Engineering Update

Biological Systems Engineering

March 2010

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).

Visit BSE Specialists in Seitz Hall
Automatic Section Control Technology

Automatic section control is a precision farming technology that has been readily adopted by producers over the past couple years. Currently, equipment manufacturers and third-party companies are offering systems that control sections, nozzles, and rows on sprayers, planters, and other implements. Simply, the technology turns application equipment OFF in areas that have been previously covered or ON and OFF at headland turns, point rows, terraces, and/or waterways. Many farmers have implemented the technology for use on sprayers with popularity growing for planters.

**Manual Operations**

Spraying while making sharp turns can result in 3 to 4 times the desired pesticide rate along the inner boom, and as high as 40 to 50 times at the pivot position. Yet, the rate of pesticide near the end of the outer boom can be 1/2 to 1/10 the desired rate. It should be obvious, then, that one must avoid the practice of sharp turns while spraying!

To minimize uneven application rates when spraying around waterways or other irregular-shaped areas, outline those areas with a single round. For the waterway shown in Figure 1, spray in a straight line as much as possible along the waterway’s edge. Then, when you reach the end of the waterway, turn off the sprayer, make your turn, and begin spraying again in a straight line on the other side of the waterway. If the waterway is more squarish at the field border as shown in Figure 2, back into the corners and drive each side of the waterway. Then, when making the back-and-forth inside passes, shut off sections of the boom that reach the waterway first to avoid swath overlap with the outline round.

A row crop planted in irregularly-shaped fields creates rows of different lengths. Although you outline such fields like you do with any other field, spraying point rows (i.e., uneven row lengths) is a challenge in preventing swath overlap. Shut-off switches controlling every 2 to 3 nozzles provide greater flexibility in treating uneven row lengths without overlap (Figure 2) or when finishing the field with the last swath that is narrower than the boom length. Applicators find it easier to spray from long to short rows. Doing so allows you to turn on sections of the boom in the return swath in the reverse order as you shut them off.

Since these processes are difficult to implement during the operation while the operators is focused on driving, many have opted to use automatic section control to aid in spraying waterways and irregularly shaped field or planting point rows.

**Components**

Figure 3 illustrates an example of manual control versus a sprayer equipped with GPS enabled boom section control. To-
Automatic Section Control Technology

(Continued from page 2)

The cost for this technology generally starts around $2,000 but depends upon existing technology and equipment you may already be using on your farm. As a minimum, you need:
- GPS receiver
- Controller with software capable of automatic section/row control
- Proper boom valves for sprayers or row clutches for planters

Other components can include a flow meter/control or other sensors to maintain the desired application rate when turning rows or sections ON/OFF. Please consult manufacturers for the necessary components and cables.

Benefits
Calculations have shown input savings from 5% to over 30% for each pass across a field using automatic section control. However, these savings are dependent upon field shape and size with higher benefits occurring in large, irregular shaped fields or fields containing conservation management structures such as grass waterways and terraces.

Benefits of this technology can include:
1. Improved overall sprayer and planter accuracy
2. Reduced overlap thus reducing overall input costs
3. Improved environmental stewardship
4. Reduced crop damage from over-application
5. Improved application efficiency
6. Optimized operator efficiency

Utilizing a guidance system in conjunction with automatic section control, can significantly improve field efficiency while providing input savings. Generally, automatic section control technology can pay for itself over 1 to 2 growing seasons.


Figure 3. Example operation of manual sprayer control system (a) and a sprayer equipped with GPS-based section-control when traversing a grassed waterway (b). In this example, the technology provides the benefit of treating the cropland while preserving the grass waterway.

Example benefits of planter individual row control to reduce overlap and skipped areas. The technology improves planting efficiency while savings on the amount of planted seed.
A Continuously Operating Reference Station (CORS) is a static, survey-grade GPS receiver which is permanently positioned at a known geographic location. These receivers are generally mounted on a public building with a solid foundation.

The benefit of a CORS site or network is the ability to provide accurate, repeatable position data free of charge permitting users to return to the exact same locations over time. Data collected from CORS sites has a wide array of uses. For example, CORS data can be used for monitoring coastal subsidence, surveying, determining the amount of precipitable water vapor in the atmosphere, recording and locating utility lines, and machine guidance for construction and precision agriculture.

Coordinated by the National Geodetic Survey (NGS) of the National Oceanic and Atmospheric Administration (NOAA), CORS sites provide Global Navigation Satellite System (GNSS) measurements in support of 3-dimensional positioning activities. NGS supports a network of CORS sites throughout the US which can provide centimeter level horizontal and vertical position accuracy.

Current sites can be identified by visiting the NGS CORS website (www.ngs.noaa.gov/CORS/).

CORS data can be used for Real-Time Kinematic (RTK) applications, meaning that the station provides continuous correction data to roving GPS receivers with internet accessible capabilities. The GPS correction data is typically transmitted at 1-Hz through the internet. Therefore, a GPS system utilizing a cellular modem can obtain the correction data which in return provides centimeter level position accuracy within a short range of the CORS station (1 to 30 miles depending on terrain and other operating conditions).

**CORS in Agriculture**

The use of CORS in agriculture is unique. Agriculture equipment equipped with an internet accessible cellular phone or modem (with internet data package) and RTK-level GPS equipment can utilize the around-the-clock data output for their GPS correction signal.

Traditionally, base stations have been required for growers to implement RTK-level accuracy for auto-steer systems in their farming operations. These base stations (at a cost of approximately $12,000 per station or more) can potentially provide up to a 6-mile coverage radius requiring direct line-of-sight to the base station. In most cases, farmers must move the base station to obtain full coverage of their farm. However, a CORS provides extended signal range (with no line-of-sight required; only cellular coverage), accessibility by a wide range of users, and reduced investment costs for RTK-level technology (i.e. auto-steer systems). Grower applications include planting, harvesting, spraying, controlled traffic, and drip irrigation installation. Therefore, benefits include:

1. Reduced investment costs for RTK guidance systems
2. No base station maintenance and movement
3. Free RTK level correction (mobile phone or modem with internet data plan required)
4. Extended coverage range

According to my Auburn University colleagues: “In regards to accuracy, we have seen no difference between running on CORS versus the traditional base station; you are just using a different means of obtaining the correction data. Our dynamic testing suggests no difference up to 20 miles away from a CORS base station; you are just using a different means of obtaining the correction data. Our dynamic testing suggests no difference up to 20 miles away from a CORS base station and most cases producers will see no difference up to 25 miles. After 25 miles, accuracy can slowly start to decrease but probably not to a level of concern (3 to 4 inches) until you get out to 30 miles.”

(Grisso)
Top Ten things to check before planting season

1. **Level the planter.** Check hitch height. Make sure the planter's tool bar is level (vertically) or running slightly up hill. When planters tip down, coulters run too deep and closing wheels run too shallow.

2. **Check bushings and parallel linkage.** Worn bushings increase row bounce which increases seed bounce. Stand behind the row unit and wiggle it up and down and back and forth checking to make sure bushings are tight.

3. **Drive system.** Check every chain. Kinked chains cause shock and vibration in the meter. Start with fresh, lubricated chains and check them daily. Include transmission chains, meter drive chains and insecticide box chains.

4. **Calibrate corn meters.** Calibrated meters can add six or more bushels per acre. Take your meters and samples of your seed to a certified representative to gain an additional accuracy.

5. **Double disk openers.** Test to make sure there is good contact between the double disks. Slide a business card from the top down along the front of the disks until the card won’t lower any further. Mark that spot with chalk. Then, take the card from the back and slide it forward until it stops. Mark that spot and measure the distance between the two marks. If it is less that two inches, reship or replace the disks.

6. **Seed tubes.** Inspect seed tubes for wear at the bottom. Frequently, the tubes will have a small dog ear flap on the left side of the seed tube. Replace them.

7. **Closing wheel system.** Consider an alternative to rubber closing wheels. For cool, moist planting conditions, take a look at running one spike wheel (15”) and one rubber wheel (13”). The spike wheel can help chop the sidewall improving fracturing and sealing in the tough soil conditions. For no-till, an even more aggressive approach may improve trench closing. Two 13” spike wheels with a drag chain provide the most aggressive action.

8. **Closing wheel alignment.** With your planter setting on a concrete, pull ahead about five feet. Look at the mark left behind the planter by the double disk openers. The mark should run right down the centerline between closing wheels. If a closing wheel is running to close to the mark, adjust the closing wheels to bring it back to center.

9. **Row cleaners.** With higher levels of residue and more corn on corn, almost any planter can benefit from well adjusted row cleaners. Row cleaners sweep residue from the row, warming the soil around the seed trench, reducing wicking and seedling blight. Make sure row cleaners gently sweep residue - you don't want to move soil, just residue. Watch the row cleaners running. They shouldn't turn constantly. They should gently turn sporadically, especially through areas of thick residue.

10. **Improve germination with seed firmers.** Uniform germination adds, on average, six bushels and acre. Seed firmers promote uniform germination by improving depth control and seed to soil contact. By using seed firmers to set seeds to the bottom of the seed trench, you increase the odds that seeds absorb moisture uniformly and emerge evenly.
Maximizing Yields, It Begins With Your Planter!

It's a common question and is probably on everyone's mind; "What can I do to increase my yields"? The answer to that question requires a fully integrated approach that actually starts with your planter.

That's right, your planter! That bag of seed never has more yield potential than it does when it gets poured into that planter box which makes your planter the first place to look for maximizing yields.

Think back to last year. Were you satisfied with your emergence? Was it even? How about the plant spacing, was it even? Were there excessive skips, doubles or triples? Did your planter monitor stay consistent from row to row? Chances are you were not satisfied with more than one of these items so it is probably time to pull that planter into the shop, find the operators manual and give it a thorough checkup.

General Maintenance
- Check all chains for proper alignment, excessive wear, and stiffness. Lubricate with an all purpose lubricant and replace if necessary.
- Lubricate grease points as required
- Check hydraulic system for leaks.
- Make sure tire pressure is correct.

Row units
- Make sure row units are level and straight across the planter.
- Check the up-down and side to side movement. Excessive movement is a sign of worn bushings.
- Make sure closing wheels are aligned.

Disc Openers
- Check for wear. If the disc diameter is more than ½ inch smaller than its original size it should be replaced.
- Adjust if necessary to achieve a true "V" shaped furrow, if not the furrow could have a "W" shape that will interfere with seeding depth.

Gauge Wheels
- Make sure gauge wheels are tight against the disc opener to prevent soil from accumulating between them.
- Check stops, broken stops will allow wheel to ride higher interfere with desired planting depth.

Seed Tubes
- Check for obstructions.
- Check for wear or damage. Worn or damaged tubes will allow seed to drop at an incorrect angle which will interfere with seed placement.
- Check monitor sensors.

Seed Meters (Vacuum or Finger)
- CALIBRATE! CALIBRATE! CALIBRATE! Even if the planter is new!! New meters as well as used meters should be calibrated for accuracy.
- The seed meter is the most important part of your planter; it is well worth the investment to have them tested for performance. This will identify the components that need to be replaced or adjusted.

Seed has become a high value investment in your operation so it is vitally important that your planter is tuned up and ready in order to maximize the value of your investment. Remember an ounce of prevention is worth a pound of cure and more return per acre.

(Tim Jordal, CCA Central Agronomist)

Once an equipment decision is made, producers should shop around for the best value and talk to local vendors about their ability to provide any necessary maintenance or repairs to the equipment.

Now is ideal for buying equipment because producers have some time to reflect on the past year and review their options. Dealers are also trying to plan out equipment discounts to those who plan ahead.

Farmers who are looking for new equipment are doing so for several reasons. Late planting and a delayed harvest in 2009 put those without sufficient drying and storage equipment in a bind. Others are looking to replace outdated equipment or ramp up storage or drying capacity to match their combine’s production.

In addition, producers looking to increase the size of their operation in 2010 may need additional equipment.

Producers should consider several factors including which piece or pieces of equipment would most improve their operation, their operation’s size, capacity of current equipment and harvesting strategy. Reviewing previous harvests helps producers find any recurring equipment deficiencies or problems.

(Adapted from SE Farm Press, Grisso)

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**Planter/Drill Considerations for Conservation Tillage Systems**

No-till planters and drills must be able to cut and handle residue, penetrate the soil to the proper seeding depth, and establish good seed-to-soil contact. Many different soil conditions can be present in the Mid-Atlantic region at planting time. Moist soils covered with residue, which may also be wet, can dominate during the early spring and occasionally in the summer. Although this condition provides an ideal environment for seed germination, it can make it difficult to cut through the residue. In contrast, hard and dry conditions may also prevail. Although cutting residue is easier during dry conditions, it is more difficult to penetrate the hard, dry soils. Proper timing, equipment selection and adjustments, and crop management can overcome these difficult issues.

VCE publication 442-457, “Planter/Drill Considerations for Conservation Tillage Systems,” has been posted to the VCE publication website at:


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**Machine Bushing**

Minimum of 2 between arm and shank.

Minimum of 1 between arm and bolt head.

**Blades must have 1/16-inch minimum clearance between shank and blade.**

**Double discs should have 1-to 1.5-inch contact. Two-shim minimum between bearing and spindle.**

Shim the depth wheel to lightly contact disc. Check adjustment during field operation.
Soil Management of Harvest Ruts

Combines working in wet conditions to harvest crops have formed ruts in fields. About three-fourths of combine mass and virtually all of loaded grain tank weight are carried on the combine’s front axle. With good yields, grain tank extensions, and a 12-row head, front axle load can be 18 to 20 tons.

The consequences of such wet conditions are significant soil compaction caused by this heavy equipment and yield reductions that will be realized next season. Compacted soil created beneath the rut may interfere with subsequent crop rooting and development. Ruts deeper than about two inches can also interfere with seed depth control during planter operation.

Using tillage to loosen the soil and relieve compaction requires soil to be dry enough so that soil shattering is effective. Because soil moisture has refilled the top 12 to 24 inches of the soil profile, deep tillage with a chisel plow or subsoiler will use fuel and time — but is unlikely to loosen soil effectively between tillage shanks.

However, the full soil moisture profile in upper layers will freeze and thaw over the winter and help loosen soil, depending on air temperatures and snow cover. Entering the field in wet moisture conditions for deep tilling or any type of tillage will be counterproductive by creating much deeper soil compaction.

Ruts deeper than planting depth will need to be leveled before planting. A good strategy may be to wait until a week or two before planting and use a light tillage pass, such as with a field cultivator, light disk, harrow, or soil finisher. If only a portion of the field is rutted, consider tilling only that area to avoid recompacting subsoil in other parts of the field.

Waiting until warmer weather allows for some potential drying of the top two or three inches of soil and avoids further compaction of wet, plastic soil on the surface — which will happen with a tillage pass this fall.

If compaction effects are observed during the 2010 growing season and soil is dry after harvest, tillage next fall may be considered deep enough to break through the compacted layer.

**Summary**
- Rutting creates compacted soil and an irregular soil surface.
- Avoid deep tillage to correct the problem of wet soil does not shatter/loosen.
- Shallow tillage will level ruts for planter operation.

(Grisso)
Push mower safety

- Start the mower from a firm stance with both feet in a safe position.
- If the mower has a self-propelled mechanism, make sure it is disengaged before you start the engine.
- If the self-propelled mechanism is in gear, the mower will start to move once the engine has started.
- Never perform any kind of adjustment while the mower is running. For example, if you want to change the height of the wheels, first turn the engine off and disconnect the spark plug. Then, reposition the wheels.
- Always push the mower in a forward direction. Never pull the mower toward you. If you slip, your foot could go under the mower deck and cause a serious injury.
- If the mower deck should become clogged with grass, stop the mower and turn the engine off before clearing the clog.
- Never touch any part of the mower while operating it except for the handles and throttles.
- If the mower has an attached grass catcher, stop the engine before detaching the grass catcher. Do not let the grass catcher become too full.
- Perform a safety check before and after each time you use the mower.
- Check and tighten all loose nuts, bolts and screws.
- Replace the belt if necessary.
- Clean the mower after each use.

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)
Don't Assault Your Battery

Batteries in autos, trucks and tractors operate the ignition system, starter, lights and other motors and accessories.

The battery converts chemical energy to electrical energy. So to operate properly, it must have the plates and electrolyte in proper proportions and the elements must be clean both inside and outside the battery case.

Here are a few tips for battery care:

1. Add clean, pure water. Other chemicals reduce the effectiveness and shorten the life of the battery. Manganese -- at just a few parts per million -- can ruin a battery in a few weeks. Be sure to keep the electrolyte above the plates, otherwise the plates will harden.

2. Keep the battery terminal clean. Clean the battery posts with terminal tools, scraper and brush. Also clean the inside of the clamps.

3. Clean away dirt and corrosion. Clean corrosion and dirt from the battery with warm water or baking soda and water if it has considerable corrosion. Be sure to flush thoroughly with water after using the soda.

4. Keep the battery charged. A discharged battery will freeze at slightly freezing temperatures and a battery with a specific gravity testing of 1.1 will freeze at 19°F. A fully charged battery freezes at a minus 90°F. A battery has only 65% of its cranking power at 32°F; 100% at 80°F; and 40% at zero degrees F.

5. Do not overcharge the battery. Overcharging a battery will cause the acid to become more concentrated, which in turn will cause a destructive reaction to take place, intensifying corrosion.

6. Battery gases are explosive. A battery taking a charge gives off hydrogen gas. Small quantities of this gas are given off at all times.

7. When connecting jumpers to batteries, make the last connections to the grounded terminal of the fully charged battery. Never pull a jumper from a discharged battery, then try to re- connect it.

8. When connecting jumper cables be sure negative positive poles are matched. If the cables are not matched correctly, the diodes on the alternator may be damaged.

9. Take better care of your battery. You’ll get a better charge out of it.

New Farm/Rural Safety Tool On-line

What is FARM-HAT? The Farm/Agriculture/Rural Management - Hazard Analysis Tool (FARM-HAT) is a simple method of providing first-hand information about hazards, a process for evaluating hazards, and recommendations on correcting hazards.

It can be used with farming, ranching, roadside farm markets, agritourism farms, and other similar operations. The evaluation system provides users with critical safety and health information using minimal text.

A description of the program is contained in the latest issue of the Penn State Farm Safety Program Newsletter Ag Safety and Health News.

http://www.agsafety.psu.edu/newsletters/ASH0110.pdf
As you begin the process of selecting the most efficient air conditioning system for your home, investigate the critical issues of system size, placement, installation, and contractor experience. Your goal is to obtain an efficient system by: sizing the system for the specific cooling load of your home; selecting and properly installing the thermostats or controls; designing a ductwork system to deliver the correct amount of conditioned air to each space; and sealing and insulating all ductwork.

**AC Size**
Heating, ventilation and air conditioning load calculations are required for new homes in many municipalities. These design loads are usually performed for each zone in a dwelling in accordance with Air Conditioning Contractors of America (ACCA) Manual J, ACCA Manual N or the ASHRAE Cooling and Heating Load Calculation Manual. Some firms have acceptable in-house procedures based on the same methodology. If you prefer to conduct your own research on load calculations, a quick Internet search, a call to your local community college HVAC professor, or enroll in a HVAC class may be helpful.

The load calculations should be based on the exact area and type of construction for each component of the building envelope, as well as the heat given off by the lights, people, and equipment inside the building. If a zoned heating and cooling system is used, the loads for each zone should be calculated. An accurate load analysis will help to prevent problems that occur when a house is equipped with an oversized system.

**Energy Efficiency of an AC System?**
The cooling efficiency of a heat pump or an air conditioning system is rated by the Seasonal Energy Efficiency Ratio (SEER), a ratio of the average amount of electricity used. Federal regulation mandates a minimum SEER 13.0 for most residential air conditioners manufactured after January 23, 2006. Efficiencies of some units can be as high as SEER 17.0 or more (Chances are that older homes have units with SEERs less than 10). Note that it is important to understand that even though the SEER may be high, overall or system efficiency includes the air distribution system as well.

The SEER rating is based on equipment performance in the Virginia climate. Some equipment may not produce the listed SEER in actual operation in our climate region.

**What about Removing Moisture?**
The Sensible Heat Ratio or SHR describes the moisture removing capability of air conditioning systems. A SHR on HVAC equipment of 0.7 means that 70% of the air conditioning load is devoted to cooling and 30% to removing humidity. It is critical that the HVAC contractor accurately estimate the humidity, or latent load. It is important to note that many high SEER units have poorer humidity removal capacity, so verify system performance before purchasing and ask the HVAC contractor to provide written confirmation.

**Why are Size, SEER and SHR Important?**
This is where it gets a bit complex. The SEER, the SHR, and the system tonnage must be in balance so difficulties don't occur with indoor air quality. Systems without an adequate SHR or with inaccurate tonnage, cool without removing moisture. An oversized air conditioner will cool your home too quickly to remove moisture very effectively.

This results in a home that is cool and "clammy." If units are not providing sufficient dehumidification, the typical owner response is to lower the thermostat setting. Since every degree the thermostat is lowered increases cooling bills 3% to 5%, systems that have technically high efficiencies, but inadequate dehumidification, may suffer from higher than expected cooling bills.

**AC Component Locations**
Central HVAC systems have a component called an air handling unit or AHU. The advantages of placing the AHU in conditioned space include: it is in a more benign environment; a central location can minimize duct lengths and optimize air flow; there is easier access for maintenance; and any leaks occur in conditioned space.

Another often-neglected area of installation concerns the placement of the outside unit (condenser). Manufacturer's recommendations for proper clearance distances should be followed to ensure there is no blockage of air flow from the unit. Also, do not vent a clothes dryer within 10 feet of the outdoor unit as dryer lint will cling to the
condensing coil, lowering both the system’s efficiency and service life.

**Questions the HVAC Contractor Should Ask**

The HVAC contractor should ask you the following questions to properly conduct a comfort analysis and system design for your family and home:

- Would you change anything about your current air conditioning and/or heating system?
- What do you like most about your present system?
- What benefits do you expect from your new system?
- Does your existing system heat and cool your home to your satisfaction?
- Are there rooms that are too hot or too cold?
- What temperature is your thermostat set on during the summer? Winter?
- Do you have a scheduled lifestyle that encourages adjusting the thermostat frequently, or while you’re not at home?
- Do you set the thermostat at different temperatures for the hours that you’re awake and the hours you’re asleep?
- What types of heating or cooling problems have you experienced?
- Have you had any problems with condensate drainage?
- What is your average summer electric bill?
- Who performs your regular energy savings check-ups?
- How long do you plan on residing in this home?
- Do you plan to remodel and/or expand your floor plan in the future?
- Have you made any changes to your home since the existing air conditioning and/or heating system was originally installed?
- How many people reside in your home?
- Does anyone residing in your home have allergies?
- Do you understand ratings like SEER and SHR?
- Do you understand how HVAC systems work or, more specifically, do you understand how the system I’m recommending placing in your home, works?
- Many of the same questions should be asked when determining what HVAC system should go in a new home. In addition...

  - **Be sure your contractor is licensed** (if required in your municipality), well trained, and experienced. Ask to see a valid license, proof of coverage for workers’ compensation, and certificate of insurance coverage for liability and property damage. Inquire about references and membership in contractor associations. Ask for proof that your contractor is certified to handle refrigerant in cooling systems.
  - **Request a calculation of your savings.** Heating and cooling equipment comes with two price tags: the cost to buy the equipment and the cost to operate it. Your contractor should be able to calculate your utility bill savings and total lifetime costs.
  - **Request a load calculation.** Ask your contractor to calculate equipment size using computer software or professional guidelines. This will require taking measurements in your house and asking questions. Don’t use a contractor who wants to size your unit solely on the square footage of your house.
  - **Inspect ducts.** Ask your contractor to inspect your ducts for leaks, incomplete connections, and compatibility with the rest of your system. Evaluate your system’s performance. Ideally, your contractor should use diagnostic equipment, and, if necessary, fix leaks using a quality duct sealant. In some cases, proper duct repairs may include actual duct modifications to ensure proper supply and return airflow.
  - **Consider a house pressurization test.** Test your house and appliances for “backdrafting,” which occurs when the fumes from the combustion process are pulled back into the home, threatening the health and safety of occupants.
  - **Replace both indoor and outdoor coils.** If you’re replacing an air conditioner or heat pump, be sure to replace both indoor and outdoor coils on a matched system for maximum efficiency and reliability.
  - **Obtain a written contract.** Always obtain a written contract or proposal before allowing your contractor to install a new system. Be sure to ask about warranties for labor and parts.
  - **Weigh the costs.** Remember that the lowest price may not always be the best price. Carefully evaluate a contractor’s proposal to ensure you get the equipment and service that best meets your needs. Paying slightly more now may get you better equipment, service and save you money in the years to come due to lower costs of ownership.
  - **Install for easy maintenance.** Make sure the inside coil can be reached for its annual cleaning. The air filter(s) should also be easily removed, cleaned or changed when dirty. Check it monthly during peak season.
Geothermal Heat Pumps

The geothermal heat pump offers one of the most effective ways to save energy and cut carbon emissions. In fact, the Environmental Protection Agency (EPA) says this appliance stands as one of the most energy-efficient and environmentally friendly of our heating, ventilation, and air conditioning options. The numbers are impressive. Installing geothermal heat pumps to their full potential nationwide would:

- Avert construction of 91-105 GW of generation capacity, which is 42%-48% of the 218 GW of new power the US will need in 2030.
- Save $33 to $38 billion annually in reduced utility bills.

Yet installations of geothermal heat pumps remain relatively uncommon. A Department of Energy (DOE) report says that to grow the market, the industry needs to present more hard data and analysis on system performance. First, the data would underscore the technology’s superiority to policymakers and consumers. Second, it would enable installers to maximize the potential of the technology.

Identity Crisis
Geothermal heat pumps suffer from a bit of an identity crisis. Consumers often wrongly believe, that geothermal heat pumps are unavailable for their use because they confuse the technology with power production from geothermal geysers, which relies on steam from underground geysers and hot springs, trapped and directed to spin turbine generators in a power plant.

Geothermal heat pumps (GHPs), on the other hand, can be used virtually anywhere a building sits on the ground. They do not fuel power plants but rather are appliances to heat and cool buildings or to provide hot water.

A geothermal system has three main components (see figure).
- A series of underground pipes, called the geothermal loop
- A heat pump unit
- A distribution system (such as a fan and ductwork or a hydronic radiant floor)

The way the system operates depends on whether it is heating or cooling the building. In the heating cycle, the water circulates through the loop and extracts heat from the soil. The water flows to the heat pump unit inside the building and then passes through a heat exchanger. For air conditioning, the cycle is reversed, pulling heat out of the building.

Operating Basics
Underground temperatures are cooler than air in the summer and warmer than air in the winter, remaining between 45°F and 75°F depending on latitude. Geothermal heat pumps capitalize on this temperate underground climate, using water (or an antifreeze solution) as a medium to transfer heat between the ground and the building.

Geothermal heat systems may be either open- or closed-loop. An open system often relies on well water that is drawn up to the heat exchanger. At the end of the cycle, the water goes either into a separate well, a stream, a pond, or a gulley. Closed-loop systems rely on a continuous loop of underground pipes that circulate antifreeze.

(Grisso)
Illnesses can be prevented by breaking habits

The Centers for Disease Control (CDC) tells us that proper hand washing is the single most important action each of us can perform to help stop the spread of diseases. Hand washing instructions populate many Web sites, such as www.flu.gov. The Internet boasts videos on "how to wash." The media in general keep the H1N1 pandemic in the forefront of local, state, and national press. After countless messages reminding us to wash our hands, you might think that all of us have finally been educated in the importance of hand washing in the fight against the transmission of diseases. Unfortunately, too many recent studies prove otherwise.

In a recent hand washing survey conducted by Bradley Corporation, participants were asked whether the threat of H1N1 had changed the frequency of their hand washing. Surprisingly, the majority of those surveyed had not altered their hand washing habits, even during this time of H1N1 pandemic! In fact, 54 percent of the 1,020 participants indicated they did not wash their hands more frequently, nor did they wash less frequently, in public restroom facilities as a result of the virus threat.

In another report, more than 400 British commuters were part of a study of microbiological contamination on the hands of the general adult public. The study's author, Gaby Judah of the department of infectious and tropical diseases at the London School of Hygiene and Tropical Medicine, found the results astonishing: 28 percent of the 404 people tested were found to have fecal bacteria on their hands. Not only a disgusting scenario; failure to wash hands after using the bathroom constitutes a huge health risk. Hepatitis A, a foodborne illness, is transmitted when human sewage comes into contact with uncooked food.

The fifth annual Clean Hands Report Card® issued by the Soap and Detergent Association (SDA) in September 2009 gives America a hand hygiene grade of a B-minus versus the 2008 grade of C-minus. Positive results from the survey: 50 percent say they wash their hands more than 10 times per day. This is up from 26 percent in 2008. More Americans claim to wash their hands after coughing, sneezing, using the bathroom, and before eating lunch. Negative results: Women are still washing their hands more than men (62 percent of women wash more than 10 times per day versus only 37 percent of men). A disturbing 39 percent of survey participants seldom or never wash their hands after coughing or sneezing.

The survey also shows that nearly half (46 percent) of participants do not wash their hands the recommended amount of time for proper cleansing. The CDC and SDA recommend washing with soap and warm water for at least 15 to 20 seconds. Wash between the fingers, around cuffs (Continued on page 15)
Good Hand Hygiene Practices (cont.)

(Continued from page 14)

articles and beneath nails, the backs of the hands, and the wrists. Friction during the hand washing process helps remove germs from the skin. Rinse thoroughly. Use a clean disposable towel to turn off the faucet and a second towel to completely dry the hands. Use a final paper towel to open the restroom door, preventing your hands (at least for a few moments) from becoming recontaminated. Finally, this survey shows that only one-third of the 888 participants said they had changed their overall hygiene habits in response to H1N1 concerns.

Good Hand Hygiene Practices

Poor hand hygiene is but one habit that needs to be broken to help decrease the spread of disease-causing bacteria. Some additional habits include:

1. **Touching the "T-Zone" of the face.** The mucus membranes of the eyes, nose, and mouth provide warm and moist entryways in which bacteria thrive. How often do we touch the "T-Zone"? In a study by the University of California at Berkeley, the average contact rate was 15.7 touches per hour. During an eight-hour workday, that represents more than 125 times the average person touches his eyes, nose, or mouth. These 125 T-Zone touches then transferred to other items within our environment: workplace tools and equipment, desktops, keyboards.

2. **Shaking hands.** Although the handshake is the traditional form of warm personal greeting we are all used to, one of the recommendations in pandemic plans is that of social distancing. Recently, the Association of Corporate Travel Executives called for the temporary suspension of handshaking until the H1N1 threat "has been reduced to the status of the common cold."

3. **Sneezing/coughing into hands.** Remember being taught to use your hands to cover your nose and mouth if you cough or sneeze? The CDC now teaches children (and adults!) to sneeze or cough into the bend of the elbow instead. Public service announcements, featuring characters from children’s television programs, demonstrate this elbow-bend method and are often seen during prime-time hours so adults can change their unsanitary habits. Health and Human Services Secretary Kathleen Sebelius demonstrated this elbow-bend method during a press conference on Sept. 17, 2009, when a reporter sneezed into his hand rather than his arm. When you must blow your nose, use a facial tissue and immediately dispose of it, then wash your hands (or use an alcohol-based hand sanitizer if hand washing facilities are unavailable). If you are among the few men and women still carrying a cloth pocket handkerchief, break the habit and use disposable facial tissues. Imagine the contamination on your hands and clothing when reusing a cloth handkerchief soiled with mucus!

(Adapted from: www.cdc.gov/cleanhands — Grisso)
Could You Handle an Agricultural Emergency?

If you found someone caught in a farm machine, would you know what to do? Could you stop the engine? Do you know how to get help?

People living or working on a farm should be able to do most of the possible lifesaving tasks listed here. It is also a good idea for those who regularly travel country roads and visit farmers to know these basics – including people in ag sales, insurance, etc.

Obviously, if two people find someone in distress, one could go for help while the other assists the victim. But a person alone, depending on the situation, probably needs to alleviate the victim’s plight before seeking help. (Of course with cell phones, this is perhaps not the problem that it once was.)

Being trained in first aid techniques is a plus, especially if the victim is bleeding or stops breathing. Unless there is an immediate threat, such as fire, no layman should try to move the seriously injured person or attempt more than a simple extrication. Let experienced rescuers and medical people take care of those things.

Preparedness items one should know:
- Where and how to turn off the ignition on gasoline-powered equipment
- How to operate the fuel shut-off on diesel-powered equipment
- How to disengage the power-take-off (PTO)
- How to drive equipment forward and in reverse
- How to turn on the lights
- Where the fire extinguishers are and how to use them
- Where the electric power lines are in relation to movement of equipment
- How to turn off or disconnect electric power
- Where and how to turn off stationary farmstead equipment such as automatic grain equipment, grain dryer, silo unloader, conveyors, etc.
- How to turn off a portable auger or elevator
- How to operate hydraulic control levers
- How to raise and lower a tractor loader and bucket
- How to raise a combine head
- How to use safety bars on self-unloading wagons
- How to turn on the fans to get air moving in manure pits and confinement housing
- The location of the water container or tank in case of an anhydrous ammonia incident
- How to contact emergency or rescue personnel and knowing location identifier or address
- How to get emergency vehicles into various areas of the farm – especially if livestock are involved and they have to get into a pasture area
- The location of the best source of water for fire fighting

(From: Dr. Carol J. Lehtola, University of Florida)

For more information...

Farm Emergency and First Aid Kits:
http://www.extension.iastate.edu/Publications/PM1563K.pdf

First on the Scene Farmedic Program:

Article “First Response to Farm Emergencies”
http://www.nycamh.com/resources/safety_pubs/entry_detail.asp?article=119
Avoid Injury by Staying Alert Around All Cattle

Majority of livestock attacks did not result in fatalities, but attacks can lead to many bruises, broken bones and crushed egos. Most of the victims have been experienced cattle producers, veterinarians, agriculture educators and even extension specialists. Statistics support the fact that farming is one of the most dangerous occupations.

DANGEROUS JOB

National and Virginia statistics show livestock, machinery and falls as the dominant sources of occupational injury on farms. Some studies show that up to one-third of injuries on the farm are associated with livestock. While many cattle are placid, they weigh over six times the weight of a man and can crush bones with a single kick, step or charge.

It is important that all livestock handlers recognize the different behavior factors when working around livestock.

In fact, the Centers for Disease Control and Prevention (CDC) released a study that documented farm worker fatalities in Missouri, Iowa, Kansas and Nebraska. There were 21 cattle-related deaths in these four states from 2003 to 2008. Of these deaths, 13 involved attacks by individual bulls, six involved attacks by individual cows and five involved multiple cattle.

DOCILE ANIMALS

Most attacks have resulted from animals that had never acted aggressive toward their handlers before. Some may even have been show animals that were broke to load or otherwise were very docile. Victims usually can recall that on the day of the attack some unusual circumstances could have caused the animal to blow up.

Cows are more prone to do this if you’re doing something to their newborn calf and you get between the cow and her baby. Dogs may irritate her and she could take out her frustrations on the nearest intruder which could be the owner. Bulls tend to become aggressive around cows that are in heat or when other bulls invade their spaces.

Don’t assume that an animal that’s halter broken or that you’ve petted out in the pasture won’t have a bad day and their hormones take over. When this occurs, bulls or cows can surprise you at how fast they move. Your big beef or dairy bull may not be as fast but they will be quicker than you expect.

TIPS TO AVOID INJURY

- Be careful around livestock and have an escape route planned such as going under or over a fence or through a man pass.
- Carry a device that offers some protection in case of attack. Even though dogs can provoke an animal they can also sometimes help the owner escape.
- Nose rings in bulls can help control cattle in some situations.
- Remember, you may not move as quickly as you once did. It is also a good idea to have another person with you when working with newborns or moving bulls.
- Cull animals that act aggressive. Temperament or docility is a heritable trait and if you fear some animals in your herd are inherently mean, pay more attention to that trait when you select replacements.
- Do not be in a hurry and end up being careless. “Easy-does-it” is a good policy around livestock.
- Keep fences and gates in good repair and sturdy enough to protect you and your help.

(Grisso)
Agricultural Air Quality Perceptions

(By Jactone Arogo Ogejo, Nancy Franz, and Kurt Stephenson)

Our National Institute for Food and Agriculture research project (#2009-55112-05214), “Integrating Education and Development of a Biodegradable Litter Amendment to Mitigate Ammonia Emissions from Poultry House” includes an Extension component. As part of this work we conducted four listening sessions on agricultural air quality with 44 agricultural agency representatives, farmers, and Extension agents/specialists. The purpose of the listening sessions was to gather information from the community (stakeholders) about their perceptions, concerns, what they would like to know, and who should be educated about agricultural air quality. We made a short presentation to introduce the subject and then solicited stakeholder reaction. These meetings were very informal but facilitated to meet our objectives. Meals were served at each meeting. The common themes from these sessions are found below.

Participants stated that they attended the sessions voluntarily to learn more about agricultural air quality (AAQ), how it is measured, current regulations or impending regulations for AAQ, and to get information on the topic to share with others.

Agricultural air quality topics and emerging issues that were most important for the participants included odor, ammonia, land use changes and ensuing conflicts (land being developed for housing near farms), measuring AAQ, how measurements/models are developed, regulations, particulates/dust, spreading nutrients, and federal (EPA), state, and local regulations and interpretation.

Listening session participants wanted educators to provide comparisons between agricultural air pollutants and other examples of air pollution (i.e. dairy cows and household pets e.g. dogs), to highlight good AAQ practices already being used by farmers, to realize the psychological aspects of AAQ that people smell with their eyes, the need for general awareness of agriculture by the public, and the interrelationships between AAQ and water quality. Agricultural AQ appears to be a relatively new issue for many communities in Virginia.

The listening session participants felt the audiences for AAQ education should be broad and include the general public, school children, agricultural professionals, intermediaries, and producers. The suggested educational topics for each audience were:

- General public - agricultural awareness-connection to food, AAQ awareness, current AAQ BMPs being used by farmers, AQ comparisons between agriculture and other sources, expectations for living in a rural agricultural area, AAQ research, and AQ regulations
- School Children - agricultural awareness, actions to help make change, current AAQ BMPs being used by farmers, and AQ comparisons between agriculture and other sources. Extension educators were asked to work through current school programs and curriculum/SOLs and to strive to inform adults through children.
- Agricultural professionals (agents, agency workers) - awareness of regulations, why AAQ is an issue, what is (Continued on page 19)
Agricultural Air Quality Perceptions (cont.)

AAQ, measuring AAQ, models of what others are doing about AAQ, and BMPs for farmers to implement.
• Intermediaries (sheriff, health workers, zoning and planning workers, county supervisors,) – agricultural awareness referral resources, AAQ awareness, and AAQ regulations.
• Producers – regulations, types of emissions and sources, BMPs from new technologies/research, cost recovery/incentives for BMP adoption, measurement, a simple model for measuring AAQ, exposure information, AQ comparisons between agriculture and other sources, and incentive information. Producers want to learn from each other and to become aware of how the public perceives them. Extension educators were asked not to pit commodities against each other in their educational efforts (i.e. pigs smell more than cows). Commodity groups were also asked not to create conflict with each other in terms of who produces more odor.

Participants were asked how education should be delivered. They responded that many methods should be used to reach a variety of learners and learning preferences. Some believed offering a meal or joining with the agenda of other training, events, or established youth education programs were important incentives to enhance participation. They felt neighbors (early adopters) educating neighbors and farm tours were successful educational methods. The listening session participants also suggested success comes from a positive approach with short messages that reach people where they are at. Fact sheets, web, You tube and short sound bites for TV and radio. They requested that fact sheets be short and easy to read.

To improve the likelihood of success with an Extension AAQ program, participants were asked what prevents them from learning. They felt time priorities, the importance of the topic, perceptions of the topic and host organization, personalities of the people involved, lack of incentives, vagueness of the relevance and concepts of AQ, weather, economics, and too much or complicated information prevented them from engaging in education. Conversely, they said incentives to learn such as mandates, meals, people (those who are easy to understand and be with), and saving money would help them more fully engage in learning. They also suggested that education needs to meet people where they are at with education—where and how they learn as well as making the case for how they value from the education. The listening session participants believe education is more successful if it is short, includes examples of successful BMPs, lays out economics/costs, is timely (i.e. spring is odor time), includes collaboration and a unified voice across groups (municipalities, agricultural factions, and producers/industry). Producers want help with understanding and adopting new BMPs and incentive programs by showcasing successes and providing clear and simple BMPs. They hope the ultimate goal of AAQ education is the prevention of AQ mandates or regulations.

The factors that prevent farmers from adopting AAQ BMPs are similar to those that (Continued on page 20)
Agricultural Air Quality Perceptions (cont.)

hinder learning. Listen session participants believe these factors include time, distrust of who is behind the initiative and how models are created and used, the lack of practical, appropriate, evidence-based, clear, holistic BMPs, difficulty keeping up with innovations, economics/costs/incentives, a non systems approach, fuzziness/uncertainty/unfamiliarity with AAQ issues, concepts, and BMPs, poor timing of information/changes, and the decreasing voice of farmers in society (anti agriculture facts, internal agriculture facts, no municipal support). Other issues voiced about AAQ education included:

- AQ issues are not the farmer’s fault - the general public is at fault for being unsympathetic to agriculture and unaware of agriculture
  - Holistic and unifying approach to AAQ needed
  - Farmers need to become aware of what other groups are saying and doing about ag AQ
  - Farmers fear mandates that will require costly measures
  - Land use changes that create conflicts are driving AAQ
  - AAQ is still unclear or not seen as relevant by many
  - AQ means different things to different people
  - The psychological AQ needs to be addressed (what people see is what they believe)
  - Producers are interested in new technologies/BMPs
  - Farmers want to know what others are doing to deal with AAQ

We hope these thoughts from agricultural stakeholders in Virginia will inform AAQ educational efforts across the nation.

Agricultural Air Quality Education Program

We are developing an Extension program on agricultural air quality (AAQ) as part of a NIFA funded research project. We invite you to help us with this process. Attached you’ll find a summary of four listening sessions we held in December and January at Abingdon, Eastern Shore, Rocky Mount, and Harrisonburg on AAQ. The AAQ topics and issues most important to participants included:

- odor
- Ammonia
- land use changes and ensuing conflicts (land being developed for housing near farms)
- measuring AAQ
- how measurements/models are developed
- particulates/dust
- spreading nutrients
- Federal (EPA), state, and local regulations and interpretation.
- nitrogen loading of the Chesapeake Bay related to AAQ

We are beginning to design education materials on these topics and

- defining AAQ
- sources of air pollutants
- best management practices to reduce emissions.

We will also gather information on factors that influence adoption of air quality best management practices by producers and develop a model to help them select appropriate technology.

Please feel free to share your thoughts and advice with us as we develop this new Extension program so we can help you better serve your clients and help them be successful.

Jactone Arogo Ogejo
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It is that time of year when manure that has been in storage the last 4-6 months will be applied to land. Here are a few reminders you may want to share with your clientele in your regular communications – newsletters.

DO NOT enter manure storage areas if at all possible. Many people have died when they entered manure storage areas without proper safety precautions. Remember that when manure is agitated the conditions around manure storage area present the greatest risks of danger. Moving or agitating manure increases the release of dangerous gases several folds. The following procedures will minimize, but not eliminate, the risks of death, if you must enter a manure storage area.

1. If manure storage structure is enclosed, take precautions and provide extra ventilation to buildings over or near the manure storage, when agitating, pumping, or moving manure.

2. Test the oxygen level to make sure that adequate oxygen is available. Also test for hydrogen sulfide (which is a toxic gas) to be sure that concentrations are less than 10 ppm.

3. Continuously monitor the oxygen levels as it will be consumed while working in a manure storage area.

4. Provide additional forced ventilation to increase oxygen and decrease hydrogen sulfide and other toxic gases while working in the area.

5. Anyone working in a confined space or manure storage area should wear a body harness with a safety line. There should be enough people and/or a winch in the area to hold the safety line ready to pull the worker out of the area should a problem develop.

6. Wear a supplied air respirator if oxygen levels are below the safe concentration or gases are present at toxic levels. The person using a respirator should be trained on the use of the mask. It is particularly important that the mask form a tight seal around the face.

7. Provide a clear escape path. Make it as easy as possible for the worker to exit the manure storage area quickly. No tools or other objects in the path.

8. Keep fire or anything that can create sparks (electrical tools, smoldering cigarettes, cigarette lighters) away from the area. There is a chance methane gas which is a byproduct of manure degradation, will be present and may cause explosion. Test the methane level with an explosion meter.

9. First aid. Someone on the site should be trained in CPR and first aid measures.

Some resources to consider:


Upcoming Publication:


Good manure management starts with the recognition and under-stating the value of manure as a resource containing nutrients for crop production and the potential negative impacts manure can have on air, water, and soil. This publication outlines the general guidelines about managing livestock and poultry manure and provides a list of resources with detailed information on specific topics on good practices for manure management and use.

(Jactone Arogo Ogejo)
New factsheet entitled: “Preventing Secondary Injuries in Agricultural Workplaces” has been posted at: http://pubs.ext.vt.edu/442-085/ The intention of this fact sheet is to reduce the number of secondary injuries by familiarizing the readers with secondary injuries and the steps they can adopt to minimize them. In addition to identifying common secondary injuries and the most vulnerable groups, the publication discusses steps that can be taken to prevent such injuries. The fact sheet also provides a list of agencies that farmers can contact for assistance when they experience secondary injuries.

A new factsheet that has been sent for publication but coming soon to VCE website is: "Assistive Technologies in Agriculture" which is sister publication of above. The intention is describe different type of Assistive Technologies used in agricultural workplaces. Assistive Technology (AT) is the bridge that can help farmers and ranchers with disabilities or primary injuries to continue to be productive while reducing opportunities for secondary injuries.

Many have used AT systems in the past to continue with their agricultural related activities (National AgrAbility Project - http://www.agrability.org). While some of these ATs are independent of the type of operation, many are operation-specific. The goal of this fact sheet is to introduce readers to the ATs used in agriculture and the steps involved in the design of a successful AT system. The fact sheet also cites AT systems used in agriculture that are common and operation-specific and how they influence secondary injuries. The fact sheet also lists agencies that can help farmers and ranchers with the implementation of ATs.

A new factsheet that has been sent for publication but coming soon to VCE website is: “Predicting Tractor Diesel Fuel Consumption.” The objective of this factsheet is to examine several methods that use the field measurements and Nebraska Tractor Test Laboratory results to estimate fuel consumption. Using these equations, farmers can estimate and compare the fuel savings for different operating and loading conditions.

General relationships capable of predicting tractor diesel fuel consumption are very useful for budget and management purposes but may not have the ability to compare fuel consumption for several potential engine configurations such as turbocharging and air densification components.

Finally, revision of the fact-sheet entitled, "Gear Up and Throttle Down — Saving Fuel" found at: http://pubs.ext.vt.edu/442/442-450/442-450.pdf will be soon ready for review. If you are interested in being a part of the review panel for this publication, contact Robert Grisso (rgrisso@vt.edu).

(Grisso)