Engineering Update
Biological Systems Engineering
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To: Extension Unit Directors, Extension District Directors, Extension Program Leaders, and ANR Agents

Dear Co-Workers: Engineering Update is a joint effort of Biological Systems Engineering and other interested parties. Subject matter areas include timely information on water quality, natural resource management, TMDL, air emissions, animal waste management, machinery management, precision farming, application technology, farm safety, energy, engineering education, and technology. Please use this information in your on-going Extension programs and circulate to all Extension staff and interested parties. Engineering Update is electronically accessible at:

(http://intra.ext.vt.edu/anr/bse/index.html).
A new project at VT’s Eastern Shore Research and Extension Center is examining yet another way nutrients can be removed from farm runoff before reaching waterways. A bioreactor, likely the first of its kind on the Delmarva, was installed on the research farm three months ago and has been gathering data since. Zach Easton, BSE Faculty member at VT is leading the project.

The bioreactor is essentially a trench dug out of a field with filter cloth laid down in it and wood chips backfilled in the trench. In this case, the bioreactor is 100 feet long, five feet wide and about seven feet deep. Runoff and subsurface water from 12 acres of the field runs through bioreactor and Easton said the drainage area will vary with each site. Test wells on the field where the bioreactor was installed showed nitrate levels between 9 and 16 parts per million, higher than the levels allowed for drinking water and soil tests on the field show carbon at less than one percent. “That means there’s no food for these microbes to do their job,” Easton said.

That’s where the bioreactor comes in. The filter cloth allows surface and subsurface water to pass through it keeping soil out. The wood chips provide a carbon source and drainage control allows water table control, which created the anaerobic conditions that promote microbial denitrification, converting nitrate in groundwater to nitrogen gas that escapes to the atmosphere. Easton will also add biochar to the wood chips to see what effect it will have on microbial activity. Biochar is a charcoal substance created by pyrolosis of biomass. In this case, the biochar is from western red cedar wood, and is speculated to enhance microbial activity. Though he only had limited data to share at the AREC field day, Easton said the initial results look encouraging.

The early data is varied but showed between 20 to 30 percent of the nitrates removed from the water column. He added that the bioreactor could take about six months to a year to reach optimal efficiency and microbial activity. Later this year Dr. Easton’s graduate student, Emily Lassiter will be quantifying the potential of bioreactors to contribute greenhouse gases that can occur if the denitrification cycle is not fully completed. He said if the project proves effective at removing a significant amount of nitrates, the practice could be fairly easy to implement on farms. The cost of constructing the bioreactor on the research station, not counting the data recording instrumentation or biochar was about $1,000, with most of the cost in excavation. Bioreactors could be constructed so crops could be planted over them and not take land out of production.

(Adapted by Z. Easton)
The Virginia Household Water Quality Program (VAHWQP), coordinated by Erin Ling and Brian Benham in BSE, offers affordable water testing and private water system education via drinking water clinics that are conducted through local extension offices in 12-16 Virginia counties each year. BSE is thrilled to announce a new initiative that builds on the successes of the VAHWQP (www.wellwater.bse.vt.edu).

The new project is funded through a USDA-Rural Health and Safety Education grant and led by Leigh-Anne Krometis, Assistant Professor in BSE. This new project will focus in three rural regions of Virginia (figure 1): Southside (Charlotte, Halifax, Mecklenburg, and Lunenburg counties), Southwest (Russell, Tazewell, Dickenson, and Buchanan counties) and the Northern Neck (Westmoreland, Northumberland, Richmond, and Lancaster counties).

With the USDA grant, BSE will offer a Virginia Master Well Owner Network training and multiple VAHWQP drinking water clinics in each region in 2012. In addition to the standard group of constituents drinking water clinic samples are tested for, in 2012 we will expand the analysis to include quantification and source tracking of bacteria, lead, and arsenic.

Clinic participation in the areas targeted by the Rural Health grant will be subsidized to decrease barriers to low-income population participation. In addition, we will begin collecting self-reported demographic and basic health data from participants to identify relationships between these data and household water quality. The new USDA grant will allow BSE to partner with the Southeast Rural Community Assistance Program, a non-profit organization that offers financial and technical assistance in the form of low-interest loans and grants for families who need water system repairs or treatment devices installed (www.sercap.org).

For more information about the new USDA grant and VAHWQP, please contact Leigh-Anne Krometis (krometis@vt.edu) or Erin Ling (ejling@vt.edu).

(by E. Ling)
A century ago, child labor in the US was an accepted practice across all industries. The Fair Labor Standards Act (FLSA) of 1938 took children under 16 out of most workplaces for their own safety and over time has restricted the most hazardous work activities for 16 and 17-year-olds.

Agriculture has been the lone exception. Originally, most farms were small family operations and child labor was not considered necessary. The 21st century agricultural work environment is much different. Farms are larger and more specialized, with new technologies, processes, machinery and equipment.

Now the US Department of Labor (DOL) is proposing new rules regarding the Agricultural Child Labor Hazardous Occupations Orders (Ag H.O.). The ag H.O.s describe work activities that are particularly hazardous to young workers under age 16, such as operating machinery and working in and around silos and grain handling facilities. The proposed changes will be the first update since 1970. They are based on a comprehensive evaluation conducted by the National Institute for Occupational Safety and Health (NIOSH), which reported on its evaluation in recommendations concerning both non-agricultural and agricultural hazardous occupations orders. As a result of the report, regulations for non-agricultural H.O.s were revised and became effective in 2010. Recommendations to bring the agricultural H.O.s more closely in line with non-agriculture are included in the recent Notice of Proposed Rulemaking. For example, the use of power-driven equipment which has been prohibited for 14- and 15-year-olds employed in non-agricultural industries for over 50 years, is included in the proposal.

NOTE: The updated rules would continue to exempt family farms and do not provide protections for 16- and 17-year olds. Both of these changes would require an act of Congress.

Retain and Expand Ag H.O. #1
- Prohibit operating a tractor, or connecting or disconnecting an implement or any of its parts to or from such a tractor. Remove the 20 PTO Horsepower threshold criteria. Small garden-tractors would be covered under this Ag H.O.
- Continue to allow for a student-learner exemption and require that tractors operated by 14- and 15-year-old student-learners be equipped with approved roll-over protective structures (ROPS) and seat belts. The use of seat belts will be mandated.
- Certificate training options would be eliminated.
- Move the prohibition regarding youth riding on tractors as passengers from Ag H.O. #7 to this Ag H.O.
- Include provisions similar to those proposed in H.O. #19 (non-Ag) prohibiting the use of electronic devices, including communication devices, while operating tractors.
- Require that student-learners operating tractors have a valid state driver's license to operate tractors and other farm machinery on public roads.

Combine Ag H.O. #2 and #3 [Ag H.O. #2]
- Prohibit operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines: corn picker, cotton picker, grain com-

bine, hay mower, forage harvester, hay baler, potato digger, mobile pea viner, feed grinder, crop dryer, forage blower, auger conveyor, the unloading mechanism of a non-gravity-type self-unloading wagon or trailer, power post-hole digger, power post driver, or non-walking type rotary tiller.

- Prohibit operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines: trencher or earthmoving equipment, fork lift, potato combine, or power-driven circular, band, or chain saw.

- Expand prohibitions from lists of specific machines to all power-driven equipment. Use of “power-driven equipment” has been prohibited in non-agricultural industries.

- Prohibit minors from riding as passengers on all farm machines when being moved on public roads.

- Youth would be permitted to ride as passengers inside cars, trucks, and buses if certain requirements are met, including mandatory use of seat belts.

- Revise and strengthen the exemption for student-learners and limit the types of equipment that student-learners may operate.

- Require that a student-learner operating equipment on a public road hold a valid driver’s license for such operations (see Ag H.O. #1 above).

- Student-learners riding as passengers must have an “approved seat” with a seat belt; seat belt use is required.

- Include “distracted driving” provisions prohibited use of electronic communication devices while operating equipment [as in proposed Ag H.O. #1 and non-agricultural H.O. #19].

**New Ag H.O. #3**

- Prohibit employment in occupations involving the operation of non-power driven hoisting apparatus and conveyors.

- A student-learner exemption would not be permitted.

**Retain and Expand Ag H.O. #4**

- Prohibit working on a farm in a yard, pen, or stall occupied by a bull, boar, stud horse maintained for breeding purposes, sow with suckling pigs, or cow with newborn calf (with umbilical cord present).

- Expand the current Ag H.O. to prohibit *Certain Occupations Involving Working With or Around Animals*. It would prohibit the following:

  ✓ working on a farm in a yard, pen, or stall occupied by an intact (not castrated) male equine, porcine, bovine, or bison older than six months, a sow with suckling pigs, or cow with new born calf (with umbilical cord present);

  ✓ engaging or assisting in animal husbandry practices that inflict pain upon the animal and/or are likely to result in unpredictable animal behavior such as, but not limited to, branding, breeding, dehorning, vaccinating, castrating, and treating sick or injured animals;

  ✓ handling animals with known dangerous behaviors;

  ✓ poultry catching or cooping in preparation for slaughter or market; and

  ✓ herding animals in confined spaces such as feed lots or corrals, or on horseback, or using motorized vehicles such as trucks or all terrain vehicles.

**Retain and Revise Ag H.O. #5**

- Prohibit felling, bucking, skidding, loading, or unloading timber regardless of size and specifically prohibit the removal of stumps by other than manual means.

**New Ag H.O. #6**

- Prevent employment in construction, communications, wrecking, demolition, and excavation.

- This new Ag H.O. brings many of the protections and prohibitions already applicable to the employment of 14- and 15-year-olds in non-agriculture to the employment of hired farm workers of the same age.

- These proposals address the need to bring parity between the agricultural and non-agricultural child labor provisions.

**Revise and Renumber as Ag H.O. #7**

(Continued on page 6)
- Prohibit working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of over 6 feet.
- Expand to include work on elevated farm structures including silos, grain bins, windmills, and towers; and vehicles, machines, and implements.
- Reduces the maximum height at which youth under age 16 may work to 6 feet, including work on ladders.

Expand and Renumber Ag H.O. #7 [Incorporate into Ag H.O. 1 & 2]

- Prohibit driving of all motor vehicles and off-road vehicles.
- Expand Ag H.O. #7 to prohibit work as an outside helper on motor vehicles.
- Retain provision prohibiting riding on a tractor as a passenger or helper, but moved it to Ag H.O. 1.

Expand and Split as Ag H.O.s #8 & #9

- Prohibit all work inside a fruit, forage, or grain storage (such as a silo or bin). Prohibit working inside a fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere; an upright silo within two weeks after silage has been added or when a top unloading device is in operating position; a manure pit; or a horizontal silo while operating a tractor for packing purposes.

Ag H.O. #9
- Prohibit work inside a manure pit.

Revise and Renumber Ag H.O. #9 as Ag H.O. #10
- Prohibit handling or applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 135 et seq.) as Category I of toxicity, identified by the word “poison” and the “skull and crossbones” on the label; or Category II of toxicity, identified by the word “warning” on the label.
- Revise to be consistent with the EPA Worker Protection Standard for pesticides and re-designate it as Ag H.O. #10.
- Ban all work that falls within the EPA classification of pesticide handler.
- Use definition of pesticides contained in FIFRA.

Retain Ag H.O. #10 and Renumber as Ag H.O. #11

- Prohibit handling or using a blasting agent, including but not limited to, dynamite, black powder, sensitized ammonium nitrate, blasting caps, and primer cord.

Retain Ag H.O. #11 and Renumber as Ag H.O. #12

- Prohibit transporting, transferring, or applying anhydrous ammonia.

New Ag H.O. #13
- Prohibit the employment of young hired farm workers in occupations involving the production and curing of tobacco in order to prevent them suffering from green tobacco sickness (GTS).
- Includes, but not limited to, planting, cultivating, topping, harvest-

New Non-Ag H.O. #18
- Occupations in farm-product raw materials wholesale trade industries, which includes, but not limited to: most occupations performed at country grain elevators, grain elevators, grain bins, silos, feed lots, feed yards, stockyards, livestock exchanges, and livestock auctions.

New Non-Ag H.O. #19
- The use of electronic devices, including communication devices, while operating power-driven equipment, including motor vehicles.

DOL is also proposing to amend 29 CFR Part 579 to incorporate the major provisions of Field Assistance Bulletin 2010-1, Assessment of Child Labor Civil Money Penalties, issued by the Wage and Hour Division (WHD) on January 20, 2010. This proposal will bring clarity and transparency to the child labor civil money penalty assessment process by detailing the process WHD follows when making such assessments. The public is invited to provide comments to DOL on these important proposals. Comments must be received by December 1, 2011 send to:

www.regulations.gov
Colleagues at Penn State have developed state-of-the-art educational materials and resources to reduce confines space hazards. This site contains information about reducing manure pit entry risks for educators, producers, building installers and regulators. Included are recommendations, standards, and design procedures and demonstrations for ventilating manure pits to reduce entry risks. Click on the various links to access detailed information.

Two videos addresses hazards and ventilation of confined space manure storages. The first video is for storages with a solid cover over the storage and is approximately 24 minutes long. The second video is for storages with a partial or a fully slotted floor. This video has three parts and is approximately 27 minutes. The first part focuses on low level of gas in the manure storage before ventilating, while the second part focuses on high level of gas in the manure storage before ventilating. The third part shows the effect of using an outside source of fresh air to ventilate manure storages. We highly recommend viewing all three parts of this video.

**ANSI/ASABE S607 OCT 2010 Ventilating Manure Storages to Reduce Entry Risk**

The primary purpose of this engineering standard is to reduce risk from asphyxiation, poisoning, and explosions when entering confined space manure storages by specifying the positive pressure, forced ventilation requirements, including ventilation system layout, air exchange rates, and minimum ventilation times, for evacuation of contaminant gases from, and replenishment of oxygen into, empty or nearly empty covered or partially covered confined-space, on-farm, manure storages, reception tanks, agitation tanks and other similar containers that hold/contain manure prior to entry. This standard is to be used in conjunction with the appropriate confined space entry considerations defined in ASABE EP470, JAN 1992, R2005, Manure Storage Safety.

The standard specifies the forced-ventilation times required to evacuate contaminant gases (H2S, CH4, and CO2) from on-farm, confined-space, manure storages with either solid, totally slotted or partially slotted covers to concentrations below American Conference of Governmental Industrial Hygienists (ACGIH) recommended 8-hr, Threshold Limit Values (TLV’s).


The purpose of this Engineering Practice is to set forth existing known practices for manure storages that help (1) minimize the hazards of manure gases to livestock and humans, and (2) minimize the potential for drownings at manure storage sites. This Engineering Practice does not include the design loads or structural specifications for manure storages (see ASABE Engineering Practice EP393, Manure Storage). This Engineering Practice contains information on safety equipment, management suggestions on safety, and the manure gases hydrogen sulfide, methane, ammonia, and carbon dioxide. Also given is a listing of the maximum safe gas concentrations, related standards and practices, and pertinent references.

For additional information or if you have additional questions, contact Dennis J. Murphy (djm13@psu.edu).

http://www.manurepitsafety.psu.edu/
The dispute between LightSquared Inc. and global positioning system (GPS) device manufacturers recently shifted back to Congress, where several House Armed Services Committee members criticized the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) for "advocating" for LightSquared at the expense of critical GPS operations.

Network Control Center (NCC) is a member of a coalition of GPS manufacturers, farm equipment companies and agricultural organizations closely monitoring the issue.

During a hearing of the House Armed Services Strategic Forces Subcommittee, Rep. Turner (R-Ohio), the subcommittee chairman, criticized the FCC for allowing LightSquared to move ahead with its proposed nationwide mobile broadband network, despite interference concerns.

Reps. Turner and Sanchez (D-Calif.) have offered an amendment to the FY12 National Defense Authorization Act that would prevent the FCC from granting LightSquared final approval until the agency eliminates the threat of interference to Department of Defense and Department of Transportation GPS receivers.

In a Sept. 9 letter to Defense Deputy Secretary William Lynn and Transportation Deputy Secretary John Porcari, NTIA Administrator Lawrence Strickling urged both agencies to work with LightSquared to develop a joint testing plan to assess interference between the company’s network and cellular and personal/general navigation GPS receivers. NTIA said the testing and analysis should be completed by Nov. 30.

The agency also said a second phase of testing will be necessary to evaluate LightSquared’s proposed plan for mitigating interference to high-precision and timing receivers. Two days later, the FCC’s International Bureau and Office of Engineering and Technology issued a public notice concurring with the NTIA on the need for additional testing.

During the hearing, Rep. Scott (R-Ga.) expressed concern that NTIA is essentially “advocating” on behalf of a private-sector corporation.

Both agencies play a vital role. While the FCC manages all commercial and public radio spectrum in the United States, the NTIA manages the federal government’s use of the airwaves.

Under the FCC’s initial March 2010 order approving the transaction that led to the creation of LightSquared, the company must also build a terrestrial broadband network covering at least 100 million people by the end of 2012, at least 145 million people by the end of 2013, and at least 260 million people by the end of 2015.

Failure to comply with the build-out condition would result in the company’s licenses automatically canceling.

Despite criticisms, the FCC has withheld final approval until the interference issues are resolved.

In June, LightSquared unveiled a new plan for deploying its network using a different block of spectrum that is farther away from the GPS spectrum band. It also has agreed to limit the permitted power level of an estimated 40,000 base stations to avoid overwhelming the signals of GPS devices.

Recent test results have confirmed that use of the company’s upper 10 MHz block of frequencies — not the lower block, the block that LightSquared now proposes to use for initial rollout of its network — interfered with GPS receivers used by the Coast Guard, NASA and the Federal Aviation Administration, and caused GPS receivers used by state police, fire, and ambulance crews to lose reception.

Jeffrey Carlisle, LightSquared’s executive vice-president of regulatory affairs, has said the company plans to unveil a prototype receiver that will allow precision GPS devices to operate without experiencing harmful interference from LightSquared’s network in the lower 10 megahertz block of spectrum.

(Adapted by B. Grisso)
There are several recommended steps for producers and ag retailers to take when getting their equipment ready for the off season.

Self-propelled sprayers take a beating during the crop growing season, which makes it essential to properly put them away for the winter. So that, they are ready to go in the spring when any downtime should be avoided at all costs.

This includes proper cleaning of not only the outside of your sprayer, but also the inside liquid systems. If you don’t do a stellar cleaning job inside and out before parking the rig for the winter, then you are asking for all types of problems come the following spring when you can least afford them.

For instance, crop protection chemicals and fertilizers in the sprayer tank and plumbing will impregnate to hoses and soft parts, which not only weakens the overall systems but also heightens the risk of chemical cross contamination when it’s time to start spraying again. Chemical residue also causes parts to flake off, and these flakes get into the plumbing, resulting in plugged nozzles, screens and excessive wear on pump parts.

A full and thorough cleaning of your sprayer inside and out will also surface potential problems that can be dealt with when during a lax time. Leaky hoses, cracks in welding, wear and tear of fittings — these are all signs of mechanical things going wrong and need to be addressed.

At the end of the spray season, examine your spray rig thoroughly and WRITE DOWN any potential problems in the making. When it comes time for repairs in the winter or early spring, refer back to this list. Otherwise, they might be forgotten or overlooked. You just can’t rely on your memory when it comes to keeping track of these types of issues, and it’s much more efficient to deal with them when they are small problems — before they become expensive, time-consuming big problems. This checklist also helps indicate which replacement parts you need to keep on hand for quick repairs during the off-season or spraying season, and they are a good aid to help set machine inspection dates.

Proper Winterizing

Here are some essential guidelines on how to service and store your self-propelled sprayer for the winter:

- Clean the machine thoroughly to prevent premature rust from fertilizers and crop protection products.
- Touch up any chips, scratches and rusted areas with the appropriate protective paint.
- Replace any damaged or missing decals and safety signs.
- Grease all service points after cleaning.
- Flush the spray system with water.
- Clean the liquid system thoroughly.

If You Anticipate Below–Freezing Temperatures:

- Put an antifreeze solution of 55% propylene glycol and 45% water in the main product tank and rinse tank.
- Before flushing with propylene glycol and water, put plugs in all boom nozzle bodies except the outside nozzle bodies for each pipe of boom plumbing.
- Install a hose with a fitting in open-nozzle bodies and run the hose to a container for proper collection and reuse.
- Open and close the tank sump valve and reload valve several times before operating the liquid pump.
- Operate engine at idle speed. Make sure the tank valve is open, increase engine speed and engage liquid pump.
- Turn on controller. Increase or decrease the flow after you have engaged the liquid pump.
- Open sparger valve completely for several minutes to fully mix anti-
**Winterizing Your Self-Propelled Sprayer**

(Continued from page 9)

- Open the by-pass valve to flush the by-pass line. Close by-pass valve.
- Open the clean water valve to draw antifreeze solution from the rinse tank and properly flush the clean water lines.
- Open tank rinse valve to flush the tank rinse line. Close the tank rinse valve.
- If equipped with the chemical eductor option, open chemical eductor valve to flush line going to the eductor. Operate each function of the eductor to properly flush all lines. Close eductor valve.
- Move boom spray controls on and off a number of times to flush pressure plumbing. Collect solution that comes out of end outlets on boom for use again. Move boom spray controls to off.
- Disengage the liquid pump. Open the reload valve and let the solution flow into a container until the tank is empty.
- Pivot down each end of the boom by hand to let the remaining liquid flow out.
- Leave all valves half open.
- Open hand rinse valve on safety water tank.
- Remove product line strainer.
- Remove boom strainers if installed.
- Disconnect all hose quick couplers to remove any remaining liquid.
- Remove plug from bottom of product pump.
- Remove drain plug from rinse tank.
- Remove plug from bottom of boom manifolds.
- Store loose parts (strainers, nozzles, plugs, etc.) in a labeled container.
- Open the drain valve on the bottom of the foam markets and let the liquid flow out.
- Remove the control console if specified by the manufacturer.

**Following Guidelines**

Whether you are a professional applicator or grower, following these guidelines will ensure that your spray equipment is properly stored for the winter. Then, when the spring spraying season rolls around again, you can focus on things like season fluid changes, simple checks, tire inflation and controller calibration verifications. You’ll be up and running a lot faster with fewer delays and headaches if you have put your sprayer away properly for the off season. (B. Grisso)

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**Biomass field day demonstrates industry's expertise**

"From Grow to Go Field Day," sponsored by the University of Tennessee and the US Department of Energy along with several co-sponsors, demonstrated the industry's growing expertise in biomass production, processing, and conversion research to farmers, industry representatives and students.

More than 1,000 attended a two-day event, including some 625 local middle- and high-school students. Other co-sponsors of the event included Genera Energy, LLC; DuPont Danisco Cellulosic Ethanol; and Ceres, Inc. The event was designed to provide state-of-the-art, research-based information to participants regarding biomass production and related systems.

Day one, Oct. 25, was organized as a traditional field day and was held at Color Wheel Farm. Owners Brad and Kim Black, recipients of the 2010 Tennessee Farmer of the Year Award and participants in the UT's switchgrass production program, showed off their healthy stands of switchgrass —some 292 acres of various varieties. Their fields also hosted five speaking tours focused on topics from biomass agronomics, to environmental sustainability and market development as well as mowing, baling, and raking equipment demonstrations from several different manufacturers. Participants were also able to see three varieties of switchgrass in full production.

Kelly Tiller, president and CEO of Genera Energy and a professor of agricultural economics at UT, was among the luncheon speakers. Tiller shared with the crowd her assessments of the current state of the biofuels industry in the state and region and concluded that the area is well positioned for success.

(Continued on page 11)
Good return on investment

Tiller also noted that the return on investment of the state of Tennessee’s original investment in the $70 million research and production program and biorefinery has to date totaled more than $160 million in research grants, including the establishment of the Oak Ridge National Laboratory’s Bioenergy Science Center and the UT Center for Renewable Carbon’s recent USDA grant of $15 million.

Co-speaker Harry Rymer of Polk County, TN grows some 378 acres of switchgrass as part of UT’s production research program, and he shared his enthusiasm and concern regarding the new energy crop. Overall, his assessment of the effort to date was positive from the farmer’s perspective, but he did express the need for continued development of commercial markets. Each day of the event was operated independently, and attendees were welcome to attend either day, or both days. Most returned for the second day’s tours and demonstrations at Genera Energy’s Biomass Innovation Park (BIP).

The BIP collects, preprocesses and stores biomass materials prior to their distribution to the biorefinery or other facilities. Genera Energy is wholly owned by the UT Research Foundation and dedicated to developing integrated biomass supply chain solutions and strategic partnerships to support the region’s emerging bioenergy industry.

Most of the crowd also toured the grounds of the nearby pre-commercial biorefinery operated jointly by Genera Energy and DuPont Danisco Cellulosic Ethanol. The facility is one of the world’s first pre-commercial-scale cellulosic ethanol biorefineries.

Sam Jackson, vice-president for feedstock operations for Genera Energy, said “we planned a broad-based event that addressed every aspect of biomass production and processing, particularly switchgrass and woody biomass, and I think we addressed a lot of the questions circulating about production and processing issues. I am particularly pleased we were able to address the questions young people have about the future of the industry,” he said. Jackson plans on developing a Field Day for 2012.
To understand compaction, one must first understand the makeup of the soil. Soil consists of organic matter, minerals, and pore space. The mineral fraction of the soil is made up of a combination of sand, silt, and clay particles. These particles do not fit together tightly, but are surrounded by open pore spaces. This open space is important because it allows soil to hold air and water. Spaces between the particles are filled with air in dry soil, water in saturated soil, or both in moist soil. Soil compaction occurs when soil particles are pressed together, limiting the space for air and water.

The amount of soil water is a critical factor in soil compaction potential. A dry soil, which has friction between the soil particles, is not easily compacted. Water acts as a lubricant between the particles, making the soil easier to compact. However, as soil water content increases, a point is reached where pore spaces in the soil are filled with water, not air. Water cannot be compressed, so water between the soil particles carries some of the load of the soil, resisting compaction. Therefore, a very wet soil will not compact as much as a moderately moist soil.

Above figure demonstrates the relationship between soil-water content and susceptibility to compaction. The vertical axis shows the susceptibility to compaction. The horizontal axis shows water content.

The gray zone shows where most soil compaction occurs. To the left of the gray zone, less compaction occurs; to the right, soil gets squeezed to the side rather than compacted. Avoid traffic on wet soil, traction is difficult and can leave ruts that have to be tilled out later.

Soil texture (the percentage of sand, silt, and clay in a soil) has some effect on compaction, although compaction can be a problem to one degree or another in almost all soil types. Soils made up of particles of about the same size compact less than soil with a variety of particle sizes. Smaller particles can fill the pores between larger particles making for a more dense soil. A sandy loam soil (67% sand, 24% silt, and 9% clay) is the most susceptible to compaction. Soil texture is not easily changed.

The structure of a soil (how well the soil breaks up into small, cohesive clumps when crumbled) also plays a role in its potential for compaction. A soil with higher levels of organic matter generally has a more stable structure and resists compaction better than soils with lower organic matter levels.

Organic matter helps create larger and stronger soil aggregates. Hard, dense, low organic-matter soils suffer more from compaction than loose, friable, high-organic-matter soils.

Detecting soil compaction

If compaction is suspected, the best tool to find it is a shovel. Surface crusting and tillage pans can easily be found with a shovel. Vehicle-induced compaction is harder to find, however. This kind of compaction occurs over large areas and is difficult to isolate. To test for vehicle-induced compaction, start by digging first into a wheel track, then into an adjacent area. Any differences in hardness may indicate compaction, but it could also simply be a difference in soil density. It may be best to make the comparison dig from a section of the field where no traffic has occurred.

Cone penetrometers are often used to locate compaction. However, they can be difficult to use. Since penetration resistance is a function of soil density and moisture content, not necessarily compaction, penetrometers need to be used in combination with soil moisture samples to the depth of penetration.

(Adapted by B. Grisso)
Research into Soil Compaction

Aims of Soil Compaction Management

1. Avoid compaction in the subsoil altogether.
2. Limit compaction in the topsoil as much as possible.

Axle Load

Axle load is the first factor that has to be considered in soil compaction. Axle load is the total load supported by one axle, usually expressed in tons or pounds. Farm equipment with high axle loads will cause compaction in the topsoil and subsoil, whereas low axle loads will cause compaction in the topsoil and the upper part of the subsoil only (Figure right). Deep subsoil compaction can only partially be alleviated with subsoilers, and at considerable cost. Freezing/thawing and drying/wetting cycles have been shown not to remediate soil compaction at this depth. Finally, biological activity is concentrated in the topsoil and therefore also contributes little to alleviation of deep subsoil compaction.

Therefore, avoiding deep subsoil compaction is critical. The key to eliminating deep subsoil compaction is to keep axle load low.

What is the critical axle load that is likely to cause subsoil compaction? Research has shown that a 10-ton axle load almost always causes deep subsoil compaction (more than 20 inches deep) under wet to moist field conditions. If the soil is dry, deep subsoil compaction is less likely, even with high axle loads. The 10-ton axle load is only a rough cutoff point, but limiting axle loads to 10 tons at the very most is advisable. Researchers stated some years ago that 6-ton axle loads contribute to subsoil compaction. Axle loads less than 5 tons are not likely to cause subsoil compaction, although they may create significant surface compaction.

(Adapted by B. Grisso)
Compaction is a problem in soils

Soil compaction is one of the biggest challenges we have when trying to grow crops on the highly weathered, low organic matter, sandy soils.

Interestingly, it is the sandier soils that cause the worst problems. Soils high in clay and silt, are not as prone to compaction as are the sandier soils found in the Coastal Plains.

The reason is because sand and clay don’t mix very well and most of our sandy topsoils have a subsoil that contains some clay. When clay is mixed with sand or vice versa, the clay tends to bind the sand particles together into something resembling concrete.

The lack of organic matter makes the situation even worse. Tillage can aggravate the issue by mixing the sand and clay. Tillage when the soil is too wet really creates a problem.

The following values illustrates the relative compaction (force) that different activities can have on a soil.

- Person walking — 6 pounds per sq. inch;
- Crawler-type tractor — 12 pounds per sq. inch;
- Cow walking — 23 pounds per sq. inch;
- Horse walking — 40 pounds per sq. inch;
- Tractor with disk harrow — 150 pounds per sq. inch.

Surface compaction in pastures and hayfields can occur, but is not as much a problem as in cultivated fields.

When a pasture is over-grazed during wet weather, some compaction occurs from the animals. Note the trails where cattle walk frequently have nothing growing in them.

Likewise, if heavy equipment is pulled over a hayfield during wet weather, soil compaction occurs. However, the good news is that plant roots do a terrific job of penetrating the soil and relieving potential compaction.

As roots and rhizomes die and are replaced by new roots, organic matter is deposited and channels are opened up in the soil, resulting in a lower soil bulk density and less compaction.

If you suspect soil compaction is a problem in a pasture, hayfield, row crop, or garden. How can you be sure? A device called a “pentro-meter” which actually gives a measurement of soil strength when pushed into a soil.

Soil sampling tube also works

A stiff wire (surveyor’s flag), a welding rod, or a piece of rebar will work just as well. Those fortunate enough to have a soil sampling tube can use this to detect soil compaction.

The key is to do it when the soil is wet or at least moist. All dry soils have a relatively higher soil strength than wet soils. Measure compaction when the soil is suitable for root growth i.e., when it is moist or near field capacity. Late fall, winter, and early spring after a good, soaking rain is the best.

Take a stiff rod and try to push it into a very moist soil. Do this in several spots, especially if you have rocky or cherty soils. You should be able to push the wire or rod into the first few inches with little difficulty. If you cannot push a wire or rod into a moist soil, roots cannot grow into it.

Grass roots should naturally keep the first few inches of topsoil relatively permeable. If you cannot push it into the soil 3 or 4 inches, you definitely have surface soil compaction. This is a serious problem,

(Continued on page 15)
Compaction is a problem in soils

(Continued from page 14)

because neither rainfall nor roots can get through this. A good, deep sod is the best solution to surface soil compaction.

In field crops, you can usually push the rod down about 4 to 6 inches with no difficulty because this is the plow layer. However, if you encounter a stiff layer between 4 and 8 inches deep, you may have discovered a “hardpan” or “traffic pan.”

What can I do about soil compaction?

First, find out why the soil is compacted and where the compaction is occurring and try to eliminate whatever caused it. Perhaps it was over-grazing a pasture or plowing a field when it was too wet.

Establishing a good root system is the best way to reduce soil compaction. That is one reason so many row crop farmers have switched to some form of high-residue, conservation-tillage. This system leaves old root channels in the soil to reduce soil compaction and increases surface organic matter.

Raindrops on a bare soil result in crusting, another form of soil compaction on the surface.

Rototillers, disk harrows, and turning plows are the worse machinery for creating subsoil compaction. This is another reason for the popularity of conservation-tillage or no-tillage.

Subsoiling under the row and paratilling are very energy intensive operations, but these will break up traffic pans or hardpans and allow for deeper rooting of row crops.

(Adapted by B. Grisso)

Horse Owners: Follow These Hay-Buying Tips

With supplies tight and prices pushing upward, hay is a challenge to find for horse owners. Follow these tips when trying to shore up hay supplies:

Know how much hay you need. Most horses will consume approximately 2-2.2% of their body weight per day in forage.

Calculate feed losses when figuring hay needs. These losses can be 5-50% depending on the type of feeding system used for your horses. Hay fed on the ground with no rack incurs the highest losses.

Assess total costs. In addition to the price of the hay, consider transportation and labor costs associated with getting the hay to the barn or storage area.

Utilize listing services. Ag departments, university extension offices and hay-grower associations in many states maintain lists of growers with horse hay for sale.

National Hay Association—http://www.nationalhay.org/


WVU Extension Service hay listing—http://anr.ext.wvu.edu/hay_for_sale


(Adapted by B. Grisso)
Fall is here and as temperatures drop, the water in your irrigation systems can expand as it freezes. Now is the time to prepare your irrigation systems for winter. Since automatic irrigation systems are usually buried only about 12 inches below the surface of the soil, water left in an irrigation system in freezing climates, even a mild winter, will certainly freeze, causing damage to pipes, fittings, valves, and sprinklers. Damage caused by a frozen irrigation system can be expensive and time consuming to repair next spring. Preventing winter damage by properly winterizing the irrigation system is an important consideration.

Using compressed air to force water out of the irrigation system is the most common method of winterization. However, irrigation systems equipped with automatic or manual drain valves may not require compressed air to winterize if the piping has been installed with slope leading toward the drain valve. If you are not sure that the system was designed to drain itself completely, then use compressed air. Using compressed air on an irrigation system equipped with automatic or manual drain valves will not harm the components of the irrigation system when properly executed and will ensure the irrigation system is properly winterized.

**Selecting an air compressor**

A properly sized air compressor is critical in effectively and efficiently blowing air into the irrigation system, forcing water out through the sprinklers. Air compressors are available in various sizes. The most common portable air compressor, which represents roughly 80% of the portable air compressors going into rental fleets today, is the 185 portable air compressor. This machine is rated at 185 cfm at 100 psi at full load. You can find one through a contractor’s equipment rental shop that is more than adequate to get the job done for most residential and commercial irrigation systems. Smaller 5 horsepower electric air compressors, although capable of delivering 100 psi, are not capable of delivering enough volume of air to adequately winterize an irrigation system. For winterizing sprinkler systems, it is the volume of air that is more important than high pressure. In fact too high of pressure will cause damage. The preferred operating pressure will be set at 40-50 psi. This is enough air pressure to evacuate the water through the sprinklers within each zone.

**Winterizing an irrigation system with compressed air**

A note of caution: The expanding air coming from the air compressor into the irrigation system will get hot and may melt the plastic pipe.

(Continued on page 17)
Carefully check the temperature of the air-hose connection at the blow-out point, and make sure to slow down or stop momentarily if it feels too hot. Cycling through each zone two or three times for short intervals will prevent too much heat buildup. Another option is to use long stretches of compressor hose laid on the ground to absorb much of the heat before it enters the sprinkler system. Those who have experience winterizing large systems will use a combination of both or try and find an air compressor that will blow cold air. They are not as common, but they do exist.

**Drain system winterization**

Although using compressed air is the most common method for winterizing an automatic irrigation system, there are two systems that do not require the technique. The first type is a system equipped with automatic drains that open when the system pressure falls below 10 psi. For these systems, it is usually only necessary to turn off the water.

An irrigation system equipped with manual drain valves requires locating and opening the drain valve for each zone and the main line. Once the valves have emptied, the manual drains must then be closed. The backflow devices and irrigation controllers also need to be winterized.

With either of the systems, it is important to activate each valve to drain water out of the valve and allow air to enter into the system to slowly push water toward the drains.

**Backflow winterization**

There are several types of backflow devices or assemblies used in irrigation systems that are connected to potable water systems. The most common is a pressure vacuum breaker. In order to winterize this device, open the top of the pressure vacuum breaker and remove the internal discs and springs. Storing these components near the irrigation controller makes them easier to find come springtime. Turn the handles on the two ball valves and all test ports to a partially open 45 degree position. Ball valves, when fully closed or fully open, will trap water in between the ball and the valve housing. The valve housing will crack during a freeze if not left partially open.

Some newer pressure vacuum breakers are freeze resistant, with a built-in relief valve to protect the internal components and the body from freezing. It is not necessary to remove the internal components in these devices.

The other types of backflow assemblies used in irrigation systems are a reduced pressure principle backflow device, or RPZ or in some areas a double check valve is permitted for use on irrigation systems. In either case, it is usually best to remove this device completely during the winter and store indoors. Then cap the pipes to the irrigation system. If removal of the backflow device is not possible, carefully follow the manufacturer’s instructions for winterization. Each manufacturer has specific instructions for winterizing.

**Irrigation controller and rain sensor winterization**

(Continued on page 18)
To prepare the irrigation controller for winter, simply turn the controller to the “off” or “rain shutdown” position. Disconnect the power and remove the battery, but this is not necessary. It is important not to allow the controller to cycle through an irrigation schedule without water in the system because the remote control valves require water to move through the solenoid assembly for cooling purposes.

If your irrigation system is equipped with a rain sensor or a soil moisture sensor, it is not usually necessary to cover or remove the sensor for the winter. Check with the manufacturer to make sure the sensor does not require any special instructions for winterization.

**Pump winterization**

Centrifugal pumps have a drain valve located at the base of the pump housing that needs to be removed and stored for the winter. The power supply for the pump should also be disconnected to prevent the pump from being accidentally turned on without any water, as a pump running without water will quickly burn up. Additionally, if the pump is drawing water from a lake or stream, the intake hose has a foot valve located at the base of the suction line. It is necessary to completely remove the intake or suction line from the water and store it for the winter. Sometimes a check valve is also located on the discharge side of the pump, which also needs to be removed and stored for the winter. Any part of the pumping system that can be exposed to freezing conditions will need to have the water drained to prevent damage. Often there are drain plugs or valves meant to be opened to facilitate drainage.

Preparing an irrigation system for winter can be a complicated process. An improperly winterized irrigation system can be an expensive repair the following season. Save time and money next year by investing in proper winterization of the irrigation system now.

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**New BSE Extension Factsheets**

- **Best Management Practice Fact Sheet 1: Rooftop Disconnection**, 426-120, [http://pubs.ext.vt.edu/426/426-120/426-120.html](http://pubs.ext.vt.edu/426/426-120/426-120.html)
The device tracks heart rate, breathing, and movement without requiring the user to wear anything.

Gadgets and apps that track a user’s sleep are growing in popularity, but they typically require a person to wear a headband or bracelet. Now a startup called Bam Labs is offering a sensor pad that can track heart rate, breathing, and movement to track sleep and other health measures from underneath the mattress.

"Using it is as easy as going to bed, and all your data is made available through our Web services and apps," says Richard Rifredi, president of Bam Labs.

The company’s sensor takes the form of a thin, self-inflating mattress pad, like those popular with backpackers. A sensor at one corner of the pad tracks air-pressure fluctuations caused by the tiny tremors caused by heartbeats or the more sizable shaking that occurs when someone turns over or gets out of bed. That data is transmitted by wireless to a box connected to the Internet, which in turn relays the data to computer servers, where it is interpreted as heartbeats, breaths, and other movements. Processed data can be viewed using mobile apps which show trends over time and calculate measures like sleep quality and duration of sleep.

The company recently began offering a version of the product called Touch-free Life Care, or TLC, to senior-care homes, after several months of trials in such facilities.

Early customers in the US and Japan include nursing homes, who can use it for elderly people at risk of falling or getting lost in the night. Should a person get out of bed in the night, an on-duty staff member is notified via a mobile app. It preserves privacy, because residents don’t have staff constantly checking on them. The website dashboard provides more detailed access to data. A nursing home is using data from TLC devices to track the quality of its residents’ sleep to help staff identify those who may need medical attention.

Future versions will be useful for managing chronic health conditions. If someone gets a mat and establishes a baseline of when they are healthy, a home user or a caregiver should be able to see changes early and proactively tackle health problems.

Sleep-tracking gadgets can help people discover and address needs not served by doctors. Most healthcare systems are not aware of our sleep needs. These devices allow people to collect information that can help them improve sleep and also educate their doctors.

The fact that Bam Labs’s device can detect sleep apnea—a temporary cessation in breathing—is one good example. Apnea is extremely hard to detect because the symptoms reported to the doctor are nonspecific, such as obesity, high blood pressure, and fatigue.

Sleeping with a partner or sharing a bed with pets or children could confuse the sensor.

If the technology appears in more medical settings, such as hospitals, the staff will likely appreciate its being safely hidden away under the mattress. Conventional sensors in hospitals that attach to a patient often become dislodged by medical staff, or by a patient’s movement, leading to false readings and false alarms. Most alarms—over 80 percent—from sensors in a typical intensive care unit are false alarms.

The sleep sensors could also allow sophisticated monitoring of sleep and vital signs in natural settings that are currently off limits to medical staff—for example, after a person returns home from the hospital. The sensors are unobtrusive, and are not administered by a health care professional. They can just sleep as normal, but still be monitored closely.

(Adapted by B. Grisso)
In addition to being a dreaded winter chore, shoveling snow can be hazardous and is associated with many serious, even fatal events among both adults and children. A recent study found that an average of 11,500 snow shoveling-related injuries and medical emergencies were treated in US emergency rooms each year from 1990 to 2006.

According to the study, which was conducted by researchers at the Center for Injury Research and Policy of The Research Institute at Nationwide Children’s Hospital, the most common injury diagnoses were soft tissue injuries (55%), lacerations (16%) and fractures (7%). The lower back was the most frequently injured region of the body (34%), followed by injuries to the arms and hands (16%) and head (15%). Acute musculoskeletal exertion (54%), slips or falls (2%) and being struck by a snow shovel (15%) were the most frequent mechanisms of snow shoveling-related injuries.

While cardiac-related injuries accounted for only 7% of the total number of cases, they were the most serious, accounting for more than half of the hospitalizations and 100 percent of the 1,647 fatalities associated with shoveling snow. Patients 55 years of age and older were 4.25 times more likely than younger patients to experience cardiac-related symptoms while shoveling snow. Among patients 55 years of age or older, men were twice as likely as women to exhibit cardiac-related symptoms.

The cardiovascular demands of snow shoveling are increased by the freezing temperatures that typically accompany snowfall. Not only is the heart’s workload increased due to shoveling snow, but cold temperatures also add to the chances of a heart attack in at-risk individuals. Talk to your doctor before you shovel snow is recommended, especially if you do not exercise regularly, have a medical condition or are in a high risk group.

Experts also recommend that people consider alternatives to shoveling snow such as hiring someone else to do it or using salts, deicing sprays, heated sidewalk mats or snow blowers.

The following are a few additional tips for preventing injuries when shoveling snow:

- Warm up with light exercise before you start.
- Make sure to pace yourself by taking frequent breaks for rest.
- The best way to clear snow is by pushing it instead of lifting.
- Ergonomically designed shovels can reduce the need for bending and heavy lifting.
- When possible, avoid large shoveling jobs by clearing snow several times throughout the day.
- Remember to wear warm clothing, including a hat, gloves and slip-resistant, high-traction footwear.

While the majority of snow shoveling-related injuries occurred among adults, more than 1,750 children and adolescents under the age of 19 years were injured each year while shoveling snow. Patients in this age group were almost 15 times more likely than those in other age groups to be injured as a result of being struck by a snow shovel, and two-thirds of their injuries were head injuries.

Shoveling snow can be a great outdoor activity for kids; however, it is important for parents to teach children the correct way to shovel snow and remind them that shovels are not toys. Many of the snow shoveling-related injuries to children are the result of horseplay or other inappropriate uses of snow shovels.

(B. Grisso)
Talking or texting on a cell phone while driving is not an addiction; it's a compulsion. That's what new research suggests following a study of why drivers engage in the risky practice of using their cell phones while behind the wheel.

According to University of Arkansas researchers, the use of cell phones while driving may be linked to obsessive-compulsive disorder (OCD) traits instead of addiction, which commonly had been named the culprit in this dangerous behavior.

The study showed that another potential driver of such [distracted driving] behaviors may relate more closely to obsessive-compulsive disorders than addictions. This is important because behavioral interventions to treat OCD and addictions differ fundamentally, and the possibility that mobile phone usage is a compulsion rather than an addiction may suggest more effective legislative interventions and prevention tactics.

While some states have imposed legislation to ban mobile phone usage while driving, this legislation relies on links to addictive traits and has not necessarily proven effective, researchers said. According to the Highway Loss Data Institute, mobile-phone-related accidents have actually increased in many areas since the passage of these laws.

The bottom line is that drivers continue picking up their phones while behind the wheel despite the risks. In 2010, the National Safety Council estimated that the cause of approximately 28 percent of all vehicle accidents - a total of 1.6 million annually - could be attributed to distracted driving resulting from cell phone usage.

A Study In Obsession

Through an online survey website, researchers collected data from 451 men and women of various age groups and locations. The survey did not restrict the sample pool by demographics but did require that all respondents own a cell phone. More than half (57.6%) of the participants used a smartphone.

The researchers measured types of usage by posing questions grouped into the following categories: general mobile phone usage, compulsive mobile phone usage and dangerous mobile phone usage.

Within these categories, participants were asked basic questions, such as whether they answer calls, make calls, read text messages/emails, send text messages/emails while driving, browse the internet or access social network applications while driving. Researchers also asked respondents how many years they had owned a cell phone and how many hours they spent per day talking, emailing and texting on their phone.

Compulsive Checking

By offering users a way to check messages anywhere, mobile devices may alter the user's "perceived responsibility" toward work and family obligations, researchers explained. This perceived increase in responsibility could lead to compulsive usage. Drivers aren't checking their phones for fun - rather, they feel compelled to do so because of a heightened sense of stress and anxiety.

The findings suggest that the most significant predictor of dangerous mobile phone usage was answering text messages while driving. Incoming mobile alerts could create more distraction and trigger dangerous usage among drivers.

Conversely, initiating text messages was not a significant factor. That means motorists may more likely be driven to dangerous distraction when they take note of incoming messages and feel compelled to check or answer them.

For drivers who exhibit obsessive-compulsive tendencies, legislative bans on cell phone usage likely will not be effective, researchers added. Instead, convincing drivers of the potential cost of such behavior versus the small benefit of responding instantly could more successfully mitigate the dangerous, compulsive use of phones while driving.

Researchers suggested that public-service announcements and other informative interventions might stand a better chance of increasing safety than punitive actions could. From a purely technological perspective, he added, creating different ring tones or alerts corresponding to different "net-works" (work, family, friends) or importance levels could alter stimuli produced by mobile phones and thus reduce compulsive use.
Farm Industry News compiled a list of the 40 most fuel-efficient tractors with help from the Nebraska Tractor Test Lab and its results of tractor tests from the last 10 years.

Top 40 most fuel-efficient tractors: Ratings for tractors #40 through #30

Oct 28, 2011 4:50pm

The fuel efficiency rankings were based on PTO test at rated engine speed. Tier 4 interim-compliant engines use either Selective Catalytic Reduction (SCR) or Exhausted Gas Recirculation (EGR). See “Terms to know” below for explanations of the two systems.

Ever since tractor makers announced how they will meet the EPA’s latest round of clean air standards, claims have been flying about whose tractor will be best on fuel.

AGCO, Case IH, and New Holland claim Selective Catalytic Reduction (SCR) technology is the best way to meet the Tier 4i emissions standards without sacrificing fuel economy. Deere, on the other hand, claim Exhaust Gas Recirculation (EGR) technology is the way to go.

Confusion is caused when companies use different test numbers to back their claims, preventing apples-to-apples comparisons. For example, technicians measure power and fuel use at both the PTO and drawbar and at varying rates of power and pull to replicate the full range of field conditions. Tier 4i has only complicated the issue.

An issue is how to deal with diesel fuel expended for regenerations in an EGR system, which Deere would like to downplay, and how to deal with diesel exhaust fluid (DEF) consumed with SCR systems, which CNH and AGCO would like to downplay. See “Terms to know” below for explanations of the two systems.

The Farm Industry News worked through these variables to come up with a Top 40 ranking on fuel. Rankings are based on the PTO test at rated engine speed, which is a good indicator because it is a test that is run for all tractors.

The rankings include all models tested in the last 10 years, including several 2011 models equipped with Tier 4i engines. However, tractor buyers should consider the other test measures report in the Nebraska Tractor Test Reports. Because power and fuel use will vary depending on the intended application. (See tractortestlab.unl.edu)

Ratings range from 19.00/hp-hr/gal to 17.81. The higher rating indicates better fuel efficiency. Assuming diesel fuel is priced at $4.00/gal., a difference of just one hp-hr/gal point can translate into an annual cost savings of $1,300 for a 200-hp tractor used 500 hours a year.

Terms to know

With a Selective Catalytic Reduction (SCR) system, diesel exhaust fluid (DEF) is used to minimize nitrogen oxides (NOx) emissions. The rate of NOx formation is proportional to combustion temperatures, and the rate of DEF injection is related to engine loading. Higher engine loadings will consume more DEF, whereas when the engine is unloaded, the DEF rate will be near zero.

In an Exhaust Gas Recirculation (EGR) system, soot contained in the exhaust gas is captured in a diesel particulate filter and burned off in a process called regeneration. The object of regeneration is to heat the exhaust gas temperatures high enough to convert collected soot into ash and carbon dioxide. As engine speeds rise, there is more exhaust gas to heat and therefore more fuel required. As engine loading increases, exhaust gas temperatures from combustion are higher; because there is less of a temperature differential to overcome, less fuel is required. At times, normal exhaust gas temperatures are high enough to allow passive regeneration to occur.
New technology is often surrounded by hype and misperceptions that make it harder for us to use effortlessly. When you reflect on the unexpected challenges encountered with the new technology we learn some things are completely contrary to what I had always thought regarding a system upgrade of this magnitude. Below are the top eight misconceptions:

**Myth No. 1:** Cutting edge technology is unproven. When technology is so new, cutting edge implies that not many companies would have bought and used it. In this case, the burden of proof rests on both the vendor AND the customer. The vendor will attempt to back up its claim about its new technology by describing it in as narrow a scope as possible to avoid extra liability, while at the same time aggressively promising benefits to lure the customer. This means that most of the burden of proof needs to lie with the customer. I believe this is where many companies fail. Often, they do not have clear specifications of the intended use. And sometimes they do not even agree among themselves what the intended use is supposed to be.

**Myth No. 2:** Everything is intuitive—obvious. "It’s so easy, anyone can do it." New technology is almost never "intuitively obvious." The fact that new technology will involve learning new concepts and possibly a new way of thinking about something is in direct opposition to "intuitively obvious." More likely, this just means the vendor has a clear idea of how they think the product will be used. Even the slightest ambiguity about the new technology may cause considerable confusion, and thus warrants a clear explanation.

**Myth No. 3:** New technology will work seamlessly with older technology. No matter what the new technology, it won’t always work as predicted. Early in our implementation, we were under the false assumption that our new content management system would integrate with our existing circulation database. That has not been the case, and while not a deal breaker in itself, it definitely contributed to some limitations we weren’t expecting with the technology.

**Myth No. 4:** New tools will help improve productivity significantly. Most new technology will give you some increase in productivity. Timesaving is certainly a desirable effect of new technology, but expectations should be tempered. A technology that bills itself as being a major time-saver may deliver far less than it promises. To realize improvements in productivity via new technology may require you to perform old functions in new ways, perform some new or additional functions, and eliminate others.

**Myth No. 5:** I only need one good tech guy. Ideally, at least one IT person and/or programmer is assigned to the new technology. But that’s not enough. Companies should form a project team, the group responsible for designing, testing, and implementing the system. End users must be involved early on and throughout the project. The technology won’t be successful if all constituents don’t understand how to use it, the solution doesn’t meet their needs, or the proposed training is inadequate. And if that dedicated tech person gets hit by the proverbial bus (e.g., leaves the company), at least the team is not left without any knowledge of the project whatsoever.

**Myth No. 6:** Technology is just too big and complicated. Yes, it sure is. And, so is your car. So, you take it to an automobile expert who gives you simple advice on how to make it run more smoothly. Again, between our dedicated tech guy and the support of the vendor, we had enough technical expertise to move forward — little by little — on the project. Some companies have the in-house staff required to implement a new product or system with little outside help. Most companies, however, do not have the luxury of these dedicated resources, and even those that do must still partner with the right vendor when purchasing the technology.

**Myth No. 7:** I don’t know if it’s worth the money. You should be concerned with how you invest your money. Big bang technology solutions that promise huge rewards are usually not real technology solutions. That’s why you need to focus on measurable success. The right technology solutions — like precision ag software, customer databases or online applications — should provide significant results and quickly pay for themselves.

**Myth No. 8:** Looming deadlines necessitate shortcuts. With unexpected delays in our technology implementation, I am sure many of us were tempted to take shortcuts just so we could complete the project on time. Taking a "let’s just be done with it" approach would have been the easy way out, but would have jeopardized the long-term viability of the technology. Stay the course — adjusting timelines as necessary — and the technology will be well worth the investment.
## 9 Reasons Workers Do NOT Report Near Misses

Safety personnel stress that near misses provide important information about hazards and are essential elements for calculating risks. Unfortunately, it can be all but impossible to get an accurate count of near misses. If employees are reluctant to report them, that just makes it more difficult. Here are the top nine reasons workers often don’t report near misses:

1. **“Fear”** Believe it or not, fear actually may be the least common reason workers avoid reporting near misses. It’s true that some workplaces cultivate an environment where employees are punished for being injured, so these workers are unlikely to report near misses if they fear they will lose their jobs. Overall, however, this usually isn’t the most common reason workers neglect to report their near misses.

2. **“Embarrassment”** A safety director who called a particular employee “accident prone” and a “frequent flyer” based on past injury record. If workers see their supervisors or coworkers humiliate those who make mistakes or experience incidents, they may be too embarrassed to come forward and admit they experienced a near miss. Make the workplace culture one that accepts the fallibility of all people.

3. **“Difficulty”** If an organization makes near misses difficult to report, with confusing paperwork or a convoluted process, workers won’t do it. Instead, supervisors should simply listen to the worker’s account of the near miss and then complete any necessary paperwork on the worker’s behalf. Difficulty is what prevented workers from reporting his own near misses they ended up asking half a dozen people how to file a report, never got a straight answer and finally gave up.

4. **“Bureaucracy”** Some organizations may ask workers who experienced near misses to attend committees or meetings to share their stories. While this approach can work in some companies, it also may be problematic. If workers suspect their near miss is going to trigger a bureaucratic machine of paperwork and meetings, they might rather avoid the whole thing. People have natural predisposition toward expediency. Do not bog the worker down with bureaucratic rules and garbage.

5. **“Peer pressure”** This is the big one, for example take the “frequent flyer” woman: If her injury or near miss cost the workplace its perfect safety record, which means all employees lost out on a cash bonus or prize, how will she feel? Peer pressure from other coworkers can drive near misses underground.

6. **“Loss of reputation”** Similarly, workers do not want the reputation of being considered accident-prone or a crybaby. "Macho" industries such as construction, logging, oil/gas, maritime, etc. may encourage a culture where workers brag about their scars and never want to be seen as weak or unable to “take it.” This can drive near miss reporting down, as well.

7. **“It’s easier not to”** If workers suspect that no one at the organization actually cares about near-miss reporting, or think it will be too difficult or worry about being embarrassed, they may conclude that it’s simply easier not to report it. They might even think the near miss was not a big deal.

8. **“Lack of interest”** from the organization When workers know the organization does not consider near misses important or take them seriously, they won’t. And if a company does not actually use the near-miss information in a meaningful way, workers will be less inclined to report the near miss.

9. **“Perceived as pointless”** If a near miss was not particularly serious and likely would not have resulted in a significant injury, some organizations may consider the process pointless. Companies cannot have it both ways claiming that near-miss reporting is important but then complaining when "small" incidents are reported. It takes a lot of work to do in near-miss reporting because we have to somehow overcome these very real issues.

To encourage workers to report their near misses, frame near misses in a slightly different way: Position near-miss reporting as employee participation in making the workplace safe. If workers view the process as a way to offer ideas and suggestions for safety, their attitudes may change.
Secret Weapon against Arthritis

EXERCISE – Secret to Pain Management

Shoulder Shrugs
- Raise shoulders towards ears.
- Hold 5 seconds.
- Relax downward to a normal position.

Neck Tilts
- Keep shoulders relaxed and arms hanging loosely.
- Tilt head sideways, first to one side, then the other.
- Hold 5 seconds on each side.

Wrist/Forearm Stretch
- Place hands palm to palm.
- Rotate palms around until they face downward, keeping elbows even.
- Hold 5 seconds.

Back and Hip Stretch
- Bend left leg over the right leg and look over the left shoulder.
- Place right hand on the left thigh and apply slight pressure.
- Hold 5 seconds.
- Repeat for the right side.

Upper Body Stretch
- Interlace the fingers, turn palms upward and straighten the arms above the head.
- Elongate arms to stretch through the upper side of the rib cage.
- Breathe deeply and hold for 10 seconds.

Hamstring Stretch
- Sitting, hold onto the upper left leg just above and behind the knee.
- Gently pull the bent knee towards the chest.

Upper Back Stretch
- Interlace the fingers behind the head with elbows out.
- Pull shoulder blades together.
- Hold 5 seconds.
- Relax.

Neck Stretch
- Sit or stand with the arms hanging loosely.
- Gently tilt the head forward.
- Keep the shoulders relaxed and downward.
- Hold 5 seconds.

Wrist/Forearm Stretch
- Place hands palm to palm.
- Move hands downward, keeping palms together and elbows even.
- Hold 5 seconds.

Back Stretch
- Lean forward.
- Keep head down and neck relaxed.
- Hold 10 seconds.
- Use hands to push back up.

Side Stretch
- Hold the left elbow with the right hand.
- Gently pull the elbow behind the head to feel a stretch in the shoulder or back of the upper arm.
- Hold 10 seconds.
- Repeat on the right side.

Hand/Finger Stretch
- Separate and straighten fingers.
- Hold 10 seconds.
- Bend fingers at the knuckle.
- Hold 10 seconds.
- Repeat.

Stretching 4 minutes before, during, and after you garden can reduce tightness, stiffness, and increase productivity for any gardening activity.

Contact your local Healthcare Professional for more information on stretch activities.

http://www.agrability.ext.vt.edu/

AgrAbility
Cultivating Accessible Agriculture
Slip-resistant outsoles can help prevent slip and fall injuries.

Slips, trips and falls are the third-largest cause of workplace injuries and the single most common reason for visits to the emergency room. According to the Centers for Disease Control, they make up 15 percent of all job-related injuries, which account for between 12 and 15 percent of all workers’ compensation expenses.

As a farmer, shop manager or an employee working in an environment with potentially slippery or contaminated surfaces, having the right slip-resistant outsoles is a key factor in helping prevent dangerous and costly slip and falls.

The Slip-Resistant Testing Process

Slip-resistant outsoles are tested at accredited, third-party laboratories. During these tests, the outsole heel and flat contact modes are tested on:

- **Dry tile**
- **Wet tile (water)**
- **Wet tile (oil)**
- **Wet stainless steel (water)**

The outsole is given a rating in each of these environments as well as an overall rating. Outsoles must meet the standards for what is an acceptable test result in order to be labeled as slip-resistant.

What to Look for In Slip-Resistant Outsoles

The following outsole design characteristics can maximize slip resistance:

- **Compound:** Rubber is traditionally the most slip-resistant compound, although polyurethane (PU) also can be highly slip-resistant.

- **Lug design:** Outsole edges help grip the ground and cut through contaminants. The more leading edges (which run parallel with the width of the outsole), the more likely the outsole will test well for slip resistance. Outsoles with many leading edges often are laid out in geometric patterns, which help channel water away.

- **Open channels:** Although surface contact is important, a completely flat sole is not good for slip resistance. For maximum slip resistance, an outsole needs to have channels where water or other liquids can escape out from under the outsole in order to maintain traction.

- **Surface contact:** Outsoles with low lugs or minimal lug height generally perform better because more of the outsole is in contact with the ground.

Outsoles with these characteristics tend to perform better in slip-resistant testing. When considering a slip-resistant outsole, it’s important to consider the type of work, flooring materials and contaminants the outsole will be exposed to. For example, the most slip-resistant outsoles often are wedge outsoles, where the entire bottom of the shoe comes in contact with the floor, therefore maximizing surface area. However, if a person often is on a ladder, an outsole with a defined, 90-degree heel is a much safer choice.

No shoe is 100-percent slip-proof, but having the right outsole for a particular work environment is the first line of defense against slips and falls and greatly can reduce the chances of injury.

New VCE Publication Resources:

Preventing Falls In and Around Homes
http://pubs.ext.vt.edu/3307/3307-1592/3307-1592.html

Preventing Work Place Falls
http://pubs.ext.vt.edu/3307/3307-1593/3307-1593.html
How it Happens:
People can become caught or trapped in grain in three different ways:
1. The collapse of bridged (crusted) grain
2. The collapse of a vertical wall of grain
3. Entrapment in flowing grain

Moving or flowing grain is involved in all three, people who work with grain; loading it, unloading it and moving it from bin to bin need to know about the hazards of flowing grain and how to prevent a grain entrapment situation.

Collapse of Bridged Grain
Grain can become bridged when it is moldy, high in moisture, or in poor condition. The kernels stick together and form a crust, which may be self-supporting. This gives a false indication that it is safe to stand on the surface of the grain. The worker cannot tell if there is grain under the crust or not.

Collapse of a Vertical Mass of Grain
Grain can “set up” in a large mass against the bin wall or in various formations when it has been stored while in poor condition. The mass of grain can collapse and "avalanche" down on workers who attempt to break it loose with shovels or other objects. There will be no warning when it breaks loose and cascades down. The impact will knock workers off their feet, burying them in various positions. Individuals working in the bin can be buried almost instantly.

Flowing Grain
Flowing grain will not support the weight of a person. It will pull a person down and into the grain mass as it flows. The “suction” action is strong enough that a person cannot "swim," climb, or walk against it and get out. As grain flows out of a bin the victim will be pulled down and under very quickly with little time to react. A person cannot be pulled from flowing grain without risk of injury to the spinal column if the grain is at waist level or higher. The grain will have a very strong grip on the body. Research has shown that up to 400 lbs. of pull is required to extract a body from waist-deep grain. That is more than enough force to permanently damage someone’s spinal column.

Rescue Procedures
1. Shut off all grain-moving machinery. Stop the flow of grain.
2. Contact the emergency rescue service or local fire department.
3. Ventilate the bin using the fan without activating the heat source.
4. Work in such a way that additional grain pressure is not exerted on the victim.
5. Protect the rescue workers; be sure the power to the auger is locked out, and use safety lines and respiratory protection or support.
6. Make a retaining wall if the grain is above the victim’s head. Form retaining walls with plywood, sheet metal, or snow fence and tarps to keep grain from flowing to the victim.
7. Remove grain from around the victim using shovels and a grain vacuum conveyor. Use extreme care when victim is not visible.
8. Cut holes in bin sides to drain grain away from the victim if the person is completely submerged. Cut at least two V-shaped or U-shaped holes on opposite sides, or more holes equally spaced around the bin, using a cutting torch, metal-cutting power saw, or air

(Continued on page 28)
Grain Bin Safety

(Continued from page 27)

chisel.

Bin Opening Guidelines For Rescue

FIGURE 1

9. Apply care to the victim as soon as possible, providing breathing assistance, maintenance of body temperature, and emotional support. PLAN AHEAD FOR VICTIM REMOVAL PROCEDURES.

10. DON'T GIVE UP when conditions appear to be grim. People have survived submersion in grain for up to TWO HOURS; sometimes the victim can still breathe while buried in the grain. NEVER GIVE UP.

Safety Precautions

1. Children should not be permitted to work or play in an area where there is flowing grain. It is an attractive nuisance and is dangerous to people of all ages, especially children.

2. All workers involved in situations where there is flowing grain should be warned to stay out of the grain.

3. Warning decals should be placed at all bin entrances: truck and trailer boxes used for grain hauling and on all gravity discharge wagons.

4. Never enter a grain bin without stopping the auger first and then using "lock-out/tag-out" procedures to secure it. Use a key type of padlock to securely lock the auger switch in the off position. Attach a tag to the locked switch so that other people involved can positively identify the switch.

5. If you must enter a grain bin, never enter alone; have at least two people at the bin to assist in case problems arise. Use a safety harness or safety line when entering the bin.

6. Install a permanent rope handing from the center of the bin for a person to grab on to. Tie slip reducing knots about one foot apart along the rope. A rope in a grain bin does not make it safe to enter the bin and should not lead workers to taking undue risks because of a false sense of security. Rope or Life-lines are commercially available through safety equipment retailers.

7. Control the access to grain storage facilities to prevent grain entrapments.

8. Break up crusted grain from the outside of the bin with a long pole. When using a pole, check to see that it doesn’t come into contact with electric lines.

9. Ladders should be installed inside grain bins for an emergency exit. Ladders are easier to locate inside a dusty bin if they are brightly painted stripes just above or behind the ladder.

10. Stay near the outer wall of the bin and keep walking if the grain should start to flow, get to the bin ladder or safety rope as quickly as possible.

11. Grain dust may cause difficulty in breathing, anyone working in a grain bin, especially for the purpose of cleaning the bin, should wear an appropriate dust filter or filter respirator.

12. To prevent grain bin accidents store grain in good condition, which also prevents spoilage, which means more money in your pocket.