for holding and carrying cut grapes during hand harvest. These tubs were 13 percent smaller in volume than the traditional tubs, resulting in a seasonal average load weight reduction of 5 kilos/11 pounds (from 26 to 21 kilos or from 57 to 46 pounds) for the tub and its contents. Reducing the load to below the 23-kilo (50-pound)

Above, farmworkers harvesting winegrapes are in the process of dumping grapes from smaller tubs into a gondola, a trailer pulled through the field by a tractor.

The former large tub, above left, and the current smaller tub, shown on right, indicates visually the reduction in weight (and the subsequent reduction in pain suffered by workers).

threshold resulted in a five-fold reduction in workers' post-harvest symptom scores and, most importantly, back and knee pain showed reductions of at least 50 percent.

Equally important, the workers accepted the use of the small tub. The small tub results in a 2.5 percent decrease in worker productivity as measured by pounds of grapes per shift. However, this was not remarked upon by either workers or managers but was identified by the research staff. The 2003 harvest survey showed over 3,000 workers using the small tubs.

Using History and Accomplishments to Plan for the Future

A 15-year summary of agricultural safety and health plus action steps for future directions

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The continuing changes within agriculture, and agricultural safety and health, called for a project to serve several purposes. These purposes included: documenting recent past activities, describing progress made, identifying gaps and needs that remain, and recommending future action steps for the public record.

These objectives were achieved through a three-year project with three primary and overlapping phases: a conference, a consensus development process, and document publication.

Conference

The conference in 2001 attracted 165 registered participants to hear and discuss seven presentations made in general sessions and 34 presentations made in the concurrent sessions. Participants included 26 practicing farmers representing eight states and 25 Latino farm workers representing seven states.

Consensus work groups

Six individual work groups, including one conducted in Spanish, conducted business through a series of teleconferences and two face-to-face meetings. Three key questions were posed to the work groups to guide discussion. These questions asked the current gaps and needs in agricultural safety and health, suggestions for addressing those gaps and needs, and barriers to implementing the solutions suggested. After compilation and work-group review, these findings were incorporated throughout the project document both directly within the content and indirectly through the recommendations offered.

Document

The document was compiled based upon conference presentations, work-group findings, and research as needed for background and explanatory material. The compilation included reviews by the project advisory committee and representatives of the farmers and farm workers with subsequent revisions and reviews as needed.

The primary focus of the document is on 10 specific recommendations amplified by a total of 41 underlying strategies that could be used to enact the corresponding recommendations. The recommendations cover a broad range of agricultural safety and health concerns.

The document recognizes the impact of the many local and private activities addressing agricultural safety and health concerns while conceding the magnitude and scope of the recommended research and programming require national resources. Recommendations include one to develop a specific federal research and surveillance agenda for agricultural safety and health, including measurable goals and objectives. Another supports enhancing determinant research, e.g., better defining recommended exposure limits for indoor air exposure for confinement facility workers.

Another recommendation supports the continuation of research and properly evaluated programming for special populations at risk, e.g., youth, elderly, women, disabled, and minorities. And a recommendation seeks to further enhance collaborative efforts between professionals working in agricultural safety and health and those working in primary health care.

One recommendation seeks to increase the capacity, personnel, equipment, and training — to provide rural emergency medical services as well as occupational and mental health and rehabilitative services in rural areas. Another recommendation calls for applying current engineering and application technology to the fullest extent. An example is global positioning system applications in farm equipment coordinated with similar equipment available and within the means of small rural fire and rescue departments.

The recommendations within this document are by no means all-inclusive but do provide meaningful recommendations based upon knowledgeable and practical input with concrete strategies to use in implementing the recommendations offered. Additional information on the project, the conference including an electronic proceedings, and yearly summaries is available at www.age.uiuc.edu/ash-net/ConfDocts.htm.

Migrant/seasonal workers labor in a cauliflower field. ***(Photo courtesy of Steve Lacey, University of Illinois-Chicago)***

Gearing Up for Safety

A computer-based approach to teaching agricultural safety

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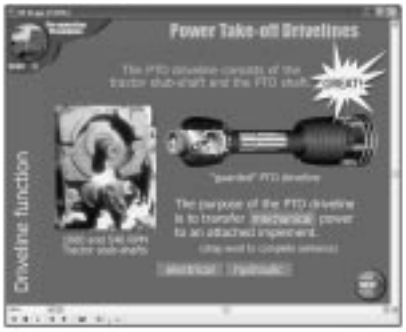
Based on the federal guidelines for youth employment certification, *Gearing up for Safety: Production Agricultural Safety Training for Youth* uses high quality pictures, colorful graphics, video clips, and 3-D animations to teach the subject of tractor and agricultural machinery safety. Users of the program can learn tractor and agricultural machinery safety, general farm safety, and general first aid tips in the CD-ROM/World Wide Web's 11 interactive chapters. The new curriculum is based upon a set of critical core competencies developed by the researchers and an expert panel of various stakeholders chosen for their personal interest and expertise in the areas of agricultural safety and agricultural education. A comparative field test between the computer-based curricula (CD-ROM and Web) and a traditional instructor-based curriculum was conducted in the fall of 2002 with 6- and 12-month follow-ups conducted in the spring and fall of 2003 using six geographically diverse, Indiana high school agricultural science and business classrooms.

Methodology

Field testing was conducted using 166 subjects, ages 13 to 19, in six high schools geographically dispersed throughout the state. The schools were chosen to provide geographical diversity and for availability of adequate computer facilities. All participants were coded to ensure confidentiality. To ensure a random test population and to eliminate biases, each class was randomly divided into one of three educational strategy groups: CD-ROM, Web, and traditional method of teaching. Subjects were administered a participant questionnaire, an attitude/behavior survey, and a 50-question knowledge-based pretest prior to assignment in an instructional method. After completion of all course units, both the computer and traditional groups were given a post knowledge test and a post attitude/behavior survey. The evaluation was conducted over a period of seven days at five of the sites and in five days in one school operating with block scheduling. Five chapters of the computer curriculum were chosen for the comparative field test. These chapters were selected as the contents most closely matched the required training topics prescribed by the Fair Labor Standards Act: Hazardous Occupations Order in Agriculture.



These computer screens display examples of interactive computer-based educational activities from the *Gearing Up for Safety* program.

A 6- and 12-month follow-up were used to determine whether students retained the information over a longer period of time.

Results

A one-way Analysis of Variance (ANOVA) was run to determine whether the means for all three instructional methods were equal, based upon randomization prior to and post instruction. The calculated F-value that resulted from the analysis of the pretest equaled .833 with a P-value of .437. The calculated F-value that resulted from the post-test analysis equaled 1.552 with a P-value of .215. The F-value that resulted from the analysis of the six month follow-up equaled .377 with a P-value of .687 and the F-value from the analysis of the one year follow-up equaled 2.657 with a P-value of .074. This P-value for all tests exceeds the .05 for statistical significance, concluding participants in the three instructional method groups had similar mean scores on all test given to them.

Gearing Up for Safety: Production Agricultural Safety Training for Youth, the new interactive computer curriculum developed for teaching the classroom requirements of the farm

Mean scores throughout study

Group		Pretest	Posttest	6-month	Year
Traditional	Mean	26.09	35.02	31.13	28.48
	N	55	55	40	42
CD-ROM	Mean	27.75	34.00	32.20	31.71
	N	60	60	45	42
WWW	Mean	27.61	32.94	31.00	30.78
	N	51	51	39	41
Total	Mean	27.16	34.01	31.48	30.32
	N	166	166	124	125

***Gearing Up for Safety* provides independent student learning.**

tractor and machinery certification courses as prescribed by the Department of Labor's Hazardous Occupations Order in Agricultural, was determined to be an effective and successful method of instruction for youth seeking employment in production agriculture. It was determined that youth learn equally as well from either a traditional lecture-based, CD-ROM, or Internet method of teaching. In addition, it is believed that the resource could be used to train older agricultural employees who could benefit from additional training on agricultural safety and health or are required to have such training under existing occupational safety and health requirements.

Green Industry Injuries

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The "green industry" is one of the fastest economic-growing industries in the United States. This general term encompasses greenhouses, horticultural specialties, nurseries, and landscape services. The U.S. Department of Labor classifies these occupational activities within the agricultural industry, which unfortunately, ranks as one of the most hazardous industries in the United States.

In a five-year period, 1998 to 2002, the floricultural and nursery product services experienced 10 fatalities per year, while the landscape and horticultural services averaged 131 fatalities per year. In 2001, the occupational fatality rate for the agricultural industry was 15 per 100,000 workers, compared to the low rate of 4.5 for all other private industries. The most common causes of occupational fatalities in the green industry are associated with transportation, falls, contact with objects and equipment, and exposure to harmful substances or environments.

Injuries and work-related illnesses are occurring at an even higher rate than the reported fatality rates. While the average incidence of nonfatal injuries for private industry was 5.3 per 100 full-time equivalent workers in 2002, the horticultural specialty rate was 7.0, and landscaping and horticultural services was at 5.9. Strains and sprains, cuts and punctures, bruises, fractures, chemical burns, and amputations are the predominate injuries reported. Landscape and horticulture workers experience a high prevalence of musculoskeletal disorders; asthma from exposure to fertilizers, insecticides and dusts; and skin diseases related to plants and chemicals. Pesticide applicators are at greater risk for cancers of the nervous and lymphatic systems.

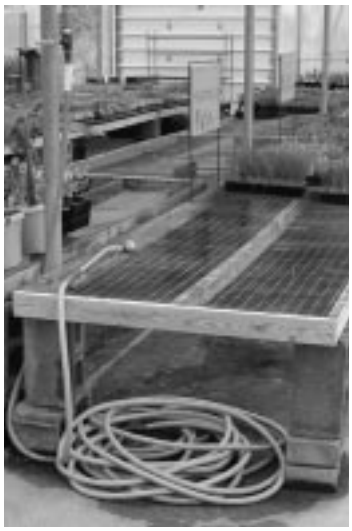
The green industry succumbs to irregular work forces in that a high proportion of activities are seasonal. A compounding factor for some sectors of the industry is that a high number of these seasonal employees are youth or migrant workers, who are more vulnerable to occupational injuries. Employers must provide ongoing training and safety updating for permanent employees, as well as train new employees on safety regulations, correct handling of hazardous substances, and proper use of protective equipment.

Special concerns for greenhouses

Greenhouse safety should begin at the foundation. A safe greenhouse is one that has been properly designed and made of proper construction materials. Renovating an older facility to meet industry standards is possible but expensive.

A safely designed greenhouse is capable of handling the loads imposed by wind and snow. It meets the local and state building codes, as well as fire and electrical codes. Since water and electricity are both present in greenhouses, special attention should be placed on proper wiring and lighting within the facility. Covers are required on all receptacle outlets and light fixtures. Ground-fault circuit-interrupters are recommended for outlets within 1.8 meters (6 feet) of sinks and other wet locations.

The potential for slips and falls is greatly reduced by proper greenhouse design and housekeeping. Hoses and other items around the floor can easily catch a person's foot. Excess water on the floor for long periods of time can also lead to algae growth and ultimately reduce traction. Workers should wear shoes with pliable soles and low heels.



Hoses laying around in greenhouses pose serious trip hazards for workers.

Chemicals should be kept in a locked area and stored separately from other greenhouse supplies. When chemicals are applied, proper posting for the area and terms for re-entry are required. Employees applying chemicals are legally required to follow all personal protective equipment instructions appearing on the container labels. Employers are responsible for providing the correct equipment for each employee.

Ergonomic concerns are plentiful in the green industry. Bending, turning, lifting, and repeated movements of the hand contribute to tired and achy muscles. It is important to minimize repetitive motion and use ergonomically-designed tools for comfort. Review the work environment to ensure an efficient process with minimal reaching, bending, or gripping. Back disorders can be minimized by allowing the worker to sit or stand while performing tasks.

A hanging hose system elimates the trip hazard.

Special concerns for nursery operations

Nursery operations vary in scope but often include a combination of field work, container production, greenhouse activities, and material handling in warehouses. The broad range of activities increase the worker's contact to equipment hazards, chemical exposure, and environmental concerns.

Equipment hazards include tractors and towed implements, skid loaders, power machinery, and conveyor systems. Although each piece of equipment is unique and designed with a specific purpose in mind, all machinery shares one commonality: risk points. The main hazards associated with machinery are pinch points, cut points, wrap points, crush points, burn points, pull-in points, free-wheeling parts, thrown objects hazard, and stored energy hazard (in either springs or hydraulic systems). Maintenance of equipment is important for the life of machine as well as safety of operator. Likewise, all shields and guards should remain intact.

Personal protective equipment for nursery workers can include hearing protection while working around motorized equipment, comfortable work boots and gloves, lifting belts, and rubber goggles, gloves, and aprons when mixing and applying pesticides. A sun-safe hat (which is simply a hat with a 7.6-centimeter/3-inch brim all the way around) should be worn while working in the sun to prevent skin cancer.

This fan is properly secured with all electrical components concealed using a National Electric Code-approved outlet with cover.

Heat stress is a serious environmental concern within the green industry. Adapting work activities to the weather conditions and employees' physical conditions are important considerations for employers and supervisors. Tolerance to outdoor conditions develop over time, however it is important to provide ample water and rest breaks for all employees. Recognizing signs of heat stress is important for everyone on the work crew.

Safety is as much an attitude as it is a practice. Short, frequent training programs are effective strategies to increase awareness of hazards and remind employees of their obligation to practice safety. Ultimately their actions will lead to a safer, and greener, industry.

Industry Culture, Injury Risk

A systems model for rural injury prevention

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Agriculture is one of New Zealand's worst performing industries – in terms of rates and absolute numbers – for serious and fatal injuries.

The size of the problem is indicated by the relatively high premiums for rural workplace personal injury insurance. Rural workplace fatality rates are also nearly twice the "all New Zealand male workers" rate.

Industries such as marine diving and electricity line maintenance have many parallels with agriculture. They are physically demanding, have changing workstations, challenging work environments, and require unsupervised multi-skilled independent decision-making. In fact, they might well be perceived as being considerably more hazardous than livestock farming. But both marine diving and electricity line maintenance attract much lower personal injury premiums than agriculture in New Zealand, and both have lower rates of injury and death.

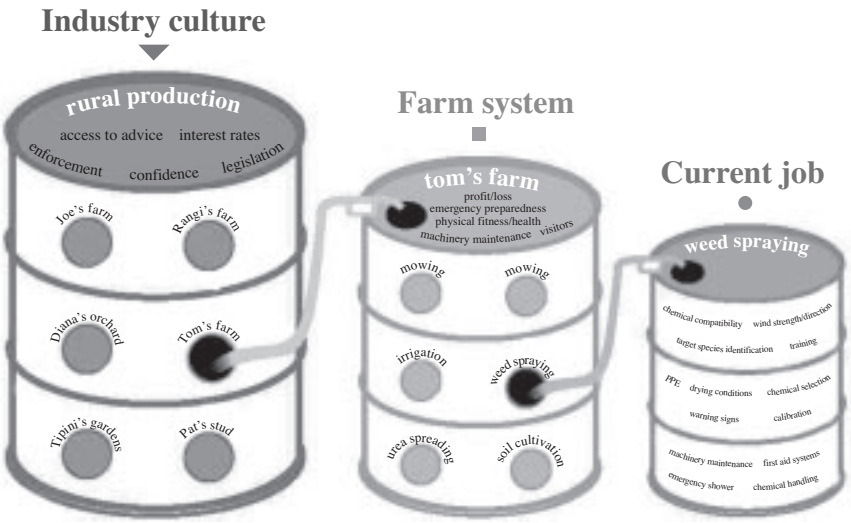
The difference may be accounted for by examining the culture of each industry — the shared values and beliefs that produce identifiable behavioral norms, summed up in the phrase: "the way we do things around here."

Traditional interventions for rural injury prevention have concentrated on single injury risk factors such as all-terrain vehicles or animals.

A new approach is proposed based on an holistic systems model – working inward from the industry level to the actual on-farm job – to provide a more useful framework for designing and targeting rural sector injury prevention initiatives.

The model has three phases. Discrete characteristics of a work culture can be identified for every industry. Each farm within the industry will contain its own work culture characteristics. The farm itself can be broken down into a number of current jobs that also have discrete work culture characteristics. Injury risk factors can be identified at each phase.

The model's three phases can be seen as concentric subsystems, with the current job the smallest. It is nested within the farm, which itself is nested within the agriculture industry. This is illustrated by the fuel drums, on page following, where the larger drum fills (influences) the smaller.



The model has three phases. Discrete characteristics of a work culture can be identified for every industry. Each production system within the industry will contain its own work culture characteristics. The farm itself can be broken down into a number of current jobs that also have discrete work culture characteristics. Injury risk factors can be identified at each phase.

The risk factors of the current job may include many traditional single risk factors such as ladders or tractors. The farm phase requires recognition of factors such as:

- the health of the business,
- the health of the owners and operators,
- the level of risk the owners and operators are prepared to tolerate,
- attitudes towards upskilling or training, and
- fear of prosecution for non-compliance with regulatory requirements.

At the industry phase, there may be a requirement for supply chain traceability or an audited quality assurance system that can dictate how a current job is undertaken back on the farm.

This three-phase model allows risk factors to be analyzed at several levels. Recognition of such factors will allow more effective targeting and design of appropriate interventions. Injury prevention should then become "the way we do things around here."

A Holistic Systems Approach: SHEEP

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This holistic approach – SHEEP – is designed to increase the **S**afety, **H**ealth, **E**rgonomics, and **E**nvironmental **P**rotection-awareness of top executives/decision-makers. The SHEEP system looks at "the whole picture" and addresses how each component acts and interacts with each other to provide a safe and healthful environment free of accidental harm.

Key SHEEP operational definitions include:

- Harm: unwanted deviation from normal bodily and property functions.
- Safety: absence of accidental injuries and property damage.
- Health: absence of dis-ease (lack of ease or comfort).
- Environment: physical and psycho-social space and time that contain humans and their possessions.
- Protection: maintenance of status quo and reduction of accidental harm.

Two extremes of environmental protection must always be taken into account: 1) humans can destroy the environment by controlling and manipulating it to suit themselves, and 2) if animals and their droppings are to be considered part of the environment, then humans and their droppings (nuclear waste; overpopulation; dirty land, water, and air) are also the a part of the environment.

Ergonomics is a study of human interaction with the environment. Disharmony between internal bodily environment and external environment leads to stresses which lead to errors, accidental injuries, and illnesses.

Unprecedented progress in communication, technology, transportation, and biotechnology in the 21st century will make the socio-cultural and geo-political barriers/divides obsolete. In an increasingly diverse workforce and corporate boardroom, it is essential that the two: a) communicate with each other and b) understand the expectations, motivations, and goals of each other. The challenges of accidental injuries, illnesses, and pollution affect the bottom line and the quality of life. SHEEP factors affecting the bottom line include: workers' compensation, medical and health expenses, environmental cleanup and disposal, lost wages, productivity, quality, morale, and more. Growing international SHEEP challenges include: AIDS, accidental injuries and illnesses, acid rain, air pollution, deforestation, desertification, ergonomic disharmony, fisheries' depletion, the global greenhouse, hazardous substances/wastes, ozone concerns, population pressure, radiation perils, species extinction, stresses of the modern society, and water diversion/pollution.

SHEEP builds bridges across traditional disciplinary, political, geographical, cultural, and gender boundaries. The futility of artificial compartmentalization of disciplines is constantly explored. Most boundaries are found to be artificial and of human creation. They are generally created to study a discipline in depth or to manage a set of people with similar experiences and interests. Human limitations lead to specialization to the extent that one loses sight of the overall picture to the paramountcy of his/her speciality. No real-life system can be truly bounded. Can one categorically state where one discipline begins and the other ends in mathematics, physics, chemistry, biology, medicine, and sociology? All human endeavors are a continuum from birth to death. A holistic approach aids in overall understanding. It identifies not only the benefits but also the side effects of change.

Inside ASAE

NEWS ABOUT THE SOCIETY AND ITS MEMBERS

Tampa to Host 2005 ASAE Meeting

Make plans now for the upcoming ASAE Annual International Meeting in Tampa Bay, Fla. July 17-21, 2005.

Come join your colleagues and friends at this exciting ASAE Annual International Meeting location on the beautiful Tampa Bay waterfront where you can relax in the warm sunshine and enjoy the gentle bay breezes. The waterfront convention center is conveniently located in the heart of downtown and is just minutes from Tampa International Airport.

Great dining, unique shopping, family entertainment, and sports all come together in perfect harmony for your enjoyment in downtown Tampa. Visitors can easily get around town via buses, historic electric streetcars, or free historic rubber-tired trolleys. Connections can be made between downtown and local dining, shopping, and entertainment destinations.

Tampa Bay, one of Florida's most invigorating travel destinations, is a perfect choice for the ASAE Annual International Meeting and also doubles as an exciting family vacation venue. In addition to its sandy beaches and beautiful sunsets, the Bay Area offers the best in attractions, nightlife, nature, history, opulent architecture, and diverse cultures. Enjoy sailing, canoeing, fishing, golfing, hiking, biking, horseback riding, big league baseball, and eco-tours.

Tampa Bay is also full of exciting things to do and see for the whole family that won't break the bank. Visitors can tour a historic Latin Quarter, see the graceful manatees that populate Tampa's waterways, view Greek and Roman antiquities, or excavate a model of a Stegosaurus dinosaur in Tampa Bay – all for under $10 a person.

In addition, the Port of Tampa offers three to seven-day cruise options offered before or after the ASAE Annual International Meeting via Carnival, Celebrity, Holland America, and Royal Caribbean cruise lines as well as a cruise ferry to the Yucatan Peninsula by Scotia Price Cruises.

Located on Florida's west coast, Tampa's central location also makes it easy to get to the beaches along the Gulf of Mexico and all the attractions throughout Central Florida. The Tampa Bay area includes Busch Gardens, Lowry Park Zoo, Museum of Science and Industry, the Florida Aquarium, and the University of South Florida. Just 84 miles east of Tampa is Orlando – home to Disney World, MGM Studios, and Universal Studios, Orlando.

Some of the country's earliest recorded history is written about the Tampa Bay region. Tampa was a melting pot in the late 1800s when people from different cultures came together to live and work in Ybor City's cigar factories. This "cigar city" attracted Cuban, Spanish, Italian, German, and Jewish immigrants who created a diverse landscape that can still be seen and explored in Tampa today. Ybor City is now a National Historic Landmark District in addition to other numerous historic buildings, unique shops, and interesting places for meeting attendees and families to explore.

With Tampa Bay as your ASAE meeting and vacation headquarters, you can experience some of the best of Florida all in one place! Make plans now to visit Tampa Bay in July 2005!

A preliminary program listing all these great activities and more will be posted on the ASAE Web site in January 2005 at www.asae.org/meetings/.

A WORD FROM THE PRESIDENT

Committee Sets New Dues Structure

ASAE President Jerry L. Wille, Curry-Wille & Associates

Greetings. As I approached the time that I would actually have the distinction of being ASAE President, I thought I might need to pinch myself to see if it was really true that I would be so honored by this office. Little did I know that the responsibilities and opportunities of this office are far more effective than a pinch in making one aware of what has just happened.

One of the first responsibilities and opportunities I have is to notify you of an upcoming dues adjustment. A special Dues Committee, chaired by Nolan Clark, conducted a thorough study of our dues structure and, equally as important, our procedures for periodic review. The purpose and desired results of these periodic reviews of ASAE dues are to:

1. Maintain the financial viability of the Society.
2. Maximize the desirability of ASAE membership.
3. Maintain fairness among the membership categories.

In order to achieve this purpose and the desired results, the Dues Committee has recommended dues be reviewed at regular five-year intervals and that the following factors be considered:

1. Evaluation of the accumulated Consumer Price Index since the last dues adjustment and then calculation of proposed dues rates that would maintain equivalent income.

2. Consideration of any changes in member services provided by ASAE since the last dues adjustment that would justify a dues change.

3. For each of the past five years, calculation of the percentage of Society expenses covered by dues and projection of what the percentage would be five years ahead if past trends continued. Historically, the percentage of society expenses covered by dues has averaged about 23 percent. The Dues Committee thought it reasonable to keep the dues contribution in the rage of 20 to 30 percent of total Society revenues.

Based on these factors the Dues Committee has proposed, and the Board of Trustees has approved, the tabulated dues structure to take effect on Jan. 1, 2005.

Membership Category	Current Dues	New Dues
Students – Undergraduate	$19.00	$20.00
Students – Graduate	N/A	$32.00
Student Transfer	$30.00	$32.00
Below age 27	$70.00	N/A
Below age 35	$90.00	$90.00
Age 35 through 64	$110.00	$118.00
Age 65 through 74	$76.00	$50.00
Age 75 and above	N/A	$10.00
Sustaining	$70.00	N/A
International Level I	$15.00	$16.00
International Level II	$35.00	$37.00
International Level III	$55.00	$59.00

The major changes in the dues structure include:

1. Elimination of the dues categories for corporate members below age 27 and the sustaining members category.

2. Limiting the student membership category to students seeking a baccalaureate degree.

3. Creation of a new category was created for graduate students who wish to be classified as corporate members but do not want to pay the full membership cost.

4. Establishing a category for members 75 years and older.

Rationale for changes

Graduate Student Membership. Members in this group have completed the requirements for corporate membership and want to begin their professional careers. However, they often opt for the lower-cost student dues while in graduate school. This new category provides them with the incentive to move forward in their careers without creating the financial burden of regular membership. This rate should be the same as the student-transfer rate, and the graduate students, like the student transfers, would be able to maintain this rate for one year after graduation.

Student-Transfer Rate. There is no change in this category except for students transferring from the graduate-student rate to full-membership rate. Graduate students will be eligible for one year of transfer membership rather than the two years for undergraduate students.

Below age 35. The age bracket below age 27 was eliminated. This was rather narrow and tended to conflict with the new graduate-student rate. Most new engineers entering the work force have established their careers well enough to provide for regular dues. The below 27 category accomplished little in getting new members or retaining existing members.

Age 65 through 74. During this age span, many members are retiring; however, they wish to maintain their memberships. A reduced rate similar to the reduced rate for young professional is provided for this age group.

Age 75 and older. Any member who has obtained the age of 75 and still wants to maintain membership will be welcome. A $10 rate is charged to ensure that address and contact information is kept current.

On behalf of ASAE and myself, I would like extend a word of appreciation to Nolan Clark and his committee – Gary Bubenzer, Kelly Detra, Carroll Goering, Ron McAllister, Chad Yagow, and Mark Crossley – for their efforts in not only establishing a new dues structure but also creating a systematic and routine procedure for evaluating future dues structures.

The responsibilities of this office are really not that formidable with the help of the many members like the special Dues Committee. I know our Society has been accused, by ourselves as well as others, of working too hard and not playing more. That attitude and willingness to work hard is exactly what makes ASAE so strong. As I begin to serve this year as your President, I want to thank you for the high honor and privilege and also for your support and willingness to serve.

Greenhouse Becomes 43rd ASAE Historic Landmark

On June 4, ASAE dedicated the first air-inflated double-layer polyethylene greenhouse (AIDLPG) as the 43rd Historic Landmark of Agricultural Engineering in recognition of this development and in honor of Rutgers University Professor Emeritus William J. Roberts. Roberts, along with colleagues and students, made many improvements in greenhouse structures, coverings, and energy conservation practices during his career.

ASAE President Robert J. Gustafson (l) and Professor Emeritus William J. Roberts stand in front of the first air-inflated double-layer polyethylene greenhouse at Rutgers University. ***(Photograph by Alan Goldsmith)***

History

In the early 1960s, as an extension agricultural engineer, Roberts worked with growers who used low-cost polyethylene film on simple wooden frames to construct greenhouses for spring transplant production and bedding plant operations. One early concern was the tendency for a single-layered roof to collect condensation that dripped on the small seedlings. To ameliorate this problem, a second layer of film was added by fastening it to the underside of the frame, which created an airspace and kept the inner layer warmer.

Recognizing the importance of the double-layer covering on a greenhouse to reduce condensation, Roberts tried fastening two sheets together around all four edges and used a small, low-pressure fan to inflate the space between. The historic landmark — a wooden frame structure designed for the width of polyethylene sheeting available at the time — is the first greenhouse in which this concept was successfully applied. Not only was there a significant reduction in the required construction materials and labor time, but the tension in the film due to the slight air pressure reduced the film flexing and flapping in the wind, thereby increasing structural reliability and extending film life.

Roberts also designed wooden greenhouse frames of several sizes to match available film widths as well as a pipe frame structure and pipe bender to assist hand bending of the hoops. He then developed the engineering plans and drawings for these easy-to-construct greenhouses. The early popularity of these designs and their rapid commercial acceptance was due primarily to their low cost compared to conventional greenhouses glazed with glass or fiberglass. The insulation properties of the inflated air space reduced heat requirements by over a third, which became even more appreciated in the years following the energy crisis of 1973.

David Mears of Rutgers University worked with Roberts on some aspects of the early research and contributed the engineering analysis of film stress as related to the geometry and size of the coverings and the structural loads. Later, Mears and a series of graduate students advised by him and Roberts did further research on structural aspects, energy conservation and management, and film properties. The key to all these advances was the simplicity and functionality of the concept developed by Roberts of using air to inflate the space between the layers.

Impact

Today, approximately 65 percent of all commercial greenhouses in the United States use the air-inflated system. The original AIDLPG structure has been used continuously for a variety of research studies. It was the first greenhouse in which developments in floor heating and movable insulation/shade curtains were attempted. The method of fastening the film has been upgraded from the original wooden-strip fastening method to various designs involving aluminum extrusions. Otherwise, the first AIDLPG frame remains virtually the same as constructed in the early 1960s.

For more information visit http://aesop.rutgers.edu/~horteng.

Dedication

The unveiling of the commemorative plaque was performed by Cook College Acting Executive Dean Keith Cooper, ASAE President Robert J. Gustafson, and Professor Emeritus William J. Roberts. Following the unveiling, several invited speakers reminisced about and attested to the national and international impact of the AIDLPG system. These speakers included K.C. Ting, Ohio State University; Merle Jensen, University of Arizona; Sadanori Sase, National Institute for Rural Engineering, Japan; Wei Fang, National Taiwan University, Taiwan; and David Mears, Rutgers University.

The ASAE Historic Landmark activity was established to commemorate significant past accomplishments. For a listing of all the ASAE Historic Landmarks, visit www.asae.org/awards/historic2/index.html.

A. J. Both
Assistant Extension Specialist
Controlled Environment Engineering
Rutgers University

PREPROFESSIONALS

Young Awarded ASAE Foundation Engineering Scholarship

Jo A. Young, a senior in the Biological Systems Engineering Department at Virginia Tech, was recently selected to receive the 2004 ASAE Foundation Engineering Scholarship.

Young is the recipient of the scholarship grant, which is presented annually to an ASAE student member enrolled in an ABET or CEAB accredited agricultural/biosystems engineering program. To qualify students must maintain a high grade point average, verify that graduation assures eligibility for the Professional Engineering licensing exam, and can attest to the need for financial aid.

Young was presented the $1,000 grant on Aug. 2, 2004 during the Virginia Tech Alumni and Friends Social held during the ASAE/CSAE Annual International Meeting in Ottawa, Ontario, Canada.

This scholarship is made possible by the generous contributions of ASAE members through the ASAE Foundation.

Young will graduate during the fall semester of 2005 with a bachelor of science degree in biological systems engineering and plans to continue her studies at Virginia Tech pursuing a master's degree.

According to Saied Mostaghimi, Biological Systems Engineering Department professor and department head, "Jo Young is a highly-motivated individual who is interested in increasing her knowledge and experience in value-added agricultural products. Young has exceptional potential to become a successful engineer and serves as an excellent role model for young female engineers."

Warner Receives Adams Scholarship

Dustin L. Warner, a senior in the Biological and Agricultural Engineering Department at Kansas State University, was selected as the recipient of the William J. Adams, Jr., and Marijane E. Adams Scholarship for 2004.

According to James Koelliker, professor and head of the Department of Biological and Agricultural Engineering at Kansas State, "Dustin is an outstanding student and young man with outstanding promise for a professional career in the agricultural machinery area. His service contributions in our department and at the college level have been excellent."

Warner plans to graduate in May 2005 with a bachelor's degree in biological and agricultural engineering. His goal is to obtain employment with an agricultural equipment manufacturer. During the summer of 2003, Warner interned with design and testing engineers at Class Omaha LLC of Omaha, Neb. This past summer, he interned with the Engineering Field Test Division of AGCO Corp. in Hesston, Kan.

Warner was selected for the scholarship based on his excellent academic standing, financial need, and interest in agricultural machinery design and development. He will be presented the $1,000 scholarship on Sept. 2, 2004, during a K-State ASAE Student Branch meeting.

The scholarship grant is presented annually to an ASAE student member enrolled in an ABET or CEAB accredited agricultural/biosystems engineering program. It is intended for students interested in careers in agricultural machinery product design. To qualify for the scholarship, students must maintain a grade point average of a least 2.5 (4.0 basis) or equivalent.

The scholarship is made possible by the generosity of Mr. and Mrs. William J. Adams, Jr. of San Jose, Calif., through the ASAE Foundation.

Smith Recipient of Merriam Scholarship

Sara M. Smith, a senior in the Agricultural and Biosystems Engineering program at South Dakota State University, was selected to receive the 2004 John L. & Sarah G. Merriam Scholarship.

Smith, a resident of Tamarack, Minn., is the recipient of the scholarship grant presented annually to an ASAE student member enrolled in an ABET or CEAB accredited agricultural/biosystems engineering program. It is intended for students who have demonstrated a special interest in soil and water engineering. To qualify, students must maintain a grade point average of a least 2.5 (4.0 basis) or equivalent.

Smith will receive the $1,000 scholarship grant during the fall Annual Awards Banquet.

The scholarship is made possible by the generosity of Mr. and Mrs. John L. Merriam of San Luis Obispo, Calif., through the ASAE Foundation.

Smith plans on graduating in May 2005 with a degree in agricultural and biosystems engineering with an emphasis of study in soil and water.

According to Smith, "Soil and water engineering is a discipline that I cherish. I feel that I did not 'select' the soil and water discipline, rather I was just always meant to study and work with this type of engineering." During the summers of 2002 and 2003, Smith worked for the University of Minnesota Extension Service of Carlton County as a soil technician and research project leader. This past summer, Smith accepted an agricultural engineering student position with the Natural Resources Conservation Service in Preston, Minn. She served as president of the ASAE student branch at South Dakota State University.

Board of Trustees Approves Amendments to ASAE Bylaws

The amendments are to Article B5, Fees and Dues. The deletions are denoted by ~~strikethroughs~~ and additions by **bold face**.

Par. 1 The annual dues, admission fees and reinstatement fees shall be as follows for all members except Honorary Members and Life Status Members who shall pay no annual dues or fees:

Annual Dues

Dues Categories	Annual Dues	Admission Fees	Reinstatement Fees
Students	~~$19~~ **$20**	--	--
Graduate Student (Para. 11)	**$32**	**--**	**--**
Student Transfer (Para.12)	~~$30~~ **$32**	--	--
Below age ~~27~~ **35**	~~$70~~ **$90**	$10	$10
~~Age 27 through 34~~	~~$90~~	~~$10~~	~~$10~~
Age 35 through 64	~~$110~~ **$118**	$10	$10
~~Age 65 to Sustaining~~	~~$76~~	~~$10~~	~~$10~~
~~Sustaining (Para. 11)~~	~~$70~~	~~$10~~	~~$10~~
Age 65 through 74	**$50**	$10	**$10**
Age 75+	**$10**	**--**	**$10**
International Level I (Para. 13)	~~$15~~ **$16**	--	--
International Level II (Para. 13)	~~$35~~ **$37**	--	--
International Level III (Para. 13)	~~$55~~ **$59**	--	--

Par. 11 ~~Sustaining member status is attained whenever a member acquires a combination of years of full corporate dues payment plus age equal to one hundred five.~~

Graduate Student dues are for members qualified for corporate membership who are currently enrolled in a curriculum whose major activity is completion of a postgraduate degree. Graduate student members transferring to corporate membership before the end of the calendar year following their year of graduation shall have dues at $32 for only their first year of corporate membership and shall have the regular admission fee waived.

Par. 12 Student members transferring to corporate membership before the end of the calendar year following their year of graduation shall have dues at ~~$30~~ **$32** for their first year and second year of corporate membership and shall have the regular admission fee waived.

This action was approved by the Board of Trustees on Aug. 1, 2004, at the ASAE Annual International Meeting in Ottawa, Ontario, Canada.

2004 Streams, Wetlands, and Watersheds Conference Exhibitors

MN DNR-Ecological Services

Contact Karen Terry, 1509 First Ave. North, Fergus Falls, MN 56537, 218-739-7576, karen.terry@dnr.state.mn.us.

"Healthy Rivers: A Water Course" is a multimedia CD-ROM program that explores the ecology and management of river systems. The user-friendly program organizes information around a logical, five-component framework for understanding complicated principles of river and stream ecology. The program is intended for those working with conservation and watershed organizations on river management issues; land management agencies, local governments, environmental consultants, and policy makers working toward sustainable management of river and stream resources; and secondary and post-secondary educators.

Shamrock Environmental Corp.

Contact John Peters, 6106 Corporate Park Drive, Browns Summit, NC 27214, 336-375-1989, jpeters@shamrockenviro.com.

Shamrock Environmental Corp.'s focus is to meet customer demands for environmental and industrial waste services. Headquarters are located in Browns Summit, N.C., with operational facilities in Greensboro and Charlotte, N.C. The corporation encompasses a wide array of environmental procedures including remediation, industrial services, stream and wetland restoration/construction, emergency response, waste processing, recycling, and waste management services.

Hach Company

Contact David Kamps, 6833 Aleda Ave SE, Grand Rapids, MI 49508, 616-554-1127, dkamps@hach.com.

Hach Company is a manufacturer of online and portable water quality instrumentation, water samplers, flow and level instruments, high quality rain gages, laboratory instruments, and field test kits. Hach Company brands include Hydrolab, Ott, American Sigma, GLI, Lachat, and Anatel.

RIVERmorph, LLC.

Contact J. George Athanasares, 1901 Nelson Miller Parkway, Louisville, KY 40243, 502-212-5000, info@rivermorph.com.

RIVERmorph® Stream Assessment and Restoration Software incorporates virtually every function needed to assess, monitor, and design streams using natural channel design techniques. The software's intuitive graphical user interface places critical design data at the user's fingertips and significantly reduces calculation time. RIVERMorph® allows the user to explore a myriad of design solutions simply by graphically adjusting on-screen design variables. RIVERMorph® also allows graphs and tables to be created for insertion into reports and presentations, and provides a means to develop a reference reach library for use in future designs. For more information about this geomorphic analysis and design tool, visit www.rivermorph.com.

MEMBER NEWS

Allen P. Zimmerman, professor of engineering technology and technical physics at The Ohio State University, ATI, recently received the North American Colleges and Teachers of Agriculture (NACTA) 2004 Teaching Award of Excellence. This award is NACTA's highest honor in recognition of demonstrated excellence in college teaching

Zimmerman's professional interests include energy-efficient home construction, problem solving, curriculum development, and improving the teaching and learning process. He is a 35-year member of ASAE.

David A. Bainbridge, associate professor at the U.S. International College of Business at Alliant International University (AIU), San Diego, Calif., has received the American Solar Energy Society's Passive Solar Pioneer Award honoring innovative work on environmentally responsive buildings and direct use of solar energy for ventilation, heating, cooling, and lighting.

Bainbridge was an early proponent of straw-bale building, a technique that provides the super-insulation needed for high-performance solar buildings at modest cost. Because of these advantages, straw bale buildings in Mongolia are now providing energy savings of 80 percent-plus.

In his sustainable management courses at AIU, Bainbridge introduces students to what he calls "the world's only safe nuclear reactor" – the sun. Bainbridge has been a member of ASAE for six years.

Sandro Liberatori recently received the BÁNHÁZI commemorative medal, the highest Hungarian tribute of respect awarded for foreign scientists acting in agricultural engineering by the Scientific Council of MGI (Hungarian Institute of Agricultural Engineering). Liberatori was honored for his well-known scientific activity and for deepening of the international and Italian-Hungarian contacts on the field of agricultural mechanization. Liberatori is Director of ENAMA in Rome, Italy, and founder/main coordinator of the European Network for Testing of Agricultural Machines. He is a six-year member of ASAE.

Digvir S. Jayas, P.E., Associate Vice-President (Research), Distinguished Professor, Canada Research Chair in Stored-Grain Ecosystems, and Interim Director of the Richardson Centre for Functional Foods and Nutraceuticals at the University of Manitoba, was awarded the 2004 W. J. Eva Award by the Canadian Institute of Food Science and Technology for outstanding contributions to food science through research and science. Jayas has been a member of ASAE for 22 years.

ASAE Annual Meeting Highlights in October

Look for complete coverage of the ASAE 97th Annual International Meeting held in Ottawa, Canada, in the October issue of *Resource*!

John H. Boldt, P.E., of Naples, Fla., recently retired Collier County Stormwater Management Department Director, has relocated to Colorado Springs, Colo. Boldt has been named the first Director of the Association of Christian Design Professionals. The Association serves as the prayer and financial support for Engineering Ministries International (EMI). EMI is a group of volunteer engineers, architects, and land surveyors who offer a free technical design service to Christian missionaries serving the poor in third world countries. For more information on EMI, visit www.emiusa.org, or contact Boldt at john.boldtemiusa.org. Boldt has been a member of ASAE for 43 years.

Thomas J. Brumm, Iowa State University faculty member, recently received an award for innovative teaching from the Center for the Advancement of Teaching and Learning.

Brumm was one of 61 teachers from higher education institutions around the world who received the Award for Innovative Excellence in Teaching, Learning, and Technology. Brumm was cited for his creative strategies that emphasize student-centered learning and assessment in Iowa State's agricultural engineering and agricultural systems technology programs.

Brumm is an assistant professor in agricultural and biosystems engineering. He earned his bachelor's degree in agricultural engineering from Iowa State, a master's degree in agricultural engineering from Purdue University, and a doctorate in agricultural engineering from Iowa State. He has been a member of ASAE for 14 years.

IN MEMORIAM

Frank Saco, 58, president of Ag Water in Sebring, Fla., died March 30, 2004.

Saco introduced the innovative drip irrigation system to the Superior Farming Co. and the San Joaquin Valley in 1967. In 1976, he moved to Escondido, Calif., where he was employed by Reed Irrigation as an engineer where he designed, built, and installed drip irrigation systems. From there, he branched out to Central and South America where he designed and supervised the installation of irrigation systems. For a short period of time he taught a course in hydraulics in the agriculture department at the University of Caracas, Venezuela.

Saco's expertise in irrigation gained him recognition, and he was sought after as a consultant. He traveled extensively, designing, building, and supervising the installation of irrigation systems in many countries such as Costa Rica, Russia, China, Saudi Arabia, and Israel. He served in the United States Army and had been a member of ASAE for 25 years.

Survivors include two brothers, Bobby and Isaac of Lamont, Calif.; and a sister, Susannah of Chula Vista, Calif.

WELCOME NEW MEMBERS

ASAE welcomes the following new members who joined the Society, reinstated a lapsed membership, or upgraded to full membership from student/preprofessional membership in July. When available, the member's place of employment has been provided. Please join us in extending a warm welcome to these new and returned members of our Society.

New Members for July

Balachandra Babu
Merlin D. Bailey
Wayne K. Blenkhorn, Stonecrest Engineering Inc.
Maria Del Mar Delgado, INIA
Marlys L. Disrud, Applied Engineering
Volodymyr O. Dumenko, Chernivtsy Institute of Agroecology and Biotechnology
Steve R. Duncan, International Technology Group
Fredrick F. Hager
Yingchang Han, Purdue University
Jon T. Harris, Barge Waggoner Sumner & Cannon
Makoto Hoki, Mie University
Minda A. Huebner, Burns & McDonnell
Kohta Ishii, Hokkaido Central Agricultural Experiment Station
Asad Javaid, CNH America
Candice L. Johnson
Murat Kacira, Harran University
Ali Bulent Koc, Harran University
Naoshi Kondo, SI Seiko Co. Ltd.
Aaron D. Kuehl, Deere & Co.
Kevin J. Kuehner, BNC Water Quality Board
Benoit Lacasse, Agriculture Canada
Robert Lagace, University Laval
Jennifer L. Lees, John Deere
Ming Han Li, Texas Transportation Institute
Rachel A. Lipsey, University of Arkansas
Bob Paul Lusembo, James Finlays Uganda
Ricardo Mireles Jr, USDA-NRCS
Alexandre B. Nascimento, TeeJet Mid-Tech
Cuauhtemoc R. Negrete
Kentaro Nishiwaki, National Agricultural Research Center for Tohoku Region
Miller A. Pounds, Halls Gin Co.
Steven R. Real, Turner Collie & Braden
Jose Reyes-De-Corcuera, Washington State University
Joseph M. Schultz, GDS Associates
Herbert Segane, Makerere University
David R. Shields, University of Nevada
Jason W. Skinner, USDA-NRCS
Christopher S. Smith, WRIME Inc.
Vince L. Stout
Julius K. Tangka, Ministry of Higher Education
Victor J. Tokar
Snizhana M. Tsopa, Chernivtsy Institute of Agroecology and Biotechnology
Pablo Vidal, University of Extremadura
Jay Vincent, Conestoga Rovers & Assoc. Inc.
Gregory A. Wells, Natural Resources Conservation Service
Mark R. Wilkins, USDA-ARS

COOPERATIVE STANDARDS PROGRAM

Proposed New Project

X390.4, Definitions and Classifications of Agricultural Field Equipment.This standard is being revised to provide a definition of scraper tractors that will allow such tractors to be recognized for this application.

For more information, contact ASAE Standards, 2950 Niles Road, St. Joseph, MI 49085-9659, USA; 269-428-6331 or 269-429-0300 ext. 315, fax 269-429-3852.

Attitude makes a difference

An interview with featured guest Robert J. Gustafson

Suranjan Panigrahi

***Robert J. Gustafson** is a successful professional with 33 years experience. He has served as a faculty member at two universities and as a department chair for 11 years. He is currently associate dean for academic affairs and student services at the Ohio State University. He has served in various leadership positions in ASAE, including president of ASAE (2003-04) and is an ASAE Fellow. He is involved with other professional associations and participates in international research and education activities.*

Panigrahi: What challenges does our professional Society face today?

Gustafson: How to evolve with the changing needs of agricultural, food, and biological engineering. We need to move with the needs of society and industry. For example, biological engineering has rapidly expanded in recent years. We are going through changes in the profession to accommodate this change.

Panigrahi: How do you think our Society should plan to appeal to a broader domain?

Gustafson: Our Society is already made up of practicing engineers from heterogeneous groups. We need to focus on adding value for our agricultural and biological engineering members. One advantage we have is that we are relatively small in size, and people know each other. This makes networking easier. As a part of our approach, promotional and informational items are being developed and used to increase awareness of our Society, e.g. our staff did an excellent job by facilitating a segment on the show, "Voices of Vision" for public television.

Panigrahi: We are losing young professional members. What do we need to do?

Gustafson: We need to market our profession aggressively at the individual, university, department, and/or Society level. People think ASAE is a diverse Society. Actually, other societies are very diverse. ASAE is small and faces constraints as it maintains a tax-exempt status. We need to be aggressive in capturing opportunity. ASAE failed to capture "biological engineering" fully when the concept was developing. Now many other societies claim biological engineering efforts within their missions. Societies like ASEE, ASME, and AICHE have a consistent presence in Washington, D.C. We need to reach out to political entities and decision makers. It takes substantial resources, a significant mobilization effort, and effective planning.

Panigrahi: Our Society is going to celebrate its 100th year. Any plans for celebrations?

Gustafson: Lyle Stevens of Deere & Co. is leading the effort. There will be an appropriate celebration in the form of activities throughout the year and at the annual meeting. It is an opportunity both external and internal for our Society.

Panigrahi: What characteristics are employers looking for from our agricultural and biological engineering graduates?

Gustafson: Employers value the work ethic of our students. They are looking for work and co-curricular experiences. Our programs provide a well-rounded education with flexibility. With the growth of the bioscience industry, biological/biosystems engineering components will provide options for our students who are prepared for these new opportunities.

Panigrahi: You have been involved with academic administration for some time. How do you suggest we deal with perceptions about our program within the university?

Gustafson: Department leadership and faculty need to get actively involved in interdisciplinary activities and faculty governance. Working with people and providing contributions can lead to a positive image for our programs.

Panigrahi: What are your secrets of success?

Gustafson: I have been blessed with being at the places where opportunities were. I have found that an engineering training/mindset is excellent training for administrative positions. Working with people with different priorities is a challenge. Time and priority management are very critical. I read a lot of literature and engage myself in professional development and continuous learning. My international experiences, although brief, also have been very rewarding and helpful.

Panigrahi: Any suggestions for our members?

Gustafson: Look for and take advantage of opportunities for leadership at the workplace and in ASAE. Having your own personal philosophy is critical. Be alert for opportunities. At the same time, knowing one's limitations, and setting realistic goals, is also important. Career decisions need to be based on introspection and careful evaluation. Finally, no matter where you work, you will work with people. Dealing with people with an appropriate attitude and demeanor can make a lot of difference.

ASAE member Suranjan Panigrahi is an associate professor in the department of agricultural and biosystems engineering at North Dakota State University, Fargo, N.D. To suggest an individual to be featured in a future issue, e-mail s.panigrahi@ndsu.nodak.edu.

(continued from page 2)

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Administrative Relationships: Reports to the Resident Director, Texas Agricultural Experiment Station, Amarillo, Texas.

Qualifications: (Required) Ph.D. in Biological and Agricultural Engineering, Chemical Engineering or Environmental Engineering. B. S. and M. S. degrees in accredited engineering curriculum are preferred. Knowledge and experience in air quality engineering research and animal agriculture are preferred. Requires demonstrated capability to perform independent research and publish results in refereed journals, ability to communicate effectively in English language, and cooperate as an interdisciplinary team member.

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Date Position is Available: September 1, 2004

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Dr. John M. Sweeten, P.E.,
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Beth Ahner, Co-Chair Search Committee
Biogeochemistry and
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Intervention Strategies

Decreasing human illnesses attributed to foods derived from animals

Marilyn C. Erickson and Michael P. Doyle

Annually, food-borne pathogenic bacteria sicken an estimated 76 million Americans. Furthermore, compilation of outbreaks for which the etiology and transmission vehicle were known revealed that one-half were attributed to foods of animal origin. Within this group, beef was the most frequently reported vehicle of transmission, followed by pork and eggs, while *Salmonella* was the pathogen most often identified followed by pathogenic *Escherichia coli*. Although not as frequently associated with outbreaks, another agent of concern is *Listeria monocytogenes* because individuals infected with this pathogen have a high mortality rate. Interventions to thwart the presence of these pathogens in foods derived from animals are multifaceted and cover each link in the food chain, from the producer to the consumer. This article addresses those interventions, both novel and traditional, employed to control foodborne pathogens in animal products.

Strategies designed to reduce contamination of animal food products have traditionally been applied during post-slaughter processing, whereas over the last 10 years, increasing attention has been directed to reducing contamination at the farm level or during slaughter. Three main approaches have been taken during production:

• reduce environmental sources of contamination (feed, water, pests, manure, contaminated animals),

• reduce proliferation of pathogens in animals (prebiotics, competitive exclusion, bacteriophages, vaccines), and

• develop tools to rapidly detect contaminated animals before slaughter.

Although the magnitude of transmission of pathogens through contaminated feed to animals is unknown, feed contamination has been targeted through the application of heat treatments, such as pelletization, addition of antibiotics, sodium chlorate, or other chemicals to the feed, or through fermentation of the feed (poultry). Water is another potential source of contamination, but treatments such as acidification of the water or addition of chemicals (chlorine, ozone, sodium chlorate, acidic calcium sulfate) have had limited success, especially in cattle operations, due to the continuing presence of rumen content or manure in water troughs. Hence, systems must be designed to clean the troughs on a regular basis to maximize water disinfectant treatments. One potential system is synergistic isogenous active decontamination whereby a screw pump continuously pumps liquid in and out of an ultraviolet light photonics pasteurizer, thus increasing the exposure of pathogens to the UV light. In the meantime, management/husbandry practices have had an impact on reducing fecal shedding of pathogens by contaminated animals and exposure of animals to pathogens. Some of these practices include reducing moisture content of poultry litter, regular cleaning and disinfection of equipment and barns, and chemical dip treatments of egg surfaces prior to hatching. To reduce intestinal proliferation of the pathogen, microbial cultures have been administered to both cattle and chickens with the intent of outcompeting harmful pathogens. In the United States, adoption of this strategy, known as competitive exclusion, has been slow as the cultures must be shown to effectively reduce pathogen levels and not contain specific antibiotic resistance genes, and its use requires FDA approval which can take many years to obtain. A variation on this strategy is the administration of nonfermentable sugars (prebiotics) such as sorbitol, L-arabinose, trehalose, and rhamnose, through feed or water, which favors growth of non-pathogenic microbial populations in the rumen. Orally treating calves with bacteriophage (viruses that selectively kill microorganisms) have also shown promise in reducing *E. coli* O157:H7 carriage. Vaccines used in the United Kingdom have decreased *Salmonella* Enteritidis infection of layer chickens and subsequent contamination of eggs. The complex ruminant digestive system of cattle, however, has restricted the usefulness of traditional vaccination procedures in controlling *E. coli* O157:H7. Instead, vaccination approaches have concentrated on targeting specific genes in pathogens or specific proteins involved in attachment of the pathogen to the host's intestinal lining. Irregardless, development of rapid procedures for detection of contaminated animals on the farm would be advantageous as it would assist in culling contaminated animals so that they could be subjected to more rigorous on-farm or processing treatments.

Despite the intervention steps applied during production, animals presented for slaughter usually are dirty and harbor pathogens from fecal contact in pastures, grow-out houses, feedlots, and transportation vehicles. To minimize this contamination, several intervention strategies are commonly applied during slaughter. Application of hot water

spray rinses, steam pasteurization, pulsed vacuum-immersion, or spray sanitization with organic acids or cetylpytidinium chloride to beef carcass surfaces help reduce contamination. Removing by manual trimming or steam vacuuming areas on carcasses with visible fecal contamination has also been effective. Fluorescent assays have been developed to detect areas of contamination that are invisible to the naked eye. Addition of disinfectants to chill water tanks is used to reduce pathogen contamination of poultry carcasses.

In post-slaughter operations, heat has been the most common treatment used for killing pathogens. Recent variations on this approach involve radio-frequency heating, pasteurization of in-shell eggs, and post-packaging pasteurization. Less common physical treatments for inactivation include irradiation and hydrostatic high-pressure. Certain approved chemical additives that sensitize pathogens to heat or reduce their growth during product storage include acidified calcium sulfate ($Safe_2O^{®}$), sodium diacetate, sodium or potassium lactate, and activated lactoperoxidase. Recent studies have revealed that edible packaging materials such as zein containing a combination of antimicrobial agents such as nisin and EDTA can reduce pathogen contamination on fresh poultry.

Post-processing contamination by *L. monocytogenes* is a major issue for ready-to-eat meat and poultry products and improvements are needed in reducing environmental contamination of food processing plants. Improvements in design of food processing equipment to enable effective cleaning, proper placement of air filters in ventilation systems, and effective treatments to control listeriae in wet areas such as floor drains are needed. One promising treatment to reduce *L. monocytogenes* contamination of drains is the use of competitive exclusion bacteria that colonize drain surfaces and kill listeriae by producing naturally occurring antimicrobials in their presence.

High turnover and inexperience of personnel handling foods are major issues in food distribution and retail that can contribute to food-borne outbreaks. One approach suppliers have taken to address this concern is packaging and handling foods at central facilities before it arrives at the food service operation, and developing foods that would be cooked from the frozen state rather than the refrigerated state. In addition, using automated, easy-to-use chemical sanitation systems helps minimize human error by delivering proper concentrations of cleaning and sanitizing agents. Similarly, smart equipment is being installed that provides continuous on-site monitoring of temperatures and equipment functions and notifies service companies when preventive maintenance is required. On the flip side, consumer preference has driven stores to operate more in-store delis and such operations provide multiple opportunities for cross-contamination of products. Critical equipment used within the deli such as meat slicers should be designed for easy, frequent, effective cleaning and disinfection. Alternatively, incorporation of antimicrobial agents (triclosan or silver) into food-contact surfaces or food service gloves or utensils may minimize cross-contamination opportunities.

Another important source of contamination in food service operations is personnel that are infected by harmful microbes and do not use safe hygienic practices such as suitable handwashing procedures in handling foods. Light-scanning technology that detects organic material on hands could be used to monitor the effectiveness of handwashing, and vaccinations of employees against hepatitis A would prevent the transmission of this pathogenic agent. These types of interventions in retail stores do not replace the need for effective training programs and continuing education workshops in safe food handling.

In addition, there is a need to implement good retail practices, standard operating procedures, and hazard analysis critical control point systems that address the risk factors of greatest concern in contributing to foodborne outbreaks at retail. Third-party audits to verify compliance by food suppliers and surveillance equipment to monitor activities in retail operations are other system management tools being prescribed. Concerted efforts are needed to better maintain and monitor storage temperatures at retail and both hand-held temperature monitoring devices and RFID (radio frequency identification) temperature probes have been developed for this purpose. Regrettably, while automatic temperature monitoring devices are currently available, they must be retrofitted for the retail market.

As the final link in the food chain, consumers are increasingly being asked to share the food safety burden. Food safety brochures and Web sites devoted to consumer education have been designed addressing handwashing, controlling cold and hot temperatures, avoiding cross-contamination, and proper cooking. Even with this information, many consumers misperceive their own roles in preventing food-borne illnesses. Hence, new strategies are needed to capture people's attention and encourage behavioral change.

In conclusion, the number of intervention strategies to reduce food-borne illness from foods of animal origin have increased dramatically in the past few years. While the targets of these strategies range from the farm to the consumer, there are still many areas where improvements could be realized. Ultimately, as each weak link in the food continuum is addressed, the safety of foods of animal origin will be enhanced. **R**

Marilyn C. Erickson and Michael P. Doyle are affiliated with the University of Georgia Center for Food Safety; 770-228-7284, merickson@griffin.uga.edu, mdoyle@uga.edu and base these observations on CAST Issue Paper No. 25 (Jan. 2004).

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