Biological Systems Engineering

Engineering Update Summer 2005

BSE Named a University Exemplary Department!

Virginia Tech

In this issue…

Visit us in Seitz Hall

Engineering Update – Biological Systems Engineering

June 2005

To: Extension Unit Directors, Extension District Directors, Extension Program Directors, and ANR Agents

Dear Co-Workers: Engineering Update is a joint effort of the Biological Systems Engineering and other interested specialist/agents. 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, engineering education and technology. Please use this information in your on-going Extension programs and circulate to all Extension staff. Engineering Update is electronically accessible via the VCE Intranet World Wide Web site (*at http://www.ext.vt.edu/vce/anr/bse/index.html*).

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Issued in furtherance of Cooperative Extension work, Virginia Polytechnic Institute and State University, Virginia State University, and the U.S. Department of Agriculture cooperating. Patricia Sobrero, Director, Virginia Cooperative Extension, Virginia Tech, Blacksburg; Lorenza W. Lyons, Administrator, 1890 Extension Program, Virginia State, Petersburg.

VIRGINIA STATE UNIVERSITY

Summer Safety Tips

Heat Exhaustion

Heat exhaustion is one of the milder heat-related illnesses you may encounter during hot summer months. Others include heat stroke, heat rash, and sunburn. People most prone to heat exhaustion are elderly, those with high blood pressure, and people working or exercising in a hot environment.

Some warning signs of heat exhaustion include: heavy sweating, paleness, muscle cramps, tiredness, weakness, dizziness, headache, nausea or vomiting, and fainting. If the symptoms are severe or the victim has a heart problem, seek medical attention immediately, otherwise help cool the victim off. Give the victim a cool non-alcoholic beverages, rest, cool shower or sponge bath, move to an air conditioned space, and/or put on lightweight clothing. *See below:*

Lightning safety

Did you know washing dishes can sometimes be dangerous? While it may sound like a 10-year-old's excuse to avoid dish duty, experts say some routine activities can be hazardous during thunderstorms.

Lightning kills or injures hundreds of Americans each year. Use the following tips to stay safe in stormy weather:

While most of us have heard the warnings about swimming or boating during thunderstorms, avoiding other water contact when lightning is flashing is also good safety advice. That even means staying out of the shower or tub and yes, keeping your hands out of dishwater.

Seek shelter. Stay in enclosed buildings. Inner rooms are the safest. Avoid doors, windows and anything that conducts electricity. Stay out of picnic pavilions and rain shelters. If need be, seek safety in a car and close the windows. As long as you aren't touching metal, the car's steel frame offers some protection.

Don't use electrical appliances or telephones with cords. Lightning can follow electrical wires and phone lines into your home or workplace.

If you're caught outdoors, use the 30-30 rule -- seek a safer location immediately if the thunder occurs 30 seconds or less after the lightning. Once the storm has passed, wait at least 30 minutes after the last lightning flash before leaving shelter.

Avoid lightning targets. Stay away from trees and any tall, isolated structures. If you're caught in an open area, drop metal items such as golf clubs and tennis racquets.

Heat Index Chart

Relative Humidity (%)

Air Temperature °F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	119	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	102	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	100	106	110	113	117	121
83	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Heat Index (Apparent Temperature)

With Prolonged Exposure and/or Physical Activity

Extreme Danger
Heat stroke or sunstroke highly likely

Danger
Sunstroke, muscle cramps, and/or heat exhaustion likely

Extreme Caution
Sunstroke, muscle cramps, and/or heat exhaustion possible

Caution
Fatigue possible

Source: The National Weather Service, http://weather.noaa.gov/weather/hwave.html

Out in the Heat

If you have to be out in the heat:
- Limit your outdoor activity to morning g or late evening.
- Cut down on exercise. If you must exercise, drink two to four glasses of cool, nonalcoholic fluids each hour.
- Try to rest in shady areas.
- Protect yourself from the sun by wearing a wide-brimmed hat, sunglasses, and by putting on sunscreen of SPF 15 or higher.

(Bobby Grisso)

Source: Centers for Disease Control & Health. http://www.bt.cdc.gov/disasters/extremeheat/heat_guide.asp

Simple Steps Can Help Prevent Hay Bale Fires

Fires that damage or destroy hay and barns -- resulting in building replacement, feed replacement and lost revenues -- cost area farmers thousands of dollars each year. Proper harvesting and storage practices will reduce the possibility of hay fires and reduce the associated costs. Hay fires usually occur within six weeks of baling because the most common cause is excessive moisture.

The risk of fire and mold can be reduced by baling small square bales at 18 to 20 percent moisture content and large round bales at 14 to 18 percent moisture content. Higher moisture levels increase microbial activity, which also causes dry matter and usable protein loss. Such losses can reduce the feeding value of hay by as much as one-third.

Heating in hay bales will occur to some extent in all forages over 15 percent moisture content; temperature peaks at three to seven days after baling. It takes 15 to 60 days for hay temperature to decline to non-damaging levels, depending on outdoor humidity, density of the bales, and amount of rain soak up by the bales. The longer it takes for hay temperature to decline, the more damage is done.

New hay that is stacked in the field or placed in a barn should be initially checked at least twice a day for abnormal heating. If storing hay inside, be sure the barn roof and plumbing does not leak and that surface water cannot run into the barn. If internal hay temperature reaches 130 °F, move the hay to allow increased air circulation and cooling. Fire is imminent if interior bale temperatures exceed 175°F. Fire is present at temperatures greater than 200°F. Other symptoms of hot hay or internal hay fire include a slight caramel or strong burning odor, visible vapor or smoke, a strong musty smell, and/or hay that feels hot to the touch. If any of these symptoms occur, call the fire department immediately.

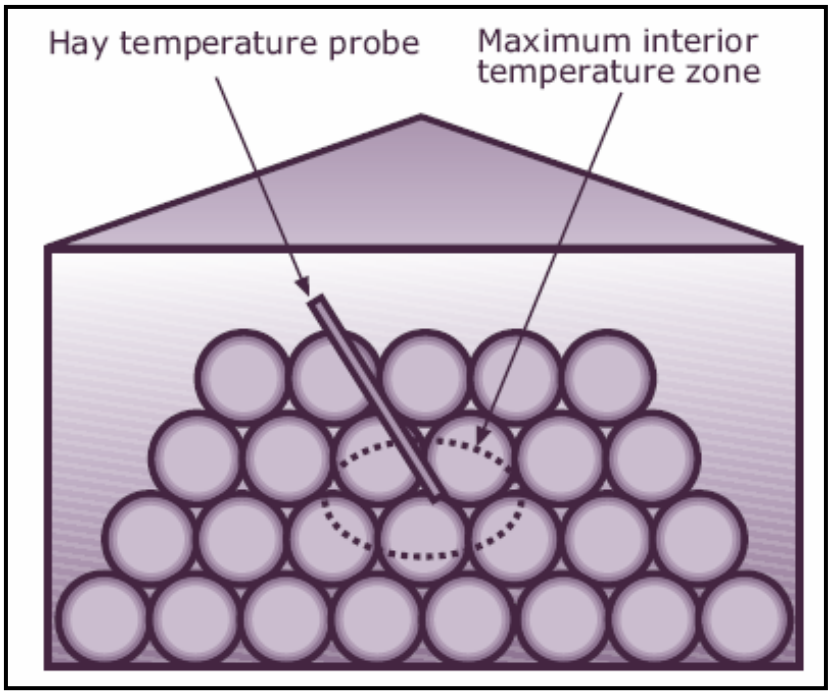
Let firefighters take control of the situation once they arrive. Do not move hay if signs of fire are present. Moving hay exposes the overheated or smoldering hay to oxygen and may cause the fire to burn uncontrollably. Do not open barn doors if hay is smoking. The added oxygen can cause hay to burst into flame.

Hay temperature can be easily checked using a garden-composting thermometer. A probe can also be built using a 3/4-inch diameter pipe. Drill eight 3/16-inch diameter holes about three inches from one end then hammer that end of the pipe together to form a sharp edge. Drive the probe from the top of the hay stack into the inner most bales. Lower a thermometer to the end of the probe with a piece of light wire. After 10 to 15 minutes, retrieve the thermometer and read the temperature.

For details concerning hay fires, review "Hay Fire Prevention and Control," a VCE publication available online at:
http://www.ext.vt.edu/pubs/bse/442-105/442-105.html
and "Determining Forage Moisture Concentration" found at http://www.ext.vt.edu/pubs/bse/442-106/442-106.html

For details on baling, review "Management Tips for Round Bale Hay Harvesting, Moving, and Storage" found at http://www.ext.vt.edu/pubs/ageng/442-454/442-454.html

(Susan Gay)



Proper location for inserting temperature

Neighbor Relations: Essential Component of Manure Management

Complex technologies or treatment systems is not the solution to good manure management. Sometimes, the often forgotten or ignored relationship with your neighbor can resolve many issues arising from animal agriculture, especially, with respect to odor. Manage manure according to a nutrient management plan to utilize its value as a fertilizer, enhance soil quality, and reduce potential negative impacts to water quality. This approach works well in areas where farming and its consequences are recognized as part of the community.

However, the reality is, our communities are changing. The demographics of rural areas (where farming has traditionally occurred) is changing and what used to be exclusively rural areas are becoming urbanized. Public awareness of environmental issues are changing. As a result, an increase in farm-neighbor conflicts around the country are being seen. Commonly, the non-farm community members complain that their quality of life is affected by odors and sometimes nutrients related issues associated with farming activities.

The structures of farms are also changing - animal feeding operations are expanding, requiring installation of manure storage facilities and acquisition of fields further away from the farm for land application to utilize manure nutrients. Increasingly, farmers are being forced to consider social as well as air quality concerns in developing manure management plans.

Here are some reminders of good practice as part of your manure management strategy:

Know your neighbors

It is important to recognize that our neighbors are changing and that what used to be farming friendly communities are changing and becoming urbanized. We have numerous and diverse neighbors to say the least! Some are long term residents who farmed in the area and are now retired. Some are the result of urban sprawl. Some live in communities next to our agricultural land but within the city limits.

Schools, churches, hospitals, and even large golf courses are also some of our neighbors. It is interesting to note that some non-farm community members are buying former farms and moving into the country, seeking "fresh" air. *Bottom line*: the concurrent urbanization of rural areas and consolidation of livestock farms can result in tense relationships between farmers and their non-farm neighbors. It is important to recognize this fact and proactively pursue ways to deal with it. Remember how you handle business on your farm can impact how you can resolve issues related to your farm.

Challenges

Remember, a large number of animals near non-agricultural residents will elicit odor and visual issues related to confined animal feeding operations. Also, as demographics change, you may notice that local roads are busy with aggressive drivers traveling at high speeds who do not recognize the slower speeds of farm traffic. If anything, they will complain about the farming operation and the farmer will complain about them – pointing fingers! With the hectic pace of life, there may be little, if any, communication between the farmer and neighbors. This can create an environment for misunderstandings and high likelihood of conflicts. Sometimes seeking common ground and mutual agreement that everyone can live with is not always realized in time, until it is too late and damage is done that is difficult to repair or overcome. Do not let situations with your manure management issues get this far. Be proactive in talking to your neighbors to seek compromise. Implement responsible and defensible farm management practices, and conduct activities which promote the benefits of the farm to neighbors and to the community at large.

Some thought on how to address the challenges

***Tell your story*:** There are a variety of outreach efforts you may want to consider to enhance the perception of the farm among neighbors and the larger community. Accept visits (tours) to your farm as often as your schedule can allow. Tell the visitors what you do and why you do it. The visitors should include all ages and groups. If possible, provide neighbors with sample farm products, assist or volunteer to mow brush in the summer or plow snow in the winter, and providing access to areas of the farm for recreational activities. Consider sending to your neighbors newsletters describing your farming operations and farm activities, including scheduled dates for manure applications. If neighbors have special events occurring at their homes on certain dates that may be impacted by a farming operation, e.g. land application of manure, work with them to reschedule that operation. Note, outreach to community, open houses, and neighborly assistance can help cultivate open communication and understanding between farm and non-farm community.

***Engage local leadership*:** Before embarking on new or expansion projects on the farm, request to meet with the local authority boards at their regular meetings to show them your plans, explain the thought process, tell them the reasons for the project, and solicit questions and comments. After finishing the project, hold a neighborhood barbecue and a tour to meet all the neighbors personally to show them what you do and why. It is more difficult to carry a disagreement with some you know and are friendly with, or has at least made a first move to get to know you more personally.

When planning farm operations that will impact people in the area (e.g. spraying liquid manure next to a school, church or golf course), ***communicate and explain*** the operation ahead of time. Plan the operation at a time of least disruption to the other party. Remember, people are much more accommodating if issues are addressed ahead of time, even if it's something they do not particularly like.

Remember, most people will give you more latitude with something they do not like if you are making ***good faith effort*** to deal with their dissatisfactions about your farming operation.

Cleanliness: Remember, sometimes people tend to smell with their "eyes" more than their noses. It is therefore extremely important to have a neat and clean farmstead, clean animals, well tended crops, building and machinery in good repair. Yards around barns and along the road and ditches should be mowed. It is not always possible to prevent all farm odors, but if people are presented with the picture of a clean, orderly, well-managed farm, they will tolerate more actual odor than a farm that looks untidy.

Other things that you need to Remember:

Manure can be an economical source of crop nutrients if managed properly. Here are some manure management tips you need to remember during this summer season, when many people venture outdoors and most manure land application activities occur.

Test manure to know the nutrient content of the manure

Test soil to establish existing soil-fertility levels

Apply manure at uniform rates based on crop nutrient needs and avoid soil contamination, crop damage, and runoff.

Adjust the rate of supplemental fertilizer to compensate for the nutrients applied in the manure.

Use of manure and fertilizer as nutrient sources for crop production must be managed properly to ensure that they do not contaminate ground or surface water.

Check soil moisture before applying manure, and adjust application rates to avoid runoff. Limit the volume of water applied to an amount that brings the soil to field moisture capacity.

Avoid runoff, do not apply manure to saturated soils.

Calibrate application equipment to obtain the desired application rate.

Incorporate raw or untreated manure to reduce odors and nitrogen losses.

Think Safety and Manure Handling: Liquid-manure can produce gases that can be toxic. Production of manure gases are enhanced in the hot weather, so practice caution when handling manure in the summer. Also, remember that outdoor and open-top manure storages can be potential drowning sites.

(Jactone Ogejo-Arogo)

Waste Solutions Forum Identifies Key Animal Waste Management Strategies

A forum of key farm, business, conservation, academic, and government leaders has identified the most promising strategies for addressing excess animal manure and poultry litter produced on Shenandoah Valley farms.

Forum participants -- approximately 80 university scientists, engineers, farmers, waste management facility operators, economists, conservationists, policymakers and government regulators -- convened April 28-29 in Roanoke and agreed to a number of management options or alternative uses of manure and litter, which hold the greatest practical and economic potential. A few of the priority approaches include:

Piloting advanced feed management on dairy farms to reduce nutrients in the manure. Implementing transportable waste-to-energy demonstration projects to produce bio-oils, fertilizers, and fuel. Conducting multiple training workshops on composting technologies. Establishing a stable and significant source of state funding for agricultural best management practices and for innovation grants.

Some 600,000 excess tons of animal manure and poultry litter are produced annually in the Shenandoah Valley, with much of it currently spread as fertilizer on crop fields and pastureland. There is increasing recognition, however, that land application of excess manure and litter is contributing to local and regional water quality problems, as there are far more nutrients generated than there is land on which to appropriately apply them.

"Thus we see the challenge for this forum [is] to develop a strategy for utilizing excess manure and litter generated in the Shenandoah Valley of Virginia that is both feasible for working farmers and also eliminates the threat to the Bay and its tributaries," said Virginia Secretary of Natural Resources W. Tayloe Murphy Jr. in kicking off the Waste Solutions Forum.

The goal of forum participants was to create a detailed action plan for identifying, researching and implementing alternative solutions for the Valley's animal waste management problems. Finding and implementing such solutions is deemed critical for agriculture to thrive in the Mid-Atlantic region and for the Chesapeake Bay and its tributaries to return to good health.

Dr. Katharine Knowlton, Dairy Science Professor at Virginia Tech and chair of the forum steering committee, stated, "The forum identified workable solutions, which build upon our current research findings, but also identified key questions requiring further study."

Said Ann Jennings, Virginia Executive Director for the Chesapeake Bay Foundation and a member of the forum's steering committee, "I believe the forum achieved its objective of developing a collaborative action plan – with specific actions, timelines and responsibilities – that will not only help Virginia's farmers but also improve Virginia's water quality as well. This is a momentous step forward."

With a high level of energy and enthusiasm, the forum participants brought their varied expertise, experiences, and perspectives to the table to identify workable solutions for Virginia's farmers. Dale Gardner, Executive Secretary of the Virginia State Dairymen's Association said, "We must move forward and begin implementation of these solutions or risk the loss of the farming economy in the Valley."

(Jactone Ogejo-Arogo)

Safety Videos, Slide Sets, and Films

BSE has a loan library of safety presentation materials available on a short-term loan basis for educational programs. Users are required to pay return postage fees.

Following is a categorical listing of safety presentations currently available:

- ATV Safety
- Automobile Safety
- Bicycle Safety
- Chain Saw Safety
- Chemical & Pesticide Safety
- Electrical Safety
- Falls
- Fire Safety
- General Farm Safety
- Gun Safety
- Home Safety
- Garden & Landscaping
- Spraying Systems
- Tool & Shop Safety
- Tractors & Machinery
- Water & Recreation
- Wood Stoves
- Miscellaneous

Descriptions are found at: ***http://www.ext.vt.edu/vce/anr/bse/farmsafety/videos.html***

To request: Phone (540) 231-6809, Fax (540) 231-3199 or E-mail: tlcox@vt.edu

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***
(Susan Gay)

Hurricane season is here: Are you prepared?

Hurricane season began June 1, and 60 percent of those most at risk are unprepared, according to a national poll released by the American Red Cross. But the good news is, there's still time to get ready. "While most people are not prepared for hurricane season, there's still time to pull together a plan and a kit," said Bobby Grisso, extension engineer. "Please take an hour out of your day to lay out an emergency plan with your family and throw together a disaster supplies kit with everything you need. Preparing brings peace of mind."

On a positive note, the survey indicates that coastal residents who do make preparations take the issue very seriously. Of those households with an evacuation plan, 84 percent have included their children in the disaster planning process. Additionally, 71 percent of families who have a person with a disability or health problem have special plans to take care of their needs -- a significant increase from 50 percent in 2001. The Atlantic hurricane season officially will last until Nov. 30.

Protecting yourself and your family should be the highest priority. As communities prepare for hurricane season, the Red Cross recommends the following safety steps and tips:

- **Assemble a disaster supplies kit**: Gather emergency supplies including emergency medications, nonperishable food, a non-electric can opener, bottled water (at least 3 gallons per day per person), a battery-powered radio, flashlight, extra batteries, extra clothes, important documents, cash and credit cards, a first aid kit and other items for infants, elderly or disabled family members and pets.
- **Store supplies** in a waterproof, easy-to-carry container, such as a plastic tub with handles.
- **Prepare a personal evacuation plan**: Identify an evacuation route ahead of time, and discuss it with family members. If advised to evacuate, do so immediately. In case of evacuation to an American Red Cross shelter, be sure to bring the disaster supplies kit, medications, extra clothing, pillows and blankets, and other hygiene and comfort supplies. Make advance preparations for pets so you can bring them with you when you leave. But remember, because of health department regulations, pets aren't allowed in public shelters.
- **Prepare for high winds**: Measure windows and obtain shutters or cut plywood to cover each one. Remove diseased and damaged tree limbs well before a storm strikes. Strengthen garage doors with vertical support beams made from 2 x 4s and "L" brackets. Get professional help if needed.
- **Pick up free copies** of American Red Cross Hurricane Readiness Guide or review webpage at: http://www.redcross.org/services/disaster

(Bobby Grisso)

AgrAbility Virginia

AgrAbility Virginia helps individuals with disabilities overcome barriers to continue in their chosen profession in agriculture. The program collaborates with community professionals to:

- Modify farm and ranch operations
- Adapt equipment
- Increase farmstead accessibility
- Provide financial counseling
- Identify funding sources
- Coordinate community services.

The National AgrAbility Project and its state programs are supported by the United State Department of Agriculture (USDA), and services are currently delivered in 24 states. The program was originally authorized by the 1990 Farm Bill and has been providing funding to state programs through a competitive grant process since then. AgrAbility Virginia is a program of Easter Seals Virginia, a nonprofit organization, and provides services free of charge through a contract with the Virginia Tech Cooperative Extension.

AgrAbility Virginia is a cooperative effort of the Rural Rehab Partnership:

- Virginia Tech Cooperative Extension (VCE)
- Easter Seals Virginia (ESV)
- Department of Rehabilitative Services (DRS)
- Virginia Assistive Technology Partnership (VATS)
- Woodrow Wilson Rehabilitation Center (WWRC)
- Virginia Farm Bureau Safety (FB)
- Centers for Independent Living (CIL's)
- Virginia Disability Service Agencies

New relationships have increased the scope of on-farm assistance provided. AgrAbility Virginia is dedicated to working closely with these agencies to provide the best services possible and to eliminate duplication of services. As an example of services provided below is a recent case story.

Mr. Bradshaw suffered a spinal cord injury in 1996 at the L3 level which resulted in paralysis from the waist down. He had been an automotive mechanic for 13 years prior to his injury but was unable to return to work due to symptoms and issues related to his injury. For seven years, Mr. Bradshaw has been receiving Social Security Disability Insurance as his only source of income.

He had been raising meat goats for personal consumption and realized that he could expand his operation and potentially become self-sufficient as a producer of meat goats. He spoke with his DRS counselor about getting assistance in purchasing a mobility vehicle and was then referred to AgrAbility Virginia. Before DRS could assist him, he developed a business plan for the meat goat enterprise. Mr. Bradshaw and an AgrAbility Virginia staff member then met with the Small Business Development Center for assistance with the business plan.

Others involved in the business plan development were the Virginia Department of Agriculture, Virginia Tech, DRS, Virginia State University, and VCE. Mr. Bradshaw also received assistance from the Benefits Specialist from Centers for Independent Living (CIL) and the Social Security Administration, specifically the PASS cadre. He has submitted his business plan to DRS and did receive funding for a mobility aid, thus increasing his abilities to be productive with his farming operation.

The impact of AgrAbility Virginia in this case is not just the cooperation between providers and agricultural members, but potentially to the meat goat market in the state of Virginia. Regional slaughterhouses sometimes have difficulty buying from local suppliers since the supply is not sufficient. Customers are demanding more goat meat each month and the supply is generally imported from other states. Mr. Bradshaw is entering a growing market and has the potential to be a successful meat goat producer.

For more about the AgrAbility Project: http://www.agrability.ext.vt.edu/

Power Mower Safety

The familiar sound of a lawn mower marks the arrival of another summer in Virginia. Lawn mowers are so common place that we seldom notice them, it is so easy to forget how powerful and dangerous these machines can be.

Nearly all of the powered lawn mowers on the consumer market are "rotary mowers". The defining characteristics of rotary mowers are one or more heavy horizontal blades which revolve at about 3,600 revolutions per minute. Because of their weight and speed these sharp blades have more than enough energy not only to cut grass but also to propel small objects at high velocity or even sever a body part. The blade is enclosed in a sturdy metal housing called a deck. The deck separates the operator from the blade and directs the mower discharge away from the operator.

AgrAbility Virginia Project is committed to assist clients with their current issues and as their needs evolve. Each case has proven to be a dynamic situation, and has challenged the staff to find solutions to a wide range of issues presented by injury and the aging process. AgrAbility Virginia remains dedicated to providing ideas and solutions for people involved in agriculture to continue their way of life both in a productive and safe manner.

Direct Contact: **Kirk Ballin**
AgrAbility Virginia
Easter Seals Virginia
201 East Main Street
Salem, VA 24153-3841
540-777-7325 (Outside VA)
800-365-1656 (Inside VA)
Fax: 540-777-2194

E-Mail: kballin@va.easter-seals.org

According to a recent study by the National Safety Council; Americans suffered 71,912 serious injuries in one year resulting from lawn mowers. Most of these injuries were caused by: coming in contact with the mower blade, being struck by an object thrown by the blade, or loss of control of the mower. Most if not all of these injuries could have been avoided if the operator had followed the procedures on the safety warning labels and in the operators manual.

Prevention of blade contact injuries is a matter of keeping hands, feet and other body parts outside the mower deck while the machine is in operation. Most mowers have multiple built in safety features to help prevent any part of the operator's body from coming into contact with a moving blade. Walk-behind mowers generally have an engine brake or blade brake/clutch which will stop the mower's blade and or engine as soon as the operator lets go of the handle. Riding mowers and lawn tractors also incorporate safety interlock systems which stop the blades and/or engine if the operator is not in the seat. These systems should never be circumvented or disabled and should be checked for proper operation before each use. Never attempt to clear a blockage or adjust the mower with the engine running. Walk behind mowers are unidirectional; they are only intended to cut in the forward direction. Pulling a walk behind mower backwards could cause the mower to run over the operator's foot.

Prevention of thrown object injuries starts before mowing begins. Rotary mowers are designed to create a strong up draft under the deck to lift the grass for cutting. This up draft will also pull up small objects such as stones; sticks, toys and other debris when they are in the path of the blade. The blade will strike these objects with considerable force turning them into hi-speed projectiles. Removing pets, bystanders and debris from the area to be mowed before mowing should be part of the regular routine which will not only reduce the risk of you or a bystander being struck by an object, but will also prevent damage to the mower. The mower's discharge chute or bagger system are designed to help contain thrown objects or deflect them downward into the grass thus decreasing the distance an object thrown by the blade can travel. The rear portion of a walk behind mower deck should have a heavy rubber or plastic skirt to protect the operator's feet from objects thrown out under the deck. Keep all shields and deflectors in place and replace them if they are damaged. Pay attention to strange noises and vibrations, they may indicate a damaged, bent or out of balance blade which could fail with catastrophic consequences. If the mower develops a vibration or strange noise, stop the engine immediately and check for damage.

Preventing injuries caused by loss of control begins with knowing the mower and it capabilities. Review the operator's manual carefully before using a new machine. Know how to operate the controls and how the machine maneuvers before using it to mow. Slopes and wet grass are serious challenges to maintaining control of the mower. Of course, it is always better to wait for dry turf conditions to mow; not only does wet grass tend to clog the mower, but it also decreases traction and control. For best stability, always mow across a slope with a walk behind mower and up and down a slope with a riding type mower. When cutting slopes with a riding mower always keep the machine in gear, never coast down a slope. Avoid mowing near ditches or other drop offs, the weight of a riding mower could be enough to cause the bank to shear resulting in an overturn. No mowing machine is suitable for every mowing task. Matching the machine to the task to be done will assure better results and increase safety and control.

Tips for safer mowing:
Review the operator's manual frequently, follow the recommended safety and maintenance procedures for your machine.

Dress appropriately when mowing. Sturdy closed toe work boots with an aggressive sole are a must to protect your feet and help with traction on slopes and damp grass. Long heavy pants will help protect the legs and safety glasses to protect the eyes.

Beware of carbon monoxide, always start internal combustion engines outdoors, carbon monoxide can build up to dangerous levels in even a short time without proper ventilation.

Always fuel gasoline powered equipment outdoors; fuel vapors are harmful as well as explosive. Never refuel a mower while it is hot. Allow several minuets for the machine to cool down before refueling. If fuel is spilled while refueling, wipe the spill up and wait until the fuel vapors have cleared before attempting to start the mower. Finally never smoke while handling any type of fuel.

Keep your mowing equipment in good repair. Check fluid levels and remove any accumulation of dried grass that could cause a fire.

No extra riders should be allowed on the machine, especially children. Riding mowers and tractors are intended for one person. If a rider falls from the machine, the safety interlock system will not disengage the machine, often with tragic results.

Power mowing equipment should never be left running **unattended**. Always shut the machine off and remove the key to prevent children from starting the mower. (Christian Mariger)

BSE Researchers develop chemical processes

Cotton-gin residues

(Blacksburg, VA March 11, 2005) Solving problems in the commonwealth's agriculture sector is part of VT's College of Agriculture and Life Sciences' mission. "Our goal is to add value to the cotton crop by using its residue to make a valuable product," said Dr. Agblevor.

About 100,000 acres of cotton are grown in Virginia. The ginned cotton residue, left at the processing plants, contains the chemical ingredients commercially valuable products. The residue accumulates at the site and must be removed, otherwise it's a hazard because it easily ignites and can contribute to air pollution if it burns.

"We have been able to develop the manufacturing processes that can extract specific chemicals and make two products – ethanol, which can fuel automobiles, and xylitol, a sugar. Our work developed a manufacturing process for extracting both products simultaneously from the cotton residue so in the future it is possible that a manufacturing company operating in Southside Virginia could produce both the ethanol and the xylitol products."

Agblevor's research team has taken the cotton-gin residue and chemically processed the material in a laboratory. The processes extract the glucose to make ethanol and xylose that then can be made into xylitol. The Southeastern Regional Biomass Energy Program supported Agblevor's preliminary work. The project offers a solution to one of cotton production's problems. "Our estimate is that about 90 gallons of ethanol can be produced from a ton of cotton-gin residue. At the end of a ginning season, the plant sites in Virginia are piled high with the residue," Agblevor said. "There is enough raw material to make it possible to have a manufacturing process there."

An Iowa firm that produces ethanol from corn is interested in developing the technologies. If the technologies to use cotton-gin residue can work efficiently at a pilot level, it will be possible to process the residue commercially, and it will not require government subsidies to make it economically viable. Currently, the production of ethanol from corn receives subsidies to make it profitable.

Biomass Sugar Analysis

A more accurate, higher resolution method for measuring biomass sugars using High Performance Liquid Chromatography (HPLC) has been developed under a subcontract with Dr. Agblevor. Application provides the first quantifiable evidence that some of the sucrose present in the water extractives portion of corn stover can survive dilute acid pretreatment. This is an important discovery, since previously it was assumed that during pretreatment all of the sucrose contained in corn stover would degrade into degradation products.

A key implication of (some) sucrose or its hydrolysis products, glucose and fructose, remaining after pretreatment is that modestly higher levels of ethanol may be produced from biomass than previously assumed. The development of the new HPLC method for biomass sugar measurement made this possible. The new method improves chromatographic resolution, and thereby enables more accurate quantification of a larger number of biomass-derived sugars. In addition to the five biomass sugars normally monitored in biomass hydrolysates (i.e., glucose, xylose, galactose, mannose and arabinose), the new method is able to resolve and quantify sucrose and fructose (derived from sucrose).

In contrast, the methods now in routine use within the Biomass Program are not able to quantify these sugars. This was a significant limitation because corn stover (and likely other herbaceous lignocellulosic feedstocks) contains appreciable levels of sucrose. The sucrose content of corn stover is variable but significant, ranging from 2-20% (dry weight basis) depending upon when it is harvested, with an estimated average value around 10%. In addition, by providing higher quality analytical data, the new HPLC method should enable biomass researchers to obtain more accurate feedstock and process intermediate compositional data as well as better closure of carbon mass balances across pretreatment and saccharification/fermentation processes. For all of these reasons, this new HPLC method will facilitate more efficient biomass technology research, development, and deployment efforts.

For more information on these projects contact: fagblevo@vt.edu

Tips for selecting a turf sprayer

It's time to be thinking about your turf sprayer. It may be time to replace your sprayer or perhaps you're thinking of purchasing one for the first time. Whichever the case, when you go to select spraying equipment for use on turfgrass there are several factors you will need to consider.

It's important to know the total acreage you will be spraying and if there is any change you may be responsible for spraying larger areas in the future. This will have a bearing on the size of tank you need to purchase. Other factors you need to consider are the type of material the tank is made of and what type of agitation is available. You will need to determine if the sprayer will be tractor-drawn, truck-mounted or mounted on a turf utility vehicle. You will also choose the type of spray boom and nozzles for the sprayer. Finally, you should evaluate the type of accessories manufactures offer to help make your spraying job more efficient.

SPRAYER TANKS

Common tank size for turfgrass sprayers can range from 100 to 300 gallons. If you need a 300-gallon sprayer (or even larger), the tank may require a couple of baffles for sprayer safety and to cut down on the bouncing. Sprayer tanks should be easy to fill, clean, service and be resistant to corrosion. The tanks used for turf spraying are usually made out of two types of material. If you are looking to keep the weight down, there are tanks made of polyethylene that are light-weight, impact resistant and offer UV inhibitors that protect the poly from drying out and cracking. The other material that is used on turf sprayers is stainless steel. This material is durable and is normally used when mechanical agitation is part of your standard procedure. You will find that any of these tanks can be mounted on single or tandem axles, turf utility vehicles or used as dedicated turf sprayers.

PUMPS: THE HEART OF THE SPRAYER

The pump is by far one of the most important factors to consider when you are looking to purchase spraying equipment. There are two types of pumps widely used in turf application: Diaphragm and centrifugal pumps.

Pumps can be divided into two general categories: positive displacement and non-positive displacement pumps. Diaphragm pumps are in the positive displacement category. With positive displacement pumps, the flow from the pump is directly proportional to the pump speed. This positive flow is why all positive-displacement-pump hook ups include a relief valve and a bypass line between the pump outlet and the nozzle shut-off valve. The pump must be capable of delivering the volume of material required by the nozzles, the volume required by the tank agitators, and an additional capacity of 10 to 20 percent.

Because of their design, diaphragm pumps are positive displacement and provide improved handling of abrasive and corrosive material. Their design may involve two to six pumping cylinders that are separated from the piston chambers by a synthetic diaphragm. This keeps the spray material from contacting and corroding the internal pump components. Diaphragm pumps are compact, self-priming and are low-volume, high-pressure units. A diaphragm pump will produce 10 to 14 gpm. The pressure output of a diaphragm pump can be as high as 800 to 1,000 psi. The PTO on your vehicle or a gasoline engine mounted to the sprayer frame can also power these pumps.

The most common non-positive displacement category are centrifugal pumps. These pumps have a rotating impeller that creates a centrifugal force that, in turn, feeds the liquid through the system (instead of capturing and discharging a fixed volume of material as diaphragms would do). Therefore, if the outlet is closed, the impeller will simply continue to rotate harmlessly. This is why there are no special relief valves required in centrifugal pumps. Traditionally thought of as high-volume, low-pressure pumps, centrifugals are compact and can be powered by a PTO on the vehicle, hydraulics or by a gasoline engine mounted to the sprayer frame. A centrifugal pump can generate 60 to 100 gpm at a pressure of 70 to 100 psi. The spray material travels directly through the pump to make contact with a rotating impeller. Centrifugal pumps are not self-priming, so they must be situated below the tank and also be positioned low on the machine.

AGITATION

Agitation of most spray solutions is necessary. Any separation of material will vary the spray concentration. Jet, venturi and mechanical agitation are designed to keep chemicals in suspension and prohibit them from settling on the bottom of the tank. For a jet agitator, a flow of 6 gpm for every 100 gallons of tank capacity is usually adequate. Venturi-type agitation ensures full coverage across the bottom of the tank and to the corners. If you use venturi-type attachments, they will reduce the agitator flow from the pump 2 to 3 gpm for every 100 gallons of tank capacity. Mechanical agitation incorporates a shaft that passes along the lower part of the tank and has paddles attached to it. The shaft is powered by a pulley and belt that is driven by the sprayer's power source. Mechanical agitation is used with diaphragm-type pumps because of the low volume that it produces.

BOOM TYPES

Depending on your needs, you can select from booms that you can mount with your sprayer or a walking boom. The boom may be a "wet boom" or a "dry boom." The "wet boom" actually carries the spray material through a pipe to the nozzles and is made of stainless steel.

The "dry boom" carries material through poly tubes to the nozzles and is attached to steel framing to give it the ridgity it needs. Depending on your situation, choose from mounted booms that are 15 to 20 feet in length and adjustable. They come in three sections, with each section having own independent control for on/

off that you can fold for maneuverability and transport. This offers you the flexibility to spray in tight areas and also helps you to control your chemical cost.

There are walking spray booms that can be up to 80 inches in length with three sections that can also be folded up. You can use these booms where turf compaction is a factor, such as on greens and tees. You can control the spray material to the boom and at the boom with the use of electric solenoids, manual screw-type closure valves or electric systems. Manufacturers will use one or all ofthese types of closures, depending on the particular sprayed model.

SPRAY NOZZLES

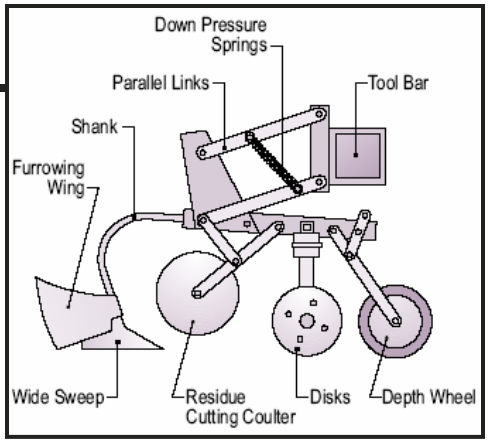
There are nozzles for practically every kind of spray application, but only a few are commonly used for applying chemicals that are labeled for turf. The different types of nozzles available can provide different flow rates spray angles, droplet sizes and patterns. Nozzle types commonly used in sprayers include flat fan, flood, raindrop, hollow-cone and full-cone. Often, you will base nozzle selection on droplet size. The droplet size from a nozzle becomes important when the efficacy of a particular chemical is dependent on coverage, or the prevention of spray leaving the target area is a priority.
The majority of the nozzles can be classified as producing fine, medium or coarse droplets. Nozzles that produce fine droplets are usually recommended for post-emergence applications that require excellent coverage on leaf surfaces. The most common nozzles used are those producing medium-size droplets. You can use nozzles producing medium-sized droplets for contact and systemic herbicides, pre-emergence surface-applied herbicides, insecticides and fungicides.

An important point to remember when choosing a spray nozzle that produces a droplet size in one of the three categories is that one nozzle can produce different droplet-size classifications at different pressures. A nozzle might produce medium droplets at low pressures while producing fine droplets as you increase pressure. Higher pressure not only increases the flow rate through a nozzle, but it also influences the droplet size and the rate of orifice wear. As pressure increases, the droplet size decreases and the rate of orifice wear increases.

ACCESSORIES

Once you have determined the other features of your sprayer, you need to consider accessories. All these extras can help you build the sprayer you want and need. Available accessories include electronic controllers, personal wash tank, rinse tank, foam marker system, hose reels, outer-wheel kits, electric boom lifts and kits for controlling drift. Sprayer controllers can provide you with three-boom section control, programmable applications rates, readouts for your speed, total volume of material applied, total field area, volume left in the tank and the distance traveled. From a safety standpoint you can include a personal wash tank that provides a clean water source in case of an emergency. A foam marker kit will help you to increase the accuracy of chemical applications. Foam markers can pay for themselves just by decreasing the amount of chemical you use and additional savings can come from preventing skips or overkill. Electronic boom lifts are also good time savers when you're working in tight areas. If you're trying to decide between two similar sprayers, accessories can often by your final deciding factor.

For information on sprayer setup see: Plumbing Systems of Agricultural Sprayers (VCE Publication 442-552 http://www.ext.vt.edu/pubs/bse/442-452/442-452.html)



Crop Cultivation

Cultivation only for the sake of stirring the soil is a waste of fuel, labor, and valuable soil moisture. Crop roots near the surface are pruned, crop residue is buried, and the soil is left in a condition that is prone to erosion and crusting. Cultivating wet soils smears the soil layer below the cultivator sweeps, increasing runoff and erosion.

Cultivation for broad spectrum weed control may be needed if the weed pressures are above thresholds such that they would be causing yield reductions. Considering the root pruning and moisture loss from cultivation, specific weed problems may be more economically addressed using a properly selected and timed postemergence herbicide program.

In wet years or under no-till conditions where the residue holds the soil moisture near the soil surface, root pruning is greater since there are more active roots near the soil surface. Cultivation, when performed, should be shallow to undercut the weeds so that they dry down quickly (usually within hours). Operating deep may leave too many weed roots intact in moist soil, leave a furrow which concentrates runoff and accelerates erosion, and dry the soil out to the depth of tillage. That is why the new style cultivators have wide, flat sweeps.

The cost of the cultivation is offset partially by using a band application of herbicides at planting time (or no herbicide at all) and no tillage for next year's crop.

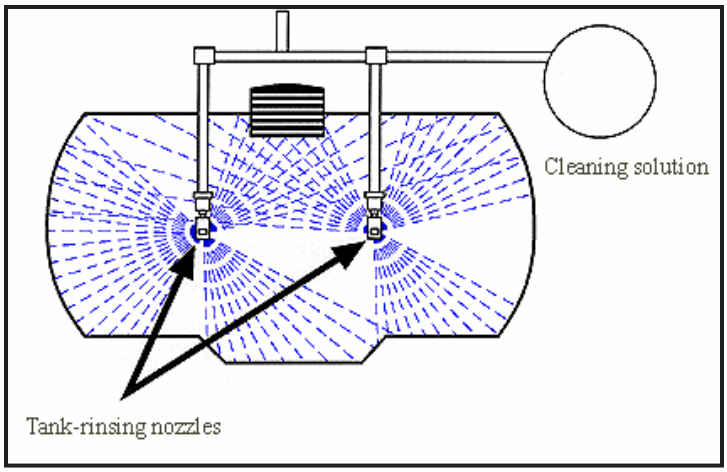
Some producers think the soil needs to be loosened to allow the crop roots to grow. The crop roots are already a foot or more into the soil so stirring the top inch or two won't make much difference. Others think that the corn needs "hilling" so that it stands up. The hybrids used today stand much better than those of the past and rootworm control has improved such that corn doesn't need much propping up. With a proper planting depth (around 2 inches), the brace root formation is such that hilling is not needed, especially when the soil is moist. Shallow planted corn may not properly form brace roots in dry soil near the surface so hilling may help if the cultivation operation does not further dry the soil.

For a systems approach, some producers use the cultivator for herbicide application (not advised usually), for rootworm or corn borer insecticide application, or for side-dressing fertilizer. These trip-saving approaches may be okay if you can minimize the negatives of cultivation listed above.

(Bobby Grisso)

In-tank nozzles aid thorough cleaning

Contamination of spray tanks is becoming a bigger issue as more highly active herbicides are used. Many of the sulfonylurea herbicides are used at such low rates that a little residual in the tank could damage the next crop sprayed. Round-Up Ready soybeans has the potential to damage other sensitive crops. Chemical residues that have dried and solidified can accumulate on the tank interior. The best way to prevent these potential contamination sources is with frequent and regular tank cleanings. Always follow the product's label to determine the best cleaning solutions and methods to remove potential residues.



Tank-rinsing nozzles

Since it is impractical to dedicate a sprayer to a single herbicide, the tank and spray system should be thoroughly cleaned when switching products or crops to reduce the potential for crop injury. By using in-tank rinsing nozzles, the volume of rinsate and the potential of contamination is reduced. These in-tank rinsing nozzles can direct a stream of fluid to areas of the tank that you might be unable to reach when rinsing by hand using a hose. They can more thoroughly cover and clean the entire inner tank surface. An in-tank rinse system features specialized nozzles, a pump and a cleaning solution tank.

Several sprayer manufacturers offer in-tank rinsing nozzles which typically have multiple orifices and can rotate 360 degrees. The rotation of the nozzle is usually driven by the fluid pressure. Install at least two rinsing nozzles in the tank, one positioned on each side of the tank opening (see figure). If the sprayer is equipped with baffles, place a nozzle in each baffled section.

Sprayer tank setup

The system has to have adequate pressure to drive the nozzles and develop a stream that is effective in removing and flushing the product from the tank. Operating pressure of the rinsing nozzle affects the speed of rotation, flow rate, and distance of coverage. Most systems will need a pressure of 10-60 psi. Follow the manufacturer's instructions for installation and set-up. Triple-rinse the inside of the spray tank using 5 to 10 gallons of cleaning solution for each rinse. A tank-cleaning agent can be used to penetrate, loosen, and dissolve pesticide residues and then remove them through dilution. Sometimes the agent will provide deactivation or decomposition of the herbicide. Always follow label directions.

Circulate the rinsate for two to three minutes. Dispose of rinsate properly and re-rinse. Be sure to clean the entire sprayer system, not just the spray tank.

Operate the pump and flush the cleaning solution through the plumbing, hoses, strainers, screens, and nozzles. Small amounts of residue left in these areas can damage sensitive crops. After the tank has been rinsed, dispose of the rinsate properly. Remember to clean the sprayer in an area that will not contaminate water supplies, streams, or crops that are not accessible to children, pets, and livestock. The best place for rinsate disposal is in the field and in a manner consistent with the product's label.

For information on sprayer setup see: Plumbing Systems of Agricultural Sprayers (VCE Publication 442-552 http://www.ext.vt.edu/pubs/bse/442-452/442-452.html)

(Bobby Grisso)

Visit our website: http://www.bse.vt.edu