



Mid-Atlantic Regional Agronomist Quarterly Newsletter

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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 cover page. Please go to www.scenicbuckscounty.com to view more photographs.

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Tip Dieback and Zipper Ears in Corn

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Drought stress during the 2007 growing season has resulted in a wide range of ear development problems. Of these, unfilled ear tips, i.e. ears of corn with no kernels and/or undeveloped kernels on the last two or more inches of the ear tip, are among the most common. Several factors may cause this problem. The ovules at the tip of the ear are the last to be pollinated, and under certain conditions only a limited amount of pollen may be available to germinate late emerging silks. Pollen shed may be complete before the silks associated with the tip ovules emerge (not uncommon under drought stress). As a result, no kernels form at the ear tip. Severe drought stress may result in slow growth of the silks that prevents them from emerging in time to receive pollen. Uneven plant development within fields may have magnified this problem. Pollen feeding and silk clipping by corn rootworm beetles and Japanese beetles also contribute to pollination problems resulting in poorly filled tips and ears. I've observed this insect injury in late-planted (late May/early June) corn fields, especially field surrounded by early (late April/early May planted corn). In several fields, the damage has been extensive with many ears showing most cob and only a few scattered kernels.

Incomplete ear fill may also be related to kernel abortion. If plant nutrients (sugars and proteins) are limited during the early stages of kernel development, then kernels at the tip of the ear may abort. Kernels at the tip of the ear are the last to be pollinated and cannot compete as effectively for nutrients as kernels formed earlier. Stress conditions; such as heat and moisture stress, nitrogen deficiency, hail, and foliar disease damage; may cause a shortage of nutrients that lead to kernel abortion. Periods of cloudy weather following pollination or the mutual shading from very high plant populations can also contribute to kernel abortion. Some agronomists characterize the kernel abortion that occurs at the end of the ear as tip dieback. Kernel abortion may be distinguished from poor pollination of tip kernels by color. Aborted kernels and ovules not fertilized will both appear dried up and shrunken; however aborted kernels often have a slight yellowish color.

Another widely observed ear development problem involves ears with missing kernel rows on the side of the cob away from the stalk that give a zippering look on the ears. The zippering often extends most of the cob's length. The zippering is due to kernels that are poorly developed and/or ovules that have aborted and/or not pollinated. Affected ears are often associated with corn plants which have experienced drought stress during early grain fill; cobs associated with the zippering are usually smaller than normal and poor tip fill is usually present. Differences in the degree of zippering among hybrids are evident. What's difficult to explain is why this very distinct "missing row" anomaly occurs on the outside or underside of the ears fairly consistently.

Some of the explanations for zipper ears that I've heard are discussed below. Silks attached to the kernels (associated with the missing row) may have been covered up by other silks and

simply did not get pollinated; or, more likely, were pollinated late and as a result were more prone to abortion. Another possibility is differential corn rootworm beetle silk clipping and feeding. In this case, it may be that beetles are below the ear during daytime hours and have preferentially clipped the silks of kernels facing downward. A third possibility is differential kernel growth rate on the ear. Under drought stress, silk emergence can be slower than pollen shed. It may be that silks on the outside or underside of the ear emerge more slowly than those facing the stalk. If this occurs as a result, they may be pollinated later or emerge after pollen shed is complete. The later pollinated kernels may be out-competed for limited photosynthates by other kernels which are larger and further along in development, and thus more effective in competing for the limited supply of photosynthates (similar to the problem that occurs with kernel abortion that occurs at the tip of the ear - "tip dieback"). Finally, small, short ear shanks might play role in this problem - if the shanks collapse or pinch (due to drought) perhaps it might impair the vascular tissue conducting nutrients to kernel rows on the outside or underside of the ear.

In studies in which corn plants have been subjected to severe defoliation during the late silk and early blister stages, we've observed the resulting ears to show zippering, which suggests that a sudden reduction in photosynthate supply may be a factor. The zippering did not occur when plants were subject to similar defoliation at the milk or dough kernel development stage.

Late Season Flood Damage to Corn: Management Considerations

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Recent flooding in parts of Ohio, especially NW counties, has caused major damage to many cornfields. In some river bottoms, corn was immersed up to the tassels. Since much of the corn was shorter than normal (with low ear height lower due to drought conditions), the likelihood that ears were immersed by flood waters was greater. Much of the corn was in the dent stage when flooded. The impact of this flood damage on corn will be highly dependent on kernel stage of development, length of the flooding period, how much of the corn plant was immersed during flooding, and subsequent weather conditions.

Since late season flooding is an uncommon event, little information is available on its effects on corn at this stage of kernel development, and how to best salvage damaged corn. A major concern is the impact of flooding on grain and silage quality. In past reports, when corn in the dent stage was covered by flood water for six hours or more and nearly completely caked with mud for up to two weeks, damage from ear rots and premature kernel sprouting was extensive in those areas of fields where water had covered the ears the longest. Although such damage may be negligible in fields where water never covered the ears, prolonged flooding may cause significant injury to the roots, if not premature root death. Such plants will be more vulnerable to stalk rots thereby increasing the likelihood of stalk lodging, especially if harvesting is delayed. Therefore, as soon as plants have dried, stalks should be inspected to determine the degree of rot. If rot is extensive, these affected fields should be harvested first to minimize further yield loss.

Another issue that may impact injury from immersion is whether ears were in an upright or downward position when flooded. If most plants had not yet reached black layer when flooding occurred, most ears were probably in an upright position which would probably result in ears catching and retaining more soil, etc. Corn growers in the South have observed that once the ears are soaked from flooding, they quickly rot at high temperatures so prompt harvesting is necessary. Moreover, soaked ears are often associated with premature kernel sprouting, which can lead to secondary bird damage and insect feeding, especially if husks are loose.

The combined effects of excess moisture, bird and insect damage and warm temperatures may also result in ears being colonized by mycotoxin producing molds. In general, mold development and ear rots are of greater concern when favorable weather occurs during silk development, however, fungi may also infect and cause ear rot late in the season, especially if ears remain in an upright position and accumulate soil and moisture. Normally, healthy, intact kernels at the dent growth stage are not easily infected by fungi, however, these same kernels softened by excess moisture and damaged by birds become easy targets for both saprophytic fungi (and bacteria) and ear rots, most of which are present in soil particles and debris found in flood waters. Samples of grain harvested from flooded fields, especially if ears were covered with flood water for extended periods or plants were lodged, should be sent for toxin analysis before feeding grain to animals. Laboratories for mycotoxin analysis can be found on the Ohio Field Crop Disease web site:

<http://www.oardc.ohio-state.edu/ohiofieldcropdisease/wheat/mycotoxin%20text2.htm>

When dealing with flood damaged corn, a common suggestion is to allow rains to wash off as much soil as possible before harvesting. Another observation is that flooding often deposits considerable debris on fields making harvesting difficult, as will dust associated with soiled plants.

For more information on salvaging corn damaged by late season floods, consult the Penn State Corn and Soybean Management website - Managing Flood Damaged Crops

<http://cornandsoybeans.psu.edu/flooddamagemanagement.cfm>

Stalk Rot and Lodging in Corn: Potential Problem in 2007?

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Hot, dry weather has plagued many corn fields throughout the growing season. Drought conditions experienced during grain fill often increase the potential for lodging and stalk rot problems in corn. When stalk rot occurs late in the season as it often does, it may have little or no direct effect on yield. Nevertheless, stalk lodging, which results from stalk rot, can have such an impact on harvest losses that many plant pathologists consider stalk rots to be the most significant yield limiting disease of corn.

For a corn plant to remain healthy and free of stalk rot, the plant must produce enough carbohydrates by photosynthesis to keep root cells and pith cells in the stalk alive and enough to meet demands for grain fill. When corn is subjected to severe drought stress, photosynthetic activity is sharply reduced as leaves roll tightly and plant growth slows. As a result, the carbohydrate levels available for the developing ear are insufficient. The corn plant responds to this situation by removing carbohydrates from the leaves, stalk, and roots to the developing ear. While this "cannibalization" process ensures a supply of carbohydrates for the developing ear, the removal of carbohydrates results in premature death of pith cells in the stalk and root tissues, which predisposes plants to root and stalk infection by fungi. Even mild, early-season water stress during the pretassel stage of development can significantly increase root infection by stalk rot fungi and result in greater stalk rot at maturity. As plants near maturity, this removal of nutrients from the stalk to the developing grain results in a rapid deterioration of the lower portion of corn plants in drought stressed fields with lower leaves appearing to be nitrogen stressed, brown, and/or dead.

Other plant stresses which increase the likelihood of stalk rot problems include: loss of leaf tissue due to foliar diseases (such as gray leaf spot or northern corn leaf blight), insects, or hail; injury to the root system by insects or chemicals; high levels of nitrogen in relation to potassium; compacted or saturated soils restricting root growth (recent flooding); and high plant populations.

Most hybrids do not begin to show stalk rot symptoms until shortly before physiological maturity. It is difficult to distinguish between stalk rots caused by different fungi because two or more fungi may be involved. Similarly, certain insects such as European corn borer often act in concert with fungal pathogens to cause stalk rot. Although a number of different fungal pathogens cause stalk rots, the three most important in Ohio are *Gibberella*, *Collectotrichum* (anthracnose), and *Fusarium*. For more information on stalk rot in corn, consult the OSU Plant Pathology web site "Ohio Field Crop Diseases": <http://www.oardc.ohio-state.edu/ohiofieldcropdisease/> for more details and pictures of the disease symptoms associated with these pathogens.

The presence of stalk rots in corn may not always result in stalk lodging, especially if the affected crop is harvest promptly. It's not uncommon to walk corn fields where nearly every plant is upright yet nearly every plant is also showing stalk rot symptoms! Many hybrids have excellent rind strength, which contributes to plant standability even when the internal plant tissue has rotted or started to rot. However, strong rinds are not will not prevent lodging if harvest is delayed and the crop is subjected to weathering, e.g. strong wind and heavy rain.

A symptom common to all stalk rots is the deterioration of the inner stalk tissues so that one or more of the inner nodes can easily be compressed when squeezing the stalk between thumb and finger. It is possible by using this "squeeze test" to assess potential lodging if harvesting is not done promptly. The "push" test is another way to predict lodging. Push the stalks at the ear level, 6 to 8 inches from the vertical. If the stalk breaks between the ear and the lowest node, stalk rot is usually present. To minimize stalk rot damage, harvest promptly after physiological maturity (about 30% grain moisture). Harvest delays will increase the risk of stalk lodging and grain yield losses, and slow the harvest operation.

Evaluating Corn Hybrid Demonstration Plots in 2007

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This is the time of year when many farmers visit and evaluate hybrid demonstration plots planted by seed companies and county Extension personnel, among others. When checking out these plots, it's important to keep in mind their relative value and limitations. Demonstration plots may be useful in providing information on certain hybrid traits, especially those that are usually not reported in state corn performance summaries. The following are some hybrid characteristics to consider while checking out hybrid demo plots.

Plant/Ear Height—Corn reaches its maximum plant height soon after tasseling occurs. Remember that although a big tall hybrid may have a lot of "eye appeal," it may also be more prone to stalk lodging in the fall. Unless your interest is primarily silage production, increasing plant height should not be a major concern. Generally later maturity hybrids are taller than

earlier maturity hybrids. Big ears placed head high on a plant translate to a high center of gravity, predisposing a plant to potential lodging. The negative effects of stalk rot on stalk lodging in the fall may be worsened by high ear placement.

Stalk Size—Generally speaking, a thicker stalk is preferable to a thinner one in terms of overall stalk strength and resistance to stalk lodging. As you inspect a test plot, you will see distinct differences among hybrids for stalk diameter. However, also check that the hybrids are planted at similar populations. As population increases stalk diameter generally decreases. Also keep in mind that uneven emergence, which affected many corn fields this year, may make such comparisons difficult because late emerging plants are “spindlier”.

Diseases—During the grain fill period, leaf diseases can cause serious yield reductions and predispose corn to stalk rot and lodging problems at maturity. Ear rots can also impact yield and grain quality. The onset of leaf death shortly after pollination can be devastating to potential yield, since maximum photosynthetic leaf surface is needed to optimize grain yield. Hybrids can vary considerably in their ability to resist infection by these diseases. Demonstration plots provide an excellent opportunity to compare differences among hybrids to disease problems that have only occurred on a localized basis. Look for differences in resistance to northern corn leaf blight, gray leaf spot, and diplodia ear rot. Symptoms of these diseases and others are available online at the OSU Plant Pathology website:

<http://www.oardc.ohio-state.edu/ohiofieldcropdisease/corn/corn2.htm>

Check to see if foliar fungicides have been applied and what crop rotation has been followed. Typically you’ll encounter more severe foliar disease problems in no-till, continuous corn.

Stalk Rots—Hybrids will likely differ widely when faced with strong stalk rot pressure. Begin checking plants in late August or about 6 weeks after pollination by pinching lower stalk internodes with your thumb and forefinger. Stalks that collapse easily are a sure indicator of stalk rot. Remember that hybrids with thicker stalks may be in plots having thin stands.

Lodging—Perhaps as important as stalk rot resistance is the stalk strength characteristics of a hybrid. Sometimes, superior stalk strength will overcome the effects of stalk rot. If your variety plot is affected by stalk rot in late August and early September, be certain to evaluate the stalk lodging resistance of the different hybrids. Most agronomists characterize plants with stalks broken below the ear as ‘stalk lodged’ plants. In contrast, corn stalks leaning 30 degrees or more from the center are generally described as ‘root lodged’ plants; broken stalks are 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 western 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. A hybrid may be particularly sensitive to root lodging yet very resistant to stalk lodging. A cornfield 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).

Transgenic Traits—Because damage from European corn borer (ECB) and western corn rootworm (RW) can be very localized, strip plot demonstrations may be one of the best ways to assess the advantages of ECB Bt and RW Bt corns. The potential benefit of the ECB Bt trait is likely to be most evident in plots planted very early or very late; the potential benefit of the RW Bt trait is likely to be most evident in plots planted following corn or in a field where the western corn rootworm variant is present.

Husk Coverage/Ear Angle—Hybrids will vary for completeness of husk coverage on the ear as well as tightness of the husk leaves around the ear. Ears protrude from the husk leaves are susceptible to insect and bird feeding. Husks that remain tight around the ear delay field drydown of the grain. Hybrids with upright ears often associated with short shanks may be more prone to ear and kernel rots than those ears that point down after maturity. Under certain environmental conditions, some hybrids are more prone to drop ears, a major problem if harvesting is delayed.

The following are some additional points to consider during your plot evaluations:

1. Field variability alone can easily account for differences of 10 to 50 bushels per acre. Be extremely wary of strip plots that are not replicated, or only have "check" or "tester" hybrids inserted between every 5 to 10 hybrids. The best test plots are replicated (with all hybrids replicated at least three times).
2. Don't put much stock in results from ONE LOCATION AND ONE YEAR, even if the trial is well run and reliable. This is especially important this year given the tremendous variability in growing conditions and crop performance across the state. Don't overemphasize results from ONE TYPE OF TRIAL. Use data and observations from university trials, local demonstration plots, and then your own on-farm trials to look for consistent trends.
3. Initial appearances can be deceiving, especially visual assessments! Use field days to make careful observations and ask questions, but reserve decisions concerning hybrid selection until you've seen performance results.
4. Walk into plots and check plant populations. Hybrids with large ears or two ears per plant may have thin stands.
5. Break ears in two to check relative kernel development of different hybrids. Use kernel milk line development to compare relative maturity of hybrids if hybrids have not yet reached black layer. Hybrids that look most healthy and green may be more immature than others. Don't confuse good late-season plant health ("stay green") with late maturity.
6. Differences in standability will not show up until later in the season and/or until after a windstorm. Pinch or split the lower stalk to see whether the stalk pith is beginning to rot.

7. Visual observations of kernel set, ear-tip fill ("tip dieback"), ear length, number of kernel rows and kernel depth, etc. may provide some approximate basis for comparisons among hybrids but may not indicate much about actual yield potential. This year we've seen more ear stunting [aka "beer can" ears than normal (see article below by Dr. Greg Roth)]; some hybrids express this disorder more than others. The appearance of this ear anomaly is relatively rare and seems associated with specific environmental conditions. Usually the problem is very limited in occurrence across a field, but if growers have experienced perennial ear stunting problems, they may want to ask their seedsman for advice in selecting hybrids less prone to the problem.
8. Find out if the seed treatments (seed applied fungicides and insecticides) used varied among hybrids planted, e.g. were the hybrids treated with the same seed applied insecticide at the same rate? Differences in treatments may affect final stand and injury caused by insects and diseases.

Severe Blunt Ear Symptoms Appear in Pennsylvania

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Sporadic cases of blunt ears or "beer can ears" in the past in Pennsylvania but recently I reviewed several fields with a crop consultant had perhaps the most severe symptoms that I have seen to date. This year there have been reports of this phenomenon occurring throughout the Midwest as well. The incidence of these symptoms in the fields I observed was also quite high, ranging up to 70-80% in one field.

Several fields we visited had what I would call the typical blunt ear symptomology, with plants that appeared normal, with normal husks, but then inside the husk was an ear that ranged from 30 to 60 percent of normal. <http://fcn.agronomy.psu.edu/images/roth0729image3.jpg> Unlike typical drought stressed corn, the cob development was arrested, apparently early in the development of the ear. Often ears have a rudimentary ear shoot on the end of the ear.

This year, we found more serious cases of this arrested ear development than we have seen before. On these ears, only a very short ear with a few ovules <http://fcn.agronomy.psu.edu/images/roth0729image2.jpg> or even only a tiny ear shoot developed <http://fcn.agronomy.psu.edu/images/roth0729image4.jpg>. In our fields, some of the severe plants had an unusual white flashing above the collar on upper leaves. <http://fcn.agronomy.psu.edu/images/roth0729image1.jpg> Crop records on the fields indicated adequate to high soil nutrient levels, recommended herbicide programs, no fungicide applications, and no unusual practices. According to the consultant, there seemed to be some hybrids that were more prone to the problem, but it was not consistent.

Dr. Bob Nielsen, at Purdue University, has been finding the same problem in Indiana and has written a good summary of the symptoms and potential causes of the problems (<http://extension.entm.purdue.edu/pestcrop/2007/issue23/index.html>). Bob suggests the normal blunt ear symptoms may be associated with dramatic changes in temperature or a cold temperature shock during ear development. He has suggested that the more severe arrested ear development symptoms may be associated with post emergent herbicide, fungicide or other chemical applications near the V12 stage.

In our fields, one of the only issue that seems to be consistent with these potential causes is the dramatic change in temperature. On June 9, a high of 90° F. occurred, followed by lows of 53° and 48° on June 10 and June 11. Also, on June 20 we had a high of 87° F. followed by lows of 53° and 47° on June 21 and 22.

We are continuing to evaluate this problem and will be evaluating plant tissue tests as well. Plants in problem fields should be turning red as the crop ripens.

Wheat Fertilizer Considerations Following Drought Affected Corn

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Corn in many areas was impacted by drought this summer. The current statewide yield forecast is 80 bu/ac which is about 66% of our long-term average corn yield in Virginia. Low crop yields during a drought year mean that significant amounts of unused nutrients may remain in the soil at the end of the growing season. A number of corn acres will be planted to wheat this fall and many growers are interested in reducing fertilizer applications to wheat if carryover from the low-yielding corn crop is truly available.

Phosphorus and Potassium Carryover

If phosphorus (P) or potassium (K) was applied but not used because of lower than expected yields, it usually remains plant available and in the top few inches of soil. The unused portion can be credited against nutrient needs for the upcoming wheat crop. A routine soil test is one potential option for detecting carryover nutrients, especially if large amounts of fertilizer were applied. But since it takes a relatively large amount of fertilizer to change P and K soil test values, a single year's application may not be detectable. Alternatively, the amount of unused phosphorus and potassium can be calculated based on the ratio of the actual yield and the yield goal used to determine nutrient application for the corn crop. For example, if the actual yield is 2/3 of what was expected, we could anticipate that 2/3 of the applied P and K were used by the corn crop and that 1/3 remains and will be available to the following wheat crop. The remaining nutrient levels can then be subtracted from the total fertilizer application planned for the wheat crop.

Soil pH and Liming

Maintaining appropriate soil pH is crucial for maximizing the uptake of essential plant nutrients. Optimum plant uptake of most nutrients occurs at a soil pH near 6.2. Soil samples should be taken from the depth of the plow layer in tilled fields and from a two- to four-inch depth in no-tillage fields. If needed based on soil test recommendations, lime should be applied at the appropriate rate prior to planting.

Nitrogen Carryover

The majority of carryover nitrogen (N) exists in the nitrate form with some in the ammonium form. Nitrate is soluble in water and mobile in soil so leaching below the root zone does occur, especially if rain occurs after corn matures and stops taking up nutrients. This factor makes the determination of carryover N much more difficult. A preplant soil nitrate test can be used to determine how much N remains following the corn crop. Sample as closely as possible to wheat planting but before any preplant N is applied. Sample soil by taking 15 to 20 cores across the field to a depth of 0-6 inches and 6-12 inches, or as deep as possible and divide samples into one foot increments below the surface samples. Thoroughly mix the soil from each depth and collect a subsample to be sent to the lab. Sample between rows to avoid starter fertilizer bands and areas where roots have depleted soil N. Combine, mix, and air dry samples as quickly as possible by spreading the mixed soil in a thin layer on newspaper or other clean surface. Samples can also be dried in an oven at low heat (200 to 225° F.) or in a microwave for 5 to 8 minutes at the high power setting. Always immediately air-dry or freeze samples. Do not store or send moist composite samples to the lab. If samples can't be taken to the soil testing lab within one day after collection, they should be air-dried or frozen immediately after collection.

If laboratory analysis for nitrate is not possible, the Nitrate Quick Test Kit used for the pre-sidedress soil nitrate test for corn can be used. If nitrate in the top 6 inches of soil is greater than 30 ppm, then no N is needed at planting. If the soil nitrate test level is less than 30 ppm, apply 20 to 30 pounds of N. It is critically important for high yields to have N available for young wheat plants to develop fall tillers as shown in the picture below.

With the relatively high price of N and disappointing corn yields, it will be tempting to delay or skip preplant N applications to wheat. Again, adequate fall N is very important for high wheat yields. Nitrogen stress early in the season will prevent adequate tillering and root development which reduces overall yield potential. Since the level and availability of carryover N is difficult to predict and because 20 to 30 pounds of preplant N per acre is generally sufficient to promote maximum growth and tillering, N should be applied to most field regardless of the performance of the preceding corn crop.

Estimated corn stover and nutrient uptake for various corn grain yields.

Grain Yield	Equivalent Stover Dry Weight	Estimated Nutrient Use		
		N	P	K
--bu/ac--	----tons/ac----	-----lb/ac-----		
40	2.4	40	11	71
80	4.0	80	19	120
120	5.1	112	26	156
160	6.9	150	35	208

Early season wheat growth with deficient (left) and adequate (right) preplant nitrogen.



Wheat Production Basics

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Planting winter wheat in the Mid-Atlantic region has not been this popular for a number of years. Since the 2007 harvest, rising prices for wheat coupled with a drought shortened corn crop in much of the region that is being harvested earlier than normal has generated the interest. In this issue of the Mid-Atlantic Agronomist Newsletter, I will review variety selection, planting date, and seeding rate.

Wheat Production Basics-I **Variety Selection**

Choose varieties that have good agronomic characteristics including yield potential, disease resistance, lodging tolerance, and test weight. Information about the agronomic performance of wheat varieties grown in this region is compiled by the agronomists and breeders at the region's Universities and posted at their respective websites. The University of Maryland's web address for this information is www.mdcrops.umd.edu.

After you have selected your varieties, find outlets where you can purchase certified seed to ensure that you will be planting wheat that is clean, free of weed seeds, and has been laboratory tested to verify its germination.

After the yield potential for a variety, I consider test weight to be an extremely important trait. It can be affected (reduced) if the harvest season is plagued with periods of rainy, wet weather. When wheat is harvest ready, the kernels are dense and compact. If a rain event occurs followed by unsuitable weather for rapid drying of the harvest canopy, the kernels will absorb moisture and swell, losing their original compact size. Even though subsequent dry weather returns the crop to a harvest ready condition, the kernels will not return to their original compact size. Instead, they are slightly larger. When test weight is measured, there are fewer kernels comprising the test weight sample resulting in a lower test weight. Depending upon the severity of the rainy, wet period, test weight reductions from slight (less than one pound/bushel) to severe (four to five pounds/bushel) can occur. Both high and low test weight varieties will suffer similar reductions but by starting with a 59 lb/bu wheat versus a 57 lb/bu variety, there will be a smaller price penalty. Of course, this last statement depends upon whether pre-harvest sprouting occurred that caused reductions in falling number, an important baking characteristic for many soft red winter wheat products.

Another important agronomic consideration is to choose more than one variety especially if you are producing substantial acreage. As you select varieties, pay attention to their flowering or heading dates. By selecting varieties that have different flowering dates you will be helping to reduce your risk for *Fusarium* (scab) infection. Wheat is most susceptible to *Fusarium* infection

during flowering although some infection is possible during early kernel development. Wheat at flowering that is experiencing temperatures ranging from 65-85° F. and extended periods of rainy, wet weather is most susceptible to infection. By having varieties with a range of flowering dates, you provide an opportunity to avoid infection by not having your entire crop at the same stage of development at the same time.

Wheat Production Basics-II **Planting Date**

Wheat should be planted by a date that will allow it to germinate, emerge, and have adequate growth and development during the fall so that it is healthy when it enters the winter dormancy period. It is important to not plant too early, a practice that can result in more growth than necessary during the fall causing the wheat's crown to possibly be overly stressed before it enters the dormant period. Planting too early also increases the potential for Hessian fly infestation. Hessian fly prefers wheat over barley or rye as its primary host. Hessian fly infestations have increased in prevalence during recent years because of the use of wheat planted early for cover crop purposes and with the increase of no-till planting of double crop soybean into wheat stubble that can have varying levels of volunteer wheat.

The Hessian fly life cycle requires the presence of wheat seedlings where it can lay its eggs upon the young leaves. The eggs hatch within a few days and the larvae migrate to the whorl and ultimately to the crown area below ground. Severe, early leaf feeding can result in plants dying causing stand problems in the fall. The larvae that migrate to the underground crown eventually enter a pupae stage that allows them to overwinter. In the spring, a new generation of adults will hatch from the pupae. These adults repeat the egg-laying cycle producing larvae that will migrate into the wheat stems, killing tillers, feeding on the stems causing them to be weakened, and increasing the potential for lodging to occur. Significant infestations of Hessian fly will result in reduced yields by causing small, poorly filled wheat heads that contain kernels of poor quality.

The Hessian fly does not survive freezing temperatures. Fly-free dates that are associated with the average first-frost date have been identified for the Mid-Atlantic region. In Maryland, the fly-free dates range from late September in the northern and western counties to October 9-11 for the Lower Eastern Shore counties. By planting within an approximate three-week period following the fly-free date for your area, you will be reducing your risk for Hessian fly infestation while ensuring that you will accumulate an adequate amount of heat-units to establish a healthy wheat crop as it enters the winter dormant period. Planting during this window has also proven to optimize yield with the ideal time to plant closer to the beginning of the three-week period rather than later in the window. And, if planting does not occur until after the end of the window, yield reductions of approximately 10% per week can be expected up to about Thanksgiving.

Wheat Production Basics-III **Seeding Rate**

The long-time volumetric standard for planting wheat, two bushel per acre, should not be used if you want to achieve the plant population, 1.3 to 1.4 million plants per acre, needed to optimize yield. To achieve this population, two seed characteristics need to be considered, germination rate and seed size. A seed lot with a germination rate of 95% will require less seed to be planted than a seed lot that has 85% germination. One of the primary reasons to purchase certified seed is the assurance that you have pure seed that has excellent germination. So, if your seed lot has a germination rate of 90%, to attain the population goal of 1.3 to 1.4 million plants, you will want to plant approximately 1.5 million seeds per acre.

Though wheat seed is relatively small, it does vary in size from large (approximately 10,000 seed per pound) to small (15,000 seed per pound). If you simply set your drill to plant two bushel per acre, you will under-plant if you have a large-seed variety and over-plant with a small-seed variety.

So, how do you achieve the planting goal with your drill? You need to calibrate it for each of your seed lots, a relatively easy task. First, mark a known distance in an area where you can make a few calibration runs; a distance of 50 feet is often sufficient. Set the drill for a known seed setting using the chart provided for the drill (i.e. two bushel per acre is a good place to start). Next, put enough seed in the drill to cover the seed hopper and attach small zip lock bags under 4-5 of the seed units where they attach to the seed hopper. Make a test run with the drill in the ground and at the ground speed you will use when planting. Collect the bags of seed and weigh (if you have a scale that can weigh small amounts) or count the number of seed collected to determine how much seed each unit is planting and then calculate the average.

With this information, you can estimate the amount seed that would be planted at the setting you have used. An easy way to determine this is to calculate the length of row necessary for one unit to plant one acre. If you have a drill with 7 inch row spacing, the length of row required is 74,674 feet. If your drill has 7.5 inch row spacing, the length of row necessary for an acre is 69,696 feet. To achieve 1.5 million seed per acre, you need to plant 20 seeds per foot for the 7 inch drill and approximately 21.5 seed per foot with the 7.5-inch drill. For the 50 foot test run, you want to collect 1,000 seeds for the 7-inch drill and 1,075 seeds for the 7.5-inch drill. If you have not achieved the seed rate goal at the drill setting you have used, adjust it accordingly and make another test run, repeating the calibration steps until you are satisfied with your result.

Winter Cover Crops in Virginia

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Beneficial effects of cover crops and crop rotation have been recognized for many years. As early as 3,000 years ago, growers were using green manure cover crops to improve soil fertility. However, the steady increase of inorganic fertilizer use over the past 60 years and the development of modernized farming techniques have resulted in less diversified cropping systems. Increasing environmental concerns associated with fertilizer lost from the agricultural system, soil erosion, and high production costs have led many growers to reexamine cover cropping as a method of increasing soil productivity. Noted effects on soil characteristics as a result of cover crops include increased organic matter, greater water- and nutrient-holding capacity, nitrogen (N) contribution from legumes, improved tilth and aggregate stability, and reduced erosion.

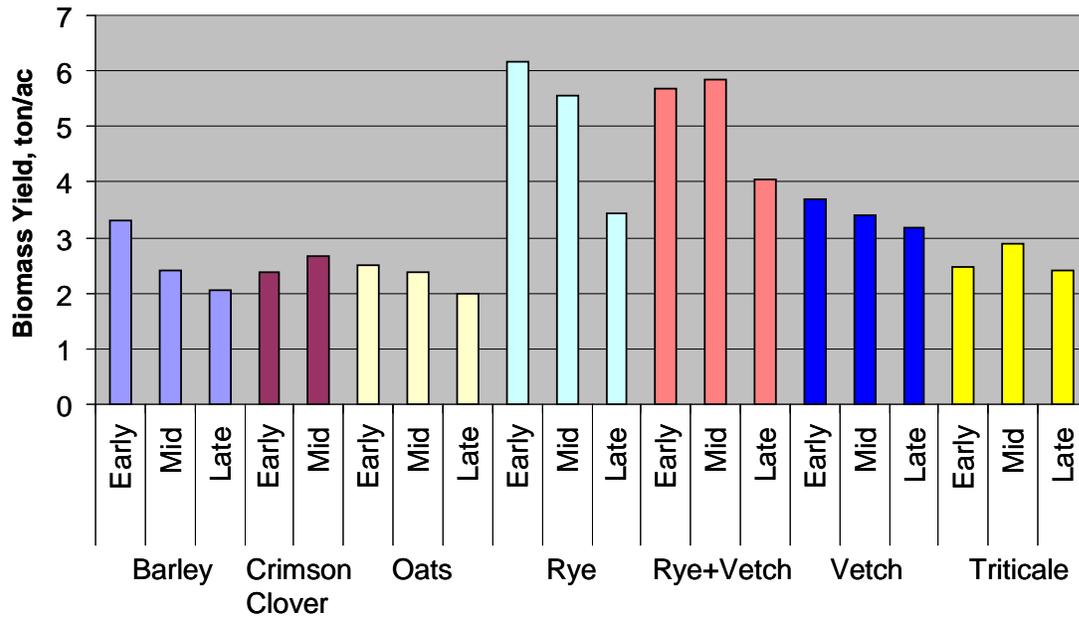
A three-year research study was initiated in New Kent County, VA in the fall of 2004 to determine the winter cover crop species and planting date that provides the most vigorous winter soil cover, the greatest biomass return to the soil system, and the highest level of N uptake. All crops were planted without tillage into corn stubble with a commercial grain drill. No fertilizer was applied at planting.

Treatments were crop species or mix: cereal rye, oats, barley, crimson clover, hairy vetch, and rye + vetch and planting date (early October, mid-October and early November). All aboveground biomass was hand clipped from each treatment just prior to killing the cover crop each spring. These samples were dried and used to calculate yield.

Earlier planting generally resulted in higher levels of biomass production due to greater fall growth (Figure 1). This is especially true for rye, barley, and oats. Yield was, on average, 0.9 tons more with the early October planting compared to the early November planting. Over years, biomass yield (average of 5 tons per acre) was greatest for rye and rye + vetch. In fact, late planted rye yielded more than the other small grain species regardless of their planting date (Figure 1).



Figure 1. Yield of cover crops by species and planting date.



Organic Certification for Field Crops

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To sell, label, or represent their products as “organic,” growers and processors who sell organic products valued at \$5,000 or more a year must be certified by a certifying agent accredited by the U.S. Department of Agriculture (USDA). The National Organic Program Final Rule (NOPFR) spells out requirements for organic crop and livestock production, handling, certification, and recordkeeping. The NOPFR and other related documents are available on the Web at: www.ams.usda.gov/nop/

Organic Certification: An Overview

Because all certifiers must follow USDA requirements, the organic certification process is similar across certifiers. The farmer-applicant, the certifying agent, and the inspector must complete specific steps.

A farmer seeking certification must do the following:

1. **Comply with the federal standards** for organic production (Table 1).
2. **Choose a certifier.**
3. **Complete an Organic Farm (or System) Plan**, which is also considered the application for certification. The Organic Farm Plan must describe all relevant aspects of the operation, include farm maps, and document a three-year field history for crops planted and inputs applied.
4. **Submit the completed Organic Farm Plan** as the application with certification fees and other required documents to the certification agency.

The certifying agent:

1. **Reviews the Organic Farm Plan** and accompanying documentation.
2. **Arranges an on-site inspection of the farm**, the next step toward certification.

The inspector:

1. **Verifies information from the Organic Farm Plan**
2. **Evaluates** crop health and growth, soil tilth, the fertility management program, pest and weed management strategies, seed sources, adjoining land uses, and the applicant’s understanding of and commitment to compliance.
3. **Reviews records to ensure monitoring and compliance.**
4. **Conducts an exit interview** to confirm the accuracy and completeness of the observations and information gathered, address the need for additional information, and discuss issues of concern.
5. **Completes a report** based on the information gathered.
6. **Sends the inspection report** and all associated paperwork to the certifying agent.

After the inspection, the certifying agent assigns a certification committee, staff members, or review committee to review the Organic Farm Plan, the inspection report, and all associated documentation. If the certifying agent determines compliance in all procedures and activities, the applicant is granted certification and is issued a certificate of organic operation that must be updated each year. If the certifying agent determines any minor noncompliance issues, the applicant has the opportunity to correct these non-compliances as a condition of certification.

To maintain organic certification each year, the certified farmer must pay annual certification fees, submit an updated Organic Farm Plan detailing changes from the previous year, and submit an update on correction of any minor noncompliance issues previously identified by the certifying agent. Each farm must be inspected at least once annually to maintain certification.

Table 1. Federal standards for organic certification

To become a certified organic production operation, the farm and farm practices must comply with the Organic Foods Production Act of 1990 and the USDA National Organic Program rules and regulations (Federal Register, Vol. 65, No. 246, pgs. 80367-80663).	
In simplified terms, National Organic Standards for crop farms require	
<ul style="list-style-type: none"> • Proof that no prohibited materials have been applied to the crop for three years (36 months) prior to harvest. (A list of prohibited materials is provided below.) • Distinct, defined boundaries for the organic operation. • Implementation of an Organic System Plan, with proactive fertility systems; conservation measures; and environmentally sound manure, weed, disease, and pest management practices. • Monitoring of the operation’s management practices. • Use of natural inputs and/or approved synthetic substances on the National List, provided that proactive management practices are implemented prior to use of approved inputs. • Management of compost production and use. If compost is used for fertility, it may be applied at anytime but must be managed according to very specific parameters under the National Organic Standard requirements for compost production. • Management of raw animal manure. If raw animal manure is used for fertility, it must be managed according to the crop being produced: 	
<p>Feed crops (crops not intended for human consumption): It may be incorporated at anytime into the soil before harvest.</p>	<p>Crops for human consumption: It must be incorporated at least 90 days prior to harvesting a crop where the edible portion of the plant <i>does not</i> have contact with soil or soil</p>

particles, or 120 days prior to harvest of crops where edible portions *do* have contact with soil or could be splashed with soil particles.

- Use of organic seeds, when commercially available, and no use of seeds treated with prohibited synthetic materials, such as fungicides.
- Use of organic seedlings for annual crops when commercially available.

National Organic Standards prohibit

- Use of genetically engineered organisms, (GMOs) defined in the rule as “excluded methods.”
- Residues of prohibited substances exceeding 5 percent of the EPA tolerance. A certifier may require residue analysis if there is reason to believe that a crop has come in contact with prohibited substances or was produced using GMOs.
- Use of sewage sludge.
- Irradiation.
- Use of any synthetic substance not on the National List.
- Use of any other prohibited substances on the National List.
- Field burning to dispose of crop residues. (Burning may be used only to suppress disease or to stimulate seed germination. Flame weeding is allowed.)

In addition, organic producers must

- Maintain or improve the physical, chemical, and biological condition of the soil, minimize soil erosion, and implement soil-building crop rotations.
- Use fertility management systems that do not contaminate crops, soil, or water with plant nutrients, pathogens, heavy metals, or prohibited substances.
- Maintain buffer zones, depending on risk of contamination.
- Prevent commingling on split operations. (The entire farm does not have to be converted to organic production, provided that sufficient measures are in place to segregate organic from non-organic crops and production inputs).
- Maintain records for at least five years.

Recordkeeping: A Critical Requirement for Certification

A certified operation must maintain records that document the production, harvest, and handling of agricultural products intended to be sold, labeled, or represented as organic. Records must be adapted to the particular commodity that the certified operation is producing. Records must also fully disclose all activities and transactions of the certified operation in sufficient detail as to be readily understood and audited. All records must be maintained for at least five years beyond their creation and be sufficient to demonstrate compliance with the National Organic Program rules and regulations.

One of the primary recordkeeping requirements of organic certification is maintaining an *audit trail*—the records that show the commodity was produced using only approved inputs, processes, and facilities. The documents needed for this depend on the production operation, but some basic documents are required for nearly every farm:

1. **Farm maps.** A farm map must clearly show the layout of the farm and the land use in areas surrounding the farm or the organic field. Maps must depict the following:
 - Outlines of the fields.
 - Adjoining land uses.
 - Location of any water crossing a field and in what direction it flows.
 - Location of any structures on the land.
2. **Field history.** The certifying agent reviews the field history to determine if a field is eligible for certification. This document must include the field number and acreage, what is grown currently and what has been grown for the past three years, the types of inputs used (both approved and prohibited), and the dates the inputs were used.
3. **Field activity logs.** The field activity log, or field record, should show all field prep work, planting information, post-planting field work (such as cultivation, fertilization, and pest management), dates and rates of any and all inputs, and harvest dates for each field in the organic operation.
4. **Storage logs.** These logs are needed only if crops are stored on the farm prior to sale. Usually grain farms will need some storage records. The following information is required: crop, amount, and date added to a bin or storage unit and what field it came from; crop, amount, and date removed from a bin, and the lot number for the sale. If the storage bin was previously used for non-organic crop storage, the storage log must indicate how and when the bin was cleaned prior to storing organic crops.
Sales documentation. This refers to all the information attached to a sale of organic products. It should include scale tickets, bills of lading, clean transport documentation, and invoices for sales
5. **Split production records.** Keep in mind that if an organic farm grows the same crop organically and conventionally, the inspector will need to see all harvest, storage, and sales records for *both* the organic and conventional crops. This is necessary to verify that no commingling occurs between organic and non-organic crops.

Recordkeeping templates can be downloaded from www.carolinafarmstewards.org or www.attra.org.

Certification Agencies

A list of all USDA-accredited organic certifying agencies can be found on the Web at www.ams.usda.gov/nop/CertifyingAgents/Accredited.html or by request through the National Organic Plan (NOP) office at 1400 Independence Avenue, SW, Room 2510 South Building, Washington, DC, 20250.

Conclusion

Organic certification requires compliance with the national organic standards and documentation of farm practices that prove compliance. Recordkeeping to establish an audit trail is critical to certification. A more detailed version of this document, with sample recordkeeping forms, can be obtained from NC Cooperative Extension (www.ces.ncsu.edu/xrdb/; publication number AG-681). See also the website: Organic Field Crop Production and Marketing in NC: www.organicgrains.ncsu.edu

Reviving Drought Stressed Pastures in the Mid-Atlantic Region

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A dry summer combined with overgrazing has significantly reduced pasture growth and vigor in many Mid-Atlantic States. The good news is that drought stressed pastures often look worse than they really are. This is especially true for pastures that were well managed prior to drought. In many cases pastures can be revived without reseeding. The key element is rainfall. The following are some suggestions for reviving drought stressed pastures.

Rest Pastures—In many cases, pastures simply need to be rested. For this reason, it is often a better choice to feed hay in late summer and fall rather than grazing recovering pastures. This allows pasture plants to rebuild their photosynthetic factory (leaf canopy) and store up sugars and carbohydrates before the winter months. The growth that accumulates during this recovery period can then be used for grazing during the winter months.

Fertilize pastures—Fertilizing pastures this fall can help to strengthen plants and get them ready to grow next spring. Adjust the soil pH to 6.0 to 6.4, apply phosphorus and potassium according to your soil test, and apply 60-80 lb nitrogen (N) per acre in mid-August to mid-September for stockpiling. Alternatively, a smaller amount of N (40 lb/A) in November or early December can

be applied. This late-season N application will not produce a great deal of fall growth, but it will stimulate tiller production and root growth. Spring growth from these stands will be vigorous and thin areas will thicken faster.

Interseed legumes into thin stands—With increasing N prices, legumes such as red and white clover and alfalfa are becoming even more important components of pastures. Pasture sod suppressed by drought and overgrazing provide a perfect opportunity for interseeding clover and alfalfa. Legumes can be either drilled in the fall or spring or frost seeded in late winter. Frost seeding works best with red and white clover and annual lespedeza. Alfalfa is better established using a no-till drill. More information on interseeding pastures is available from your states Extension service.

Interseed winter annuals—In some cases, drilling cool-season annuals, such as small grains and annual ryegrass into dormant sods can be cost effective. In this situation, sods are normally in very poor condition and there are simply not enough remaining plants to actively compete with the cool-season annuals. However, interseeding cool-season annuals into a dormant sod that was well-managed prior to the drought does not work as well as expected in many cases. This is due to the fact that the ground is very dry and when the rain finally comes the seed not only starts to germinate and grow, but so does the dormant sod. An established fescue sod has an extensive root system that competes well for limited moisture. On the other hand, newly established seedlings have a very small root system and are at a serious disadvantage when competing for water with an established fescue sod. The best place for cool-season annuals is on cropland that has already been harvested. In general production on these areas will be greater due to the absence of any significant competition.

It is important to remember that drought alone rarely kills well-managed pasture plants. In most cases, drought stressed pastures are in better condition than they appear. Most pastures can be revived with rain, rest, and fertilization. Weakened sods provide a prime opportunity for incorporating legumes in established pastureland. With a little tender loving care and rainfall this year's drought stressed pastures will be next year's profit.

Forage Stand Evaluations following Severe Stress Conditions

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In many parts of the region, hay and pastures were subjected to prolonged hot and extremely dry conditions. It's often surprising how grasses that were thought to be dead have recovered following good soaking rains. Since in times of drought animals still need feed, pastures often become overgrazed causing more injury. Where horses are grazed, the horse's ability to graze right to the soil level means that recovery of the most severely injured pastures will be slow. It is

these severely injured fields where the following guidelines may be useful in deciding whether to do a partial renovation this year or early next year.

There are two ways to evaluate pastures: first by objectively using numerical counts of tiller numbers or percent ground cover; note that tillers are grass shoots with at least 3 visible leaves. Secondly, you can do your ground cover evaluation subjectively by using your eye and mind to decide if the stand is adequate or using a transect-line to estimate percent ground cover.

Tiller Counts—For objective evaluations, you need to either walk across the pasture or hay field and count how many live plants or tillers per square foot are present or use a transect-line to determine percent groundcover for viable forage grasses. To take stand counts, make a 1-, 2-, or 4-ft² rectangle or square from wire or wood, walk across the field dropping or throwing the rectangle or square at random, count the number of tillers or live plants of your dominant grass species enclosed by your device, keep a running total, and after taking about 10 to 20 counts divide the total by the number of counts and that number by the number of square feet represented by the device. This will give you an estimate of the number of plants/tillers per square foot. Be sure to decide ahead of time how you'll do the counts. From what I've seen in the past, you will be counting the number of tillers for Kentucky bluegrass, smooth brome grass, and reed canarygrass pasture or hay fields and be counting number of plants for orchardgrass, tall fescue (for fescue you can count either plants or tillers whichever is easiest to identify), timothy, and ryegrass fields. The target counts that indicate an adequate stand are given below.

Visual Estimates of Ground Cover—Visual estimation is a very subjective measure although the transect-line method below can give you a more reliable estimate of actual ground coverage by pasture plants. In this procedure, you will need to walk across each field or paddock and estimate how much of the soil surface is covered by perennial desirable forage species. You will need to be comfortable identifying forage grasses and legumes and distinguishing them from less desirable annual species such as crabgrass, fall panicum, and the numerous annual broadleaf weeds that invade drought stressed pasture and hay fields.

Transect-Line Ground Cover Estimation—A transect-line consists of a hundred foot wire with marks or spacers set at specific intervals, often at 1-foot intervals. To use the transect-line, you stretch it across different areas of the field and then walk down the line and count the number of times the spacer or mark is directly over a desirable species leaf versus over bare ground or a weed leaf. Generally, there will be 50 or 100 spacers or marks on a line and by multiplying the number of times the spacer intercepts a desirable species by either two or one, respectively, you can obtain the percent ground cover for the desired species. As a rule of thumb after a period of perhaps six weeks recovery time following a drought, you would determine percent ground cover and renovate if the percent ground cover is below about 50 percent.

Options—Various insect foliage feeders often attack the new leaf growth aggressively during the recovery phase following prolonged droughts. For fields that were nearly dead, fields trying to recover by sending up new shoots or tillers, and fields newly renovated or seeded; it will be important to try to protect this new vegetation. The new tillers and leaves are the only photosynthetically active tissue available to the plant, therefore the plant's food reserves will be either very low for recovering plants or will be limited to that stored in the seed for new

seedlings. Food reserves must be reestablished or accumulated by seedlings by late fall if the crop is to survive winter. Contact your pesticide dealer for information on products that can be used to control damaging pests and be sure to follow all label warnings and grazing restrictions especially for pastures.

Another suggestion would be to fertilize grass regrowth with nitrogen (N) to stimulate a more rapid recovery (see article on fall fertilization with N in Volume 2, Number 2, Page 25 of the June 2007 issue of this newsletter). Finally, weed encroachment often becomes an important problem following severe stress conditions. Check with your pesticide dealer or local county Extension agent for information about weed control in pastures and hay fields. Generally for pasture situations, we prefer to remove animals before fertilization, herbicide, or pesticide application (for some pesticides, removal for a certain number of days is mandatory—consult your dealer or our “Pasture and Hay Weed Management Guide” found at http://www.rec.udel.edu/weed_sci/WeedPublicat.htm). Following fertilizer and lime applications, we prefer to have had at least one significant (>0.25 inch) rainfall event occur before returning animals to the pasture.

Partial renovation consists of no-till seeding a reduced rate of grass seed into the pasture to aid in stand recovery. For pastures, animals should be removed during planting but can be returned for a week or two until the new seedlings begin to germinate. The animals should be kept off newly renovated pastures until the new plants are well established (probably the middle of the following summer). In addition to adding seed of the dominant grass, you should add a minimal amount of nitrogen (20 to 30 lbs N per acre) and some phosphorus and potash if soil test levels are not at optimum. The phosphorus will encourage strong root growth and the potash will help the plant prepare for the stress of winter weather and regulate water use if dry weather returns. To maintain strong stands, soil test on a regular basis (every two years is best) and maintain your soil pH and nutrients in the optimum range. For pastures and hay fields, we generally recommend a 0 to 4-inch sampling depth since fertilizer and lime can only be applied to the soil surface and the downward movement of these materials is slow.

What do you do once you have obtained stand counts or visual estimates? In just walking over the field to obtain the stand count, you probably came away with a feel for whether the field needs help from partial renovation or not. If less than fifty percent of the ground surface is covered with desirable forage species, renovation will probably be necessary. Between fifty and seventy-five percent ground cover by desirable species, renovation might be needed but you may want to delay renovation about six months to the next seeding opportunity (next spring or next fall, depending on when the estimates are taken). But for those of you who prefer numerical values, here are some guidelines for minimal stands when you've taken the time to obtain stand or tiller counts. Please keep in mind that these are guesstimates on my part and are not based on research since little if any has been done on this topic.

With that limitation in mind, obtain an average count of the number of new tillers per square foot for grasses that are coming back from underground rhizomes such as Kentucky bluegrass, reed canarygrass, smooth bromegrass, and perhaps tall fescue. For the other species such as ryegrass, timothy, and orchardgrass, obtain an average count of the number of plants (a single

plant will hopefully have a number of new tiller buds developing) per square foot and compare them with the guidelines below.

Kentucky bluegrass: 15 to 20 tillers or new shoots per square foot

Smooth brome grass and reed canarygrass: 8 to 10 new shoots per square foot or, if you can distinguish plants or plant crowns, 3 to 5 crowns showing renewed tiller growth

Tall fescue: For fields established within the past two years, 5 to 8 plants showing new growth per square foot. For old established pastures, 2 to 3 plants per square foot. In each case, I would want to see a minimum of about 15 green tillers or shoots per square foot.

Orchardgrass: 5 to 8 plants showing new or greening tillers per square foot.

Timothy: 8 to 10 plants per square foot showing new tiller growth.

Ryegrasses: 8 to 10 plants per square foot showing new tiller growth.

In summary, I want to again emphasize that these are my best estimations or “guesstimates” of the counts you need for your stand to recover. My estimations are based upon both personal experiences and many years of making pasture renovation recommendations. I do however recognize that many farm specific variables such as drainage, soil variations, presence of rocks, and many more can dramatically alter the accuracy of my estimates; therefore please do not discount your specific farm experiences or that of someone else who has worked with pastures for many years. If you’re not comfortable with the stand you see when you walk the field, then it is highly likely the pasture will respond to overseeding or partial renovation. The above guidelines are yet another rule-of-thumb to use in estimating the amount of ground coverage the desirable species provide. With absolute certainty, if you can see bare soil (or annual weeds) on 50 percent of the pasture area, then adding seed of the dominant desirable grass is likely to help improve the stand.

Small Grains for Fall and Spring Forage

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Annual grasses and legumes can provide substantial amounts of feed, particularly when grown in double-cropping sequences. Double-cropping is most commonly practiced when forage supplies have been reduced by drought, such as experienced in many parts of the Mid-Atlantic region this summer. For example, when corn silage supplies are short, dairy and livestock producers frequently turn to winter small grains or annual ryegrass, either to be grazed or harvested as silage in the spring.

Although we tend to associate the use of these crops primarily with periods of forage shortages resulting from droughts or crop failures, they can routinely contribute to our farm forage supplies. And, they generally do so during a period of time when the land is otherwise lying idle. These crops often also serve a dual purpose as a cover crop. Increased use of small grains for spring silage production could potentially reduce the need for corn silage production on marginal soils subject to erosion. The use of small grains either for winter silage production or for fall and winter grazing is probably the most under utilized, least cost option that we have available in this region for increasing feed supplies.

Yield evaluations of rye, wheat, barley, winter field peas and hairy vetch, alone and in various combinations, were conducted for three years at the Central Maryland Research and Education Center at Clarksville and at the Wye Research and Education Center on the Eastern Shore. Dry matter yields as high as 5.1 tons/acre were obtained at Clarksville and as high as 4.7 tons/acre at the Wye Center. Dry matter yields (with conversions to 60% moisture silage) are presented in Table 1 for the 8 or 9 species or species combinations having the highest yields. (Not all the species and mixtures evaluated are presented in the table).

As might be expected, rye and mixtures containing rye generally provided the highest yields at both locations. However, farmers who have grown rye recognize the problems frequently encountered in making high quality rye silage. The quality of rye can change from excellent to poor within a period of 4 to 7 days due to rapid advance in maturity. Combinations of small grain species can improve silage quality since different species and varieties will reach the heading stage at different times. Our experiences in harvesting the research plots were similar to those experienced by farmers -- rye frequently reached the fully headed stage before weather permitted harvesting. Barley was usually in the late-boot to early-heading stage at the time of harvest (most desirable stage) and the wheat was still in the vegetative stage. Thus rye and wheat tended to offset each other when combined in the same mixture. Adding peas or vetch to the mixtures generally increase the crude protein content of the silage.

Suggested seeding rates are presented in Table 2. If peas or vetch are included in a seeding mixture, seeding should be completed by September 30 in areas having a growing season comparable to Central and Southern Maryland and by October 10 in areas with a growing season comparable to the Delmarva Peninsula. Peas and vetch are not adapted for double-crop spring silage production in mountainous areas of western Maryland, West Virginia and western and northern Pennsylvania. If seeding mixtures of small grains only, seeding dates should correspond with the normal seeding dates for the least winter-hardy species contained in the mixture.

The nitrogen (N) fertilization program used in the research trials was 15 to 20 lb N/acre at seeding and 60 to 80 lbs N/acre in late February to mid-March.

Early fall growth on winter small grain crops can be grazed during late fall and winter. Moderate fall and winter grazing has little deleterious effect on subsequent grains yields. Damage occurs from heavy or late spring grazing which can seriously reduce grain production. Precautions for grazing small grains are: (1) don't graze when the ground is soft and wet, (2)

remove animals when plants reach early jointing stage, and (3) if seed was treated with fungicide before seeding, be sure to follow grazing restrictions on the label. In some cases the forage may not be grazed for 6 weeks after planting.

Table 1. Percent dry matter (DM), dry matter yield, and 60% moisture silage yield of the highest yielding small grains or combinations of small grains with Austrian winter field peas or hairy vetch at two locations over three years in Maryland.									
Species/Varieties*	Year 1			Year 2			Year 3		
	Yield (Tons/A)			Yield (Tons/A)			Yield (Tons/A)		
	%DM	DM	60%	%DM	DM	60%	%DM	DM	60%
Central Maryland Research and Education Center, Clarksville Facility									
Rye ('Abruzzi')	24.3	2.8	7.0	31.8	4.7	11.8	23.1	5.1	12.8
Rye ('Wheeler')	--	--	--	--	--	--	14.5	4.9	12.3
Rye + peas	23.1	2.3	5.8	27.8	4.8	12.0	--	--	--
Rye + wheat	22.8	2.8	7.0	29.6	4.8	12.0	16.2	4.6	11.5
Rye + wheat + peas	--	--	--	--	--	--	15.9	4.6	11.5
Rye + wheat + barley	22.4	3.0	7.5	27.9	4.6	11.5	16.1	4.4	11.0
Rye + wheat + barley + hairy vetch	--	--	--	24.0	4.5	11.2	15.7	4.3	10.8
Rye + wheat + barley + peas	--	--	--	25.2	4.7	11.8	15.8	3.9	9.8
Wye Research and Education Center									
Rye ('Abruzzi')	23.7	4.0	9.9	34.6	4.5	11.3	25.8	4.4	11.0
Rye ('Wheeler')	--	--	--	--	--	--	17.3	4.7	11.8
Rye + wheat + barley + hairy vetch	--	--	--	24.4	4.6	11.5	17.3	4.4	11.0
Rye + wheat + barley + peas	--	--	--	23.5	4.2	10.5	17.3	4.2	10.5
Rye + wheat + peas	--	--	--	--	--	--	16.6	4.2	10.5
Wheat + barley	16.3	2.8	7.1	25.2	4.3	10.8	17.8	4.2	10.5
Rye + wheat	20.4	3.8	9.4	30.1	4.6	11.5	17.6	4.1	10.3
Rye + wheat + barley	20.3	3.7	9.2	28.9	4.2	10.5	16.9	4.1	10.3
Rye + barley	21.6	4.2	10.6	29.3	4.3	10.8	16.6	4.1	10.3

* Varieties used in multi-species mixtures are listed below:

Year 1: 'Abruzzi' rye, 'Scotty' wheat, 'Volbar' barley

Year 2: 'Abruzzi' rye, 'Severn' wheat, 'Pennrad' barley

Year 3: 'Wheeler' rye, 'Severn' wheat, 'Pennrad' barley

Table 2. Suggested seeding rates for small grain species seeded alone and in various combinations for winter silage production.			
Species	Rate Lb/acre	Species	Rate Lb/acre
Rye	140	Rye + wheat + peas	47 + 50 + 33
Wheat	150	Rye + wheat + barley	47 + 50 + 40
Barley	120	Rye + wheat + barley + peas	31 + 33 + 27 + 33
Rye + peas	93 + 33	Rye + wheat + barley + hairy vetch	31 + 33 + 27 + 8
Rye + barley	70 + 60	Wheat + barley	75 + 60
Rye + wheat	70 + 75		

Cover Crops, Small Grains and Crop Residue Provide Fall/Winter Supplemental Forage

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Cover Crop and Small Grains

The use of winter annual grasses, particularly the small grains, is widely advocated as a best management practice not only to reduce soil erosion but to immobilize residual nitrogen from the previous crop that might otherwise be leached out of the root zone. The widespread use of small grain cover cropping in the Mid-Atlantic region offers the opportunity for complimentary livestock enterprises. Cereal forages fill a unique niche in the U.S. cattle industry, especially in the Southeast, southern Great Plains and Southwest. They provide supplemental nutrients for cow-calf herds, support major elements of the stocker cattle industry and have demonstrated potential to produce acceptable finished beef. They can be used in similar ways here as well if we want to take advantage of the opportunities.

High quality forages associated with cereal grain production can meet or exceed nutrient requirements of grazing livestock regardless of class or species. Small grain forage is lush, high in protein (15-34% of dry matter), and low in fiber during most of the fall/winter grazing season. Unsupplemented heifers grazing moderately stocked winter wheat pasture in an Oklahoma research trial gained an average of 1.2 lb/day. Average daily gains of stocker calves frequently exceed 1.5 lb in the southwestern United States. In a comparison of wheat, winter rye, and triticale forage in a beef finishing program in Alabama, steer gains of 2.84, 3.10 and 2.22

lb/head/day, respectively, were reported; however, the animals were fed considerable quantities of a high energy supplement.

When small grains are sown as a dual purpose crop for harvest as both forage and grain or as a cover crop for forage, the recommended seeding date is three to four weeks earlier than for grain production alone. In Tennessee research trials, wheat or rye planted between September 1 and September 15 produced twice the forage tonnage by March 15 as when planted October 15. If planted mid-August to early-September in Piedmont and Coastal Plain regions, they can be utilized for grazing from October to late-December and again in early spring. However, be aware that early plantings may be affected by the Hessian fly, crown and root rot diseases and various mosaic viruses. Rye has an advantage in that it is not damaged by Hessian flies when planted early. Also, grazing reduces the incidences of diseases and viruses that otherwise may occur with early plantings.

If forage production is an important consideration in these plantings, it is generally recommended that the seeding rate be increased 50 to 100%. The amount of fall grazing from small grains can be doubled by using higher seeding rates than used for grain production. For rye or wheat planted alone, use 2-3 bushels/acre.

Small grain forages vary in their seasonal growth curves; thus, if the crop will not be harvested for grain, it can be useful to seed mixtures of species. For grazing purposes, the distribution of forage production is usually as important as forage yield. Rye grows at cooler temperatures and provides later fall and earlier spring grazing than other winter grains. It is more winter hardy than wheat, barley, oats or annual ryegrass and has a more extensive root system. Wheat, in combination with annual ryegrass, is used widely in the South for high quality winter pastures. Ryegrass produces high quality forage equal to that of small grains. Its total forage production is usually as high or higher than small grains, but most of this production occurs in early fall and late spring. Since late fall and winter production of ryegrass is less than that of rye, wheat or triticale, ryegrass is generally planted with these small grains to increase the length of the grazing season.

Early fall growth on winter small grain crops can be grazed during late fall and winter. Moderate fall and winter grazing (down to 2 inches) has little deleterious effect on subsequent grain yields. Damage occurs from heavy or late spring grazing which can seriously reduce grain production. Precautions for grazing small grains are: (1) don't graze when the ground is soft and wet, (2) remove animals when plants reach early jointing stage, and (3) if seed was treated with fungicide before seeding, be sure to follow grazing restrictions on the label. In some cases, the forage may not be grazed for 6 weeks after planting.

Crop Residues

Crop residues are an untapped resource for livestock production in the Mid-Atlantic region. Corn and grain sorghum residues can be used to advantage, particularly for beef cows. The most common means of feeding beef cows during late fall and early winter in Iowa, Nebraska and Kansas is by grazing of corn and sorghum residues.

The corn stalk is of good quality at physiological maturity of the corn plant, but quality decreases with time as the grain dries. At high-moisture grain harvest (25-30% grain moisture), the stalk is still of good quality. At dry grain harvest, quality has decreased considerably. The husk is highly digestible, often being above 60% dry matter digestibility.

Generally, the quality of grain sorghum stubble is not as high as that of corn stalks at physiological maturity; however, grain sorghum stubble does not decrease in quality as much or as rapidly. There is considerable residue produced in soybean production, but it is of low quality. Straws of small grains are generally lower in quality than corn residues. Barley and oat straws are typically slightly higher in quality than wheat straw.

A beef cow can be maintained for about 80 days on 2.25 ac of corn or sorghum residue. In Iowa, Nebraska and Kansas, calves are often weaned in mid-October when corn and sorghum are being harvested. The cows then graze the residues until early- to mid-January. Often 300 to 850 lb of corn grain remain in the field after harvest. While the grain is an excellent source of feed for the cattle, over consumption of corn can produce acidosis or founder. This can be overcome by ration or strip grazing.

If ration or strip grazing is not practiced, in essence all of the grain left in the field is available to the animals on the first day of grazing, with less available each succeeding day. Also, animals select the more digestible forage portions early, thus decreasing feed quality the longer they are on stalk fields. Cows will often gain 1-2 lb/day during the first 30 days on corn stalks. For the next 30-50 days, weight may just be maintained. Little supplementation is needed during the first 30 days, but some protein supplement is generally needed thereafter. Restricting access to only enough area to supply feed for several days (ration or strip grazing) will supply more uniform feed quality.

Corn stalks or grain sorghum stubble can also be used for backgrounding stocker cattle. Fall weaned calves can be expected to gain about 1 lb/day during November and December on corn residue or grain sorghum stubble. These animals do need to be supplemented with protein.

New fencing technologies make it feasible and economical for livestock producers to fence fields to utilize cover crops and residues for grazing. Weather conditions for much of the Mid-Atlantic region permit year-round grazing and the grazing season can be extended with fall and early winter grazing in other areas. Crop residues and small grain cover crops are substantial potential feed resources in the region that are largely unutilized. A small grain cover crop grown in association with corn residue provides a nearly complete ration for many classes and ages of livestock. The high protein, highly digestible small grain forage complements the low protein, lower digestible corn residue as the primary energy source. I believe that Mid-Atlantic area farmers have not capitalized sufficiently on their regional advantage in beef cattle production through utilization of these feed resources. These resources can also be used to advantage in wintering dairy heifers and dry cows.

When to Worry about Hay Safety

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As recently as July of this year, both the popular press and academic journal articles were published or posted on the internet to draw the horse owner's attention to particular problems and toxicities of horse hay being sold. In a July 5, 2007 from the Hay and Forage Grower magazine posted on the internet, hay buyers were warned to check alfalfa hay produced in Michigan and the upper Midwest for a toxic weed called hoary alyssum (*Berteroa incana*). The toxic weed sickened a number of horses in Georgia and most worrisome the weed was not readily visible in the hay.

When should you worry about toxins in hay? I think the greatest danger to horses comes when you change from one supplier to another and especially when you change from a local supplier (one you can visit and actually inspect the hay production fields) to a non-local supplier or hay broker. That's not to say that the non-local supplier or hay broker has lower quality or riskier hay but it does change the onus of checking the hay onto you, the buyer. No one is out to sell toxic hay; but it goes without saying that hay bought from outside the region can have plants in it that no one (not you, your hay dealer, or your veterinarian) will recognize as toxic to your horses.

The recently reported incident involving the poisonous plant *Hoary alyssum* in alfalfa hay is both eye opening and instructive. This particular poisonous plant was practically invisible in the hay. It was only after the horses consuming the contaminated hay started to show signs of swollen legs and fever, with some of the affected horses actually advancing to foundering, was the hay examined closely enough to identify the contaminate. This does speak to an often repeated recommendation: that being to carefully monitor any horse fed hay from a new hay lot or new hay dealer. It is always true: the more quickly we identify a problem, the more certain we can be that serious, if not deadly consequences, can be averted. For more information about hoary alyssum, refer to a fact sheet found online at: www.pestid.msu.edu/factsheets/HoaryAlyssum.pdf

Besides changing hay suppliers, what other commonly occurring events can bring about uncommonly dramatic changes to our hay safety? One such change to our hay safety occurs following very stressful growing seasons; such as seasons that are too wet, or too dry, or too hot. Such growing conditions produce hay stands that are somewhat thin and open allowing weeds to grow in the open areas. Weeds can contain toxins that can harm horses if eaten in too large a quantity. Hays produced under wet growing seasons and/or hay produced under poor drying

conditions will likely encouraged excess mold development in the hay which can cause respiratory problems for horses. Always check a few bales from each new hay lot that you buy to be sure moldy hay is not present; never feed any amount of moldy hay to your horses.

Many horse owners prefer not to buy hay that has been treated with a preservative; but, in actuality, hay treated with preservatives such as buffered propionic acid (prop or buffered prop) is often much higher in quality and has a much lower risk of mold development than sun-cured hay. Buffered propionic acid contains an acid that is a naturally occurring acid found in animals' digestive systems and is quite safe even for horses. Hay treated in this fashion is often greener and more readily acceptable to animals and should not be blindly ignored by the horse community since it offers a way to more safely preserve hay.

What kinds of problems can occur with hay? The most common and long-standing problem is hay from endophyte infected tall fescue (often the variety Kentucky 31) fields. The endophyte is a fungus that produces toxic alkaloids that harm livestock but help the plant survive stress conditions. Relatively new, there are now novel or friendly endophyte infected tall fescue varieties (sold as MaxQ tall fescue) that do not produce the toxic alkaloids but do help the plants survive. The new novel endophyte tall fescue is mostly used for pastures but you may someday see hay for sale that comes from novel/friendly endophyte tall fescue. Horse owners interested in breeding horses will want to avoid tall fescue hay due to the risk of getting the wrong variety but those not interested in breeding could use novel/friendly endophyte hay. However, be sure to have written certification from the producer; otherwise consider tall fescue hay as off limits for horses. I should point out that tall fescue is one of the most common grasses planted in the eastern United States and is found in many meadows (sometimes called meadow hay if cut for hay), old pastures (called pasture grass or pasture hay), or roadsides (cut and sold as grass hay or grass horse hay). These old stands of tall fescue often have high levels of endophyte in them.



When hay production fields are hurt by drought as they have been this year, these sites are often cut and sold as hay. Unless you can identify the grass species in the hay or obtain assurance from the buyer of what the grass species is, it will be safer for your horses if you choose not to buy this type of hay.

Recently in North Carolina and Virginia, concern was raised over panicum in hay samples that caused liver failure in horses and sheep. Several grass species of panicum have been implicated including fall panicum (*Panicum dichotomiflorum*), an annual grass weed common to our area (see first photo); switchgrass (*P. virgatum*), a warm-season grass used on conservation tillage areas; and kleingrass (*P. coloratum*), an introduced grass commonly grown in Texas. Of these panicum species, the one most troublesome for hay buyers in the mid-Atlantic region is fall panicum. Fall panicum produces semi-prostrate large diameter stems with

distinct nodes or joints and wide leaves with a white stripe down the mid-rib (See second and



third photos). The weedy grass grows vigorously in late summer so third or fourth cuttings of hay may contain the weed if the stand is thin and fall panicum seeds are present in the soil. Talk with your hay producer and express your concern that this species should not be in hay sold to you.

Another perennial problem, albeit more likely a pasture problem, occurs when alsike clover (*Trifolium hybridum*) is present in a hay production field. This clover is hairless like white clover, upright growing like red clover, and has a pinkish blossom the shape of white clover but closer in color to red clover. In sensitive horses, alsike can cause mild to severe liver damage resulting in photosensitivity (sun burned skin lesions) that require housing the animal inside, a change of diet off the clover, and a lot of hands-on care.

Another example of mechanical injury rather than chemical comes from numerous species of grasses that produced barbed seed heads and some legumes such as matured crimson clover (*T. incarnatum*). The grasses include the foxtails (*Setaria* spp.), wild barley (*Hordeum vulgare* ssp. *spontaneum*), wild oats (*Avena sativa*), and yellow bristlegrass/yellow foxtail (*S. pumila*). These grasses

cause problems since the barbs can penetrate and become imbedded in skin and mucus membranes causing ulcerations, infections, and abscesses. Crimson clover dried seedheads can cause similar problems or can become imbedded in the eyes causing great discomfort to the animal.

Other concerns for hay include the dustiness in red clover hay from the fine plant hairs covering the plant; cystitis syndrome caused by sudangrass (*Sorghum sudanese*), sorghum (*Sorghum* spp.), and a range of millets (*Setaria* spp.) [German, foxtail, Japanese, etc. but not pearl millet or hybrid pearl millet (*Pennisetum americanum*)]; nitrate poisoning from heavily fertilized, drought stressed hay fields; and mycotoxins which are most commonly associated with molds, usually on grains or grain products but also detected in forages and bedding.

The bottom line comes down to knowing and building a trust relationship with your hay producer. Talk to your producer about your concerns for your horses and pass along information you may discover about relevant problems such as the widely publicized hoary alyssum problem. If you decide to change hay providers, be sure to observe your horses carefully as they begin feeding on hay from a new source. Anytime you purchase hay from outside the region, limit the amount of the new hay that you feed until you are sure your animals are not having problems. If you have questions about hay, contact your local county Extension agricultural agent for more information.

Notices and Upcoming Events

October 30, 2007,

Advances in Subsurface Exploration Methods, 9:00 to noon, Registration required by Oct. 23. Phone or email Tom McKenna at 302-831-8257; mckennat@udel.edu

October 23 and 24

Keystone Crops Conference, Contact Dr. Greg Roth at gwr@psu.edu

November 13-15, 2007

Mid-Atlantic Crop Management School to be held at the Princess Royale Hotel and Conference Center in Ocean City, Maryland. Contact Dr. Greg Binford (binfordg@udel.edu) with questions or to obtain a registration booklet or visit the following web site: https://crayola.hcs.udel.edu/conf/registration/crop_management/

Winning the Game 4: Launch and Land your Post-Harvest Plan

University of Maryland Grain Marketing Workshops, \$10 Registration Fee

November 20th – Galena, FireHall, Contact Jenny Rhodes 410-758-0166

November 27th – Hurlock, Unity Wash. Church, Contact Shannon Dill 410-822-1244

December 4th – Boonsboro, Extension Office, Contact Jeff Semler 301-791-1304, 10am-2pm

December 5th – Hughesville, Contact Ben Beale 301-475-4484

December 7th – Ruthsburg, Community Center, Contact Jenny Rhodes 410-758-0166

December 10th – Upperco, Friendly Farms, Contact Dave Martin 410-666-1022

December 13th – Princess Anne, Extension Office, Contact Eddie Johnson 410-749-6141

December 14th – Mt Airy, Calvary Methodist Church, Contact Doug Tregoning 301-590-2809

November 10, 2007

Annual Equine Conference to be held at the University of Delaware Carvel Research and Education Center, Georgetown, DE, 10 am to 3 pm. Contact Susan Garey at truehart@udel.edu or 302.730.4000 or Dr. David Marshall at davidlm@udel.edu or 302.831.1340

January 7-12, 2008

Delaware Ag Week, Harrington, DE. Contact Ed Kee at 302-856-7303 or email: kee@udel.edu
Delaware—Maryland Hay and Pasture Day, Evening Program for Part-time Hay and Pasture Producers, Dairy Day, and Agronomy/Soybean Day, Equine Pasture Program, Poultry Nutrient Management, and many more offerings. Visit our web site at: <http://www.rec.udel.edu/AgWeek/home.htm>

January 15, 16, and 17, 2008

PAES Conference (formerly the Lime, Fertilizer Conference), Penn State Conference Center. Contact Dr. Greg Roth for more information.

January 24-25, 2008

2008 Annual Regional Women in Agriculture Conference, Dover Downs Hotel and Conference Center, Dover, DE. Contact Laurie Wolinski at 302.831.2538 or by email at Lgw@udel.edu

February 6-8, 2008

25th Mid-Atlantic Direct Marketing Conference and Trade Show, Harrington, DE. Sheraton Inn, Dover, DE. Contact Carl German at 302.831.1317 or by email at clgerman@udel.edu

March 4, 5, and 6, 2008

Professional Crop Producers Conference, Penn State Conference Center. Contact information will be in the next issue of this newsletter.

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 Click on Newsletter

Photographs for Newsletter Cover

To view more of Todd White's Bucks County photographs, please visit the following web site:

www.scenicbuckscounty.com