



Mid-Atlantic Regional Agronomist Quarterly Newsletter

December 2006

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Comments, suggestions, and articles will be much appreciated and should be submitted at your earliest convenience or at least two weeks before the following dates: February 28, May 30, August 30, and November 30. The editor would like to acknowledge the kindness of Mr. Todd White who has granted us permission to use his scenic photographs seen on the front coverpage.

Table of Contents

Issue 1; Number 4

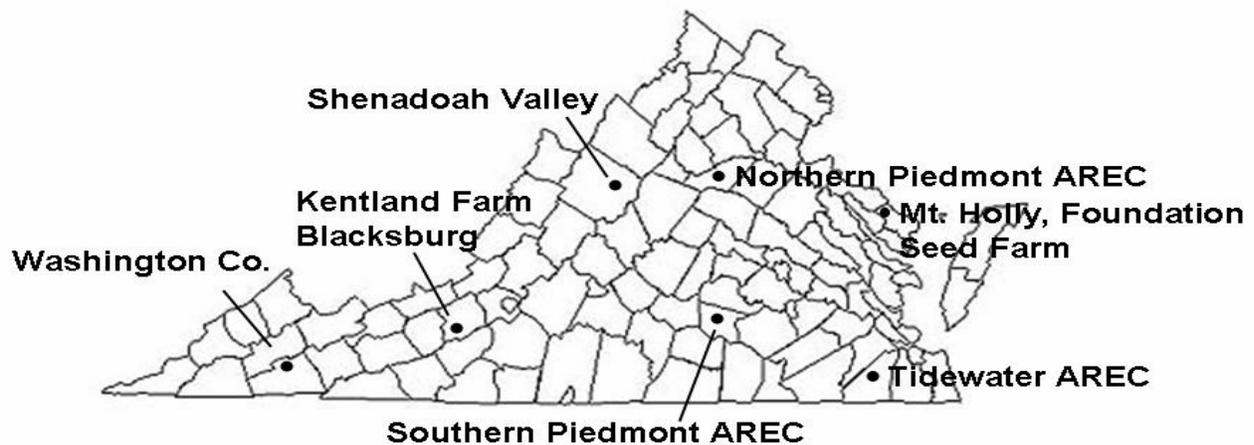
Table of Contents.....	2
Corn Hybrid Selection Strategies.....	4
Wheat Tissue Testing and Spring Nitrogen Rate Determination.....	6
Introduction.....	6
Sampling.....	7
Nitrogen Rate Determination.....	7
Falling Number Test for Wheat – What Does It Mean?.....	9
What is the falling number test?.....	9
What does the test measure?.....	9
What is starch?.....	9
What kind of damage to starch can occur during pre-harvest sprouting?.....	10
Why are too many sugar molecules in the starch (flour) a problem?.....	10
Does pre-harvest sprouting damage soft red winter wheat flour?.....	10
How is the falling number test conducted?.....	10
How can pre-harvest sprouting be avoided?.....	11
Biofuels and Crop Production in the Mid-Atlantic Region.....	12
Corn.....	13
Barley.....	13
Soybeans.....	13
Rapeseed/Canola.....	13
Switchgrass.....	14
High Fermentable Corn --- A Future Consideration in Hybrid Selection?.....	15
Stalk Versus Root Lodging in Corn.....	17
2006 Ohio Corn Performance Test: An Overview.....	18
Roundup Ready® Alfalfa for Dairy Protein or Thoroughbred Horse Hay.....	20
Understanding Cation Exchange and Percent Base Saturation.....	22
Notices and Upcoming Events.....	24
PAES Conference.....	24
Delaware Ag Week.....	24
Delaware—Maryland Hay and Pasture Day.....	24
Dairy Day.....	24
Agronomy/Soybean Day.....	24
Tri-State Conservation Tillage Conference.....	24
Tri-State Hay and Pasture Conference.....	24
2007 Area Forage Conferences, Armory, Suffolk, VA.....	24
2007 Southern and Central Maryland Hay and Pasture Conference.....	24
Southwestern PA Tillage Conference.....	24
2007 Area Forage Conferences, Central VA.....	24
2007 Area Forage Conferences, Southwest VA.....	24
Corn, Soybean, and No-Till Conference.....	25

Northeast Pasture Consortium 11th Annual Meeting	25
PASA Conference	25
Virginia Corn Growers, Virginia Soybean, and Virginia Small Grain Growers Associations' Joint Winter Meeting	25
Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, VA Horse Center, Lexington, VA.....	25
Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, Fair Grounds, Warrenton, VA.....	25
Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, High School, New Kent, VA	25
Virginia Crop Improvement Annual Meeting.....	25
Hay & Forage Conference	25
National Grass Fed Beef Conference.....	25
Grazing & Forage Conference	26
PA No-Till Alliance Conference	26
Newsletter Web Address.....	26

Corn Hybrid Selection Strategies

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Most agronomists and advisors recommend using multi-site and multi-year data to make corn hybrid selection decisions. This is often easier said than done, however. Many corn hybrids are only tested at a few sites where they are well adapted or are tested for a limited number of years in public testing programs. This forces growers to make decisions from a less than ideal database. When data are limited, it is important to use the most accurate method of hybrid performance assessment. A retrospective analysis of how well past performance predicted future performance of hybrids in the Virginia Tech Corn Hybrid Trials was conducted on data from 2003 to 2006. Each year experiments are conducted at eight locations in Virginia. There are both irrigated and non-irrigated trials at Mt. Holly.

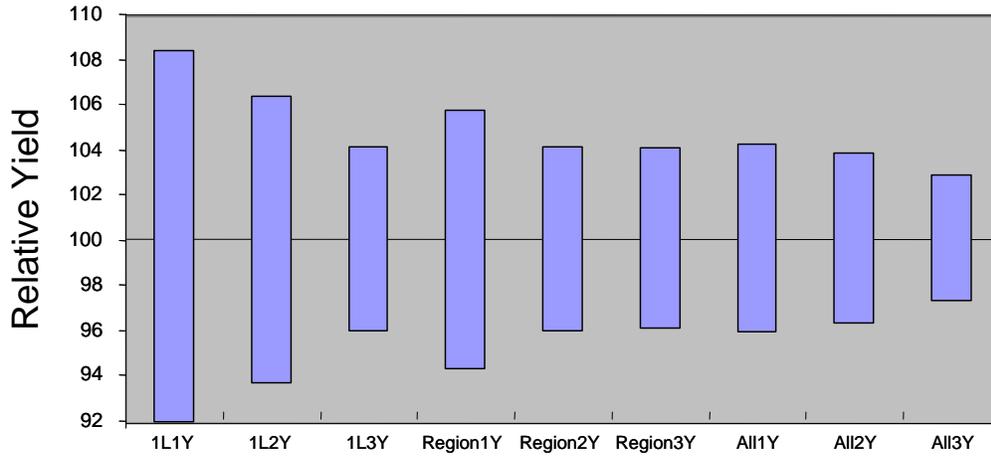


The selection strategies were as follows:

- **1L 1Y** - The top hybrid at a location in 1 year
- **1L 2Y** - The top hybrid averaged over 2 years at one location
- **1L 3Y** - The top hybrid averaged over 3 years at one location
- **REGION 1Y** - The top hybrid averaged over a physiographic (eg. Coastal Plain) in one year.
- **REGION 2Y** - The top hybrid averaged over a physiographic region in two years.
- **REGION 3Y** - The top hybrid averaged over a physiographic region in three years.
- **ALL (8) 1Y** - The top hybrid averaged over all locations in one year.
- **ALL (8) 2Y** - The top hybrid averaged over all locations in two years.

The following figure depicts the accuracy of each of these methods at predicting future performance. Using the 1L1Y strategy, if past performance would have predicted a relative yield

of 100%, one could expect an error of plus or minus eight percent. Even incorporating results from several trials conducted within a region in one year is not highly reliable. Much greater reliability of future yield could be estimated from performance data summarized over all 8 test sites over two or three years. If only limited data is available, it appears that the accuracy of prediction for the 1L3Y, Region2Y, Region3Y, and All 1Y is similar at plus or minus four percent relative yield.



Wheat Tissue Testing and Spring Nitrogen Rate Determination

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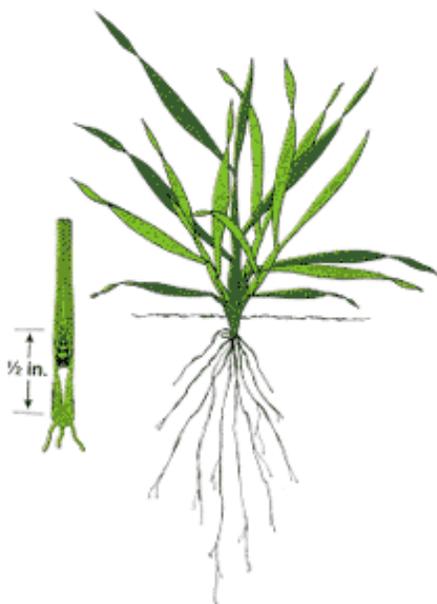
Introduction

Optimum N fertilization from January until jointing is absolutely essential to profitable wheat production. Research has shown that fall/early winter fertilization is generally very important to early tiller development. Tillers developed in the fall or winter produce larger numbers of wheat kernels per head than tillers developed in the spring. Fall/winter developed tillers also have deeper root systems that give greater protection against dry weather during grain fill in May or early June. Nitrogen timing and rate should be adjusted based on residual nitrogen available to the plant and time of planting. If the crop has already developed 100 or more tillers per square foot with three or more leaves in January (This will only happen in timely planted wheat with relatively large amounts of residual nitrogen) the crop does not need additional nitrogen until at least March. When wheat has 50-100 tillers per square foot it is desirable to apply only 30-40 pounds of nitrogen in January/February. Conversely, if the wheat has less than 50 tillers per square foot, 40-50 pounds of nitrogen per acre needs to be applied as soon as possible. January is too early to apply more than 50-60 pounds of nitrogen on most soils.

With the quantity of rainfall received in many locations this fall, denitrification and other N losses may have been experienced. If the crop exhibits a pale color or other nitrogen deficiency symptom, an early winter application of 20-25 pounds of N per acre may be warranted.

Tissue nitrogen (N) content in Virginia wheat at GS 30 can be directly related to final grain yield. This information can be used to adjust the second application of spring N to bring the crop to high yield levels. The first requirement for obtaining a good plant tissue sample for use in estimating N fertilizer requirement at GS 30 is to be certain that the wheat is in growth stage 30.

Growth Stage 30 Just prior to jointing



Growth stage 30 is when the leaf sheaths of the wheat are strongly erected and splitting the stem shows a hollow internode area about 1/2 inch in length.

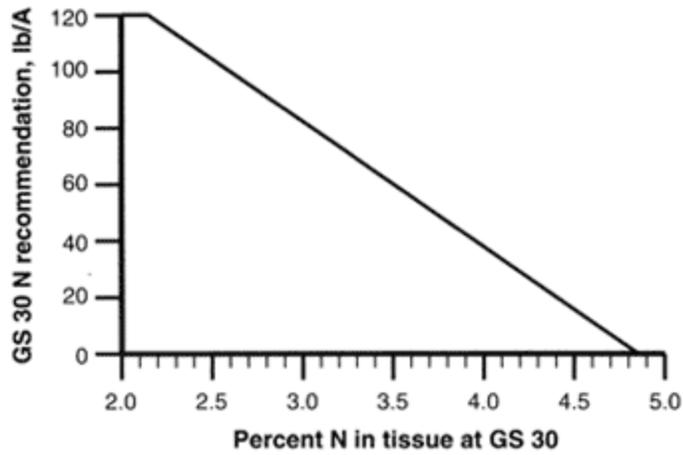
Sampling

A representative tissue sample from the field is essential for accurately predicting fertilizer N requirement at GS 30. The sample is taken by cutting a handful of wheat tissue at 20 representative areas in the field. The plants should be cut at approximately 1/2 inch above ground; soil particles brushed from the tissue; and dead leaf tissue removed from the sample. The individual samples should be placed in a paper bag large enough to allow good mixing of the tissue.

After thorough mixing of the tissue sample, take approximately three handfuls of tissue from the mixed sample and place in the sample bag provided by the laboratory, or in a clean paper bag. Samples should go directly to the laboratory. If samples cannot be analyzed within 24 hours from the time they are taken, they must be dried to prevent spoilage. Tissue samples should never be packaged in plastic bags due to condensation that can initiate sample decay.

Nitrogen Rate Determination

Use the graph below to obtain a rate recommendation from tissue test results. Up to 120 lbs. N/acre may be applied at growth stage 30 if no N was applied at growth stage 25 (due to high tiller density) and tissue N measured at growth stage 30 is low. Total spring N applications (growth stage 25 plus growth stage 30) should not exceed a total of 120 lbs. N/acre in order to avoid problems with lodging and yield loss. For example, if 40 lbs. N/acre was applied at growth stage 25, and tissue test results give a recommendation from the figure of 100 lbs. N/acre at growth stage 30, only 80 lbs. N/acre should be applied at growth stage 30.



Many agricultural testing laboratories can provide this analysis. Consult your Cooperative Extension agent or professional crop consultant for more information.

Falling Number Test for Wheat – What Does It Mean?

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Wheat harvest was just getting underway on the Delmarva last summer when it happened. The “monsoon” season began. Excessive rainfall (9-15 inches plus) was reported throughout the region between June 25 and July 6. And, if it wasn’t raining the skies were still overcast and humidity remained high. The rains were a welcome relief for the region’s cornfields but that relief came with misgivings as farmers waited to harvest their wheat wondering what was happening to the quality of the crop that had been assessed as good to excellent just one week earlier. It wasn’t long after the combines started to roll, that we were hearing that wheat quality had been severely impacted by the rainy weather with reports that falling numbers were low. Accompanying these low falling number reports were truckloads of wheat being rejected at the elevators and mills.

To some, this was a new term or at least one that had not been heard for a number of years. “What the heck is a falling number was often heard?” The following will hopefully answer some of questions that have been on producers’ minds since last wheat harvest.

What is the falling number test?

It is a laboratory test that measures the level of sprout damage that has been incurred by wheat that has experienced weather conditions (like those during 2006 harvest season) conducive to pre-harvest sprouting. The American Association of Cereal Chemists is the authoritative organization that has produced a regularly updated 20+ page document that describes the procedures for this test.

What does the test measure?

It measures the amount of damage that the starch in the wheat kernels has endured during pre-harvest sprouting.

What is starch?

Starch is the primary component of flour. It is simply sugar molecules linked together to form long chains that are called either amylose or amylopectin (the two primary forms of starch in wheat). The type of starch is determined by the type of chemical bond the sugar molecules made when they linked together.

What kind of damage to starch can occur during pre-harvest sprouting?

When pre-harvest sprouting conditions are experienced, the wheat kernel imbibes (absorbs like a sponge) water, the first step in the germination (sprouting) process. Absorbing water triggers the release of an enzyme (alpha-amylase) that is stored near the germ area of the kernel. The alpha-amylase migrates throughout the starchy portion of the wheat kernel with one goal, to cut the long chains of starch into shorter segments of sugar that will be used to feed the sprout. An easier way to envision what alpha-amylase is doing is to think in terms of the Pac-Man video game. Alpha-amylase is the Pac-Man and the link between any two sugar molecules that comprise the long-chain starch molecules is the dot that the Pac-Man is eating. Once the dots are eaten on both ends of a sugar molecule, a free molecule of sugar exists. Too many free molecules of sugar in the flour are detrimental to the products that will be made from it.

Why are too many sugar molecules in the starch (flour) a problem?

Flour is the primary product obtained when wheat is milled. Based upon the class of wheat (hard red winter, hard red spring, soft red winter, durum, hard white, soft white) grown, a number of different end products can be baked each respective flour type. Wheat is best known for producing flour that is used for bread. Bread flour that has damaged starch (too many sugar molecules) caused by pre-harvest sprouting has its baking properties changed to the detriment of the end-product, the loaf of bread. For bread wheat, flour that has been damaged by pre-harvest sprouting will have reduced mixing strength, sticky dough, reduced loaf volume, and shorter shelf life.

Does pre-harvest sprouting damage soft red winter wheat flour?

The mid-Atlantic region produces soft red winter wheat. The flour milled from this wheat is used for cookies, cakes, flat breads, noodles, pretzels, batters, etc. Research conducted in Maryland during the early 90's indicated that flour from soft red wheat that had been exposed to pre-harvest sprouting conditions would likely have less deterioration in its baking properties for some of its end-products than would occur for hard red wheat exposed to the same conditions. However, soft red wheat flour is not used solely for baking the various soft wheat products. Mills in this region will blend soft red flour with hard red flour for bread-baking purposes as well as other general use processes creating the need for sound soft red winter wheat with no pre-harvest sprout damage.

How is the falling number test conducted?

A sample of wheat is collected when the truck arrives at the elevator or mill. The sample is ground, a specific amount is placed into a tube and water is added creating a slurry. The slurry is stirred and heated to cause starch gelatinization (swelling). If sprouting has occurred, the sugar in the starch will cause the slurry to be less viscous (thick). A stirring rod is then dropped into the heated slurry and allowed to fall to the bottom of the tube. The length of time it takes for the rod to drop through the tube is the "falling number". Wheat that has not been damaged by pre-harvest sprouting will have falling numbers greater than approximately 300 seconds. Severely damaged wheat may have falling numbers 60 seconds or less.

How can pre-harvest sprouting be avoided?

A wheat kernel does not know that it is destined to be milled for its flour. Instead, it is genetically pre-programmed to sprout and grow into a plant to produce the next generation. The only characteristic that can influence a variety's susceptibility to pre-harvest sprouting is the length of its at-harvest dormancy period. Since this is a genetically controlled trait, the amount of at-harvest dormancy varies by variety. Some varieties are destined to sprout as soon as they have reached harvest maturity so when they experience weather conducive to pre-harvest sprouting they readily begin to germinate. Other varieties can endure short periods (a few days to a couple weeks) of pre-harvest sprouting weather after they have reached harvest maturity because their genetic code is telling them it is not yet time to germinate.

Unfortunately, breeding programs for soft red winter wheat do not routinely screen for pre-harvest sprouting resistance and susceptibility. So, there is no way for a farmer to know if the variety or varieties that have been purchased for production on his/her farm are susceptible or resistant to sprout damage until it is too late. If the level of susceptibility was known, those varieties that are most susceptible could be harvested first. However, when a harvest season like the one experienced during 2006 occurs, there is little that can be done even when a variety with reasonable resistance/tolerance to pre-harvest sprouting is grown. This leaves only one option, hope that the harvest season is sunny and warm allowing timely harvest of the crop. Fortunately, most of our wheat harvest seasons are not accompanied with a week to 10-days of rainy weather.

Biofuels and Crop Production in the Mid-Atlantic Region

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The recent interest in biofuels could be one of the most significant developments in agriculture in a long time. We will likely see many impacts on how we do business. We have already seen a dramatic increase in crop prices and will likely see shifting uses in crops, different cropping systems evolve and lots of opportunities for those who understand the issues.

One issue is to understand is the basis for the boom in biofuels. Biofuels, like grain and cellulosic ethanol and biodiesel, have fairly broad political support that was especially spurred by the spikes in gasoline prices this summer. But even before that, government policy was shifting to provide significant support to biofuel development at both the national and state level. The Energy Policy Act of 2005 passed by our federal government and much state recent legislation has provided a great boost to investment in this industry.

Biofuels are a new market for our grain crops and provide some basis for higher prices and in some situations can provide relief for high prices of imported oil. It's also important to understand that the impetus for biofuels goes beyond grain prices or gas prices at the pump. Rural development due to biofuels is an important consideration and has had a major impact in some states like Iowa and South Dakota. Reducing our dependence on foreign oil is another issue. Another issue is reducing the flow of dollars to oil producing countries that may not be that stable or friendly. Still another issue is the global warming issue and the need to reduce carbon emissions to the atmosphere. None of these is a simple issue, and there is no silver bullet. Many are suggesting that only with a long term vision, that includes biofuels, other alternative fuels, and energy conservation, can we address this issue.

Many new issues will surface as a result of the biofuel issue. One is the competition between feed and food. An excellent background on the biofuel and ethanol issue was recently released by the Council for Ag Science and Technology (CAST). Its entitled "Convergence of Energy and Agriculture: Implications for Research and Policy" and is available here: http://www.cast-science.org/cast/src/cast_top.htm It discusses the value of grain for energy versus feed, the economic opportunities of biofuels, the potential impact on the livestock industry and proposes some policy changes that are needed to move forward on this issue.

In our region, each potential biofuel crop has a different set of management issues and opportunities that agronomists should be aware of. I have summarized a few of these issues for several of our crops below.

Corn

Corn is a major crop in the region and can be used for ethanol production or for direct combustion in grain stoves or furnaces. Both of these areas have been experiencing rapid growth. Corn yields have been increasing in the U.S. by about 2% per year, causing surpluses and low prices. Corn is often undervalued based on its energy content. For example, a bushel of corn at \$2.50/bushel could be converted into 2.7 gallons of ethanol valued at \$2.50/gallon and 17 pounds of distillers grains. An average PA corn yield of 122 bushels per acre could produce 329 gallons of ethanol per acre. In addition the corn stover could be collected and used for cellulosic ethanol, or electricity, as some Penn State researchers recently showed (<http://live.psu.edu/story/18683>). As a home heating fuel, corn is worth about \$7.00/bushel when propane is \$2.00/gallon. Our Ag and Biological Engineering Department at Penn State has a good website that describes the relationship between fuel prices and the equivalent price of shelled corn as a home heating fuel (<http://energy.cas.psu.edu/burncorn/shellcorn.html>).

Barley

Barley is an alternative energy crop that is used as a substitute for corn. It requires less fertilizer and also grows over the winter, protecting the soil. In addition, many farmers can grow a crop of soybeans after they harvest the barley. Barley markets have been low as many feed companies prefer corn, so barley is often undervalued compared to corn. This has not stimulated barley production or research, but there is great potential for this crop to be a low cost alternative ethanol or home heating fuel crop. One special type of barley, called hulless barley, is being evaluated as an ethanol feedstock by researchers at Virginia Tech, the University of Maryland, Penn State and the University of Delaware. Hulless barley has a theoretical ethanol yield of about 2.4 gallons of ethanol/bushel, slightly lower than corn. In three on-farm demonstrations this year in Pennsylvania we were able to average 90 bushels of hulless barley (about 214 gallons of ethanol per acre) plus straw and then double crop the fields with soybeans.

Soybeans

Soybeans are a major Mid-Atlantic crop and are targeted as a key crop for biodiesel development. Soybean acreage has been increasing in Pennsylvania recently. Soybeans contain about 20-22% oil and 40% crude protein, so they contain much more protein than oil. The protein is used for animal feed. Oil yield per acre for a typical soybean yield of 41 bushels per acre is about 58 gallons. Historically, soybean processing has been limited in Pennsylvania, so most soybeans were sent to Ohio or Virginia for processing. Now, more interest has developed for processing soybeans in the region and for biodiesel production. One issue that is developing now is increasing demand for soy oil. Some new biodiesel plants are planning on the capability to use multiple feedstock to have the flexibility to deal with shortages of soybean oil.

Rapeseed/Canola

Rapeseed is another alternative oilseed crop that could be used for biodiesel production. Canola is a special type of rapeseed that produces food grade oils. These crops are primarily grown in the Dakotas and western Canadian provinces. They are also widely grown in Europe for

the rapidly expanding biodiesel industry there. They can be grown here and will yield well but there are no existing markets for the crop. Canola typically contains 40% oil and can produce oil yields of 129 gallons of biodiesel per acre from a production of 56 bushels per acre, so this crop has the potential of significantly increasing biodiesel production per acre compared to most other crops. Canola has some production issues like winterkill, disease, and shattering but improvements in varieties seem to have helped these issues. Both Penn State and Virginia Tech are involved in some evaluations of winter canola varieties with Kansas State University. At Penn State, we are also estimating the cost of production compared to other crops and formulating some recommendations for winter and spring production. We have seeded some winter canola and hope to make some biodiesel from it this summer.

Switchgrass

Switchgrass is a warm season perennial grass that has gained much popularity recently as a possible energy source for either cellulosic ethanol or in the near-term, as a feedstock for pellet stoves. Switchgrass requires relatively low inputs and can provide excellent winter wildlife cover. Dr. Paul Adler researchers at the USDA-ARS Pasture Systems Watershed and Management Unit on the Penn State campus have been evaluating switchgrass management for the past several years and recently published their findings in *Agronomy Journal*. One interesting finding of their study was that the ash content of switchgrass could be reduced by delaying the harvest until spring. Ash content of switchgrass is higher than some other feedstocks, so for use of the crop for pelletizing, it may be better to delay harvest. This could also reduce nutrient removal and provide good wildlife cover over the winter. Paul is also working with several groups to palletize some switchgrass to evaluate as an alternative to wood pellets. Other researchers at Cornell are evaluating cool season grasses for pelletizing and have developed a comprehensive website that includes a pellet stove evaluation (<http://grassbioenergy.org/intro/intro.asp>).

High Fermentable Corn --- A Future Consideration in Hybrid Selection?

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With several dry grind corn ethanol facilities under construction in Ohio, more attention is being given to the production of corn grain for that end-use. One frequently asked question is whether specialty corns for enhancing ethanol production are available?

Although some seed companies are developing hybrids better suited for ethanol production from grain than existing conventional hybrids, none of these hybrids are commercially available. According to the US Grains Council, one major seed company is developing corn with an “amylase gene”. Currently the enzyme “alpha-amylase” is added to ground corn to help speed starch conversion into sugars that can be fermented for ethanol production. Corn used in the production of ethanol, having the added benefit of the amylase enzyme, would be more efficient in breaking down starch into sugars and save steps in the ethanol process. This high amylase corn would be targeted for ethanol production and would require identity preserved grain production.

Presently, most seed companies are evaluating their existing conventional grain hybrids to determine which are best suited for ethanol production using the wet milling and dry grind ethanol production methods. More than 60% of current ethanol output is produced using the dry-grind corn process, whereas wet milling plants (corn refineries) account for the remainder. The dry-grind method produces more gallons of ethanol per bushel of corn grain, about 2.6 to 2.8 gallons per bushel, than the wet milling procedure, which produces about 2.5 gallons per bushels. Most of the growth in U.S. ethanol production in recent years has resulted from new dry-grind plants, and it’s expected that this method will be the most widely used method for ethanol production in the future.

Hybrids with high levels of extractable starch (HES) are best suited for ethanol production using the wet milling procedure. Such hybrids are often characterized as high extractable starch hybrids. Hybrids best suited for the dry-grind procedure generally contain high total fermentables (HTF) and are currently being characterized as HTF hybrids or highly fermentable corn hybrids. Hybrids with HTF may not necessarily include the HES trait, nor is either trait necessarily correlated with total starch content. Some hybrids naturally release a higher percentage of the kernel’s starch in the wet milling process. The HES trait is related to the extractability of starch from the kernel. Total fermentables are the sum of all starch and simple sugars that can be utilized by yeast cells used in the fermentation process to produce ethanol. Many hybrids with HES or HTF have high grain yield potential and are widely adapted to Corn Belt growing conditions. Unlike most specialty corn traits, HES and HTF do not require rigorous IP protocols to ensure their expression.

Measurements of total fermentables have been widely used to assess the ethanol potential of grain for dry grind ethanol plants. We collected data on total fermentables in grain of hybrids entered in the 2005 Ohio Corn Performance Tests. Analyses of total fermentables were determined using a FOSS 1241 NIR analyzer and total fermentables expressed as grams CO₂ per 100 grams dry weight of grain. We are grateful to Mike Newland at Greater Ohio Ethanol, LLC for conducting these analyses. Total fermentables in grain were measured at three Ohio test sites. Averages for total fermentables across the three sites ranged from 38.4 to 38.7 grams CO₂ per 100 grams dry weight of grain (Table 1). Although the range in values for total fermentables in grain among hybrids was usually less than 5% at any location, these small differences can be highly significant according to operators of dry grind ethanol facilities.

The results of this evaluation suggest that many of the hybrids entered in the 2005 Ohio Corn Performance Test would be suitable for use by dry grind ethanol operations. One of the companies currently building a dry grind ethanol plant in Ohio has indicated that it might pay a premium for grain with high total fermentables. Grain with total fermentables of 38.3-38.4 grams CO₂ per 100 grams dry weight could receive a premium of \$0.02/bu. With higher total fermentables, 38.7-38.8 grams CO₂ per 100 grams dry weight, premiums could increase to \$0.06/bu. Our measurements of hybrid total fermentables indicated that 68% to 88% of the hybrids entered in the three regional 2005 test locations had levels of total fermentables equal to or exceeding 38.3 grams CO₂ per 100 grams dry weight; 37% to 50% of the hybrids entered had levels of total fermentables equal to or exceeding 38.7 grams CO₂ per 100 grams dry weight.

Table 1. Total fermentables as grams CO₂ per 100grams dry weight of grain in grain of hybrid entries at three Ohio Corn Performance Test locations in 2005.

South Charleston	Hoytville	Bucyrus
Avg: 38.7 (107)* Range: 37.6 - 39.4	Avg: 38.5 (123) Range: 37.5 - 39.5	Avg: 38.4 (82) Range: 37.3 - 39.3

* Number of hybrid entries in parentheses

Preliminary data from another 2005 evaluation suggests that differences in total fermentables in grain among hybrids were fairly consistent across locations, despite marked differences in rainfall during the growing season. Total fermentables were measured in nine hybrids ranging in maturity from 107 to 112 days planted at six Ohio locations. Hybrids producing the highest and lowest total fermentables were usually the same ones at each test site.

Stalk Versus Root Lodging in Corn

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A later than normal corn harvest contributed to some significant lodging problems across Ohio. When using the term ‘lodging’, it’s important to know what’s being referred to, especially with regard to hybrid selection decisions. University and seed company agronomists characterize plants with stalks broken below the ear as ‘stalk lodged’ plants (broken stalks above the ear are not a consideration). In the Ohio Corn Performance Test (and in other state corn tests and seed company trials), the number of broken stalks in each test plot is determined just prior to harvest and only those plants with a stalk broken below the ear are considered stalk lodged. Stalk lodging is recorded at harvest because it’s usually not evident prior to maturity. Stalk lodging is reported as a percentage of final plant stand. Stalk lodging in some of our research plots this year has exceeded 50%. Affected corn includes late planted non-Bt corn exhibiting moderate 2nd generation European corn borer injury

In contrast to stalk lodging, agronomists describe corn stalks leaning 30 degrees or more from the center, as ‘root lodged’ plants; stalk breakage below the ear is not involved. Root lodging can occur as early as the late vegetative stages and as late as harvest maturity. Both stalk and root lodging can be affected by hybrid susceptibility, environmental stress (drought), insect and disease injury. Root lodging is frequently attributed to corn rootworm injury. However, much root lodging in Ohio occurs as the result of other factors, i.e. when a hybrid susceptible to root lodging is hit by a severe windstorm. Recent tornado activity near Columbus flattened some corn fields. A hybrid may be particularly sensitive to root lodging yet very resistant to stalk lodging. A corn field may exhibit extensive root lodging in July but show little or no evidence of root lodging at harvest maturity in September (except for a slight “goose necking” at the base of the plant). As a result, while stalk lodging data is regularly included in corn hybrid test results, root lodging is reported less often. This year may be an exception. I’m seeing and hearing about a number of fields where much of the corn is nearly flat on the ground. While stalk lodging may be significant in some of these situations, it’s going to be difficult to separate the root and stalk lodging because of the severe root lodging.

2006 Ohio Corn Performance Test: An Overview

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In 2006, 225 corn hybrids representing 38 commercial brands were evaluated in the Ohio Corn Performance Test. Testing was conducted in three regions of Ohio - Southwestern/West Central (SW/WC); Northwestern (NW); and North Central/Northeastern (NC/NE), with three test sites established within each region. Testing was also conducted at Coshocton, an area with high gray leaf spot incidence. Entries in the regional tests were planted in either an early or full season maturity trial. These test sites provided a range of growing conditions and production environments.

Environmental conditions varied greatly across Ohio during the 2006 growing season, especially with regard to the amount and distribution of precipitation. Cool, wet soil conditions during emergence and early vegetative growth were followed by warm, dry conditions that began in mid-late July. Temperatures during grain fill were warmer than normal and rainfall was generally below normal. However, after Sept 1 conditions were cooler and wetter than normal. The month of October was the second wettest in 124 years and 2006 was one of the latest, coldest, and wettest harvest seasons of the last 40 years. Although growing conditions were generally warmer and drier than normal during the grain fill period (approx. mid July through late August), excellent yields were recorded at several test sites.

Tables 1 and 2 provide an overview of 2006 hybrid performance in the early maturity and full season hybrid trials by region. Complete results are available online at: <http://www.oardc.ohio-state.edu/corntrials/>. Averages for grain yield and other measures of agronomic performance are indicated for each region. In addition, the range in test sites averages is shown in parentheses.

Table 1. A regional overview of the early maturity 2006 Ohio Corn Performance Test.

Region	Entries	Grain Yield (Bu/A)	Moisture (%)	Lodging (%)	Emergence (%)	Final Stand (plants/A)	Test Wt. (lbs/bu)
SW/WC	41	205 (180-231)	18.9 (17.8-20.7)	18 (1-49)	93 (85-98)	28900 (25600-34400)	57.5 (54.4-60.8)
NW	61	187 (168-209)	19.3 (17.9-22.3)	6 (1-28)	95 (79-98)	31100 (25900-37900)	56.9 (54.1-59.3)
NE/NC	51	187 (164-214)	19.8 (17.9-22.3)	16 (0-69)	95 (88-99)	30400 (27000-33500)	56.6 (53.7-58.9)

Table 2. A regional overview of the full season 2005 Ohio Corn Performance Test.

Region	Entries	Grain Yield (Bu/A)	Moisture (%)	Lodging (%)	Emergence (%)	Final Stand (plants/A)	Test Wt. (lbs/bu)
SW/WC	70	212 (182-251)	18.3 (16.7-21.2)	9 (1-28)	94 (72-99)	29000 (24500-32600)	57.7 (54.5-60.2)
NW	72	189 (166-218)	20.7 (19.0-22.8)	3 (0-34)	94 (87-98)	30300 (26800-33600)	56.6 (53.2-60.1)
NE/NC	58	194 (169-219)	22.3 (19.8-24.4)	5 (0-33)	96 (89-99)	30000 (26400-33700)	55.7 (52.3-59.5)

More information on the Ohio Crop Trials is available at
<http://www.ag.ohio-state.edu/~perf/index.html>

Roundup Ready® Alfalfa for Dairy Protein or Thoroughbred Horse Hay

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Much has been written on and many have talked about concerns and costs for Roundup Ready® alfalfa. The technology can add significantly to the initial establishment cost for a very valuable farm-produced protein source. The dairy farmer/operator must decide if the benefits in terms of weed control, initial stand establishment (ease, stand density, and reliability) exceed the cost of the technology at today's milk price. Following are some of the factors that a grower should consider when making the decision.

Companion crops, such as oats, have often been used to suppress weeds in newly-planted alfalfa fields. A number of research reports have suggested that there are negative consequences when companion crops are used especially if weather-related stresses occur early in the establishment phase. By switching to a Roundup-Ready alfalfa variety, stand density can be improved as well as increasing the likelihood of a successful seeding. Consistent, reliable elimination of weed competition by using Roundup-Ready alfalfa can reduce the risk of seeding failure from factors such as drought.

Up to now after initial establishment of conventional alfalfa, the most severe weed-related problem has been competition from late-season annual grasses (foxtails, crabgrass, and fall panicum). Alfalfa stands can be severely impacted by late-season annual grasses with stand longevity reduced by 1 to 3 years. This problem is most severe during periods of summer drought. Many producers either ignore the problem or do not identify the problem early enough to prevent alfalfa stand and yield losses. And, too often, an annual grass problem is not recognized until the grass is much larger than the recommended size for glyphosate control. As more producers adopt Roundup Ready alfalfa and this problem affects the new stands, growers must keep in mind that other grass materials are available to control annual grasses and should be employed just to rotate herbicide mode of action to prevent the development of glyphosate resistant weeds.

In situations where other Roundup Ready crops are part of a field's rotation and a glyphosate product is routinely applied, do not plant Roundup Ready alfalfa because it will be too easy and tempting to choose to make additional glyphosate applications. In the mid-Atlantic region, weeds such as marehail have developed resistance to glyphosate. Since there are alternative herbicides available for alfalfa, it is strongly recommended that non-Roundup Ready alfalfa varieties be used in rotations or fields where other Roundup Ready crops are part of the rotation.

Fields with perennial weeds or heavy weed seed banks are ideal candidates for Roundup Ready alfalfa. In these cases, when you rotate back to corn silage, choose a non-Roundup Ready corn hybrid and use a conventional herbicide program to help minimize the risk for glyphosate-weed resistance.

For fields where you expect light to moderate annual weed pressure at alfalfa planting time and there are no hard-to-control perennial weeds present, Roundup Ready alfalfa may or may not be the appropriate choice depending on economics. Research has noted that the use of Roundup Ready alfalfa can help ensure an excellent initial stand of alfalfa and minimize competition from weeds. Alfalfa seedlings often establish slowly and can be sensitive to the competitiveness of annual weeds. Research has shown that early weed control during establishment can reduce the level of stress on alfalfa (water, light, nutrients), increase seedling weight and leaf number, and improve first year following establishment yields. An improvement in leaf number and stand density (higher leaf to stem ratios) can indicate improved digestibility, crude protein, and feed value for dairy cattle and therefore help producers recover some of the initial investment cost of Roundup Ready alfalfa. Glyphosate should be applied to seedling alfalfa at the 3 to 5 trifoliate leaf stage and when weeds are less than 4 inches tall to maximize alfalfa competitiveness and establishment.

When producers are growing pure alfalfa for the thoroughbred horse hay market where it is critical to produce alfalfa hay that is free of noxious, low-quality, and potentially poisonous weeds, Roundup Ready alfalfa can add significant value. Typically, no single herbicide, including Roundup, controls all the weeds present in many alfalfa fields but with proper herbicide timing and management glyphosate can help minimize weed problems in these fields.

Industry data indicate that yield in the first few years of the stand's life can help pay for the increased seeding costs when using Roundup Ready alfalfa. However, there are also conflicting reports that suggest longer pay back periods so when first adopting this technology start with small acreage and keep track of expenses so you can evaluate the benefits versus costs.

Please refer to the following publication for additional information: Dillehay, B. L. and W. S. Curran. 2006. "Guidelines for Weed Management in Roundup Ready Alfalfa" Agronomy Facts 65. The Pennsylvania State University, College of Agricultural Sciences.
<http://cropsoil.psu.edu/extension/facts/agfact65.pdf>

Understanding Cation Exchange and Percent Base Saturation

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We often talk about cation exchange capacity and percent base saturation in the soil but I wonder how many folks really know what is meant by these terms and whether they really impact a farming operation. Depending on where you have soil tests done, you may receive a soil test report that will describe your soil's cation exchange capacity in units called either milliequivalents per 100 grams of soil (meq/100g or just meq) or centimoles per kilogram of soil (cmol kg⁻¹ or just cmol). The soil test results also may list the percent base saturation for calcium (Ca), magnesium (Mg), and potassium (K) [sometimes sodium (Na) is also reported] plus your soil's exchange acidity. So just what do all these numbers mean?

Let's start with cation exchange capacity (CEC). Plants produce hydrogen ions (H⁺) and bicarbonate ions (HCO₃⁻) in their roots where they are available for exchange with the soil. So, envision a crop plant's roots covered mostly in hydrogen ions with a scattering of bicarbonate ions. These ions on the roots are called cations if positively (+) charged and anions if negatively (-) charged. They can be exchanged for other cations or anions that are either free-floating in the soil solution (the water in the soil) or are attached loosely to exchange sites on either soil clay particles or soil humus (organic matter) particles. Cations and anions can have one or more charges (+ or -) associated with the ion and generally the more charges the stronger the attraction to the soil or OM exchange sites. As plants take up cations such as calcium (Ca⁺⁺), magnesium (Mg⁺⁺), potassium (K⁺), manganese (Mn⁺⁺), zinc (Zn⁺⁺), copper (Cu⁺⁺), ammonium (NH₄⁺), and others from either the soil solution or from the exchange sites on clay or humus particles, an equal number of hydrogen ions (+ charges) are released into the soil solution or are added to the exchange sites on the soil particles. The hydrogen ions are what add acidity to the soil so as acid is added and basic cations are removed from the soil, the soil solution gradually becomes lower in pH or more acidic. Soils, especially heavier soils or soils with more soil organic matter (SOM) can buffer or modify the addition of the acidity so the pH does not decline as fast as it would on very sandy, low organic matter soils. Nevertheless, with time the soil gradually acidifies and requires the farmer to replace the basic cations lost by adding limestone. For soils with low buffering capacity, typical of the sandy soils on the coastal plains, more frequent but smaller additions of limestone will be needed to keep the soil pH in a desirable range.

The soil's CEC is measured in units that account for the number of positively-charged ions that can be held on the soil particles. Although the units can be expressed differently (meq or cmol), they have equal value. As a soil manager interpreting the soil test result, the greater the CEC number is, the better able the soil is to store enough cations for crop growth. How do we improve a soil's CEC? Since we cannot increase the amount of clay in the soil to improve CEC, the only option available is to increase the amount of soil organic matter or humus over time. Humus has the highest concentration of cation exchange sites per gram so even small changes in SOM can have significant beneficial effects on cation availability to crops. Using cover crops,

planting no-till, reducing the number of tillage operations, and adding manure or compost products to the soil are ways to gradually build SOM and CEC.

Now let's address those negatively-charged ions called anions such as sulfate (SO_4^{--}), nitrate (NO_3^-), chloride (Cl^-), molybdate (MoO_4^-), and orthophosphates (HPO_4^{--} or H_2PO_4^-) that are absorbed by the plant roots. When these anions are absorbed by the roots, there is a release from the roots of the same number of negatively charged bicarbonate (HCO_3^-) ions. A small quantity of anion exchange sites exist on most soils in this region making it unusual for soil test reports to even mention anion exchange capacity (AEC). But, it is measured in the same units as CEC. Since the soils in this region have so little AEC, the anions such as nitrate and sulfate often are leached out of the root zone especially on sandy soils. Still, the mechanism at work for cations does apply to anions to some degree.

If cation exchange is a way to measure the ability of the soil to supply positively-charged ions to crop plants, what does percent base saturation signify? Percent base saturation describes the percentage of the soil's exchange sites that are occupied by the basic cations (Ca, Mg, and K are the ones normally reported but you might sometimes see Na saturation reported). To calculate the percentage of the cation exchange sites occupied by each of these cations, the soil testing laboratory mathematically calculates the number of units (meq or cmol per unit of soil) of each basic cation and then calculates the relative proportion of the CEC that is occupied by that cation. The methodology and calculations are not as important as having percent base saturation for Ca, Mg, and K in the optimum range.

For Ca, the usual range is from 40 to 80% and is quite wide. If the soil pH is adjusted to a level that is desirable for the crop and soil type, anywhere within this range generally will result in good crop performance. Magnesium base saturation usually ranges from 5 to 15%. For K, the range can be from 1 to 5% although some soils with low CEC require the range to be held from 3 to 5% to ensure enough K for crop growth. Since lime is relatively inexpensive compared to adding an equivalent amount of K, the percent base saturation for Ca and Mg is more economically adjusted. As long as your soil test report states that there is an adequate amount of Ca, Mg, and K for crop growth and the soil pH is optimal, the exact proportion of the exchange sites occupied by each cation is not that important. The only one that might concern a dairy farmer is K which if too high can cause problems such as milk fever. This is related to the dietary cation-anion difference or DCAD which is the balance of the cations K and sodium to the anions sulfur (S) and chloride (Cl). While lactating cows need a positive DCAD (more cations than anions), dry cows during the last 3 to 4 weeks of pregnancy need a negative or anionic DCAD. Of the four minerals in DCAD, K is generally available in the forage in the greatest quantity and varies with forage grown and soil available K so it has the most influence on DCAD. Since the recent price rise for K fertilizers, growers are less likely to fertilize with K routinely and therefore soil K levels may decline in the future. This should result in fewer problems with high K soil levels unless fields are heavily manured.

I hope this gives you a little better understanding of cation exchange capacity and percent base saturation. If you have specific questions, please feel free to email the author at rtaylor@udel.edu.

Notices and Upcoming Events

January 16 & 17, 2007

PAES Conference. Contact Mary Johnston at 814-234-8771 for more information.

January 22-27, 2007

Delaware Ag Week, Harrington, DE. Contact Ed Kee at 302-856-7303 or email: kee@udel.edu

Delaware—Maryland Hay and Pasture Day, Monday, January 22, 2007

Dairy Day on Wednesday, January 24, 2007

Agronomy/Soybean Day, Thursday, January 25, 2007

January 23, 2007

Tri-State Conservation Tillage Conference, West Middlesex, PA. Contact Joe Hunter at 814-333-7460 or jmh7@psu.edu for more information.

January 23, 2007

Tri-State Hay and Pasture Conference, Quality Inn, Somerset, PA. Contact Dr. Les Vough at 301-405-1322 or vough@umd.edu for more information.

January 23, 2007

2007 Area Forage Conferences, Armory, Suffolk, VA (8:00 am registration to 3:30 pm).

Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

January 24, 2007

2007 Southern and Central Maryland Hay and Pasture Conference, Izaak Walton League, Waldorf, MD. Contact Dr. Les Vough at 301-405-1322 or vough@umd.edu for more information.

January 24, 2007

Southwestern PA Tillage Conference, Giannelli's II, Route 30, Greensburg, PA. Contact Leanne Griffith, Westmoreland Conservation District, 724-837-5271, ext. 211 or leanne@wcdpa.com for more information.

January 24, 2007

2007 Area Forage Conferences, Central VA, Community College, Lynchburg, VA (8:00 am registration to 3:30 pm). Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

January 25, 2007

2007 Area Forage Conferences, Southwest VA, 4-H Center, Abingdon, VA (8:00 am registration to 3:30 pm). Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

January 26, 2007

Corn, Soybean, and No-Till Conference, Holiday Inn, New Cumberland, PA. Contact Greg Roth at 814-863-1018 or gwr@psu.edu for more information.

February 1-2, 2007

Northeast Pasture Consortium 11th Annual Meeting, Days Inn, State College, PA. Contact Becky Casteel at 304-293-6131 Ext. 4231 or by Fax at 304-293-6954.

February 1-3, 2007

PASA Conference. Contact Mary Barbercheck at 814-863-2982 or meh34@psu.edu for more information.

February 7, 2007

Virginia Corn Growers, Virginia Soybean, and Virginia Small Grain Growers Associations' Joint Winter Meeting. Colonial Downs Racetrack, Providence Forge, VA. For more information contact: Molly Pugh at 757-421-3038.

February 8, 2007

Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, VA Horse Center, Lexington, VA (8:00 am registration to 3:30 pm). Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

February 9, 2007

Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, Fair Grounds, Warrenton, VA (8:00 am registration to 3:30 pm). Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

February 10, 2007

Forages for Horses: Maintaining a Healthy Animal, Pasture, and Environment, High School, New Kent, VA (8:00 am registration to 3:30 pm). Contact the Va Forage and Grassland Council or Va Cooperative Extension for more information and registration materials.

February 14 to 15, 2007

Virginia Crop Improvement Annual Meeting. For more information contact: VCIA main office 804-746-4884.

February 27, 2007

Hay & Forage Conference, Grantville, PA. Contact Marvin Hall at 814-863-1019 or mhh2@psu.edu for more information.

February 28–March 2, 2007

National Grass Fed Beef Conference, Grantville, PA. Contact Marvin Hall at 814-863-1019 or mhh2@psu.edu for more information.

February 28, 2007

Grazing & Forage Conference, Grantville, PA. Contact Marvin Hall at 814-863-1019 or mhh2@psu.edu for more information.

March 13 & 14, 2007

PA No-Till Alliance Conference, Ramada Inn, State College, PA. Contact Jeff McClellan at 814-863-4260 or jtm23@psu.edu for more information.

Newsletter Web Address

The Regional Agronomist Newsletter is posted on several web sites. Among these are the following locations:

<http://www.grains.cses.vt.edu/grains/Articles/articles.htm>

or

www.mdcrops.umd.edu