



# Biological Systems Engineering

BSE Announcements—Spring 2006

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



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### **Engineering Update – Biological Systems Engineering** March 2006

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

**Dear Co-Workers:** Engineering Update is a joint effort of Biological Systems Engineering and other interested 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>).

### **BSE In-service Training Presentations Available**

**In-service presentations from Biological Systems Engineering can be downloaded at <http://www.ext.vt.edu/vce/anr/bse/2006conference.html>**

**"Virginia's TMDL Program: Restoring Water Quality Successes and Challenges"** by Brian Benham. Objectives: a) Review status of Virginia's TMDL program (development and implementation), b) Discuss characteristics of successful TMDL implementation efforts, and c) Illustrate how being engaged in TMDL implementation process can steer future activities

**"Value Added Bioproduct and Bioenergy from Agricultural Residues"** by Zhiyou Wen. Objectives: a) Byproducts utilization concept, b) Case I - Omega-3 rich algae biodiesel waste for use as animal feed additives, c) Case II - Bioenergy (hydrocarbon) production from animal manure, and d) Prospective and Challenge.

**"Introduction to Agricultural Ammonia Emissions"** by Susan Gay. Objectives: a) Discuss recent concerns regarding ammonia emissions from animal feeding operations; and b) Describe current research efforts in the field.

*(Continued on page 14)*

## Update on Air Compliance Agreements with Animal Feeding Operations

The Environmental Protection Agency (EPA) has approved the first 20 Air Compliance Agreements for animal feeding operations (AFOs). The selected farms are offered legal protection against potential past federal air law violations. As part of the agreement, the farms must participate in a nationwide project to measure air emissions from AFOs. The EPA will use data from this project to develop a regulatory program and to settle liability for certain past violations against AFOs.

Ammonia (NH<sub>3</sub>), hydrogen sulfide (H<sub>2</sub>S), particulate matter (PM) and volatile organic compounds (VOCs) are commonly emitted from animal housing and manure storage facilities. Ammonia and H<sub>2</sub>S are classified as hazardous substances under the Comprehensive Environmental Response,

Compensation and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA). Hydrogen sulfide, PM, and VOCs are regulated under the Clean Air Act (CAA).

The EPA believes that the Air Compliance Agreement and the associated National Emissions Monitoring Study will be the most efficient means to address the current uncertainty regarding emissions from AFOs. The study will be conducted to collect and analyze data that can be used to determine whether participating farms must apply for permits under the CAA or report emissions under CERCLA and EPCRA. The study will use EPA-approved monitoring and research methods and will be conducted by university scientists.

The EPA began discussions with producers in 2001 on bringing AFOs into compliance with various environmental regulations. In the January 31, 2005 Federal Register, the EPA offered AFOs an opportunity to sign a voluntary consent agreement and final order to resolve potential violations of the CAA, CERCLA, and EPCRA. A total of 2,681 AFOs, representing more than 6,700 farms in 42 states, signed up to participate in the voluntary agreement by the Aug. 12, 2005 deadline.

The 20 agreements announced on January 30, 2006 consisted of 10 swine operations and 10 layer operations. The EPA is evaluating the remaining agreements for approval.

*(submitted by Susan Gay)*

## Reducing Odors from Land Application of Manure

Land application of manure from livestock and poultry facilities is the most common source of agricultural odor complaints from the public. However, producers can reduce odor emissions from land application by using the following practices:

- **Injection or immediate incorporation of manure below the soil surface** – this best management practice eliminates the manure surface from which odor is emitted. Injection or immediate incor-

poration can reduce odor by as much as 90 percent.

- **Application of manure during cold weather** – this practice creates less odor than spreading during warm or hot weather. However, do not spread manure on frozen or snow-covered ground.
- **Application of manure during midday** – wind and thermal buoyancy tend to be strongest between 8 am and 2 pm. These natural forces will help to disperse odors, especially during warm or hot weather.

- **Application of manure when the wind is blowing away from neighbors** – this practice helps prevent the most intense odors, which usually occur during spreading, from reaching neighboring residences.
- **Application of manure on weekdays** – neighbors are more likely to be away from home and spend less time outside on weekdays.

*(submitted by Susan Gay)*

# What is biodiesel?

**Biodiesel is a domestic, renewable fuel for diesel engines, produced from natural oil like vegetable oil or animal fat.** The American Society of Testing and Materials (ASTM) has a specific, technical definition for biodiesel under the specifications of ASTM D 6751. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition (diesel) engines with little or no modifications. Bio-

diesel is simple to use, biodegradable, non-toxic, and essentially free of sulfur and aromatics.

## **Basic Terminology:**

Biodiesel is the pure, or 100 percent, biodiesel fuel. It is referred to as B100 or “neat” biodiesel. A biodiesel blend is pure biodiesel blended with petrodiesel. Biodiesel blends are referred to as Bxx. The xx indicates the amount of biodiesel in the blend (i.e., a B20 blend is 20 percent by volume biodiesel and 80 percent by vol-

ume petrodiesel).

## **How is biodiesel made?**

Biodiesel is made through transesterification of triglycerides, which is a major component in fat or vegetable oil. By analogy, triglyceride is like a capital letter “E”, while the reaction transesterification is like cutting the three “arms” of the letter “E”, by adding alcohol (usually in the form of methanol).

*(Submitted by Zhiyou Wen)*

## Biodiesel Myths and Facts

**Myth:** Biodiesel is an experimental fuel and has not been thoroughly tested.

**Fact:** Biodiesel is one of the most thoroughly tested alternative fuels on the market. A number of independent studies have been completed with the results showing biodiesel performs similar to petroleum diesel while benefiting the environment and human health compared to diesel. That research includes studies performed by the U.S. Department of Energy, the U.S. Department of Agriculture (USDA), Stanadyne Automotive Corp. (the largest diesel fuel injection equipment manufacturer in the U.S.), Lovelace Respiratory Research Institute, and Southwest Research Institute. Biodiesel is the first and only alternative fuel to have completed the rigorous Health Effects testing requirements of the Clean Air Act. Biodiesel has been proven to perform similarly to diesel in more than 50 million successful road miles in virtually all types of diesel engines, countless off-road miles and countless marine hours. Currently more than 300 major fleets use the fuel.

**Myth:** Biodiesel does not perform as well as diesel.

**Fact:** One of the major advantages of biodiesel is the fact that it can be used in existing engines and fuel injection equipment with little impact to operating performance. Biodiesel has a higher cetane number than U.S. diesel fuel. In more than 50 million miles of in-field demonstrations, B20 showed similar fuel consumption, power, torque, and haul rates as conventional diesel fuel. Biodiesel also has superior lubricity and it has the highest BTU

content of any alternative fuel (falling in the range between #1 and #2 diesel fuel).

**Myth:** Biodiesel doesn't perform well in cold weather.

**Fact:** Biodiesel will gel in very cold temperatures, just as the common #2 diesel does. Although pure biodiesel has a higher cloud point than #2 diesel fuel, typical blends of 20% biodiesel are managed with the same fuel management techniques as #2 diesel. Blends of 5% biodiesel and less have virtually no impact on cold flow.

**Myth:** Biodiesel causes filters to plug.

**Fact:** Biodiesel can be operated in any diesel engine with little or no modification to the engine or the fuel system. Pure biodiesel (B100) has a solvent effect, which may release deposits accumulated on tank walls and pipes from previous diesel fuel use. With high blends of biodiesel, the release of deposits may clog filters initially and precautions should be taken to replace fuel filters until the petroleum build-up is eliminated. This issue is less prevalent with B20 blends, and there is no evidence that lower-blend levels such as B2 have caused filters to plug.

**Myth:** A low-blend of biodiesel in diesel fuel will cost too much.

**Fact:** Using a 2% blend of biodiesel is estimated to increase the cost of diesel by 2 or 3 cents per gallon, including the fuel, transportation, storage and blending costs. Any increase in cost will be accompanied by an increase in diesel quality since low-blend levels of biodiesel greatly enhance

the lubricity of diesel fuel.

**Myth:** Biodiesel causes degradation of engine gaskets and seals.

**Fact:** The recent switch to low-sulfur diesel fuel has caused most Original Equipment Manufacturers (OEMs) to switch to components that are also suitable for use with biodiesel. In general, biodiesel used in pure form can soften and degrade certain types of elastomers and natural rubber compounds over time. Using high percent blends can impact fuel system components (primarily fuel hoses and fuel pump seals) that contain elastomer compounds incompatible with biodiesel, although the effect is lessened as the biodiesel blend level is decreased. Experience with B20 has found that no changes to gaskets or hoses are necessary.

**Myth:** No objective biodiesel fuel formulation standard exists.

**Fact:** The biodiesel industry has been active in setting standards for biodiesel since 1994 when the first biodiesel taskforce was formed within the American Society for Testing and Materials (ASTM). ASTM approved a provisional standard for biodiesel (ASTM PS 121) in July of 1999. The final specification (D-6751) was issued in December 2001. Copies of specifications are available from ASTM at <http://www.astm.org>.

**Myth:** Biodiesel does not have sufficient shelf life.

**Fact:** Most fuel today is used up long before six months, and many petroleum com-

*(Continued on page 14)*

## Reseachers break down cellulose

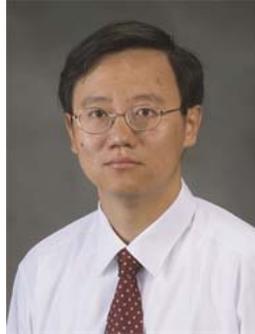
### Reseachers break down cellulose to produce ethanol by a single anaerobic microorganism.

Researchers are combining steps in the cellulose-to-ethanol production process that are now separated and could reduce processing costs even more. Most biomass operations enzymatically break down cellulose into sugars in an oxygen-rich environment and then use yeast or bacteria to ferment the sugars under oxygen-poor, or anaerobic, conditions.

However, a single anaerobic microorganism can do both jobs. Many researchers had previously sus-

pected that anaerobic microbes generate too little cellular energy, in the form of the molecule ATP, to efficiently break down cellulose.

**Yi-Heng Percival Zhang**, a new BSE faculty at Virginia Tech (formally with Dr. Lynd's group of Dartmouth Col-



lege) reported in the Proceedings of the National Academy of Sciences that an anaerobic microbe grown on cellulose, generates plenty of ATP. In fact, the microbe produces

even more cellular energy by breaking down cellulose than it does by growing on simple sugars such as glucose.

Using existing technology, they intend to bioengineer such organisms to take the next step: producing ethanol with higher yield. This offers promise for really reducing the processing cost. It shows that no theoretical obstacle remains to achieving "consolidated bioprocessing," in which both cellulose breakdown and ethanol production are done by a single microorganism. (From: Science News Online, Week of Oct. 1, 2005; Vol. 168, No. 14)

## 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>***

*(Submitted by Susan Gay)*

## Free Building Plans Available From MWPS

The 2006 MWPS (MidWest Plan Service) catalog contains more than 175 low-cost and free agricultural publications and a list of more than 100 free building plans available at the MWPS Web site. Located at Iowa State University, MWPS is a publishing consortium of 11 agricultural universities and the USDA.

Topics in the 2006 MWPS catalog include: building or remodeling a home; constructing and wiring rural buildings; storage of grain, forage and silage; farm business management, including free lease and agreement forms; agricultural marketing; farm and home safety; water quality determination and maintenance; construction and remodeling of agricul-

tural buildings, commercial greenhouses and houses; and information on 100 free building plans for agricultural buildings and greenhouses, townhouses, and garages. The catalog is available at no cost at

[www.mwpsdq.org](http://www.mwpsdq.org)

Direct link to the Free Building Plans:  
[http://www.public.iastate.edu/~mwps\\_dis/mwps\\_web/frame\\_p.html](http://www.public.iastate.edu/~mwps_dis/mwps_web/frame_p.html)

## Fuel Savings Tips To Cut Costs

With diesel prices on the rise, a little bit of savings can go a long way when it comes to taking steps to conserve fuel on the farm.

In many situations, every dollar saved in fuel may save a farmer \$5 to \$10 in total production costs. There are many simple things a farmer can do to save fuel that won't cost a thing or will cost very little.

Here are some ways to "put dollars in the bank, not in the fuel tank:"

- *Invest in conservation tillage.* You can cut tractor use in half by switching to no-till.
- *Consider auto-steering.* It is a substantial investment, but auto-steering makes it easier to adopt controlled traffic. This will minimize or eliminate compaction in the cropping zone, leading to higher yields with no-till and a quick payback.
- *Maintain proper tire inflation.* On the average farm, the majority of tires are over inflated. Over inflation causes excess wheel slippage.
- *Select the right tires.* Although

more expensive, radial tires outperform bias tires because of their design. Other tire tips include: replace tires with worn out lugs; use single tires unless duals are needed for traction and flotation, or a controlled traffic system; instead of triples, consider using wider duals. Extra tires can increase rolling resistance and use more fuel.

- *Keep vehicles well maintained.* Regular upkeep includes changing air and fuel filters. Scheduled maintenance saves fuel and increases power. Partially plugged fuel filter reduces the amount of fuel getting to the engine, thereby losing power.
- *Choose fuel-efficient machinery.* Just as with car models, tractors can vary on fuel efficiency. The University of Nebraska offers information on tractors and their fuel efficiency to help buyers make a decision between models. For information on tractors built since 1999, log on to [tractortest-lab.unl.edu](http://tractortest-lab.unl.edu).
- *Shut off idling engines.* Don't let a diesel engine idle more than about 10 minutes. Research shows it's less efficient to keep an engine idling for

warmth than it is to re-start it. Of course, results may change in extremely cold weather.

- *Don't waste fuel.* For example, don't subsoil 16 inches if going 12 inches deep is doing the job. Eliminate "recreational tractor tillage & driving." To reduce the number of trips equipment is driven to and from fields, add a carrier to the tractor or combine for a small motorcycle or scooter to use rather than driving the equipment back home.
- *Replace worn out parts.* Keeping any ground-engaging tools sharp makes a big difference when it comes to saving fuel and improving speed and field efficiency.

For more information review the fact-sheets:

<http://www.ext.vt.edu/pubs/bse/442-451/442-451.html>

<http://www.ext.vt.edu/pubs/bse/442-450/442-450.html>

(submitted by Bobby Grisso)

## Field test planter adjustments

Now is the time to check on how well your planting equipment will perform. Take your empty planter to the field as soon as weather and field conditions allow. Level the planter in the field, making sure that the toolbar is at the proper height and leveled front-to-rear, perhaps even slightly "tail" down.

This allows for the full range of movement of the parallel links on the row units, helps keep the planter on the row, and aids in seed-to-soil contact. In addition, make sure that the planter carrying wheels are exactly centered between the rows and that they are carrying some weight. This is especially important if there are any ridges in the field from cultivation or harvest.

Once the planter is leveled, try "blind" planting with empty seed boxes. Stop with the planting units in the ground and check to see if the depth gauge wheels are in firm contact with the soil surface. If they are

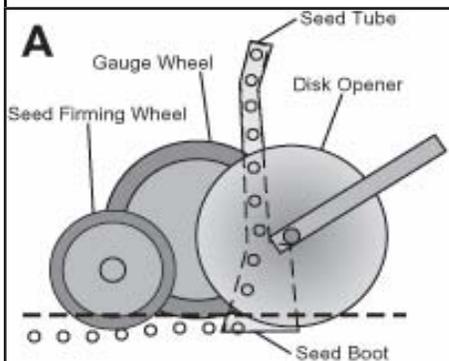
not, tighten the down pressure springs and try planting again. You may have to add weight to the planter for the springs to work against and to keep the drive wheels firmly on the ground. By putting a small amount of seed in a couple of rows, seed-to-soil contact and seed-vee closing can be observed as well. However, all these items should be rechecked when actual planting begins and as conditions change during the planting season.

Check the planter's performance by evaluating the four functions of seeding equipment. By checking residue cutting and handling, soil penetration, seed-to-soil contact, and seed-vee closing, one can make the adjustments or modifications necessary to solve any problems encountered. There is plenty of time to make adjustments or buy attachments, if needed, before planting begins.

With any piece of equipment, the owner's

manual is the starting point for the initial settings and for making any adjustments. Valuable recommendations and troubleshooting tips are in the manuals and also available from others who own and operate similar equipment.

More information review the factsheet: <http://www.ext.vt.edu/pubs/bse/442-456/442-456.html>  
(Submitted by Bobby Grisso)



# Emergency Preparedness: Deadly Bird Flu

## What You Need to Know to Protect Yourself

### Understanding the Danger

There's no way to predict exactly when the feared pandemic might occur -- it could be years away. Based on the recent cases of avian flu in humans in Asia and in birds in Europe and the Mideast, it might be as soon as next year -- it could even be this year. A pandemic can occur at any time of the year, but it is more likely during the traditional flu season.

How did the danger start? Eight years ago in Hong Kong, a deadly flu strain that normally affects birds began infecting a few humans as well. According to the World Health Organization, at least 116 people have been infected since 2003, mainly in Thailand and Vietnam. About half of them have died. Avian flu is no longer just Asia's problem -- Romania, Turkey and Greece have just confirmed that avian flu has been found among birds there as well.

### Chilling discovery

Scientists recently discovered that the flu virus that ravaged the world in the 1918 Spanish flu pandemic also was derived from a bird flu virus. That devastating global outbreak killed 50 million people.

Unlike the 1918 virus, the current avian virus is not easily transmitted from person to person. With only a few exceptions, its victims have been infected by coming in direct contact with live infected birds, typically chickens or waterfowl, such as geese or ducks. But influenza viruses have a remarkable ability to mutate. The avian flu virus could change into something much more contagious to humans, then start spreading -- within days, thanks to airplane travel. A deadly pandemic then could hit within weeks or months.

### What to do today

Important steps that you can take to protect yourself against a flu pandemic...

*Quit smoking.* Smoking irritates the bronchial tubes, making them more vulnerable to any germs that find their way into the throat, including those that can cause avian flu. Smokers also have a harder time fighting any diseases that they do contract.

*Maintain a healthy weight.* Carrying extra pounds puts unnecessary stress on your heart and lungs, making it less likely that these organs will survive a bout with avian flu.

*Get vaccinated with a flu shot or the nasal-spray vaccine.* The current generation of flu vaccine offers no specific protection against avian flu, but it will help keep your body as strong as possible, improving your odds of survival in case avian flu does strike. Should the pandemic come, those who have been vaccinated but still come down with a flu will know right away that they probably have avian flu. If you have egg allergies or have had serious reactions to flu shots in the past, talk to your doctor about whether a flu vaccine is safe for you.

(Continued on page 7)



### Mission for the Center for TMDL...

The Center for Total Maximum Daily Load (TMDL) and Watershed Studies will conduct interdisciplinary research, teaching and outreach to improve the integrity of Nation's waters and watersheds by advancing the science, tools and expertise available for developing, evaluating and implementing watershed planning and management processes.

Get the latest TMDL Newsletter—download at:

<http://tmdl.bse.vt.edu/files/CenterVol2.1.pdf>

# Deadly Bird Flu

(Continued from page 6)

There is a prototype avian flu vaccine that appears to be doing well in clinical trials. Should an avian flu pandemic strike soon, it's possible that this prototype could be rushed into use -- but at this point, we don't know how such a vaccine would be distributed... how big a dose would be needed... and how successful it might be against a mutated form of the virus.

*Take vitamin C.* Some studies suggest that consuming vitamin C supplements and/or foods rich in vitamin C (such as oranges, grapefruits, bell peppers and tomatoes) might help the body avoid viral infections.

*Stockpile emergency rations.* There likely would be a run on supermarkets at the first sign of a pandemic. Maintain a two-week supply of canned foods and water so that you don't have to leave home. This should be enough to last you until a government food-distribution plan is in place, should one be necessary. Other items to have on hand: Medications that you take regularly... alcohol wipes... surgical masks.

## If there is an outbreak...

Should an avian flu pandemic reach the US, stay tuned to TV or radio news for instructions from your health department. There might be quarantines, evacuations or mass vaccination plans in your area.

Avoid crowded places. The best way to remain safe during a pandemic is to limit your exposure to other people. All family members should stay at home as much as possible, avoiding unnecessary trips and visitors. Avoid airplanes, movie theaters and other places where large groups are in close proximity.

It's likely that some employers will tell workers that they can stay home for a time, though other people might have to choose between keeping their jobs and staying home. Local or state governments might close schools.

Take precautions if you must go out during a pandemic. Stay away from anyone who is coughing or sneezing... wash your hands frequently with soap... and carry alcohol wipes to clean your hands after touching anything that has been handled by others.

Many people have asked about wearing cotton surgical masks. There's no evidence that they prevent viral infection, but they're cheap and available at many drug-stores. They might help, so there's no reason not to wear one.

Get to a health-care provider if the avian flu is in your region and you believe that you're coming down with flulike symptoms -- chills, fever, sore throat, fatigue, cough, runny nose, headache or muscle aches. Antiviral drugs are effective only when taken within 48 hours of the onset of your first symptoms.

If possible, obtain your antiviral medication through your doctor's office or a public health office rather than from a hospital. (Your doctor might designate special hours for people with flu symptoms.) During a pandemic, hospitals are likely to be packed with infected people. Your flulike symptoms might mean you just have a cold -- but your odds of actually getting avian flu will skyrocket once you enter a hospital handling lots of flu victims.

(adapted from *Bottom Line/Personal*, November 15, 2005 by William Schaffner, MD, Vanderbilt University School of Medicine)

## Are Pet Birds and Bird Feeders Safe?

*Is it okay to have a bird feeder in my backyard?* Your bird feeder will not expose you to the avian flu. Avian flu is carried mainly by chickens and waterfowl, such as ducks and geese, none of which are typical bird feeder birds.

Even if infected birds did reach the US and one landed in your backyard, it still would be extremely unlikely to infect you

unless you came into direct contact with it. The real danger in this country is not that we'll catch avian flu from birds, but that the virus will "jump" to humans and we'll catch it from one another.

*Is this a bad time to own a pet bird?* Pet birds pose no danger. The types of birds commonly kept as pets do not seem to be carriers. There were fears that a parrot in

Britain was infected, but tests showed that it actually suffered from a completely different strain of flu that is not dangerous to humans. Besides, birds that you already have in cages in your home are unlikely to come in contact with wild birds.

(adapted *Bottom Line/Personal*, February 1, 2006 by Mary C. Pearl, PhD, Wildlife Trust)

## Conservation Tillage

**Conservation tillage** provides many benefits to crop producers. The list of benefits below was developed by the Conservation Technology Information Center.

- Reduces labor, saves time
- Saves fuel
- Reduces machinery wear
- Improves soil tilth
- Increases organic matter
- Traps soil moisture, improves water availability
- Reduces soil erosion
- Improves water quality
- Increases wildlife
- Improves air quality

### Practical Suggestions for Success

**Environment:** Temperature and rainfall patterns of an area provide the foundational information for understanding what type of tillage systems are likely to be most successful. Is rainfall generally limiting or is excess moisture a consistent problem? This environmental information, coupled with field-specific soil characteristics, establishes the fixed parameters that must be considered when designing a crop management system. If rainfall is typically limiting or temperatures are relatively high, chances are good that a reduced tillage system will work well. Design your cropping system to take full advantage of existing environmental conditions.

**Soil Characteristics:** Soils with good surface drainage are more

suited to no-till and other reduced tillage methods. Soils with good internal drainage are also more suited to less intensive tillage practices. Good surface or internal drainage can offset the lack of the other, but if both internal and external drainage are limiting, reduced tillage systems face significant challenges. Try reduced tillage systems first on fields with good drainage.

**Crop Rotation:** While monocropping in reduced tillage systems is certainly possible, chances of success are greater when a variety of crops are used in the rotation. Numerous studies have shown that no-till, continuous corn will not yield as well as no-till corn rotated with other crops, particularly a legume such as soybean or alfalfa. This diversity of crops in the rotation is most important on poorly-drained soils. In moisture-limiting environments, cropping intensity is also an important consideration. No-till increases the amount of water available to the crops, so more intense rotations can be used to utilize this extra water. When reducing the intensity of your tillage system, consider a crop rotation including some diversity.

**Crop Selection:** Reduced tillage systems like no-till have been used successfully in many crops including corn, sorghum, wheat, sunflowers, canola, cotton and soybean. In each case, success

depends on uniform distribution of residue from the previous crop, proper planter adjustment and stand establishment, adequate nutrient management, and an effective weed control program.

**Hybrid or Variety Selection:** Although the best-performing corn hybrids in one tillage system are generally the best-performing hybrids in another tillage system, hybrid selection remains critical to success with reduced tillage. Choose hybrids or varieties with good emergence, early vigor and disease resistance.

**Residue Management:** Uniform residue distribution while harvesting the previous crop is extremely important. Residue that has not been properly distributed can make uniform stand establishment very challenging for any planting equipment. Row cleaning devices for in-row residue removal can improve stand establishment in environments where high soil moisture and low soil temperature typically delay seedling development. When planning to implement a reduced tillage system, be prepared to uniformly distribute crop residue at harvest and have a planter equipped to perform in high residue situations.

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## Conservation Tillage

(Continued from page 8)

**Planter Adjustment:** Planter adjustments important for success with reduced tillage systems include: keep planter units level, ensure down pressure is adequate, adjust coulters so they cut residue but don't run too deep, adjust residue managers to move residue but not soil, ensure seeding depth is uniform and the seed furrow is closed - providing good seed-to-soil contact.

**Weed Control:** Be prepared for an increase in perennial weeds and small-seeded weeds. Start clean - don't plant into a dense mat of live weeds. Control weeds and previous perennial crops with a herbicide application before planting.

Be sure to have a post-emergence herbicide plan in place. Where they are available, herbicide-tolerant crops can help.

**Nutrient Management:** Regular soil testing is important in any tillage system, but is critical before establishing a reduced tillage system such as no-till. Collect soil samples and apply and incorporate any P, K and lime required before converting a field to no-till. Minimize the risk of N losses with proper placement and timing of N applications. While nutrients can be surface applied in no-till systems, injection may help minimize losses and improve plant availability.

**Soil Compaction:** Minimize soil compaction by controlling traffic. Confining wheel traffic to specific areas can reduce root growth limitations caused by excess soil compaction.

**Insects and Diseases:** Selecting hybrids or varieties with good resistance to the most common local diseases and insects is very important for reduced tillage systems. Crop rotation can be very beneficial to break insect and disease life cycles. Monitor crops closely to detect problems that can be corrected during the growing season. Where available, crops with built-in protection against corn borers or rootworms have proven to be very effective. Insecticide seed treatments can also provide insect protection.

**Manure Management:** When livestock are part of the agricultural system, be sure to take advantage of the benefits of applied manure. If surface applications are made, be sure applications are uniform. Manure injection can help minimize nutrient losses while maintaining surface residues for maximum soil and moisture conservation.

**Cover Crops:** Cover crops can play a major role in building soil organic matter. Cover crops can help improve the chances for no-till success in soils that are low in organic matter and susceptible to compaction.

**Rotational Tillage:** Some growers use different tillage systems for different crops and this may be beneficial on poorly-drained soils. Remember that the organic matter gains from reduced tillage will be lost when tillage intensity is increased.

### Getting Started

The ideas below can improve the chances of success when trying a new reduced tillage system: Seek advice from other growers who are successfully using a reduced tillage system. Communicate with soil scientists or others who might be conducting tillage system research. Attend plot tours or field days demonstrating tillage methods. Join a tillage club or grower association focused on reduced tillage. Plan carefully for crop rotation, residue distribution, use of planter attachments, fertilizer application and herbicide program. Conducting on-farm research is one way to gain personal experience and learn what works and what doesn't. Attend tillage-related conferences or workshops.

*Taken from Meese, B. 2005. Reduced Tillage Systems for Crop Production. Crop Insights 15(4):1-3*

*(submitted by Bobby Grisso)*

## Commentary on Presidential Address—"Feedstocks"

In his State of the Union Address on January 30, 2006, President George W. Bush Jr. stated the need to wean the U.S. from oil. He specifically mentioned wood chips and switchgrass as potential sources of renewable liquid fuel.

Switchgrass, a warm season perennial, is native to the tall grass prairie. Beginning in 1978, the DOE Biofuels Feedstock Development Program (now terminated) did 15 years of research to adapt switchgrass for other areas of the country, specifically the Southeast. A recent DOE report announced a goal to produce one billion tons of biomass annually for bioenergy and bioproducts. The potential of the Southeast was estimated at 250 million tons, second only to the Midwest.

There is discussion in DOE/USDA reports of a 5,000 ton-per-day biorefinery. The projections appear to enroll farmers as efficient producers of a bulk commodity. Farmers are the "serfs" who insure a supply of cheap energy to the urban population. This concept may be appropriate for the West where farms encompass large land holdings. It is not the correct concept for the Southeast.

The Southeast has some unique characteristics that suggest the "European Model" is more appropriate. In Europe, renewable energy power plants are being built about 60 miles apart. These plants are smaller and are supplied with biomass from farms within a 30-mile radius at a delivered price of \$60-70/ton. They supply electricity and steam to the town and surrounding farms. The community is *united*, not *divided* by their power plant. All citizens, farmers and town people, benefit, and all lend their political support to renewable energy.

The Southeast is characterized by relatively small farms, an extensive network of roads, and a uniform distribution of towns. The European Model envisions a plant that co-generates electricity from biomass and supplies process steam to an "over-the-fence" partner, perhaps a manufacturing plant attracted to the community by a design to produce their product with "green energy." Creation of jobs provides young people local opportunities instead of leaving rural communities and further concentrating the U.S. population in urban centers.

The U.S. is not well served by continued concentration of our population in sprawling cities. Opportunities to supply energy and waste disposal needs with sustainable technology are greater with a distributed population. Smaller towns with small power plants (European Model) provide a better socio-economic future.

Biomass is a distributed resource. The most efficient use of biomass occurs when used closer to the field/forest where it is produced. The ability of the U.S. to meet the energy needs of Southeastern citizens with renewable, sustainable resources is best accomplished with distributed power generation. It is time to stop focusing on large power plants and biorefineries where the increase in hauling cost for the biomass obliterates the economy-of-scale benefit in processing cost the large plants provide. There is an optimum size for these plants. The Europeans recommend plants be spaced 60 miles apart. Let's determine out what the optimum spacing is for the Southeast and get busy and build a distributed energy system that shows the way for the rest of the nation.

*(Submitted by John Cundiff)*

## "Ounce" Calibration Method

### Why calibrate?

Calibration is the best way to assure you are delivering the desired rate. The window of opportunity to spray for soybean rust is much narrower than for most pests. You may not have the time to calibrate after the rust has arrived.

Results of many "Sprayer Calibration Clinics" show that only a third of applicators are applying chemicals at a rate within 5 percent (plus or minus) of the intended rate. Calibration takes about 30 to 60 minutes and requires only three "tools": a stopwatch, a measuring tape, and

a jar graduated in ounces. Several calibration methods are available but the one described below is simple, straightforward, and does not require cumbersome equations.

### "Ounce" Calibration Method

When the spray tank is clean, fill it

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## "Ounce" Calibration Method

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at least half full with water since the amount of water in the tank may affect travel speed. Measure the distance between nozzles in inches and then drive a designated distance depending on the nozzle spacing.

For a nozzle spacing of 20 inches, drive 204 feet at normal spraying speed. Drive 136 feet for 30-inch spacing; 113 feet for 36-inch spacing; and 102 feet for 40-inch spacing. Run the parked sprayer at the same pressure level for the same amount of time it took you to drive the designated distance, and collect the output of each nozzle.

Calculate the average nozzle output by dividing the total output from all nozzles by the number of nozzles tested. The average nozzle output in ounces equals the gallons per acre applied. For example, if you catch 20 ounces the rate is 20 gallons per acre (gpa).

The next step is to minimize the application error. If the difference between your intended application rate and the actual rate is greater than  $\pm 5$  percent of your intended rate you should make some adjustments. For example, if your intended application rate is 20 gpa, the calibrated rate should be between 19 and 21. For small changes in the application rate try adjusting the pressure. For larger changes either adjust the travel speed or replace nozzles with the appropriate size. You need to repeat the calibration process until your application error is no greater than  $\pm 5$  percent.

The "Ounce" calibration method is explained in detail in Virginia Extension (VCE) Fact Sheet 442-453, available from your local Extension Office, or from the VCE web site: <http://www.ext.vt.edu/pubs/bse/442-453/442-453.html>.

Just spraying the right amount of

fungicide on each acre is not enough to achieve effective control of soybean rust. Uniform deposition on the spray target is as important as the total amount deposited. Each nozzle type produces a unique spray pattern. Some nozzles require precise overlapping of patterns from adjacent nozzles. Check the nozzle catalog to find out the appropriate boom height for your nozzle spacing that will produce uniform spraying across the boom.

### Calibrate frequently

Sprayers should be calibrated several times a year. Changes in operating conditions and the type of chemical used may require a new calibration. A survey showed that the more a sprayer was calibrated, the more accurate the application rate. Be prepared to spray for soybean rust before it arrives and have your sprayer calibrated.

*(Submitted by Bobby Grisso)*

## BioMethane Production

At a time of growing environmental concerns of global warming and political situations making industrialized countries critically review their dependency on Middle East oil, the need to develop alternatives to fossil fuels is becoming increasingly important. One of the sources of energy being revisited is methane produced by anaerobic digestion (biomethane production see figure 1).

Anaerobic digestion-based technology can convert organic wastes into profitable byproducts as well as reduce their environmental pollution potential, especially when combined with other treatment processes. If used as part of a comprehensive waste treatment plan,

anaerobic digestion can offer the following benefits to an animal feeding operation and surrounding communities:

- Electricity and thermal energy generation
- Stable liquid fertilizer and a high quality solid soil amendment production
- Odor reduction
- Reduction in ground and surface water contamination
- Revenue potential from sales of digested manure (liquid and solids) and excess electricity and/or processing off-site organic waste..

Anaerobic digestion technology is suitable for on-site use by single farms (small or large scale), co-operative enterprise (between several farms), and centralized system supplied with organic waste feedstock from several sources, including industrial sources.

The main financial obligations associated with building an anaerobic digester include capital (equipment and construction and associated site work), project development (technical, legal, and planning consultants, financing, utilities connection, and licensing), operation and maintenance, and training costs.

*(Continued on page 12)*

# BioMethane Production

(Continued from page 11)

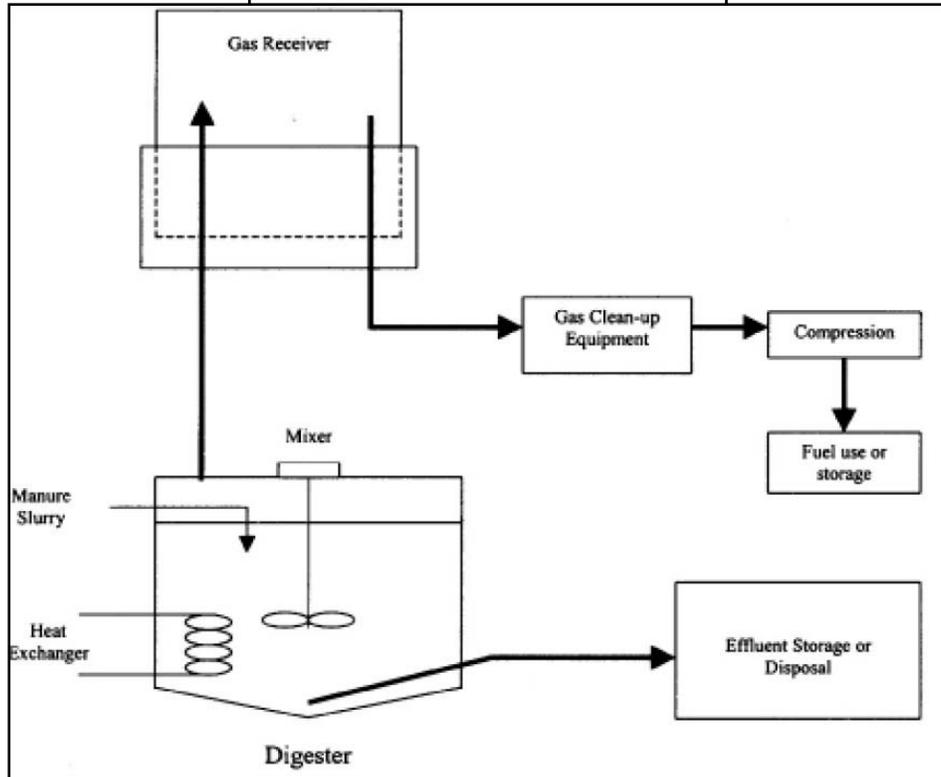
In making a decision to install a digester, a producer must realize that the system will require continuous monitoring and routine maintenance and repair which should not be underestimated. Components should be maintained as recommended by the manufacturers because manure and biogas can be corrosive on metal parts. In fact, the majority of digester failures over the past few decades have resulted from management and not technological problems.

## Anaerobic Digestion Process

Anaerobic digestion is a process that uses naturally occurring microorganisms to breakdown the degradable organic matter in manure to produce biogas (approximately 60% methane and 40% carbon dioxide, along with a few other trace gases) in the absence of air. Anaerobic digestion of organic matter is a three-step process. The first step is the decomposition (hydrolysis) of the organic matter to smaller sized molecules such as sugar, which is usable by microorganisms. The second step converts the decomposed matter to organic acids (acidogenesis). In the final step, the acids are converted to methane gas (methanogenesis). Most anaerobic digesters currently in use on farms are the single digester type (Figure 1), in which these three processes occur simultaneously. Typically, these digesters are fed liquid manure with <10% solids content.

This solids content is fairly common for dairy operations using water to flush manure.

2. Improve farm waste management:
  - Digested material is easier to manage.
  - Anaerobic digestion stabilizes slurries (so they do not putrefy or create odor), which allows digested manure to be stored more easily and for a longer time.



**Figure 1. Material flow through a single reactor anaerobic digester**

## Benefits of Anaerobic Digestion

1. Reduce greenhouse gases:
  - Some conventional manure management practices release methane through natural degradation processes. A well-designed and managed anaerobic digester will maximize generation and capture of methane gas instead of releasing it to the atmosphere, thereby reducing overall emissions. Methane is a major greenhouse gas that contributes to climate change.
  - Compared to using fossil fuels for energy, anaerobic digestion provides an energy source that does not increase the net atmospheric carbon.

3. Anaerobic digestion destroys weed seeds and kills pathogens, so digested slurry can be spread with minimal risk of spreading weeds and disease.

4. Anaerobic digestion can save producers money through energy production and by converting manure to potentially saleable products: biogas, soil conditioner, and liquid fertilizer.

5. Anaerobic digestion can contribute to rural regeneration by creating or maintaining jobs and can stimulate new industries that may use the technology creating structural changes in the local economy.

6. Anaerobic digestion can help producers meet new regulatory and public pressures to manage manure in environmentally-sound ways and reduce risks to human and animal health better than traditional manure management methods. Note, however, that digestion does not address water quality issues related to nutrient management, but digesters as part of a comprehensive manure management system can address these issues.

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## BioMethane Production

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7. Effluent from a digester has a high fertilizer value. It contains almost all the nitrogen, phosphorus, and potassium and all the trace materials fed to the digester.

8. Effluent from an anaerobic digester can be dewatered by solid-liquid separation, producing solids that can be used as bedding, composted, or used for other value-added product generation.

### Potential Challenges

1. One of the most significant barriers to the use of anaerobic digestion is economics. It is very difficult to justify the investment in an anaerobic digester based on revenue received from electricity. The operation must attribute some added value to the odor benefits and fertilizer material obtained to justify the additional cost a livestock operation must bear for construction and management of anaerobic digestion. Even though the initial capital cost may be high, multiple economic analyses have shown that substantial payback is possible on some farms, resulting in a net positive investment.
2. Daily attention required by trained personnel – a designated farm employee must be trained in the principles and management of the system to ensure its success. Management needs cannot be overstated. Most digester failures are due to underestimation of management needs, not

technology failure.

3. Potential emissions – certain emissions and effluents may need treatment to avoid damage to human health and the environment. Specifically, there is a possibility of losing nitrogen as ammonia gas if effluent

for livestock manure treatment and energy production has increased in the past few years (Figure 2). The AgStar program of the US EPA reports that almost 50 farm scale digesters are now in operation in the U.S. Of the full scale digesters, more than 50% are on dairy farms.

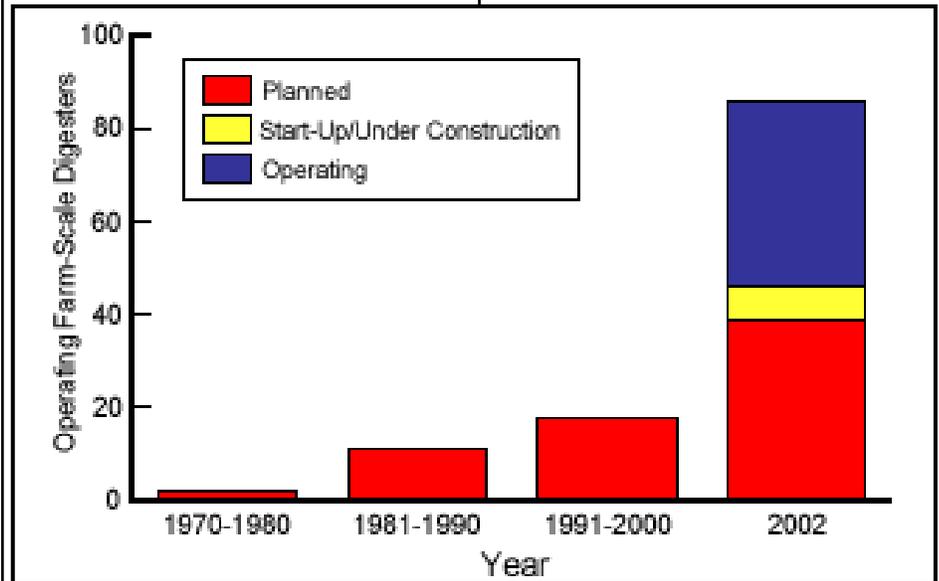


Figure 2. U.S. Farm scale anaerobic digesters (source: [www.epa.gov/agstar](http://www.epa.gov/agstar))

is not treated and managed properly during and after digestion.

4. Health and safety – if not handled properly and digested fully, there may be some risk to health from pathogenic content of the feedstock and digestate. There may also be some risk of fire and explosion.
5. Does **not eliminate or reduce** nutrients in the manure.

More than 90% of the operational systems use the captured biogas to generate electrical power and heat. The remaining systems flare the captured gas for odor control and reduction of methane emissions.

### Additional Resources

[www.manuremanagement.cornell.edu](http://www.manuremanagement.cornell.edu)

[www.epa.gov/agstar](http://www.epa.gov/agstar)

(Submitted by Jactone Arogo Ogejo)

### Case Studies

Development of anaerobic digesters

## Caring for Livestock in Disasters

Colorado Extension has produced a helpful series of publications about working with livestock in the event of a disaster. The three publications in the series are:

Caring for Livestock before Disaster: <http://www.ext.colostate.edu/PUBS/livestk/01814.html>

Caring for Livestock during Disaster: <http://www.ext.colostate.edu/PUBS/livestk/01815.html>

Caring for Livestock after Disaster: <http://www.ext.colostate.edu/PUBS/livestk/01816.html>

These publications cover many aspects of preparing for, surviving, and recovering from disasters. Issues for a variety of specific disasters -- including flash floods, tornadoes, hurricanes, blizzards and others -- are considered.

## 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](mailto:tlcox@vt.edu)

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**"Fundamentals of animal waste treatment technologies"** by Jactone Arogo. Objectives: a) Describe the basic operation principles of waste treatment technologies, b) Outline factors to consider when selecting a waste treatment technology.

**"AgrAbility Project: How to get Involved"** by Bobby Grisso. Objectives: a) Discuss the USDA AgrAbility project and the Virginia partnership b) Who qualifies for services and what can be expected, c) Describe available resources and case studies, and d) How to make contact.

## Biodiesel Myths and Facts (cont)

(Continued from page 3)

panies do not recommend storing petroleum diesel for more than six months. The current industry recommendation is that biodiesel be used within six months, or reanalyzed after six months to ensure the fuel meets ASTM specifications (D-6751). A longer shelf life is possible depending on the fuel composition and the use of storage enhancing additives.

**Myth:** Engine warranty coverage would be at risk.

**Fact:** The use of biodiesel in existing diesel engines does not void parts and materials workmanship warranties of any major US engine manufacturer.

**Myth:** The U.S. lacks the infrastructure to prevent shortages of the product.

**Fact:** There are presently more than 14 companies that have invested millions of dollars into the development of the bio-

diesel manufacturing plants actively marketing biodiesel. Based on existing dedicated biodiesel processing capacity and long-term production agreements, more than 200 million gallons of biodiesel capacity currently exists. Many facilities are capable of doubling their production capacity within 18 months.

**Myth:** There is no government program to support development of a biodiesel industry.

**Fact:** The USDA announced in January 2001 the implementation of the first program providing cost incentives for the production of 36 million gallons of biodiesel. Bills supporting the use of biodiesel and ethanol were also introduced to the U.S. Congress in 2003, including one that would set a renewable standard for fuel in the U.S. and one that would give biodiesel a partial fuel excise tax exemp-

tion. More than a dozen states have passed favorable biodiesel legislation.

### Where do I get biodiesel?

Biodiesel is available nationwide. It can be purchased directly from biodiesel producers and marketers, petroleum distributors, or at a handful of public pumps throughout the nation. Go to website [www.nbb.org/buyingbiodiesel/guide/default.shtm](http://www.nbb.org/buyingbiodiesel/guide/default.shtm) to get all the current producers, distributors, and public pumps nationwide. In Virginia, the following websites can lead you to the biodiesel retailers and distributors.

<http://www.nbb.org/buyingbiodiesel/distributors/showstate.asp?st=VA>;  
<http://www.nbb.org/buyingbiodiesel/retailfuelingsites/showstate.asp?st=VA>

(Submitted by Zhiyou Wen)

Note: adapted from National Biodiesel Board ([www.nbb.org](http://www.nbb.org)).

Visit our website:

<http://www.bse.vt.edu>

