



# Biological Systems Engineering

Engineering Update

Spring 2011

## ***BSE Named a University Exemplary Department!***

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Seitz Hall*

## Engineering Update



**VirginiaTech**  
*Invent the Future*

Biological Systems Engineering  
March 2011

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

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



# The Value of Monitoring in Stormwater Management

**Purpose:** To review stormwater quantity and quality issues from urban development, and stormwater monitoring

*Stormwater quantity and quality impacts from urban development* - Peak flows increase substantially due to increases in impervious cover; whereas conversely, base flows decrease. As urban systems are created from natural systems, infiltration and recharge to groundwater is reduced, runoff increases dramatically, and evapotranspiration is slightly reduced. The subsequent impact on stream morphology is dramatic. The net result from increasing the impervious cover is a substantial increase in peak flows and a decrease in base flows. As a result, a larger number of storm events are seen above the predevelopment mean annual flow rates.

Peak flows translate this energy directly to stream banks. The stream is a natural system that seeks a new balance in this energy by bank scour which widens the stream. The stream thus becomes a dry urban canyon.

*Overview of the commonly accepted methods of stormwater sampling* - For the most part, we are interested in assessing the total washoff of pollutants from the land during storm events.

This can be assessed as either

load (mass/volume multiplied by flow, or mass per unit time), or load per unit area (mass/area/time), or Event Mean Concentration (EMC) expressed as a concentration (mass/time) averaged over the hydrograph. Since we are interested in the total EMC rather than at each part of the hydrograph, discrete samples across the hydrograph are collected into a composite sample.

Essentially there are 2 methods of compositing: "equal-volume, variable-time," and "variable-volume, variable-time." Of these 2 methods, the "equal-volume, variable-time" method is easier to collect with programmable automated samplers. The time composite method is not considered to be reproducible or reliable. Samplers and flow splitters can bias results. Sampling programs that determine hydrograph flow elements by the Manning's equation alone are not reliable.

Some kind of primary hydraulic control must be provided, because during peak flows, uniform flow conditions are almost always violated. In general, flumes are preferred over weirs. Weirs cause the velocity to drop to near zero behind the weir, allowing sediments to settle, which affects the measurement dramatically.

Another aspect of the sampling

program to consider is the location of the intake. Consideration should be given to the velocity distribution in the open channel to ensure capture of the dominant flow path. Sampling programs should consider the sediment and particle size distribution (PSD), as pollutants tend to bind to smaller clay particles. This is especially important when evaluating phosphorus into Total Phosphorus (TP), Total Soluble Phosphorus (TSP), Soluble Reactive Phosphorus (SR) and Soluble Nonreactive Phosphorus (SNP), and Particulate Phosphorus (PP).

A sample acid digested with heat to run TP, then filtered, and the elutriate is again tested (as in TP) to get TSP. The difference between TP and TSP is PP. Any sampling program depends upon the calculation of flow at any point in time; equipment that measures flow is very important and must be calibrated to field conditions.

We do not have the resources to monitor everything, everywhere, all the time. However, the intent is to demonstrate the wide applicability and value of monitoring programs. Selective monitoring is essential to improving BMP design. In particular, we need better information on runoff water quality for small urban, homogenous sites.

(by Dave Sample)



# Importance of Stormwater Monitoring

Stormwater monitoring is essential for evaluating Best Management Practices (BMPs) and conducting performance assessments. Detention and retention ponds tend to be flow-based with the dominant variable governing design being peak flow. Smaller LID (Low Impact Development) BMPs tend to be volume-based for sizing and are notoriously difficult to monitor. Some type of water balance monitoring is usually conducted.

Several examples for monitoring LID are: Before-After/Control Impact (BACI), comparison of traditional and LID development (paired watershed study), and comparison of a LID retrofit watershed to pre-retrofit conditions (comparison of same watershed over time).

Several examples of assessing BMPs and LID include: a Floating Treatment Wetland (FTW) wet pond retrofit in Fairfax, and an assessment of bioretention, permeable pavement, tree-box filters, rainwater harvesting, and a vegetated roof at the Science Museum in Richmond.

An ongoing research project developing protocols for Manufactured Treatment Devices (MTDs) was discussed. MTDs are distributed proprietary BMPs that are used in portions of a site, usually when space is limited such as in urban redevelopment and

retrofit situations. MTDs may offer several advantages in terms of employing new and likely proprietary treatment technologies to achieve potentially greater efficiency. A need has emerged to verify vendor claims; Virginia is developing such a program focused upon the nutrient phosphorus. Virginia Tech is assisting VDCR in developing this program. Currently, these decisions are made solely by local government with little guidance.

This program seeks to balance the need to verify performance claims with encouraging innovation and investment risk so that all stakeholders benefit and water quality is protected.

Monitoring is also used for a critical task, calibration of water quality models. In effect, we are extending the performance predictions provided by the monitoring data with the water quality model, thus leveraging the model.

In terms of provision of resources for LID Implementation, local governments focus upon implementation with their limited funds, in a process that starts with assessment, then planning, leading to design and construction. For LID and urban stormwater, local governments have made impressive investments in planning and implementation.

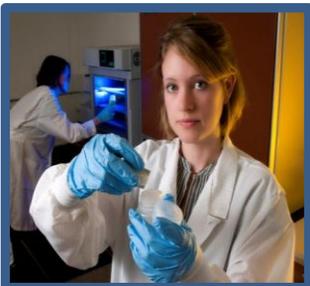
State agencies also focus upon

implementation with their limited funds. Federal agencies, through their grant programs, also focus upon implementation. An alternative vision of monitoring and its uses in adaptive management in support of design was presented. Monitoring of processes and performance is essential to improving designs. However, it is often ignored or unfunded. In collecting water quality monitoring data, we often leave out the other side of the cost effectiveness relationship: capital and operation and maintenance costs, which are essential to measurements of progress.

Selective monitoring is essential to improving BMP design and insufficient resources are dedicated to monitoring our designs and watersheds. In particular, we need information on small urban, homogenous sites, LID performance monitoring, ultra urban BMPs and MTDs. Overall, the goal need to focus on doing monitoring well rather than doing a lot of monitoring, and note that monitoring is leveraged by providing the calibration points for modeling.

*(by Dave Sample)*





**It's an IMPORTANT issue.**  
**It's a HUMAN HEALTH issue.**  
**It's a WATER issue.**  
**Extension can help!**



**Over 1.7 million, or one in five, Virginia households rely on wells or springs and are totally responsible for all testing and maintenance of these systems. Many private water supply users lack information about how to ensure their water is safe, maintain their water systems, and address problems.**

The Virginia Master Well Owner Network (VAMWON) is a dedicated group of volunteers and Virginia Cooperative Extension educators who provide outreach to private water supply users across the state. After training, extension educators work with the state coordinator to conduct drinking water clinics, which include affordable water testing, interpretation and help solving water quality and quantity problems.

## **Join us for a Private Water Supply IN-SERVICE TRAINING**

*ANR and FCS extension educators welcome!!*

**Thursday May 19**

**8 am – 5 pm**

**Virginia Cooperative Extension Southeast District Office  
2810 N. Parham Road Richmond, VA**

***LODGING the night before (Wed May 18) covered by VCE Administration!***

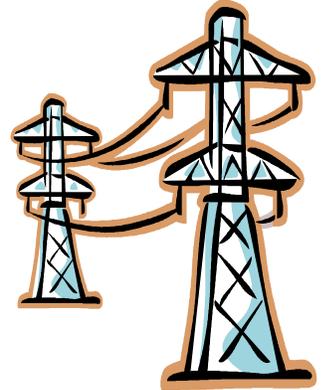
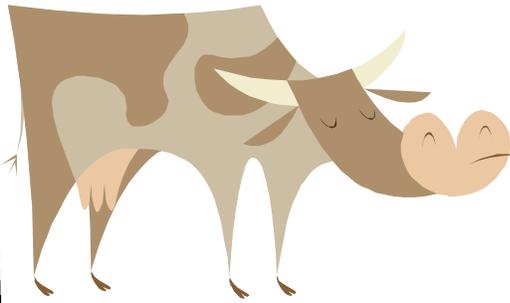
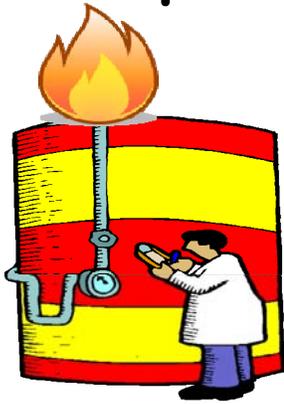
email Erin Ling at: [wellwater@vt.edu](mailto:wellwater@vt.edu).

**Space is limited—register today!**

### **Topics covered:**

- Groundwater hydrology
- Private well location, construction, and maintenance
- Land uses and wellhead protection
- Water testing and contaminants
- Addressing water problems/treatment
- Conservation
- Outreach and conducting drinking water clinics

# Exploring Anaerobic Digestion in Virginia



Interest in on-farm anaerobic digestion has waxed and waned over the past 30 years or so. Even when interest has peaked there have been technical issues prohibiting wide use of these systems. They often are expensive, can be complicated, and usually have only made economic sense for the larger farms. But we know

that there are ways to collect biogas for on-farm use that don't require a thousand cows or a million dollars. For example, outside the U.S. there are a variety of

technologies being promoted to produce and use biogas on small family farms. Usually these systems take the manure from a couple of pigs or dairy cows, add some food scraps from the family, and the collected biogas is used in a low tech cook stove. It seems that if you can harvest biogas if you're a subsistence farmer in a developing country, or on a 3,000 cow dairy in California, there ought to be a way to use an appropriate technology to collect biogas from the average dairy in Virginia.

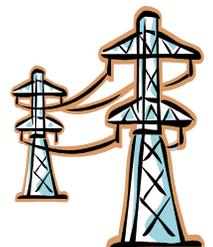
**BIOGAS WORKSHOP**   
 **THURSDAY, MARCH 31, 2011**   
 **ROCKINGHAM COUNTY FAIRGROUNDS**   
 **HARRISONBURG, VA**   
 **COST \$10**   
 **RSVP @ 540- 466-4674**

Please join us for a Biogas Workshop for Thursday, March 31st 2011 at the Rockingham County Fairgrounds in Harrisonburg, VA. The workshop will explore biogas technology, gas use, and successful biogas project examples from Canada, USA, and Europe. The goal of this workshop is to provide information to our clientele in Virginia so that they can explore opportunities of the benefits of installing anaerobic digesters in small dairies. The information presented at the workshop will include

examples of anaerobic digestion from small on-farm, to centralized, to commingled waste streams, to technologies used in developing countries, identify opportunities for integrated nutrient management in response to the Bay TMDL, and more. Registration is \$10. To register please call 540-466-4674 or visit

[www.bse.vt.edu/green](http://www.bse.vt.edu/green) and follow the "Biogas" link for more information.

*(J.Arogo & J. Ignosh)*



# Responding to Tornadoes

During the past three years, 62 tornadoes struck the Commonwealth, injuring more than 220 citizens and causing nearly \$48 million damage to homes, businesses and other property

## Know What To Do

Stay tuned to your local radio or TV for weather reports, or listen to a NOAA weather radio for more detailed information when weather conditions are favorable for the formation of tornadoes.

## When a tornado watch is issued:

- Tornadoes could develop in your area.
- Stay tuned to your local radio, TV or NOAA weather radio for further information and possible warnings.
- Be prepared to take cover if necessary.

## When a tornado warning is issued:

- A tornado has been sighted or has been indicated by NWS Doppler radar.
- Warnings are given to individual counties or cities and include the tornado's location, direction and speed.
- If you are in or near its path, seek shelter immediately.

It's really important to practice tornado safety by holding a drill in your home, workplace and school. Plan now to take part in the 2011 Statewide Tornado Drill, set for Tuesday, March 15, 2011, at 9:45 a.m. Register here for the statewide drill:  
<http://www.surveymonkey.com/s/KW9RLY5>

## If a Tornado is Headed Your Way

Shelter immediately in the nearest substantial building. Go to the building's basement. If there is no basement, move to a small, windowless interior room such as a closet, bathroom or interior hall on the lowest level of the building. Be sure to use the stairs to reach the lowest level, not an elevator. Protect your body from flying debris with a heavy blanket or pillows.



Take precautions if you cannot get to a substantial buildings. If you are in:

- **Open buildings** (shopping malls, gymnasiums or civic centers): Try to get into the restroom or an interior hallway. If there is no time to go anywhere else, seek shelter right where you are. Try

to get up against something that will support or deflect falling debris. Protect your head by covering it with your arms.

- **Automobiles:** Get out of your vehicle and try to find shelter inside a sturdy building. A culvert or ditch can provide shelter if a substantial building is not nearby — lie down flat and cover your head with your hands. **Do not** take shelter under a highway overpass or bridge, because debris could get blown under them or the structures themselves could be destroyed.

- **Outdoors:** Try to find shelter immediately in the nearest substantial building. If no buildings are close, lie down flat in a ditch or depression and cover your head with your hands.

- **Mobile homes:** Do not stay in mobile homes. You should leave immediately and seek shelter inside a nearby sturdy building or lie down in a ditch away from your home, covering your head with your hands. Mobile homes are extremely unsafe during tornadoes.

# How to buy your next planter

I've heard too many stories of farmers investing high hopes and a hundred thousand dollars in a new corn planter, only to find it performed worse than their old one.

Most common reason for the lag in performance is that buyers fail to get the planter configured in a way that fits their farming conditions, unlike their old planter that they had fine-tuned over the years. Buying a planter is a very important decision, and it takes some time. Really, it takes customization.

Following is a purchase guide that outlines all the factors farmers need to consider before buying their next planter. The buying process has gotten more complex over the years due to advances in equipment and an ever-increasing number of options designed to perfect the planting of corn. These include variable-rate seeding, swath control, bulk seed fill, automatic down-pressure control, narrow rows, twin rows, air-metering systems and planter monitors. You have to look at all the different options and how they are going to work on your operation.

There are strengths and weak-



nesses and doubles. The second is to invest in a bulk-seed-handling system in place of individual

hopper boxes to cut time spent filling the planter with seed, leaving you more time to plant.

nesses to every planter out there, so the key to buying is to identify them and find the system that will best address your biggest needs. There are a lot of options to consider, and you need to take the approach of which ones fit my operation.

*Here are the 10 factors to consider.*

## 1. Planter size

The first factor to consider when buying a planter is size. Most buyers are looking to upsize to cover additional acres within the same 10-day window typically available in the spring to plant corn. Sizes today range anywhere from 6 to 48 rows. A good rule of thumb when sizing is to assume each row can cover 100 acres per season. So a 12-row planter can cover 1,200 acres in the 10 days allotted for planting corn.

There are two alternatives to upsizing. One is to increase planting speeds without compromising seed spacing accuracy by using a planter monitor to check for

hopper boxes to cut time spent filling the planter with seed, leaving you more time to plant.

## 2. Row spacing

Currently the most common row spacing is 30 in. However, some growers have recently switched to narrow rows (15-, 20- or 22-in.-row spacing) or twin rows to accommodate the increasing plant populations of today's higher-yielding hybrids. Look at your planting population over the last five years and project what populations will be in three years. If you predict that your average populations will increase to where plant spacing is within 4 in. of each other, which is 36,000 plants/acre in 30-in. rows, while you own the new planter, take a serious look at a row-spacing change.

## 3. Seed delivery

A third decision is whether to go with a bulk-fill system or individual hopper boxes to deliver seed. Bulk-fill planters that distribute seed to row units decrease load

*(Continued on page 8)*

# How to buy your next planter

time and the amount of seed handling, which saves time during planting. If you need or want to split hybrids, plant plots or split the planter for refuge hybrids — or would have other reasons to segregate seed — a row unit with standard boxes may be a better option.

Also, examine how weight is distributed with each system. If most of the load is being passed to the ground through the center tires, soil compaction on middle rows can result. A 60-bu. decrease was observed in yield checks between the center and wing sections of planters due to center-section compaction. Look for planters that have a weight transfer system that can move weight from the center section to the wings or that use flotation tires.

## 4. Meter

Planter meters should be able to provide 98.5% seed singulation or better to ensure your crop is planted correctly. This is true whether you go with mechanical finger units or vacuum meters. To ensure the best level of performance, you should get your meters calibrated by a planting expert. Meter upgrades are available if needed.

## 5. Drive system and variable-rate population systems

There are two types of meter drive systems: hydraulic and

ground. Ground drive systems offer simplicity and reliability. But they do not permit on-the-go changes to population to match yield zones or soil types. Hydraulic drive systems are more expensive and complex, but offer the advantages of variable-rate population control and a smoother drive system, which can improve meter performance. If switching from ground drive to hydraulic, make sure your tractor has the hydraulic capacity required. Some planter manufacturers offer a PTO pump as an option.

## 6. Row shutoffs

One of the newer options for planters is swath control or row shutoff systems. These systems can reduce seed costs by preventing the planting of the same area twice. However, adding the required clutches and controls can be expensive. Look for ways to capture most of the benefit with lower start-up costs. For example, if you are using multiple hydraulic drives, you can opt for "half-width" disconnect that can cut overlaps in half or in thirds. If adding clutches, you can limit clutch costs by controlling two-, three- or four-row sections instead of every row.

## 7. Fertilizer application

Your planter evaluation also should include whether to apply starter or nitrogen with the planter. If corn on corn is part

of your cropping plan, or maybe down the road, odds are good that you could benefit from an at-planting nitrogen boost.

Consider these components when choosing a fertilizer application system:

- Coulters or knives for starter and nitrogen placement.
- Tank size: Match fertilizer tank size to seed bin capacity to synchronize fills.
- Pump system: Be aware that ground drive planters that are also running a pump can transfer vibration to your meters.

Other attachments: Row cleaners, downforce systems, parallel arms, and other modifications can limit the types of fertilizer systems available. Factor in these add-ons when choosing a fertilizer system.

## 8. Downforce

Downforce is needed to get the planter's double disc openers to the desired planter depth. Performance varies among the different downforce systems available. For example, pneumatic systems provide responsive, consistent pressure and are easy to adjust. Spring systems can be less consistent in applying pressure. Some of the side spring options exert a more consistent force through a wider range of motion but may not apply enough force in certain field conditions.

*(Continued on page 9)*

# How to buy your next planter

Reduced inner diameter (RID) gauge wheel tires, designed to reduce sidewall compaction, can be effective on row units that have a seed boot or shoe to hold loose sidewall soil away from the seed. They also can work with standard double disc opener systems in damp soils but may lack the pressure needed in dry soils to hold the sidewall for maximum yield.

## 9. Row cleaner

Almost all cropping systems will benefit from planter row cleaners to manage residue. Row cleaners should move trash and debris out of the row by lightly brushing



the ground. If set too high, debris remains in the row. Set too low, trenching occurs which can move soil affecting seed placement and lowering the effectiveness of any soil-applied herbicide.

Your row cleaner choice will affect your choice of fertilizer systems and downforce requirements. Use floating row cleaners as opposed to pinned or fixed ones because they provide consistent performance without affecting downforce requirements.

## 10. Closing system

Finally, consider all the factory and aftermarket options for closing systems. A good closing system will collapse the sidewalls and cover the seed, leaving little to no evidence of the trench being created while not moving the seed. Choose a system that is adaptable for different conditions throughout the season.

*(Adapted by Robert Grisso)*

# When Harvesting Small Grains Check Your Kernel Loss

It's time to begin harvesting small grains and some things need to be checked before moving into the field.

One of the most important things to check for prior to harvesting is the moisture content of the wheat.

Wheat generally has a moisture content of 30 percent to 40 percent when it begins to mature. However, harvesting should be

put off until the moisture content is around 14 percent. This can be checked with a



grain monitor or by feel for the more experienced farmer.

You also should be aware of how much grain could be lost. The greatest loss occurs at the header -- anywhere from one half percent to two percent on the average. But if the header isn't adjusted properly or the sickles aren't sharp your loss can be as high as 10 percent. Stop the combine often and check for grain on the ground.

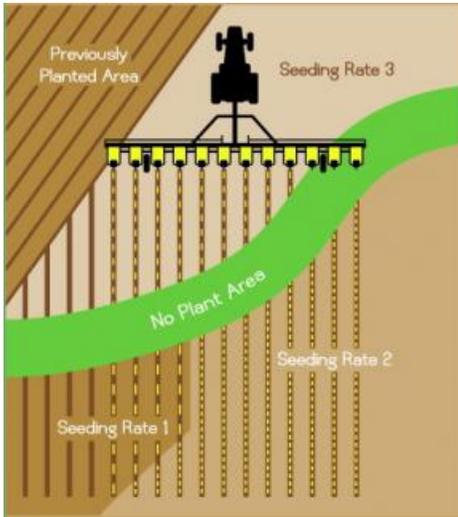
A good way to do this is to carry a piece of wire or rope along and measure off a square-foot grid. If you are harvesting wheat and you find 20 kernels in the grid

you're losing about one bushel per acre. Fourteen kernels of barley and 10 kernels of oats cause a one-bushel-per-acre loss. The kernels often are buried in the residue so it's important to take your time and dig around.

If you are using conservation tillage it's important to spread the chaff and straw evenly. Failure to do so can result in planting problems. One main problem is the planter will have a difficult time going through the residue if it's piled up. The piles also allow weed seeds to accumulate and keep the ground from warming up in the spring.

*(Adapted by Robert Grisso)*

# Technologies Changing Planters



## Planter section control

Turns individual planter sections or rows on and off based on field boundaries, no-plant zones, or previously planted areas to minimize overlap and skips during planting and to prevent wasted seed.

## Variable-rate drive

Varies the rate of seed planted in a given area based on a prescription map.

## Implement steering

Steers the planter based on GPS coordinates to keep the planter unit over the row.



## Bulk fill

Used in place of row-unit seed hoppers to reduce time spent loading seed.

## Pneumatic or hydraulic down pressure

Provides even pressure across all row units in rolling or uneven terrain to ensure consistent seed depth in planting.



## ISOBUS seed population monitor/controller

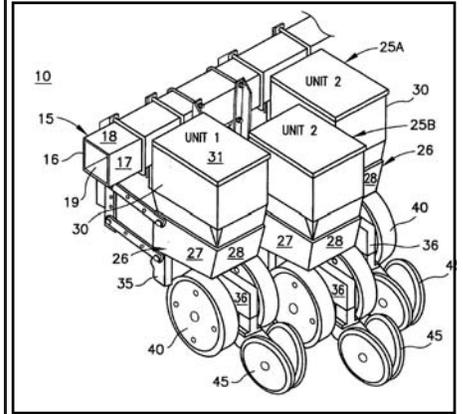


Allows a grower to use one monitor in the tractor cab that will communicate and control numerous implement functions.

## Hydraulic steering

A sensor on the front axle of the tractor tells a computer onboard the planter how much to turn, thereby eliminating the need for the rear wheels to castor and add-

ing to the planter's maneuverability and flotation.



## Narrow rows (20-in. and twin-row)

Works with new genetics to increase yields. Helps growers achieve higher yield without the crowding of 30-in. rows.

## Implement braking

As planters get larger, hydraulic or air brakes may be required in addition to tractor braking as an added safety measure for over-the-road transport.



## Air seed transfer

Use of pressurized

air to transfer seed from the central hopper to individual row units, which keeps hoses from plugging with seed and requires fewer moving parts.

# Planter adjustments-steps to successful no-till

Planters and drills have to cut and handle residue, penetrate the soil to desired seeding depth, establish proper seed-to-soil contact, and close the seed-vee. Keeping these four items in mind, a producer can



used to move the residue off the row to aid in soil drying. Unlike disk row cleaners, the spider wheel residue movers can be set to move only residue. If the soil is moved, any previously applied herbicides could be moved out

of the row or the crop may be planted deeper into cooler soil. It also might form a furrow, which may wash out or crust over. In addition, if the soil under the residue is wet, soil disturbed by row cleaners or coulters will stick to the planter's depth gauge wheels and other components.

evaluate the strengths or weaknesses of any piece of planting equipment and make the adjustments or changes necessary to make no-till successful. Fortunately, most currently available planting equipment can be used for no-till with few, if any, modifications.

Planters and drills are now being built stronger and heavier with larger-diameter disk seed-furrow openers, making no-till easy. Check the double-disk seed-furrow openers on your planter now, before the planting season, for wear and proper adjustment. The individual disks can be adjusted inward as they wear by removing spacer washers from behind them. This keeps the two blades of the seed-furrow opener working together as one cutting edge.

side-by-side, like on John Deere, Kinze, and White planters, there should be about 2 inches of blade contact on the leading edge. On staggered disk seed-furrow openers, like on Case-IH and Deutz Allis planters, the rear disk should be tucked in behind the leading disk, just touching. Adjust the disks or replace them to maintain the proper configuration. When properly adjusted, these seed-furrow openers can easily cut residue and penetrate the soil without coulters or row cleaners.

If the two blades are mounted

When no-tilling on well drained or highly erodible soils, leave the row cleaners up; residue left over the row will absorb raindrop impact. This will reduce erosion and crusting in the row and be a mulch to reduce drying of the seed zone. On poorly drained soils "spider wheel" row cleaners could be

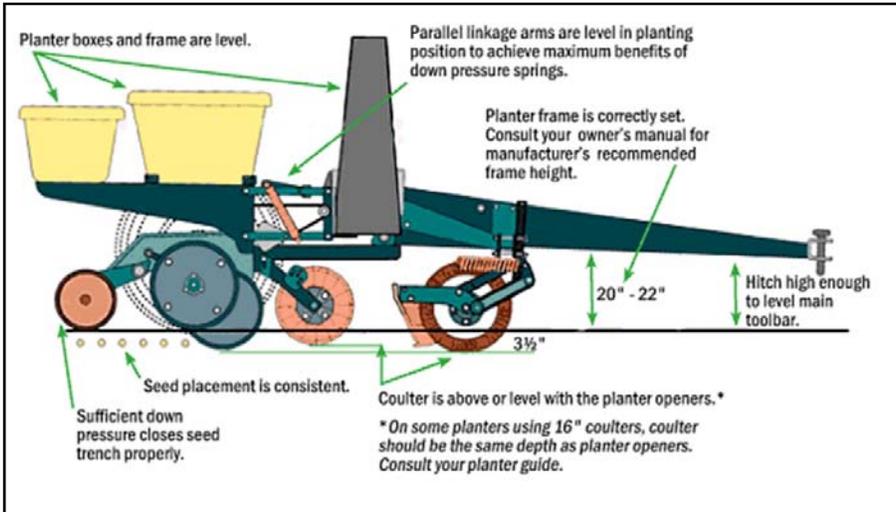
Getting the seed down through the residue and into the soil is the second important step of the planting process. The seed must be placed into moist soil, at a depth suitable for proper rooting and growth, 2 to 2.5 inches for corn. To ensure penetration to desired seeding depth, down-pressure springs may be needed to transfer weight from the planter toolbar to the individual row units. There must be sufficient weight on the units to keep the depth gauge wheels

# Planter adjustments-steps to successful no-till

in firm contact with the ground to control planting depth. If the gauge wheels are loose, tighten the down-pressure springs or add heavy-duty springs. In addition,

there needs to be enough total weight on the toolbar to keep the planter drive wheels in firm contact with the ground to prevent slipping and to help keep the planter on the row.

Having enough weight becomes more of a problem with drills simply because of the number of rows per unit width. For instance, a six-row planter on 30-inch row spacing may require more than 3,000 pounds of weight just for cutting the residue and penetrating the soil (six rows times 500 pounds per row). Whereas, a drill of the same width on 7.5-inch row spacing has 24 openers and may require more than 12,000 pounds.



Sufficient weight must remain on the press wheels to ensure firming of the seed into the soil. Wet soil is easily compacted and care must be taken not to over pack the soil, making it difficult for seedling roots to penetrate the soil. In dry soil conditions, extra closing force may be needed. The key is to evaluate seed-to-soil contact, not the top of the seed-vee. As long as the contact is there, something as simple as a harrow that acts to close the top of the vee and

are available to improve seed-to-soil contact and seed-vee closure. Unfortunately, some were designed to overcome specific problems and may be less effective or even detrimental in other conditions. Before buying attachments, evaluate any planter problems and how the attachment may function to solve the problem or if it just creates another problem.

With appropriate weight, down-pressure, and adjustments,



pull light residue cover back over the vee may be all that is needed. This is a common practice on drills that use a narrow press wheel.

A wide variety of attachments

most current planters and drills will perform well in no-till conditions. A little time spent now will help avoid headaches and delays later during the planting season.

# GPS guidance system makes planting easier

For years growers have realized the importance of accuracy in planting. If you can put a seed down in the same spot year after year, you're going to achieve a more fertile, less compact seed bed with more organic activity.

And with the introduction of a cover crop into many fields across the Mid-South and Southeast, those seed beds are becoming even more fertile. Growers who plant legumes ahead of their cotton are familiar with the benefits of residual nitrogen, for instance.

But all of those benefits are lost on a cotton plant if the cotton seed is planted inaccurately. And the presence of stubble at planting can complicate that process.

If planting into cover-crop stubble, it doesn't matter what you're planting, the fact is it is difficult to see where you have been. And while it's true that farmers planted into stubble long before anyone was able to bounce a signal off of a satellite in outer space, the benefits of a GPS system are still evident.

A GPS guidance system is not required, but there would definitely be an incentive to having one.

## **Precision Pays**

Testing to put a dollar amount on that incentive began a decade ago. Back then, growers were looking for a better way to go about planting after having strip-tilled their fields. Basically you have to do something like that in a lot of our Coastal Plains soil in the southeast. A strip-till operation is completed and then you want to come back in and plant di-

rectly on top of where you strip-tilled.

How much value a farmer stood to gain by working with a real time kinematic (RTK) GPS automatic guidance system, as opposed to simply "eye-balling" their way through planting into stubble.

With the residue, it's rather difficult to pick out exactly where you have been. If you did a decent job of strip-tilling, that means residue in the field has not been disturbed.

To get a gauge of how much an inaccurate planting job could cost a grower, ARS colleagues tested in the same field for three years. The group started out planting precisely over the path that they had strip-tilled. But as the planter moved through the field, they would deviate from that path. First they planted two to three inches off of the initial path. Eventually they would plant up to eight or nine inches off of the original course.

After harvesting and collecting data for three cotton crops, the results of the test were conclusive: precision pays.

## **Return on Investment**

The findings showed that when the planter got off the row about two inches, there was about a 16% drop in yield. When the planter was off the row, from eight or nine inches, a drop in yield were around 29%.

The drop in yield for a nine-inch error is pretty easily explained. The seed starts to fall under the edge of the tractor's tire.

The yield drop at the edge of the tire is what causes your compaction. It's not necessarily the center of your tire, for farmers who are properly inflating their radial tires.

But a 16% drop in yield for even a two-inch deviation in planting range is as curious as it is alarming. Researchers are still studying the disparity in yields for such a small error in planting width. ARS figures that drop can be attributed to the cotton's taproot not being in its optimal position.

The research also found the added benefit of savings on fuel costs. In operations that consistently rely on strip-tillage, there are considerable energy savings to be had by putting the shank in precisely the same spot, year after year.

Instead of trying to rip out areas where the tractor trafficked and where the soil is compacted. If you can plant back into that loosened area, the energy savings is quite significant.

In addition to those savings on fuel costs, the research showed a clear need for precise accuracy during planting. Their findings suggested that a grower with 1,000 acres of cotton could see an (RTK) GPS guidance system pay for itself in one season.

Generally if you spend more money, you get more accuracy. And so now the question is, how much accuracy do you need? And that depends on the individual application.

*(Adapted by Robert Grisso)*

# Application systems have cutting-edge rate controllers

## GreenStar Rate Controller

### John Deere

The GreenStar Rate Controller allows the integration with self-propelled and trailed sprayers, liquid manure applicators and liquid fertilizer applicators. The benefit to the operator is an integrated solution that can be used on many different brands of equipment and is easily transferred among machines to provide automatic rate control, field documentation, map-based prescriptions, and Swath Control Pro automatic section control.



## IntelliAg

### Dickey-john

IntelliAg has been designed for use on a wide range of equipment used in farm production and their specific applications like planters, air seeders, self propelled sprayers, granular spreaders and anhydrous ammonia tool bars. IntelliAg is ISO compliant which means it is compatible with the displays factory installed in tractors such as John Deere, Case IH and AGCO.



## Field-IQ

### Trimble

The Field-IQ system will control, moni-



tor, and map variable-rate inputs. Its modular section control and variable-rate application solution is compatible with many Trimble GPS components. The system automatically controls up to 48 rows individually. Automatic row shut-off eliminates seed overlap with Tru-Count Meter Mount air clutches, and eliminates fertilizer overlap with Tru-Count LiquiBlock valves.

## ProPlant Seed Rate Controller

### Micro-Trak Systems

The ProPlant Seed Rate Controller turns your planter into a precision machine. The most cost effective system available, it offers performance, reliability and versatility — as well as the easiest set-up and operation. Features include three pre-set seed rates (user programmable), on-the-go seed rate adjustment, VRA seeding capability, auto section control and much more. Micro-Trak Seed Rate Drives are also compatible with the following systems; Ag Leader, Trimble, John Deere, Topcon and Raven.



## IC 18

### TeeJet Technologies

The IC 18 Electronic Control Unit is an ISOBUS Certified module that has the option to control a liquid sprayer or an NH3 applicator. Combined with the BoomPilot ECU (which includes an integrat-



ed GPS receiver), the software allows the system to automatically turn off Boom Sections — up to 10-section output or 9 sections and a master output — through the known GPS position.

## Viper Pro

### Raven Industries

The Viper Pro multi-function field computer is the best in its field with extra power and capability to drive even the most advanced system functions with ease. With guidance and steering, variable rate application, wireless communications, boom control, real-time weather records and data mapping Viper Pro is built to deliver.



## System 150

### Topcon Precision Agriculture

Well suited for steer-ready machines, the System 150 offers optional auto-section and liquid rate control. A compact control package that is simple to move between machines, it consists of an AGI-3 multi-constellation receiver and GX-45 console. It features simple on-screen setup plus automatic coverage mapping. The AGI-3 receiver is a complete integrated steering solution featuring full terrain compensation, plus superior line acquisition and holding capabilities. WAAS and EGNOS are standard.



## Application systems have cutting-edge rate controllers

### Falcon VT AGCO ATS

The Falcon VT is the latest Falcon system designed specifically for control of product application equipment in the field and for recording data. It can be installed in the RoGator, TerraGator and Spra-Coupe self-propelled sprayers and is capable of up to seven functions at the same time. Connected to the vehicle's system via the CAN-BUS



wiring network, Falcon VT operates by monitoring forward speeds and adjusting the flow of product to automatically match pre-determined application rates. All information and commands — from application rates to data logging — are displayed on a single, easy-to-read touchscreen.

### DirectCommand

#### Ag Leader

Ag Leader's DirectCommand continuously controls, adjusts, and

records field application based on manually entered target rates or by using rates from a variable-rate prescription file. The system uses a flow meter signal and speed input from a radar gun or GPS receiver and can read up to three optional pressure sensors.



*(Adapted by Robert Grisso)*

## Power Tool Safety Tips

Appropriate personal protective equipment such as safety goggles and gloves must be worn to protect against hazards that may be encountered while using hand tools. Workplace floors shall be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.

Power tools must be fitted with guards and safety switches; they are extremely hazardous when used improperly. The types of power tools are determined by their power source: electric, pneumatic, liquid fuel, hydraulic, and powder-actuated.

To prevent hazards associated with the use of power tools, OSHA recommends that work-

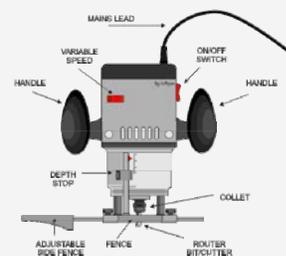
ers should observe the following general precautions:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- Keep all people not involved with the work at a safe distance from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the

switch button while carrying a plugged-in tool.

- Maintain tools with care; keep them sharp and clean for best performance.
- Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

*(Adapted by Robert Grisso)*



## Removing Bales Quickly Reduces Wheel Traffic Damage

With typical delays and interruptions to this year's hay harvest, it will not be uncommon to see hay bales left in the middle of the field. This practice can affect future yields in two ways.

Plants directly under the bale or stack are killed if covered for more than a week or two. This may not hurt yield too much, but it can create an optimum environment for weeds to get started.

Most damage, though, is due to wheel traffic on the regrowth. Studies have shown that when fields are dry, the yield of plants driven on prior to the start of regrowth was about 5 to 7 percent less at

the next cutting. It gets much worse if you wait to remove bales. Just seven days after cutting, when regrowth shoots had started to grow, yield was reduced over 25% and fewer plants survived. In both situations, when plants were driven on a second time the same day, yield was further reduced only a couple percent.

Worse yet is removing bales when fields are wet. When this happens, wheel traffic causes much more compaction and yield loss typically exceeds 30 percent.

Just seven days after cutting, when regrowth shoots had started to grow, yield was reduced over 25 percent and

fewer plants survived. Worse yet is removing bales when fields are wet. Then wheel traffic causes much more compaction. When this happens, yield loss typically exceeds 30 percent.

These studies emphasize the benefits of baling and removing bales from hay fields as quickly as possible after cutting as well as minimizing driving on wet soils. They also suggest that following the same trail when removing bales or stacks from fields can reduce losses from wheel tracks by limiting the total area damaged.

*(Adapted by Robert Grisso)*

### 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.intra.ext.vt.edu/anr/bse/farmsafety/videos.html>

## 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>

# Preventing Overturns with Riding Mowers

You might think that riding mowers and lawn/garden mowers are small and low to the ground so overturns are not a problem. Unfortunately, this is not the case.

Riding mowers and small mowers can overturn to the side or rear fairly easily. Manufacturers have minimized overturn problems, and ANSI Standard B71.1, which deals with safety for these consumer machines, has extensive coverage of overturn safety and testing. Nevertheless, the operator has primary responsibility for preventing overturns. There are several things you can do to minimize the hazard.

## Operate up and down slopes, not sideways!



It is safer to operate up and down a hill than sideways because normally the fore-and-aft wheel spacing is greater than the side-to-side wheel spacing. In other words, a mower will roll over to the side more easily than it will roll over forward or backward.

## Point your mower downhill!

If you must operate on a slope, it is safest to point your riding mower or mower downhill. Pointing the front of the mower downhill puts the drive tires on the uphill side of the mower. If you point the mower uphill, the drive tires will be on the downhill

side, and the torque reaction on the drive tires will tend to lift the front and cause the machine to roll over. As the front starts to lift, traction on the rear increases and the rollover tendency increases. By aiming the mower downhill, if the uphill wheels (the rear wheels of the mower) start to leave the ground, they will immediately lose traction and the rollover will stop. Mowing while backing up is normally not recommended, but, in the case of mowing slopes, it is safer to back up the hill and drive back down rather than driving up and down or driving sideways on the slope.

## If a problem occurs, steer downhill - fast!

In some situations, it just isn't possible to mow up and down a slope, and you must mow across a slope. If you are doing so and feel any instability, always steer the mower downhill to stabilize it. Never turn uphill when the mower feels unsteady. That will almost guarantee a rollover!

## Watch out for holes or bumps!

When operating on a slope, dropping a wheel into a hole or lifting a wheel by driving over a bump can be enough to trigger a rollover. Be especially careful of rough ground on slopes.

## Keep your speed down on slopes!

If you are moving slowly and your mower starts to feel unstable, you may be able to correct the situation. If you are moving fast, the mower may roll before you can do anything.

## If you have to load your mower on a trailer or truck, back it on!

The same principle of keeping the front pointed downhill applies when going up a ramp onto a truck or trail-

er. One of the biggest hazards comes not when going up the ramp, but when starting back down. If the operator is doing it wrong and backing down and hits the brakes, the torque reaction of the mower can easily cause an overturn. Keep the front pointed down while loading and unloading.

## Drive smoothly!

Many overturns are the result of fast turns or sudden stops. If you drive smoothly and minimize jerky operation, you will minimize the risk of overturns.

## Don't drive on slopes with loaded grass catchers!

Be sure your grass catcher is empty or nearly empty before mowing on a slope. A loaded grass catcher can have a big effect on the center of gravity of the mower.

## Don't try to stabilize the mower with your foot!

If the mower feels like it might overturn, don't put your foot on the ground to try to stabilize it. That is a good way to lose a foot to the mower blade. Just turn downhill.

## ROPS

Rollover Protective Structures (ROPS) are not required by the ANSI standard for consumer turf equipment, but the addition of ROPS would improve safety. A



ROPS is especially important on zero-turn mowers.

*(Adapted by Robert Grisso)*

## Powered Lawn Mowers Can Throw Objects

People fall victim to the revolving blades of powered lawn mowers each year. Objects can be thrown at more than 200 mph -- about 300 feet per second. The reaction time of most people is about two-thirds of a second, so there is no time to react to a spinning blade or to a thrown object.

A special precaution should be taken by adults to make sure kids are properly trained before letting them mow. If slopes are too steep for either riding or push mowers, they should be trimmed by hand or planted in a low-maintenance ground cover.

With riding mowers, take extra care when turning, and look behind before backing up. With push mowers, avoid pulling backward. You risk having your feet slip under the mower deck.

Whether power or push, be sure to shut the mower off before unclogging it or leaving it.

Persons wearing tennis shoes, sandals, bare feet and shorts run the risk of serious injury if the mower throws a rock or stick, or if their feet slip on the grass.

Select the right mower for the job, and make sure you have the size, strength and experience to run it.

Know your equipment and read the owner's manual and follow all safety decal instructions.

Prepare properly by making sure all mower guards and controls are working.

Pick up sticks, toys, rocks and trash in the area to be mown. Dress for safety too. This

means wearing deep-tread, hard-toe shoes and long pants for foot and leg protection.

It is also a good idea to use safety glasses and expandable foam ear plugs, plus a dust mask for those prone to respiratory allergies.

Wait until grass is dry before mowing. With push mowers, mow across the slope, never up and down. With riding mowers, mow up and down slopes; not across them, and never allow extra riders.

*(Adapted by Robert Grisso)*



## NEW BSE FACTSHEETS & PUBLICATIONS



**Microalgae as a Feedstock for Biofuel Production**, 442-886 <http://pubs.ext.vt.edu/422/442-886/442-886.pdf>

**Driving Safely in Plains Communities**, 3102-1533, <http://pubs.ext.vt.edu/3102/3102-1533/3102-1533.pdf>

Sample, D., Grizzard, T., Sansalone, J., Davis, A., and Roseen, R., 2011. Assessing the Performance of New Technologies for Removing Phosphorus from Urban Stormwater, Target: Journal of Water Resources Planning and Management, in review.

Sample, D., Younos, T. and Liu, J., 2011. Estimating the Water Quality Benefits of Rainwater Harvesting Systems, Target: Journal of Hydrologic Engineering, in preparation.

# Improving Tractor Operator Safety

Tractors are the main cause of accidental deaths on farms. Over the years, many farmers, farmhands and others living on or visiting farms, have been killed or seriously injured falling from moving tractors, being run over by tractors, or being crushed when a tractor rolls sideways or backwards.

## Here are some ways of improving tractor operator safety:

- Read and follow safety procedures in the manufacturer's manual.
- Insure an approved cab or roll-over protective structure (ROPS) is fitted.
- Fit and use a seatbelt on tractors with ROPS.
- If there is a risk from falling objects, fit a fall-on protective structure.
- To reduce risk of back strain, fit a seat with side restraints and a backrest.
- Wear hearing protection, and remember, not all tractors cabs are sound proof.
- Keep children away from tractors and machinery.
- Remove keys when tractors are not in use.
- Have an up-to-date maintenance schedule.
- Follow safe maintenance and jacking procedures.
- Insure the operator is properly trained for each type of tractor work.

- Always mount and dismount on a tractor's left side to avoid controls.
- Adjust the seat so all controls are safely and comfortably reached.
- Keep all guards in place, including the power take-off (PTO).
- Operate the self-starter from the operator position only.
- Never carry passengers.

## When operating a tractor:

- Drive at speeds slow enough to retain control over unexpected events.
- Reduce speed before turning or applying brakes.
- Watch out for ditches, logs, rocks, and embankments and also any person or pet, know where they are at all times.
- On steep slopes, without a trailed implement, reverse up for greater safety.
- Engage the clutch gently at all times, especially when going uphill or towing.
- Use a wide wheel track as possible on hillsides and sloping ground.
- Descend slopes cautiously in low gear, using the motor as a brake.
- Never mount or dismount from a moving tractor.
- Insure the park brake is on and operating effectively before dismounting.
- Take short breaks reg-

ularly when working long hours.

## When towing implements:

- Fit attachments according to the manufacturer's instructions.
- Always attach implements to the drawbar or the mounting points provided by the manufacturer.
- Never alter, modify or raise the height of the drawbar unless provided for by the manufacturer.
- Regularly check safety pins on towed lift-wing implements, to insure they are not worn.
- Insure all guards on towed implements are in place before operating.
- Never hitch above the centerline of the rear axle, around the axle housing or to the top link pin.
- Never adjust or work on implements while they are in motion.
- Never attach implements unless the PTO shaft is guarded.
- When parking, always lower the three-point linkage and towed implement.

*(Adapted by Robert Grisso)*



## Six Ways to Sustainability

The American Chemical Society has selected a few simple ideas culled from its journals on how to be sustainable, including stop wasting food, try working out outside, and take the bus instead of driving your car.

They has hand-picked six ideas for keeping sustainable from almost 38,000 scientific reports and articles that it published in 2010 in its 38 peer-reviewed scientific journals and *Chemical & Engineering News*, its weekly news magazine.

They are:

1. Stop wasting food. Scientists have identified a way that the United States could immediately save the energy equivalent of about 350 million barrels of oil a year — without spending a penny or putting a ding in the quality of life: Just stop wasting food. Their study found that it takes the equivalent of about 1.4 billion barrels of oil to produce, package, prepare, preserve and distribute

a year's worth of food in the United States.

2. Get five minutes of "green exercise" for good mental health. How much "green exercise" produces the greatest improvement in mood and sense of personal well-being? Just five minutes of exercise in a park, working in a backyard garden, on a nature trail, or other green space will benefit mental health.
3. Take public transportation rather than drive. Driving a car increases global temperatures in the long run more than making the same long-distance journey by air, according to another study. However, in the short run traveling by air has a larger adverse climate impact because airplanes strongly affect short-lived warming processes at high altitudes. The study also noted that passenger trains and buses cause four to five times less impact than automobile travel for every mile a passenger travels.

4. Choose eco-friendly laundry detergents. Laundry detergent manufacturers are rolling out a new generation of products aimed at making cleaning more efficient and environmentally friendly, according to the article, "Beyond the Basics."
5. Consider eco-friendly cremations and burials. Entrepreneurs in Europe have developed two new and unusual methods of body disposal — including a low-heat cremation method and a corpse compost method that turns bodies into soil — that could provide environmentally friendly alternatives to those now in use.
6. Use no-mix toilets. People in European countries have positive attitudes toward a new eco-friendly toilet that could substantially reduce pollution problems and conserve water and nutrients, scientists in Switzerland are reporting.

*(Adapted by Robert Grisso)*

## Events Attended by BSE Specialist, David Sample

Technical Aspects of Design of Rainwater Harvesting-Systems and their Evaluation, Rutgers University Conference: Managing Stormwater Runoff from ImperVIOUS Surfaces: Green Infrastructure Solutions for New Jersey, January 27, 2011, New Brunswick, NJ.

Designing the Next Generation of Stormwater Controls, Chesapeake Bay Stormwater Training Partnership Workshop, Decem-

ber 3, 2010, Prince William, VA. Done in partnership with Joe Battiatia of the Center for Watershed Protection.

Workshop on Exemplary Local Government Stormwater Strategies to Protect and Restore Urban Watersheds: Combining Technology, Economics and Policy, May 13, 2010, Washington, DC. Part of the Science and Technical Advisory Committee to the Chesapeake Bay program

workgroup that organized and developed the program in cooperation with the Local Government Advisory Group of the Chesapeake Bay Program.



## Farm Grain Bin Safety Video

The National Corn Growers Association and the National Grain and Feed Foundation - the research and education arm of the National Grain and Feed Association - unveiled a joint video project to promote awareness about grain bin safety on the farm.

The two organizations teamed up in November to develop the video in response to an increase in US fatalities and injuries associated with entry into grain bins.

"In 2010 we saw a record number of farmers becoming engulfed in grain bins and we decided it was time to have a proactive role in creating awareness about the serious nature of this issue," NCGA President Bart Schott, a grower from Kulm, N.D., said. "We hope that this video makes farmers stop and think twice before the next time they put themselves in danger."

"Flowing grain can pose a life-threatening hazard, and statistics

show that 92 percent of victims who become fully engulfed, which can happen in a matter of seconds, do not survive," said NGFA President Kendell W. Keith. "Our Foundation was very pleased to be part of this proactive, prevention-based approach by NCGA to save lives. And people need to become more aware of the hazards."

Keith noted that the NGFF in 1998 had developed a video on prudent practices to prevent engulfment incidents in commercial grain-handling facilities - material that was updated when it produced a comprehensive new safety video for the industry in 2010. But until now, such an educational tool focused exclusively on farm bins did not exist.

The new video, shot on location in several states, provides a wide range



of information from prevention tips and background data on grain bin accidents. The project also involved interviews with professionals in the fields of grain bin safety research and rescue to provide as much information to viewers as possible.

The video is available at [NCGA.com](http://NCGA.com) and on NCGA's YouTube channel. It also is being distributed by NCGA to affiliated farm organizations. The NGFA also has made the video available on its website at [www.ngfa.org](http://www.ngfa.org), and will be encouraging its grain elevator members to distribute it to farmer-customers.

*(submitted by Bob Pitman)*

## Enzyme cocktail could eliminate a step in biofuel process

Conversion of biomass to fuel requires several steps: chemical pretreatment to break up the biomass, such as with dilute sulfuric acid; detoxification to remove the toxic chemicals; then microbial fermentation to convert the soluble sugars to fuels. Virginia Tech researchers have discovered an enzyme mixture that works in the presence of the toxin-infused liquid biomass, meaning that the detoxification step is unnecessary, reducing the cost of producing biofuels and increasing biofuel yields by avoiding the production of by-products and synthesis of cell mass.

"Enzymes self-assemble a cell-free syn-

thetic pathway; that is, we can put the desired biological reactions to work without the other complex interactions that take place within a cell," said Percival Zhang, BSE. "The cell-free synthetic pathway process increases efficiency and reaction rate."

"By using an enzyme cocktail consisting of 12 purified enzymes and coenzymes, this work has also demonstrated that the enzyme cocktail systems can work in the presence of microorganism-toxic compounds from dilute-acid pretreated biomass, suggesting that enzyme systems do not require high-purity substrates for biotransformation," said

Zhang. "In other words, after pretreatment, we can do bioconversion directly, followed by chemical catalysis," he said.

A previously article compared the production of four biofuels - ethanol, butanol, fatty acid ethyl ester, and hydrogen, and report that hydrogen production through the synthetic pathway process is the most efficient for biofuels production. "Also, this analysis suggested that it was nearly economically impossible to produce advanced biofuels through aerobic fermentations as compared to anaerobic fermentations and enzyme cocktails," said Zhang. (Virginia Tech News, 2/25/11)

# Heat Stress

Heat stress is a buildup of body heat generated either internally by muscle use or externally by the environment. Heat exhaustion and heat stroke result when the body is overwhelmed by heat. As the heat increases, body temperature and the heart rate rise painlessly. An increase in body temperature of two degrees Fahrenheit can affect mental functioning. A five degree Fahrenheit increase can result in serious illness or death. During hot weather, heat illness may be an underlying cause of other types of injuries, such as heart attacks, falls and equipment accidents. More Worker's Compensation claims for heat illness come from agricultural workers than from any other occupation.

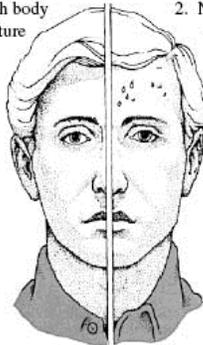
The most serious heat related illness is heat stroke. The symptoms are confusion, irrational behavior, convulsions, coma, and death. While over 20% of heat stroke victims die regardless of health or age, children seem to be more susceptible to heat strain than adults. In some cases, the side effects of heat stroke are heat sensitivity and varying degrees of brain and kidney damage.

## Preventing heat stress will:

- Protect Health - Heat illness is preventable and treatable before it is life threatening.
- Improve Safety - Any heat

## Heat Stroke

1. Dry, hot skin
2. Very high body temperature



## Heat Exhaustion

1. Moist clammy skin
2. Normal or subnormal temperature

stress can impair functioning.

- Increase Productivity - People work slower and less efficiently when they are suffering from heat stress.

Employers, supervisors and workers all have an essential role to play in preventing heat stress. Each member of the team should use good judgment to prevent heat related illness. A heat stress control program should protect all workers at the operation, from those who can work comfortably in heat to those in poor physical shape.

## Key elements for controlling heat stress are:

- Drink one glass of water every 15 to 30 minutes worked, depending on the heat and humidity. This is the best way to replace lost body fluid.
- Read medication labels to know how cause the body to react to the sun and heat.
- Avoid alcohol and drugs as they can increase the effects of heat.
- Build up tolerance for working in the heat. Heat tolerance is

normally built up over a one to two week time period.

- Take breaks to cool down. A 10 - 15 minute break every two hours is effective.
- Adapt work and pace to the weather.
- Provide heat stress training to workers and supervisors.
- Manage work activities and match them to employees' physical condition.
- Use special protective gear, such as cooling garments and cooling vests on "early entry" workers.
- Know heat stress first aid techniques.

## Heat stroke first aid:

- Move the victim to a cool place. Remove heavy clothing; light clothing can be left in place.
- Immediately cool the victim by any available means. Such as placing ice packs at areas with abundant blood supply (neck, armpits, and groin). Wet towels or sheets are also effective. The cloths should be kept wet with cool water.
- To prevent hypothermia continue cooling the victim until their temperature drops to 102 degrees Fahrenheit.
- Keep the victim's head and shoulders slightly elevated.
- Seek medical attention immediately. All heat stroke victims need hospitalization.
- Care for seizures if they occur.



# Heat Stress

- Do not use aspirin or acetaminophen.

## Heat exhaustion first aid:

- Move the victim to a cool place.
- Keep the victim lying down with legs straight and elevated 8-12 inches.
- Cool the victim by applying cold packs or wet towels or cloths. Fan the victim.
- Give the victim cold water if he or she is fully conscious.
- If no improvement is noted within 30 minutes, seek medical attention.

When possible, schedule heavy tasks and work requiring protective gear for cooler, morning or evening hours. Prolonged, extreme hot temperatures mandate the postponement of nonessential tasks.

Most protective garments limit sweat evaporation (but not sweat production) and chemical-resistant suits can cause rapid dehydration if sweat

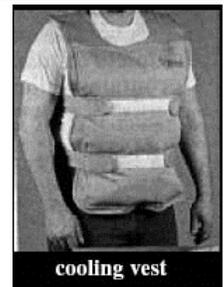
is not replaced. One way to slow the buildup of heat when wearing PPE is to use special cooling garments.

- **If the temperature is above 70 degrees Fahrenheit:** Cooling vests may be useful when pesticide handlers are wearing chemical-resistant suits and are either doing heavy or moderate work for a prolonged period.
- **If the temperature is above**

## 80 degrees

### Fahrenheit:

Working in chemical-resistant suits for more than a half hour without taking frequent water and rest breaks is unsafe. Cooling garments and frequent breaks are recommended.



Powered air-purifying respirators and supplied-air respirators generally feel cooler than other types of respirators because breathing resistance is minimized and the air-stream has a cooling effect.

## Review the Following Points

- Heat stress is serious and should be handled as such.
- As strain from heat increases, body temperature and heart rate can rise rapidly.
- Exposure to heat can be serious to children and adults.
- Have plenty of liquids available and administer first aid as needed.

(adapted from CRC)

Heat Stress Index									
Relative Humidity									
°F	10%	20%	30%	40%	50%	60%	70%	80%	90%
104	98	104	110	120	132				
102	97	101	108	117	125				
100	95	99	105	110	120	132			
98	93	97	101	106	110	125			
96	91	95	98	104	108	120	128		
94	89	93	95	100	105	111	122		
92	87	90	92	96	100	106	114	122	
90	85	88	90	92	96	100	106	114	122
88	82	86	87	89	93	95	100	106	115
86	80	84	85	87	90	92	96	100	109
84	78	81	83	85	86	89	91	95	99
82	77	79	80	81	84	86	89	91	95
80	75	77	78	79	81	83	85	86	89
78	72	75	77	78	79	80	81	83	85
76	70	72	75	76	77	77	77	78	79
74	68	70	73	74	75	75	75	76	77

**NOTE:** Add 10°F when protective clothing is worn.  
Add 10°F when in direct sunlight.

Humiture °F	Danger Category	Injury Threat
Above 130°	EXTREME DANGER	Heat stroke imminent!
105° to 130°	DANGER	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
90° to 105°	EXTREME CAUTION	Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity.
80° to 90°	CAUTION	Fatigue possible if exposure is prolonged and there is physical activity.
Below 80°	NONE	Little or no danger under normal circumstances.

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