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Engineering Update
Biological Systems Engineering
September 2008

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://www.ext.vt.edu/vce/anr/bse/index.html).

FARM SAFELY...
Protect YOUR Investment
National Farm Safety & Health Week
September 21-27, 2008

www.ext.vt.edu

Produced by Agriculture and Extension Communications, Virginia Tech

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Fertilizer Prices Show Even Greater Savings for Precision Agriculture

Farmers often question the economic value of GPS based technology. Does precision agriculture pay? In most precision agriculture circles, this is the most often asked question, and at times the most difficult question to answer.

Technology allows farmers to vary the application rates of crop inputs throughout a field. These practices are creating vast and sweeping changes on many farms. This technology allows such inputs as herbicide, insecticide, fertilizer, manure, etc. to be altered at any particular point within a field. GIS software allows various field data such as soil test results, crop scouting data and yield data to be analyzed and incorporated into the decision making process.

Combining field based data with the ability to vary input usage at specific points within a field should increase input efficiency. Increased efficiency should improve profit margin and result in the adoption of more environmentally sound practices. But does it pay?

To answer this question data was analyzed from a 45 acre farm. Seven years of accurate and calibrated yield data was available. This field was in a corn-bean rotation. Fertilizer recommendations were developed utilizing the four following scenarios.

Scenario 1: Fertilizer recommendations were made according to the farmers normal production practices. Variable rate technology (VRT) was not utilized in this scenario.

Scenario 2: The field was divided into 2.5 acre grids. Soil samples were collected and sent to a lab for analysis. The fertilizer application data was developed for this field utilizing VRT based upon the results from the soil test data.

Scenario 3: The field was divided into management zones based upon soil type. Soil samples were then collected from each soil type. Each sample size was approximately 2.5 acres or less. The fertilizer application data was developed for this field utilizing VRT based upon the results from the soil test data.

Scenario 4: GIS software was used to divide the field into management zones. These zones were based upon actual, historic crop removal data from this field. Fertilizer recommendations were based upon the actual crop removal in each of these management zones. Fertilizer applications were made utilizing VRT. No soil samples were gathered.

Table 1 contains the data from this analysis. Fertilizer recommendations were made for each of the four scenarios using the fertilizer recommendations from state specialists. Overall fertilizer use was the highest using the farmers normal production practices (scenario 1). Utilizing grid soil sampling and variable rate applications (scenario 2), fertilizer use was reduced by 3,420 pounds. Soil sampling using management zones based upon soil type and utilizing variable rate fertilizer applications (scenario 3) reduced overall fertilizer use by more than 3.5 tons. Scenario 4 which utilized GIS software to divide the field into management zones based upon crop removal and utilizing variable rate fertilizer applications produced the most efficient fertilizer use. This scenario, which is based on the actual field production, shows phosphorus recommendations were reduced by almost 1.5 tons and

(Continued on page 3)
Fertilizer Prices Show Even Greater Savings for Precision Agriculture

(Continued from page 2)

the potash recommendations were cut in half. But does it pay?

Fertilizer prices of $650/ton for Potash and $850/ton for D.A.P. were used for this analysis. Soil testing charges and variable rate fertilizer application charges were included where appropriate. Scenario 4, fertilizer recommendations based upon crop removal produced the greatest savings. This scenario, which had the lowest fertilizer use and no soil testing charges, resulted in a savings of $88/ac when compared to the farmers normal production plans. Soil sampling by soil type (scenario 3) and 2.5 acre grid sampling (scenario 2) resulted in savings of $85/ac and $36/ac respectively, when compared to the normal production practices for this farm. But does it pay? In this analysis, Yes! Each scenario involving variable rate fertilizer applications resulted in lower fertilizer use and a greater net return. With today’s soaring fertilizer prices, savings of $36 to more than $88/ac can have a significant impact on most soybean/corn farms.

(Adopted from John Barker, Extension Educator, Knox County, Ohio.)

(R. Grisso)

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>2.5 Acre</th>
<th>Soil Type</th>
<th>Crop Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Recommendation (Lbs. P₂O₅/ac)</td>
<td>185</td>
<td>164</td>
<td>134</td>
<td>121</td>
</tr>
<tr>
<td>K Recommendation (Lbs. K₂O/ac)</td>
<td>200</td>
<td>145</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Total Fertilizer Use (Lbs./Field)</td>
<td>17,325</td>
<td>13,905</td>
<td>10,080</td>
<td>9,945</td>
</tr>
<tr>
<td>P Cost ($/ac)</td>
<td>$112.85</td>
<td>$100.04</td>
<td>$81.74</td>
<td>$73.81</td>
</tr>
<tr>
<td>K Cost ($/ac)</td>
<td>$110.00</td>
<td>$79.75</td>
<td>$49.50</td>
<td>$55.00</td>
</tr>
<tr>
<td>Total Fertilizer Cost ($/ac)</td>
<td>$222.85</td>
<td>$179.79</td>
<td>$131.24</td>
<td>$128.81</td>
</tr>
<tr>
<td>Soil Test Cost ($/ac/Year)</td>
<td>$0.00</td>
<td>$0.70</td>
<td>$0.70</td>
<td>0</td>
</tr>
<tr>
<td>Fertilizer Cost + Soil Test ($/ac)</td>
<td>$222.85</td>
<td>$180.49</td>
<td>$131.94</td>
<td>$128.81</td>
</tr>
<tr>
<td>Variable Rate Fert. Application ($/ac)</td>
<td>$0.00</td>
<td>$6.00</td>
<td>$6.00</td>
<td>$6.00</td>
</tr>
<tr>
<td>Total Cost ($/ac)</td>
<td>$222.85</td>
<td>$186.49</td>
<td>$137.94</td>
<td>$134.81</td>
</tr>
<tr>
<td>Saving vs. Normal Plan ($/ac)</td>
<td>$0.00</td>
<td>$36.36</td>
<td>$84.91</td>
<td>$88.04</td>
</tr>
</tbody>
</table>

GPS Saves Time, Fuel Costs

A Motorola survey showed that almost 50% of the businesses using GPS technologies reduce their travel distance by an average of 231 miles per week which was translated into $51k in annual fuel savings. The survey focused on transportation, manufacturing, and trucking industries. Employees of businesses deploying GPS-enabled technologies saved approximately 54 minutes per day. The respondents credited location-based services with improving the organization of employees routes.

The survey indicated that GPS technology enabled mobile workers to spend less time in traffic or finding routes, while increasing the amount of time spent with customers.

The survey indentified other key applications, namely navigation for improved on-time performance and route optimization. These functions address mobile workers difficulties in locating new stops and streamline deliveries.

From: www.gpsworld.com (R. Grisso)
I have received several questions concerning the potential for wind energy use in Virginia. Most of the time, persons are thinking of the wind mills they have seen in the Midwest but they don't want to pump water they want to generate electricity.

Let's review the growth of the domestic and international wind markets.

Global installed capacity for wind energy has grown 482% over the last seven years, from 14,604 MW in 2000 to 84,934 MW in 2007.

Broken down further, the international wind industry has a compounded annual growth rate (CAGR or year-over-year) of 28.6%, which is impressive.

The graph show the forecast of global wind energy capacity that will be installed out to 2012. This data reveals that the industry will grow 215% between 2007 and 2012, from 85,000 MW to 270,000 MW.

That's a CAGR of 25.8%. That's an industry that's doubling in size every four years or less. Countries currently boasting the highest year-over-year growth in the wind industry, are along with their respective annual growth rates: Turkey, 95.4% Mexico, 84.7% Brazil, 61% China, 54% Poland, 50.9%

Of course, those are the fastest growing markets. According to GlobalData, the largest markets by megawatt capacity are: China, 51,200 MW U.S, 45,454 MW Spain, 36,715 MW Germany, 35,829 MW India, 25,935 MW

There are other factors influencing the growth of wind energy. For example, through 2020 in Europe, wind is expected to account for 34% of the new generating capacity.

It’ll account for 46% from 2020-2030. The goal of attaining 12-14% of Europe's power from wind by 2020 is well within reach.

A US DOE study found that wind energy could generate 20% of US electricity by 2030, as compared to today’s one percent.

This is snapshot of the industry—a very dynamic industry that’s constantly changing. It’s wise to have constant updates and recommendations to stay on top of things.

There is opportunity for wind energy in Virginia but location and size will be a major consideration. (Adopted by R. Grisso from The Green Chip Review, 8-26-08)
The typical American diet often lacks omega-3 fatty acids despite clinical research that shows their potential human health benefits. Zhiyou Wen, assistant professor of BSE, found a way to grow these compounds using a byproduct of the emerging biodiesel industry and presented his findings (review paper at URL shown below) at the 236th national meeting of the American Chemical Society (ACS).

"High energy prices have led to an increase in biodiesel production, which in turn has led to an increase in the amount of crude glycerol in the market," said Wen, who explained that biodiesel plants leave behind approximately 10 percent crude glycerol during the production process.

This has led the price of glycerol, a chemical compound widely used in the pharmaceutical and cosmetic industries, to drop in recent years. The rise in biodiesel production over the last decade means that the market can no longer absorb all the extra glycerol. Biodiesel producers must find alternative means for disposing of crude glycerol, which is prohibitively expensive to purify for industry use. Wen and his colleagues have developed a novel fermentation process using microalgae to produce omega-3 fatty acids from crude glycerol.

“We have shown that it is possible to use the crude glycerol byproduct from the biodiesel industry as a carbon source for microalgae that produce omega-3 fatty acids,” said Wen, who added that the impurities in crude glycerol may actually be beneficial to algal growth. “After thorough chemical analysis, we have also shown that the algae biomass composition has the same quality as the commercial algae product.”

After growing the algae in the crude glycerol, researchers can use it as an animal feed. This mimics a process in nature in which fish, the most common source of omega-3 fatty acid for humans, eat the algae and then retain the healthful compounds in their bodies. Humans who consume the fish in turn consume the omega-3s. Fish-derived products such as fish oil are an inexpensive alternative, but the taste has deterred widespread use.

Wen has partnered with Steven Craig, Virginia Cobia Farms to use crude glycerol-derived algae as a fish feed. “The results so far have been promising,” Wen said. “The fish fed the algae had significant amounts of omega-3 fatty acids.”

He and Audrey McElroy, associate professor of APS, are now trying to determine whether the algae will work as a chicken feed. Kumar Mallikarjunan, associate professor of BSE, is also working with Wen to determine the fate of omega-3s after they enter the food supply. Researchers do not yet know whether oxidation would have a major impact on omega-3 fatty acids stored in cheese, for example.

Funding for this research has come from the Virginia Agricultural Council, U.S. Poultry and Egg Association, Fats and Proteins Research Foundation, Virginia Sea Grant, and Virginia Commercial Fisheries and Shellfish Technologies.


Virginia Master Well Owner Network In-service Training

Rockingham County Extension Office, October 29-30, 2008

This training is open to ANR and FCS agents.

Topics to be covered:
- Groundwater in Virginia
- Breakout sessions:
  1. Groundwater Models
  2. Strategies for Outreach
  3. Resources for Under-served and Low-income Persons
- Proper Well Construction and Management
- Springs and Cisterns
- Wellhead Protection and Land use Impacts
- Water Testing and Interpretation
- How to conduct a Drinking Water Clinic
- Facilitating participation of underserved populations
- Solving Water Problems
- Working with Volunteers

To register, contact Ginny Ritenhour (ginnyrit@vt.edu) by September 15. For more information, contact Erin James (ejames@vt.edu).

Farm Fuel Cost Estimator Available

With the recent price of diesel fuel for farm use well over $4.00, a Fuel Cost Estimator written by Thomas W. Dorn, Nebraska Extension Educator can help calculate current $ per hour and $ per acre fuel cost for operating farm equipment. Download the Fuel Cost Estimator in an Excel spreadsheet format at:

http://hardin.osu.edu/agriculture/ag-newsletters/fuelcostestimator-2008.xls

With the spreadsheet, you can change the numbers in the fuel cost cells to your current or expected fuel price. You can also estimate how fuel costs may change in the future and project your equipment fuel cost into the future.

PLANS

In response to numerous requests, building and facility plans are now available for download from the Virginia Cooperative Extension (VCE) Intranet. Plans are categorized under five main categories: Forage Storage and Feeding, Grain Handling and Feeding, Beef, Horse, and Sheep. You will need Adobe Acrobat to download these files. For the building and facility plans, as well as additional resources, please visit:

http://www.ext.vt.edu/vce/anr/bse/index.html

http://hardin.osu.edu/agriculture/ag-newsletters/fuelcostestimator-2008.xls
No matter the commodity or the season, it is always the season for safety. Producers spend careful attention in selecting the right chemical for the job, and likewise spend a lot of hard-earned dollars purchasing and applying these chemicals. So it is only right that they spend a little effort respecting these agents for the harm they can cause to human health.

Many of the ailments that affect farmers are from low-level long-term contact with chemicals. There is increasing evidence that incidental exposure to pesticides can lead to certain cancers and other conditions such as Parkinson’s Disease.

Product-handling guides are included on every chemical label, and include the necessary Personal Protective Equipment (PPE) needed to safely handle the agent. If the handler is unsure about the product or wants additional information, the manufacturer is required by law to provide this information.

**Heed the label instructions!**

At a minimum, chemical resistant gloves should be used when handling the containers and any activities involving mixing or loading into the application equipment. There are many gloves that fit the chemical resistant description, including latex, vinyl, and nitrile. The specific chemical used will determine the type of glove needed. Several of these glove types can be found in local farm stores, hardware stores, and sometimes at the larger grocery/department stores. Hard to find styles can be found in online safety catalogs, or at the agricultural chemical supplier.

**Leather and cloth gloves should NEVER be worn when handling chemicals; they absorb the product and hold it close to the skin.**

Carry enough chemical resistant gloves so they can be changed often. Handling a steering wheel with bare hands after touching it with chemically coated gloves is not a good practice. Another useful tip is having disposable wipes or hand sanitizers available to clean chemical residue from hands and other objects. Lunch and snack breaks are great times for using those hand sanitizers! Also, before bathroom breaks.

Besides hand protection, chemical handlers need to be concerned about other clothing choices. The ball cap is one of these items of concern. Just like cotton gloves, ball-caps can absorb splashing and spraying chemicals, and hold these agents close to the skin. Then each time the cap is worn, and sometimes this can be for many months thereafter, the forehead is reintroduced to that chemical exposure.

Disposable chemical resistant overalls are perfect protection to cover shirts and jeans. Normal work clothes have high absorption rates, and should be properly covered and protected from chemical exposure. It is recommended these articles, including footwear, be removed before entering the house. This action prevents the home environment or unsuspecting family members from being exposed; children are especially at higher risk for harsh chemicals. Never hug or hold a young child while wearing chemical contaminated clothing.

(Continued on page 8)
(Continued from page 7)

All clothing exposed to chemicals should be properly laundered. It is recommended that these articles be washed separately and as immediately as possible after contamination. Use the highest possible water setting on the machine, even with the light load. This allows for better cleansing action and complete dilution of the chemical.

Many producers feel they are safe from chemical exposure if they work in cab tractors. While these cabs do provide protection from the weather elements, they are not 100% effective in filtering out chemical contaminants. Operating a tractor with the windows open, or using an air conditioning system not specifically designed to remove airborne particulates, will not prevent the operator from coming into contact with agricultural chemicals. Field applicators, even if they did not handle chemicals directly, should take proper action in protecting themselves from chemical contamination.

Staying safe around chemicals is important. Chemicals can be found in many forms, and have many uses on the farm as well as in the garden. Respect the agent for what they were designed to do, and understand that humans are living things - just like the plants and pests they are combating. Invisible residues can cause long-term harm to many healthy bodies.

This article was provided by Dr. Dee Jepsen Extension Agricultural Safety Specialist, and Mr. Tim Butcher, OSHA Coordinator, in the Department of Food, Agricultural, and Biological Engineering at Ohio State University.

(R. Grisso)

Poultry Housing—Plans, Designs and Management

Need some general guidelines and recommendation for poultry housing and management of flocks? Check out the UMN site. They cover such topics of GENERAL INFORMATION, SITE SELECTION, HOUSING DESIGNS, ENERGY, INSULATION, VENTILATION, LIGHTING, MANURE MANAGEMENT, and other items.

They also have resources and video for poultry processing: http://www.ansci.umn.edu/poultry/resources/processing.htm

A site for turkey management: http://www.ansci.umn.edu/poultry/resources/turkeymgmt.htm

Game bird management: http://www.ansci.umn.edu/poultry/resources/gamebirds.htm

Animal housing ventilation: http://www.ansci.umn.edu/poultry/resources/ventilation.htm

Industrial Publications: http://www.ansci.umn.edu/poultry/indus-

http://www.ansci.umn.edu/poultry/resources/housing.htm
Wine Grape Production Guide—Coming this Fall

Wine Grape Production Guide for Eastern North America (NRAES-145) is a new NRAES publication and will be available Fall, 2008. Tony Wolf, Virginia Tech, is the lead author and editor of the publication. The book was written by 16 authors and improved after review by 40 experts from 21 states and Canada.

This comprehensive reference will be used by novice and experienced growers, crop advisors, service providers, educators, communicators, and students. It provides information on all aspects of wine grape culture including site selection and preparation, trellising and pruning, disease and pest identification, nutrient management, irrigation, pesticide application, harvesting, vineyard cost and returns, and grape sales.

The book includes: 300+ pages, 174 color photos, 40 line drawings, 42 tables of useful information, 45+ variety descriptions, and keys to insect and mite pests of grapes.

For more information see: http://www.nraes.org/nra_winegrapecontent.html (R. Grisso)

Chapter List
1. Costs and Returns of Vineyard Establishment and Operation
2. Vineyard Site Selection
3. Wine Grape and Rootstock Varieties
4. Vineyard Design and Establishment
5. Pruning and Training
6. Grapevine Canopy Management
7. Crop Yield Estimation and Crop Management
8. Nutrient Management
9. Grapevine Water Relations and Irrigation
10. Spray Drift Mitigation
11. Disease Management
12. Major Insect and Mite Pests of Grapes in the Mid-Atlantic Region
13. Vineyard Weed Management
14. Wildlife Deterrence
15. Grape Purchase Contracts and Vineyard Leases
16. Wine Grape Quality: When Is It Time to Pick?
PAWSitively Youth: A Guidebook about Dogs for Community Outreach Leaders (NRAES-180) was authored by Dana Palmer, Elaine Noble, and Bernadine Wiesen. This book contains science-based information for those interested in learning more about the responsibilities and pleasures of dog ownership. Behavior, anatomy, health, nutritional needs, and feeding regimes are discussed. Overviews of breed characteristics, home and travel safety, community concerns, and dog sports are included.

The book is a self-directed learning guide intended for use by a teen or adult leader or by an individual that wants to learn more about dogs. Leaders can use the book or individual chapters to develop educational programs for children older than 10 years or community members interested in learning more about dogs.

Fourteen group activities explore such concepts as nutrition, first aid, breed characteristics, dog sports, and career opportunities. Each activity includes a list of needed items and suggested ways to implement it. Activities are designed with youth development principles and experiential learning models in mind. It is not necessary to own a dog to participate in the activities.

A group or an individual can choose which chapters to review based on their interests. It is not necessary to read previous chapters to understand later chapters. The book will be useful in informal and formal educational environments such as 4H, after-school programs, animal shelter outreach programs, big brothers and sisters, boys and girls clubs, boy scouts, and girl scouts.

Features: 92 pages, 33 illustrations, 14 activities, science-based information, glossary

For more information see: http://www.nraes.org/ (R. Grisso)

The Pond Guidebook (NRAES-178) contains scores of management tips and insights for pond owners and those considering constructing a pond. It addresses key topics like water chemistry, construction, safety, aquatic weed management, fish selection and stocking, nuisance wildlife, annual maintenance and more. Based on research, experiences of pond owners, and hundreds of site visits, this book is written in non-technical language, and includes 58 photographs and illustrations.

For more information see: http://www.nraes.org/ (R. Grisso)
Numbers always tell a story. For agriculture, the plot contains some stark statistics:

- About 28 of every 100,000 farmers and their employees died of work injuries. Five years ago, the death rate from work injuries was 30 per 100,000 farmers.
- Six of every 100 farmers and farm workers were injured on the job that same year.

Agriculture’s death rate places the industry first among all occupations. Mining ranks second and construction deaths are third.

Farmers and their families can ill afford the pain and inconvenience of workplace injuries and death. Farmers typically lose four days for every injury they suffer. Yet the daily duties of feeding and caring for livestock, and planting, tending and harvesting crops continue.

“They numbers represent the people who work hard to produce the world’s food,” said Glen Hetzel, 2007-08 president of the National Institute for Farm Safety (NIFS). “The story behind the numbers serves as an important reminder of the continuing need to spread the agricultural safety education and awareness message. There is no better time to do that than this week during National Farm Safety and Health Week.”

Hetzel noted that 60 percent of farm injuries occur when working with large, unpredictable livestock. Most other injuries happen during crop production with machinery accidents accounting for most injuries.

The overwhelming majority of injuries occur among workers aged 45 and older. The average age of U.S. farmers is 56.

“The number of agricultural deaths and injuries has fallen gradually during the last four years,” said Hetzel. “Safer equipment and increased safety awareness make a difference.”

(R. Grisso)

http://www.nsc.org/necas

National Farm Safety & Health Week is an annual promotion for commemorating the hard work, diligence, and sacrifices of our nation’s farmers and ranchers. The 2008 event marks the 65th consecutive signing of a proclamation by a U.S. President, beginning with FDR in 1944.

The National Safety Council (NSC) puts a spotlight on farming, ranching and the related health and safety issues. In 2007, there were 715 deaths and 80,000 disabling injuries attributed to agriculture. September 21-27 is recognized as National Farm Safety & Health Week.

The theme for 2008 is “Farm Safely – Protect YOUR Investment.” This theme highlights the value of the safety and wellness of the agricultural producer and the importance of protecting hearing, lung function, vision, skin, and the musculoskeletal system.

(R. Grisso)

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(R. Grisso)
Farm Safely—Protect YOUR Investment

YOUR Personal Protection

There are a number of tasks on a farm involving persons of nearly every age. Operating farm equipment and machinery is common place on the farm, along with many other tasks involving animals, chemicals, and storage areas.

Farmers and employees, family members, and visitors can reduce the chance of personal injury and related illness by wearing protective equipment. The following is a quick check list for Your Personal Protection:

- **Protect YOUR VISION** with appropriate safety eyewear. Particularly safeguard YOUR EYES with safety glasses, goggles and face shields when applying pesticides, fertilizers, working in the shop, or in heavy dust conditions.
- **Wear a wide-brimmed hat with neck protection** to assist in prevention of skin cancer. Protect YOUR Skin by applying sufficient sun block and be sure to wear sunglasses with UV protection when working outdoors even if on a cloudy day or during the winter.
- **Protect YOUR LUNGS** by wearing correct respiratory equipment such as dust masks, gas masks, cartridge respirators and air packs when working in dusty or moldy storage, painting, applying chemicals, working in bins and silos, or manure storage locations.
- **Protect YOUR FOOT** by wearing steel-toe boots or shoes, and be sure footwear has non-slip soles, sufficient insteps and support.
- **Protect YOUR HEAD** with a hard hat when performing construction work, trimming trees, and repairing machinery. Whether you are the driver or passenger, be sure to wear a helmet when driving or riding on an ATV.
- **Wear ear plus to protect YOUR HEARING** when working with loud equipment such as chain saws, grain bins, tractors and loud motors.
- **Remove rings and jewelry** to avoid getting caught or pinched in machinery or moving parts. Protect YOUR HANDS when working by choosing appropriate gloves for the job if insulated, rubber, waterproof, non-slip, leather, or textured non-slip gloves should be worn; and be sure gloves are the appropriate size.

USDA, FSA (R. Grisso)
There is a growing trend for people to buy small parcels of land and then use this land for small-scale farming and/or raising a few animals. Many times these individuals do not have a farming background, and so every operation they undertake, no matter how apparently simple, can present hazards of which they are unaware. A particular area of concern is the use of tractors.

The majority of deaths and many injuries on farms are associated with tractors. Combine this with a lack of experience and an enthusiasm for power and you have a recipe for serious injury or worse.

Hobby farmers should seek out proper training in order to use agricultural equipment safely and efficiently. Just to highlight one hazard, tractor operators should be aware of the dangers when working with tractors equipped with front-end loaders. As useful as this equipment is, if not used properly, a front-end loader can increase the potential for tractor overturns.

Novices may assume that the weight of a tractor gives it extra stability. The weight of the tractor is not the critical factor - the center of gravity is. Regardless of the weight of a tractor, if the right forces are applied, the tractor will overturn. A front-end loader increases this risk, especially when loaded and in the raised position. When raised, a front-end loader places more mass above the center of gravity. This situation makes the tractor vulnerable. The wrong bump, the wrong slope, or too sharp a turn and the whole rig can go over. What novices should understand about the weight of a tractor is that once it is in motion, it is difficult to stop. When the forces on a tractor are set up right, it can overturn with startling speed.

Another critical factor in the stability of a tractor is the distribution of the weight. This is an issue with older tractors that have close-set front wheels, so-called “tricycle” tractors. These tractors are sometimes equipped with front-end loaders, and they are even more susceptible to overturn than more modern tractors because of their narrow stance in front.

Also, these older tractors may not be equipped with ROPS/seatbelts or have ROPS and worn-out seatbelts.

**Tips to Prevent Loader-Induced Overturns**

1. Use a front-end loader on cleared, level ground.
2. Do a walk around to check unfamiliar areas for hazards such as potholes, rocks, drop-offs, etc.
3. Operate front-end-loaders with the bucket as low as possible.
4. If your tractor has a ROPS (and good tractors do!), always use your seatbelt. If your tractor starts to overturn, you will not be able to jump out of the way - your only chance is to use the safety equipment as it was intended.

Another safety tip: Always have the bucket on the ground when the tractor is parked. Hydraulics can release pressure allowing a raised bucket to lower thus crushing anything or anyone who may be under it. For more tips about using tractors on smaller holdings see: [http://edis.ifas.ufl.edu/AE197](http://edis.ifas.ufl.edu/AE197)

**NO RIDERS**

Safety News & Notes Vol 9, No. 5, August 2008
(R. Grisso)
New Eye Protection Fact Sheets

Florida Safety Specialist has prepared some excellent eye protection fact sheets that are now posted on our Florida AgSafe Web site. These can be used along with a Power Point Presentation about the importance of protecting one’s eyes.

PowerPoint—http://www.flagsafe.ufl.edu/powerpoint/eyesafety.ppt


http://www.flagsafe.ufl.edu/publications.html#eye
It appears farmers are moving crops out of the field and finishing another season. Though most of us are ready to park our farm equipment for a few months, we must remember that spring will be here quickly and the equipment must be ready to go. The care we provide our machinery, such as proper cleaning, maintenance and storage, not only increases equipment reliability and performance, it can also improve resale value. Farmers who properly winterize farm equipment now will be rewarded with a reduction in startup time next spring.

The following winter storage suggestions come from various Extension bulletins, but should never supersede the recommendations found in equipment operator’s manuals.

Be sure to change the oil and perform regular service. Clean engine oil will reduce internal engine corrosion during storage. Clean or replace air filters, replace fuel filters and lubricate bearings and joints to maximize the life and efficiency of your machinery. Check antifreeze for correct freezing temperature. Remember that antifreeze, like engine oil, has a lifespan. Merely adding more coolant may not be enough to fully protect your investment.

Inflate tires to recommended pressure to reduce sidewall damage. Before storing tillage implements remove soil and apply appropriate rust preventive material, then store with soil engaging components raised or on blocks to prevent rust. Hydraulic cylinders should not be stored fully extended. If temperatures increase, hydraulic oil will be confined and high pressure may cause damage to the hydraulic system.

All planters, drills, air seeders and combines need to be cleaned out. Be sure all grain and plant material left in the grain tank and augers is removed. This will reduce rusting and make it less attractive to mice and other pests. It is sometimes possible to remove more than a bushel of grain even after a combine seems to be clean. Trapped grain attracts rodents, who often then make a meal of electrical wiring, leading to electrical problems.

Reduce tension on belts to reduce stretch and increase belt life. Be sure to follow storage instructions in the operator’s manual for reducing pressure on seals, brushes, and seed plates. This will minimize warping and misshaped air seals and seed plates. Remove soil from all furrow openers to reduce rust and improve performance next season.

Balers need to have any partial bales and all plant material removed to minimize rusting. Follow the operator’s manual for instructions on reducing pressure on baler belts or other components. Compressed air is a great way to clean hard to reach places and may be a better choice than water. When water is needed to clean surfaces, use only moderate pressure and mild soap.

Cleaning farm equipment with a power washer is great for removing dust and soil. Be careful, however, and avoid direct contact with seals when using high-pressure washers. Use compressed air after washing to help dry surfaces, and operate machinery for 10 to 20 minutes to help shed excess water from hard to reach places. Repaint worn surfaces with spray paint to protect from corrosion.

Proper battery storage can protect batteries from deterioration. Even a small current drain can eventually discharge batteries and cause them to freeze in cold weather. Consider removing batteries to convenient storage where they can receive a periodic charge. Clean all connections and coat terminals with a thin layer of grease to prevent corrosion.

Where possible, store equipment in a building. If a building is not available, at least cover equipment with a well secured tarp. This will always improve equipment performance and resale value.

If you need a maintenance chart see the one included in “Five Strategies for Extending Machinery Life” (URL http://www.ext.vt.edu/pubs/bse/442-451/442-451.html) (R. Grisso)
With energy prices up dramatically in recent years, grain producers are asking how to reduce the cost of drying grain on the farm. This article will discuss in-bin grain drying.

It goes without saying, the least cost method of drying corn is to let the grain dry naturally in the field for as long as possible. Given good drying conditions (low humidity, wind, and warm temperatures), corn can lose one-third to one-half point of moisture each day. At this drying rate, the corn would dry naturally in the field from 18% to 15% moisture in about the same time as if the corn were harvested and dried in the bin using natural (unheated) air using about 1 cubic foot per minute per bushel (cfm/bu) airflow. Producers with grain drying facilities usually hedge their bets by starting harvest early and mechanically drying part or all of their grain.

**Grain Drying 101**

The biggest savings in drying time versus energy input for in-bin drying systems is achieved with the first 20°F to 40°F rise in air temperature.

All mechanical grain drying systems use a fan to push air through the grain mass. The time required to dry a grain is a function of the initial and final moisture content of the grain, the rate of airflow through the grain (cubic feet per minute per bushel, cfm/bu) and the air properties, temperature and initial humidity level.

In deep-bed drying systems (in-bin drying), air is normally pushed through the grain from the bottom of the bin and is exhausted out the top of the bin. As the air moves through the grain, moisture evaporates from the grain into the passing air. Eventually, the moisture content of the grain nearest the fan comes into equilibrium with the incoming air and no further drying takes place. The area within the grain mass where moisture is evaporating into is known as the drying zone. The top of the drying zone is the point at which the relative humidity of the air approaches 100% and no more drying can take place. The moisture content of the grain above the drying zone remains unchanged or may be slightly wetted by the saturated air leaving the drying zone. The drying zone moves through the grain in the direction of airflow as the air continues to remove moisture.

### Natural Air Drying

Natural air drying uses unheated air to dry grain. It can take several days to several weeks to dry a bin of corn using natural air. Under favorable drying conditions, natural air drying can be the least expensive drying method and usually results in the highest quality grain of any mechanical drying method.

If the airflow rate is too low to meet the recommendation rate, the bin could be partially filled. The shallower grain depth results in less static pressure for the fan to overcome, which translates into more airflow output (cfm) from the fan. Since partially filling the bin results in fewer bushels in the bin, you are pushing more cfm through fewer bushels, thus significantly increasing cfm/bu.

Research has found that stirring when using natural air to dry grain improves drying performance. Stirring helps to keep the grain from forming a static layer on top of the bin, which can slow down the drying process. It also helps to distribute moisture evenly throughout the grain mass, which can prevent hot spots and ensure uniform drying.

**Table 1. Effect raising the air temperature has on relative humidity.**

<table>
<thead>
<tr>
<th>Air Temperature</th>
<th>Relative Humidity</th>
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<tbody>
<tr>
<td>50</td>
<td>72</td>
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<tr>
<td>60</td>
<td>50</td>
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<td>70</td>
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<tr>
<td>130</td>
<td>6</td>
</tr>
<tr>
<td>140</td>
<td>4</td>
</tr>
</tbody>
</table>

**Assumptions:** Elevation 1,000 feet. Dew point 41.4°F.
Hauling Challenges

Transportation continues to be a major issue for hay growers. Rising fuel costs are a big part of the story. Trucking rates have risen from a range of $1.35-1.50/mile a year ago to the $2.20-2.25/mile mark. Reports indicate that there are 40,000 fewer trucks on the road in the U.S. than there were a year ago. With diesel fuel hitting over $4.00/gallon in many areas, drivers just can't make a go of it.

Truckers remaining on the road are increasingly reluctant to haul hay. A load of hay is typically worth $5,000-6,000, a pretty low value compared to a load of television sets or some other manufactured product.

It's easier to put a fuel surcharge on those other products, because the buyer can pass it along to the end consumer. A livestock producer buying a load of hay can't tell his milk processor he should get a dollar more per hundredweight for his milk because he's paying more to have hay delivered. But that same milk processor can add transportation costs to the retail outlet buying the milk and, in turn, the retail outlet can pass costs along to the consumer. 

How To Reduce Energy Cost For In-Bin Grain Drying

(Continued from page 16)

actually prolongs the time required to dry the grain because it disrupts the drying zone, resulting in exhaust air leaving the grain mass less saturated. Considering the long drying times associated with natural air drying, continuous stirring can cause significant damage to the grain and results in costly wear to the stirring device.

If a stirring device is installed in a bin of grain being dried by natural (unheated) air, the stirring device should be run during the filling period to reduce the pack factor from the filling operation, to redistribute fines and to level the grain. Stirring should then be discontinued to allow a drying zone to develop in the grain. Since the bottom of the bin will be somewhat over-dried by the time the drying zone approaches the top of the bin, a final stirring just before the drying zone is pushed completely through the bin will help to equalize the moisture content of the grain in the bin.

Heated Air Drying

Heating the air increases its ability to carry away more water vapor, (heating lowers the relative humidity of the air). When adding supplemental heat, the relationship between temperature rise and relative humidity is not linear. Table 1 presents the effect on the relative humidity when adding supplemental heat. All values shown in the table assume the dew point temperature (a measure of the absolute water vapor content of the air) is a constant 41.4°F.

A rough rule of thumb is the relative humidity drops by one-half for each 20°F rise in temperature. For example, natural air at 60°F and 50% relative humidity will have a relative humidity of 25% if heated to 80°F. Adding another 20°F to raise the temperature from 80°F to 100°F cuts the relative humidity by about half again and results in a drop to 13.5%. The third 20°F rise to 120°F lowers the relative humidity by about half again to 7.6%. The notable point is the second 20°F increment of added heat results in half as much reduction in relative humidity (half of half) and the third increment results in only one-eighth as much reduction (half of half of half). To minimize energy cost for drying grain, keep the temperature rise to a moderate level. The biggest savings in drying time versus energy input for in-bin drying systems is achieved with the first 20°F to 40°F rise in air temperature.

Stirring System Management When Drying With Heated Air

Management of stirring devices is different for heated air drying than natural air drying, especially for high temperature drying (over 40°F temperature rise). The relative humidity of the incoming air is so low with heated air drying, the grain on the bottom of the bin becomes over-dried by several percentage points by the time the drying front is pushed through the full depth of the grain. Stirring devices, if installed, should be run continuously with high-temperature heated in-bin drying systems to help equalize the moisture content of the grain mass and avoid overdrying at the bottom of the bin.

In-Bin Layer Drying

If a producer has several bins equipped with drying fans and is able to switch over from filling one bin to another in a reasonably short time, filling and drying several bins in layers could reduce drying time and energy consumption by 20-35% as compared to completely filling each bin in turn before beginning to fill the next bin.

In-bin drying is the most economical way to dry grain. Adopting these management techniques can preserve grain quality while minimizing energy cost.

(Adopted by R. Grisso)
Take some time to prepare your storage bins and prevent potential stored insect problems through good bin management.

If the weather continues to stay warm this fall, this may be another busy season for insects as they infest grain bins. There are some good reasons to prevent insect problems in the bin. Most countries have a zero-tolerance policy for insects in grain destined for export. Also, practices to prevent insect grain bin infestation are relatively simple and cost a lot less than practices commonly used to protect a growing crop from insect losses.

Several insect species infest stored grains. Damage caused by these insects includes reduced grain weight and nutritional value, contamination, odor, mold and heat damage, which lowers the grain quality.

The first step is to make sure that the bins are clean and free of insect infested grain. Leftover grain should be removed from the bin and the walls should be swept and vacuumed. All grain-handling equipment, including augers, combines, trucks and wagons, should be cleaned thoroughly and grain residues removed before harvest.

A residual bin spray should be applied to all interior bin surface areas two to three weeks before new grain is placed in the bin. The treatment will kill insects emerging from their hiding places (cracks, crevices, under floors and in aeration systems). Also, insects crawling or flying in from the outside will be killed.

When cleaning the bins, remember to get under aeration floors and inside aeration tubes. These are great spots for insects to hang out while waiting for you to fill the bin. Remove any vegetation or weeds that may attract and harbor insect pests within 10 feet of a bin and preferably the whole storage area.

Follow by spraying the cleaned area around the bin with a residual herbicide to remove all undesirable weedy plants. Repair and seal all damaged areas to the storage structure. This will help prevent insect infestation and reduce water leakage, which leads to mold growth.

Whenever fans are not operated, they should be covered and sealed to reduce the opportunity for insects and vertebrates to enter the bin through the aeration system.

If newly harvested grain and/or insect-free grain must be added to grain already in storage, the latter should be fumigated to prevent insect infestation. If grain will be in storage for one or more years, it is recommended that grain be treated with an approved insecticide as it is augured into the bin. Grain protectants kill insects as they crawl about or feed on treated grain or grain fragments.

Do not apply grain protectants before high-temperature drying because extreme heat will result in rapid volatilization and reduced residual qualities of the pesticides. Grain protectants applied to 13 percent moisture grain will have a greater residual life than grain at 15 percent or more moisture.

Another important step in preventing insect infestations is immediate cooling of the grain after harvest. Grain insects that are flying in the general area will be attracted to harvested grain by smell. They can find and infest grain on the truck or through an open grain bin hatch.

If the grain is warm (above 50 degrees), insects will start feeding and reproducing immediately. When grain temperatures are above 50 degrees, bins should be inspected for insect activity every two weeks. Stored grain insect pests generally are inactive at temperatures below 50 degrees.

Use a grain probe to determine what species of insect pests are infesting the grain and the extent of infestation within the grain mass.

For more details on materials see http://www.ext.vt.edu/news/periodicals/cses/2005-10/grain.html

(Adopted from 06 September 2007. Plant Health Progress by R. Grisso)
Grain storage bins are routinely monitored for temperature to control insect and mold problems. Now an Agricultural Research Service (ARS) scientist and his colleagues at Kansas State University (KSU) have preliminary research findings showing that monitoring carbon dioxide, along with humidity and temperature, may help detect problems more effectively.

Grain moisture content and temperature are the primary factors affecting grain deterioration in storage. If these factors are not properly monitored and controlled, grain quality can deteriorate quickly due to mold growth and insect infestation.

ARS engineer at the agency’s Grain and Marketing and Production Research Center in Manhattan and faculty at KSU monitored a simulated grain storage bin during aeration to determine if high-moisture grain, or adverse storage conditions, in the bin top could be detected using sensors to measure relative humidity, temperature and carbon dioxide levels.

Relative humidity and temperature can be used to estimate grain moisture, while carbon dioxide levels indicate the amount of respiration due, primarily, to molds. Current technology allows relative humidity and temperature sensors to be placed at multiple points within the grain mass. Carbon dioxide sensing is more feasible at an aeration duct.

In the study, sensors were placed at different depths in the bin. High-moisture grain, comprising about 11% of the volume, was placed at the top of the bin and produced high amounts of carbon dioxide, which in most cases was easily detectable during aeration.

Lowering grain temperature with aeration diminished the amount of carbon dioxide produced, making it more difficult to detect unless the carbon dioxide sensor was located very close to the wet grain.

Relative humidity and temperature sensing gave good estimates of grain moisture for all conditions, but under some grain conditions, high carbon dioxide levels persisted for grain considered to be at safe moisture and temperature conditions. Combining relative humidity, temperature and carbon dioxide measurements gave reasonably accurate measurements of grain moisture content as well as overall storage conditions.

(From: Sharon Durham, News Release, USDA’s Agricultural Research Service)

By now, you’ve probably heard about concerns over increasing concentrations of greenhouse gases (GHG) such as carbon dioxide in the earth’s atmosphere. Currently, there are no federal laws in the United States governing GHG emissions. However, many states, companies, and even individuals are agreeing to voluntarily limit their GHG emissions through carbon offsets or some other means.

A carbon offset is created by voluntarily removing carbon dioxide from the atmosphere or by working to prevent the emission of a GHG in the first place. Once a carbon offset is created, measured, and verified, the carbon offset can then gain value as a tradable commodity in the carbon market. In the US, the primary market is the Chicago Climate Exchange (CCX). This exchange represents North America’s only voluntary, but legally binding, GHG trading market. Renewable energy, conservation tillage, grassland establishment and forest management practices each offer opportunities for landowners to register a carbon offset and possibly earn additional revenue via the emerging carbon market.

This article was adapted from the VCE publication “Virginia Landowner’s Guide to the Carbon Market” by John Ignosh, Matt Yancey, Kurt Stephenson, Bill Whittle, and Mark Alley, which is currently under review.

(J. Ignosh)
The American Society of Agricultural and Biological Engineers (ASABE) presents the Educational Aids Blue Ribbon Awards each year in recognition of "outstanding effort and achievement in the development of noteworthy educational aids." During the 2008 Annual International Meeting, the Extension Committee (E-208) recognized two items from the BSE Department.

The first was this newsletter—"BSE Engineering Update"—which is coauthored by Robert Grisson, Jactone Arogo Ogejo, Zhiyou Wen, John Ignosh, Brian Benham, and S. Christian Mariger. The newsletter is sent quarterly to the Virginia ANR Agents and Specialists to communicate research-based information and current events concerning water quality, natural resource management, TMDL, air emissions, animal waste management, machinery management, precision farming, application technology, farm safety, energy, engineering education, and technology. Agents are encouraged to use this information in their on-going programs.

BSE Engineering Update provides research-based information to county agents that can be easily incorporated into their county outlets, programs, and events. The departmental strategy is to use this newsletter to keep field faculty alert of on-going engineering developments, research and their findings as well as seasonal information for their clientele.

These newsletters are archived on the VCE Intranet at: http://www.ext.vt.edu/vce/anr/bse/index.html

The second recognition is for a VCE numbered publication entitled, "Precision Farming Tools: Soil Electrical Conductivity" coauthored by Robert Grisson, Mark Alley, David Holshouser, and Wade Thomason.

The goals of the factsheet is to develop the awareness of the application of soil electrical conductivity (EC) to precision farming practices. EC correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. Soil EC measurement can provide more measurements in a shorter amount of time than traditional grid soil sampling.

This factsheet is one of a series to help crop producers adapt and implement precision farming tools to their operation. The EC devices help with the development of management zones that the principles of site-specific management can be applied. This factsheet can be found at: http://www.ext.vt.edu/pubs/bse/442-508/442-508.pdf

Congratulations to the BSE award winners!