



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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Forage Crops and Phosphorus Fertilizer Supply

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I was attending a meeting a few months ago when someone brought up the issue of rising fertilizer costs. He said to the group of us, "...you know, phosphate fertilizer is just going to become more and more expensive. The world reserves are only expected to last about another 40 years..." I thought I misheard him and asked, "You mean 400 years right?" "Nope" he said, "40 years". I couldn't believe this and ended up doing some searching. I found a recent paper on the topic entitled "The story of phosphorus: Global food security and food for thought" by Cordell et al. (2009) published in the journal "Global Environmental Change".

Phosphorus (P) is an essential nutrient for production of all crops including forages. Alfalfa is especially demanding of P, and it, along with potash, is critical to sustain high hay yields. Phosphorus is mostly obtained from mined rock phosphate and is often combined in mineral fertilizers with sulfuric acid, nitrogen, and potassium. Like crude oil, phosphate rock is a non-renewable resource. Unlike oil though, we don't really have anything that can replace it. Fortunately, phosphate can be captured after use and recirculated within economic and technical limits. Manure, for example, is a valuable source of "recycled" organic phosphate. In the paper, the authors estimate that peak phosphate production may occur around 2033. This doesn't mean phosphate will disappear, but it will become increasingly expensive to mine, process and ship. While the timing of the production peak may be uncertain, it does appear that the quality of existing phosphate rock is declining. To make matters worse, demand of phosphate, and other fertilizers, is increasing. Although there are many predictions about future food demand, even the most optimistic scenarios will require increases in food production of at least 50% in the next half century. We may need to get used to the fact that cheap fertilizer is a thing of the past.

So, what about our forage crops and grasslands? As I mentioned above, phosphate is especially important for legumes like clover and alfalfa. Maintaining good clover abundance in pastures has been linked to good P levels in the soil. Some of my recent research points to this as well. This brings up an interesting situation regarding the push to get more producers to use legumes in their forage/grazing systems. We always preach that more legumes in your pasture will help eliminate the need for nitrogen fertilizer – right? But what happens when phosphate becomes so expensive that we can't afford it? Well, it might make it harder to sustain legumes in our pastures or hayfields for one thing. Greater reliance on recycled P (namely manure) will likely become increasingly important in our grasslands to meet grass and legume needs. On pasture, that may mean greater attention to grazing management to help better distribute manure and its, increasingly valuable, phosphorus content.

Hay Supplies are Tight and Prices High

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High grain prices resulted in marginal hay fields being rotated into grain production this past spring. The USDA reported that the US hay acreage is the smallest in more than a century. Combine low acreage with low hay carryover from 2010, the lousy weather this spring throughout the Midwest for making hay and the current drought across the south-central states and the result is a hay shortage. The short supply of hay can be seen in the increasing price of hay. Hay prices across Pennsylvania are up about 20% from last year and the national average price for alfalfa hay jumped nearly 50% in the past year.

Since hay production in 2010 was already insufficient to meet demand and this year's hay acreage is even smaller, don't expect prices to drop significantly in the near future since demand is going to continue to outpace supply, especially for high quality hay.

Management of Drought Stressed Corn for Silage

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Harvesting Drought Stressed Corn

Some parts of the region experienced drought conditions this past summer. This article provides some guidelines for dealing with this situation.

Drought stressed corn should be harvested at the same dry matter (DM) for normal corn: 32 to 35% DM. ***Determining whole plant dry matter or moisture is critical because visual assessments can be very inaccurate! Many plants that look dry contain a significant amount of moisture in the stalk.*** Use of a microwave oven or Koster Moisture Tester is recommended. Under hot dry conditions, plants may dry down at 1 to 2 points per day. Ensiling corn at less than 28 to 30% DM will result in excess nutrient runoff and extremely acidic silages. Harvesting corn too dry (greater than 40% DM) restricts fermentation, reduces the loss of nitrates, results in forage that is difficult to pack, and can result in excessive spoilage and poor bunk stability.

Chop forage at a theoretical setting of 3/8 to 3/4 inch if harvested at the optimum DM. If you have already missed the optimum dry matter for harvest and the plants are very dry, (more than 40% DM) consider, chopping your forage finer to improve packing (but remember you will have to balance the TMR for adequate effective fiber during feedout).

If the forage is not well eared, mechanical processing may not be needed. Process if the amount and maturity of the kernels warrants it.

As always, filling fast, packing tight and sealing immediately will help to ensure a good fermentation. Be sure to have adequate tractor weight on the pile as drier forages are more difficult to pack. Allow silage to ferment for at least 3 to 4 weeks (longer would be preferable) prior to feeding and gradually introduce new silage to animals.

Silage Additives for Drought Stressed Corn

First choice:

◆ Homolactic acid bacteria (microbial inoculants): Severely drought stressed corn forage may contain lower numbers of naturally occurring lactic acid bacteria and may need some help during fermentation. If forage is in the normal range for DM, consider using a research proven homolactic acid bacteria.

Alternative choices:

◆ Heterolactic acid bacteria – *Lactobacillus buchneri*: Drought stressed corn silage often has high sugar content and can be highly prone to spoilage when exposed to air. *Lactobacillus buchneri* is an organism that safely produces acetic acid, which reduces aerobic spoilage organisms and improves bunk life. However, I suggest not using this additive if whole plant DM is less than 32%.

◆ Buffered propionic acid-based preservatives: Silage additives based on buffered propionic acid may be an acceptable additive for drought stressed forage especially if the DM% of the whole plant is high: greater than 38 to 40%. Addition of 2 to 4 lb./wet ton of forage can improve aerobic stability of the silage and reduce DM losses in the silo and during feedout. Higher application rates will increase the probability of effectiveness especially in drier forages.

◆ Water: Water can be added to increase the moisture level of overly dry forage, but the amounts needed to have a substantial impact are large. For example to decrease the dry matter of forage at 50% to 45%, one would have to add 200 lb. of water per ton of forage! In addition, added water can cause run off problems as it is not absorbed efficiently by the forage mass.

◆ Sugars/molasses: Drought stressed corn forage usually contains moderately high concentrations of fermentable sugars. Thus, the addition of molasses or other fermentable substrates is usually not warranted if the forage is harvested at the proper DM content.

◆ Non protein nitrogen additives: Non protein nitrogen (NPN) additives (urea and anhydrous ammonia) should not be used on very dry, drought stressed forages.

Nitrate Poisoning From Drought Stressed Forages

Many plants can accumulate nitrate under stressful conditions (excessive fertilization or water stress from rain after a drought). Sunflowers, corn, wheat, barley, rape, bromegrass, and sweet clover are some of the more common plants that can accumulate high levels of nitrates.

High nitrates cause toxicity because once they are absorbed into the blood stream, they are converted to nitrites that binds to hemoglobin and reduces the oxygen carrying capacity of the blood. (Nitrites are the actual poisonous compound and technical the terms “nitrate poisoning” and “nitrate toxicity are actually incorrect). Acute poisoning can be observed within 6 hours of forage consumption and is characterized by dark-brown blood, labored breathing, tremors, and weakness. The following information is primarily aimed at the management of drought stressed corn silage but general concepts are valid for other forages as well.

- Drought stressed forages should not be grazed or fed as green chop.
- Ensiling is the best method to manage forages with potentially high levels of nitrates.
- During drought conditions, forages that have been heavily rained on should not be harvested for at least 4 to 5 d.
- Although extremely high nitrate levels are rare, we recommend that you test your corn forage before chopping and after ensiling (before feeding).

Test for nitrates prior to harvest: If the levels of nitrates are extremely high you may want to raise your cutter bar during harvest and leave about 10 to 12 inches of stalk in the field (this is because nitrates tend to accumulate in the stalk of the plant). Although this will further lower yields it will reduce the concentrations of nitrates that are harvested.

When sending samples into the lab, obtain representative samples from the field. It is best if this material is chopped. (Do not send in large pieces of plants and stalks.)

Test for nitrates before feeding: Although ensiling will decrease nitrate levels by about 50 to 60% we would recommend that you test your drought stressed corn silage according to the guidelines (Table 1) just prior to feeding. Also check for nitrates and nitrites in water as these can also contribute to toxicity issues.

Laboratories are not always consistent in how they report nitrates. Some report the results as nitrate-nitrogen ($\text{NO}_3\text{-N}$) whereas others may report results as the nitrate ion (NO_3) or potassium nitrate (KNO_3). In addition some lab will report concentrations as ppm whereas others may report as a percent of the dry matter. Because of these inconsistencies we are not publishing nitrate guidelines in this fact sheet and defer you to recommendations from your analytical lab based on their reporting scheme. To be cautious, calculate the entire potential intake of nitrate (water and feeds) to determine your risk of nitrate toxicity.

Silo Gas Caution

Use extreme caution around silos because nitrogen oxide gasses that are generated during the first few days of ensiling are lethal to animals and humans! These gasses tend to accumulate in low areas and are colorless to reddish-brown. Run the blower for 15 to 20 minutes before entering an upright silo and use caution around vents in silo bags. Use a respirator before entering a silo. In severe cases, the gasses will stain forages and other items. In some instances,

patches of yellowish silage may be observed. If these spots of silage have a very low pH (1 to 3), it is possible that nitric acid was formed.

The Importance of Understanding Horse Behavior

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Taking time to observe and understand horse behavior is extremely important to the horse's well-being and to our daily human-horse interactions. Through a better understanding of the horse's nature, we can learn how to work safely and effectively with horses. Through a more thorough understanding of how the horse evolved, we will have an enhanced understanding of how to manage the horses in our care.

Evolution of the Horse

Over many years, horses have developed a survival mechanism, which is the basis behind much of their behavior. This means of survival, referred to as a strong flight response, was adapted in order to flee from predators when necessary. Domesticated horses have maintained their innate reactions to unknown or fearful stimuli. When faced with a potential threat, the horse will instinctively run. By becoming careful observers of horse behavior, many of us are able to recognize when a horse is in a hyper alert state and ready to flee (e.g. flared nostrils, whites of the eyes visible, and rigid body posture). When a horse cannot escape a fearful situation, it may rely on its fight response and resort to kicking and/or biting as a means of defense.

Horses possess many traits that made them suitable candidates for domestication. Horses could be managed on a variety of forages and grains which allowed them to adapt to many different locations. Their easy going disposition and trainability, ability to reproduce successfully in captivity, and their hierarchical social structure allowed humans to use the horse for work and pleasure.



Feeding or Ingestive Behavior

The horse's anatomic structure was designed for continuous grazing on a variety of plant species. The horse is equipped with a small stomach and is therefore best suited to consume small meals over the course of the day. Their lack of ability to vomit can cause serious digestive problems if too much feed material, especially grain, is consumed in a short period of time. Providing horses with adequate forage is a good thing, and many of us try to optimize the use of pasture on our farms to help reduce costs associated with purchasing hay. However, special management strategies need to be implemented to accommodate the grazing behavior of horses. Domesticated horses confined to pastures or small lots will tend to overgraze certain areas of their enclosure. These short grass areas (lawns) are desirable to horses because of their fairly high nutrient quality, but if allowed to be grazed too short can cause damage to the pasture. Additional areas of the pasture may consist of roughs. These roughs are characterized by the presence of taller, more mature plants and are usually the sites for defecation and urination. As a result of these distinct feeding and defecation areas, it is wise to mow and harrow pastures as needed to better utilize the available forage. Careful monitoring of pastures is necessary to ensure optimal horse health.

It isn't always possible or feasible to keep horses on pasture 24/7. When horses need to be confined to a stall, it is best to avoid large grain meals high in soluble carbohydrates. Instead, we should provide small, continuous amounts of food intake and try our best to base the diet primarily on forage. Hay and grain rations can be divided into smaller, more frequent feedings. When we follow these guidelines, we are taking steps towards minimizing digestive complications such as colic and gastric ulcers.

Water intake is also important. Horses may only visit the water bucket or trough a few times a day or more frequently depending on exercise, diet, and climate conditions. As a general rule, clean, fresh water should be available at all times.

The Significance of Body Language

To better understand a horse's disposition, it is important to closely monitor its behavior and daily activity level. Observing changes in the horse's posture, head and tail carriage, facial expressions, and positioning of the legs and ears can provide vital clues to how the horse is feeling and behaving. For example, take notice whether the eyes are wide, the ears are pinned back or pricked forward and alert? Is the horse's tail clamped tight with nervousness or wringing with frustration, or is it relaxed or simply swishing rhythmically when the horse changes leads? These are all important features that provide insight into the mental condition of the equine and they should be taken in context with the horse's immediate surroundings or circumstances. Sudden changes in the horse's overall appearance and demeanor may indicate a physical problem and having this information available to share with the horse's veterinarian or trainer can be extremely helpful.

Staying with the Group

Feral horses (free-ranging horses that were once domesticated) organize themselves into small, relatively stable herds. These small herds typically consisted of a stallion, several mares and their offspring. Within these feral herds, some of the horses would form strong bonds with one another and also formed hierarchies in which certain horses rank higher over others in the group. Vigilance behavior is an important category of behavior observed in all horses. This occurs when one member of the group surveys the horizon for danger. When one horse becomes alerted to a predator, the others in the group adapt an alert state, triggering an escape response among all of the horses in the group. A good example of this behavior in our domesticated horses is when one horse on a group trail ride spooks at something in its path, and almost immediately the rest of the horses begin to spook even though they may not know at what it is they are spooking.

Some of the difficulties encountered in incorporating the horse's social structure into their management include trying to handle horses that become anxious when separated from herd mates and introducing new horses to existing and established social groups. Particularly with regards to introducing newcomers to the herd, these introductions should be made gradually. Following an observed quarantine period to assure the new horse will not expose resident horses to disease; you can begin allowing the horses to become acquainted by housing them in adjacent paddocks. Newly mixed groups of horses should be monitored regularly in the event intervention is necessary to avoid injuries or to prevent inadequate access to resources among a subordinate horse. Allowing sufficient space between feeders or hay piles will help minimize aggressive behavior within the group.

Avoiding All Work and No Play

Supplying horses with adequate exercise and opportunities to engage in play behavior is also a very important part of their management. The level of exercise each horse receives will depend on their body condition, weight, age, level of training and intended use. Providing enough exercise can be challenging due to work schedules, family commitments and weather conditions. However, providing the horse with some controlled exercise in the form of riding, driving, or ground work will keep the horse healthy and maintain its responsiveness to handling and training.



When a horse can demonstrate play behavior, we can more easily assume that the horse is experiencing good welfare. Play behavior is especially important in young horses, such as object play (e.g. with a ball) and play fighting. These behaviors equip juvenile horses with necessary skills and useful information about their surroundings. All horses, both young and adult, are exhibiting locomotive play when they sprint across the pasture. Offering horses regular turnout in a field or paddock gives them the opportunity to engage in this behavior. In addition, turnout with other horses gives each horse a chance to socialize. Even in situations where group turnout is not possible, turning horses out in adjacent paddocks provides them with fence line contact and affords them some level of tactile communication.

Why Does the Horse Do *That*?

Some horses are seen performing repetitive behaviors that are seemingly functionless. The horse may show this behavior in nearly the same exact way and even in the same spot every time. These behaviors are known as stereotypies. Two very common categories of stereotypic behavior observed in horses are locomotor (e.g. weaving or stall walking) and oral (e.g. cribbing). While research into the underlying cause(s) of stereotypic behavior is ongoing, many studies have provided evidence that limiting a horse's ability to engage in foraging and social behavior increases the risk of stereotypic behavior. For example, some strong associations have been demonstrated between cribbing and diet/nutrition, specifically, horses fed high concentrate/low forage diets may be at greater risk of becoming a cribber. Once a stereotypic behavior



becomes established, it is extremely difficult to stop a horse from exhibiting that behavior. It may however be possible to reduce the amount of time the horse spends performing the stereotypic behavior by providing ample forage, turnout, and opportunities to socialize with other horses. Gaining a better understanding of the causes and effects of cribbing and other stereotypic behaviors could lead to improvements in horse management and well-being.

Take Home Message: Tips for Incorporating Behavior into Horse Management

When designing the layout of your horse's environment, keep in mind that sharp corners and areas where horses can become trapped by a dominate herd mate should be avoided. Provide adequate feed for the horse and base the diet on forage as much as possible. Grouping horses according to age and maintaining the social organization (herd dynamics) on your farm will help reduce conflicts among herd mates. Become an observer of horse behavior. This will improve your ability to anticipate and react appropriately to certain situations that arise when working around horses. Moreover, it will provide you with a better sense of what behaviors are normal for the horses you work with, making it much easier to detect abnormal behavior and potential health and/or training issues.

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High Profit Beef Producers

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The cost of production has far more to do with farm profitability than does the value or volume of your production. This statement is proven by Kansas State University in a study at www.agmanager.info (Dhuyvetter, K. 2011) comparing characteristics of high, medium, and low profit beef producers.

Here in Virginia, we know there are premiums to be had in the feeder cattle market place, discovered through the added value of health, sire, source, and age verified marketing programs. Buyers show they are willing to offer premiums for these features and for the additional value they see in feeder cattle prepared for the feedlot through a short co-mingled feeding period prior to sale. However, the Kansas study suggests we can make nearly three times as much difference in our bottom line through cost savings.

Kansas State University, Department of Agricultural Economics offers its beef producers the opportunity to enroll their herds in their Farm Management Association. A program with cow-calf enterprise records accumulated over 32 years, used to evaluate and compare member's profitability. Here in Northern Virginia, we offer similar management services under the Beef Management Institute records program. The intent is similar - keep records, use records, and compare records from multiple producers to evaluate differences and identify reasons for profitability.

From the Kansas study, it is "important to recognize which characteristics determine relative farm profitability between producers." We must ask questions about the size of the operation, the weight and price of calves sold, the level of costs and areas these costs cover. What are the features of profitable producers? Answers to these and related questions provide curious managers choices.

"High profit farms were larger on average and had slightly heavier calves." They also received "slightly higher prices" and generated "almost \$95 more revenue per cow, but the "differences in costs between operations were much larger than the revenue differences." "High profit operations had a cost advantage in every cost category" resulting in a net return advantage

of as much as \$345 per cow between the most and the least profitable farms. To be clear, the study found cost competitive farms in all categories - large size does not guarantee low costs. Overall, the analysis found that the largest cost to manage is winter feed costs.

Most of the net return (72%) came from cost differences, while a much smaller amount (28%) of the net return came from the gross income from higher prices and heavier calves. Dhuyvetter summarizes this situation as not “unexpected in a commodity market where producers are basically price takers, i.e. the ability to differentiate oneself financially from the average is typically done through cost management.”

While economists tend to speak a different language than the rest of us, we all understand the power of profit. The reasons for profit are uncovered through keeping records and then using them to manage among other things, your biggest cost which is winter feed.

The above article was extracted with permission from the August-September 2011 issue of **Farm Business Management Update** which is electronically accessible via the Virginia Cooperative Extension World Wide Web site (www.ext.vt.edu/news/index.html).

Fall Pasture and Hay Fertilization

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A question frequently raised by both hay producers and grazers is whether it is best to apply the soil test recommended fertilizer the first thing in the spring or not. If the pasture or hay crop is a legume grass mix, you might not think about nitrogen (N) although for pure grass stands N is the first thing most people think of in the spring. Soil test recommendations generally are for potash (K) and phosphorus (P). The answer to the question lies in the function of these nutrients.

Phosphorus really helps plants establish or grow a better root system and we've discovered that root development really goes on for quite some time in the fall for two reasons. First, we generally get more rain in the fall; and, when that is combined with the lower air temperatures and shorter days, it means that soil moisture levels are usually higher in the fall than in the summer months. Secondly in the fall, we've found that the soil temperatures stay warm until fairly late in the year unlike spring time when soils start off very cold from winter and tend to warm up slowly throughout the spring. The combination of available moisture and warm soil temperatures and the accumulation of fixed carbohydrates (sugars) and translocation of the sugars down to the roots means that fall applied P will further help plants establish a vigorous root system for better growth during the next spring growing season.

Potash has a number of functions in the plant ranging from enzyme activation to stress reduction to the control of transpiration and water use in the plant. For us, fall K fertilization helps plants lower the freezing point of the cell sap so there will be less winterkill or winter freeze damage to the plant crowns. In addition, fall K helps plants fight off disease problems and

other pest injury. For K, we prefer that growers split their application with half going on the pasture or hay field in late May or early June and the other half going on in late August or September.

Nitrogen fertilizer functions to stimulate growth in forages but also increases the crude protein content of forages. Legumes have bacteria associated with their roots that form and, in exchange for a source of energy (sugar or starch), the bacteria share reduced forms of N with the plant that they have fixed from dinitrogen gas (N₂). Since grasses lack this symbiotic relationship with bacteria, they frequently need an external source of N fertilizer. This can come from nearby legume plants as leaves or roots or nodules fall from the plant and decay or from N fertilizer the forage manager adds.

Thanks to research in the turfgrass industry, the forage industry is beginning to discover the benefits of adding at least some N in late summer or early fall to help grasses regrow after summer grazing or summer drought. Some recommendations even suggest a second application in mid-October that the previously N stimulated grass can pick up and store for early green-up growth the next spring. This second application negates the need for an early spring N application and seems to help prevent excessive forage growth the next spring. Too many people apply much of the nitrogen forages need in the spring causing such excessive growth that their grazing plan can't keep up with it or causing so much yield in the first hay cutting that there is a significant delay in being able to dry and cure the hay. This can lead to poor quality first cut hay or to hay that retains too much moisture so that it either spoils or is at risk for spontaneous combustion.

In conclusion, think about changing your fertilization timing from the early spring to late-summer or early-fall. There are many potential benefits from this change as outlined above.

Dealing with Hurricane-Damaged Corn

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Hurricane Irene has damaged a significant amount of corn in the region. Damage has ranged from lodged corn (Mid-Atlantic States) to fields completely flooded above the ears (upper New England).

Baldly lodged corn presents many undesirable issues at harvest. First lodged plants are more difficult to cleanly harvest especially with small pull-type harvesters. A discbine or self-propelled harvester will be more efficient for harvest if available. As long as the root system is still underground and the fields were not flooded with water for longer than a day or two, lodged plants are still struggling to stay alive. Secondly, reports have filtered back observing that in some ears where previous bird damage opened the husks, the significant rainfall has resulted in germination in those ears, usually at the base of the ear where free water was held. Lastly, lodged corn will most likely bring in a higher level of contaminants from the soil at harvest.

The biggest potential issues with flooded corn are death from lack of soil oxygen and contamination by silt and unwanted microorganisms. Plants in fields where the water has ponded for more than 2-3 days will probably begin to die because soil oxygen is depleted in about 48 to 72 hours. Silt contains a wide variety of unwanted microorganisms that can cause havoc with silage fermentation. The potential for this is great in alfalfa because this crop has a high buffering capacity and is very prone to clostridial fermentations when conditions in the silo are wet. The slow drop in pH often allows for excessive growth of undesirable microbes. Corn silage tends to be a little more forgiving to these unwanted microbes because its pH drops more rapidly and to a lower extent when compared to alfalfa. However, potential negative effects of silt on corn silage should not be overlooked.

If flooding was only to a moderate level in the field, chopping high during silage harvest might minimize silt contamination in the silo. Of course for corn flooded to the ears and above, chopping high won't solve this problem.

If the corn plant for silage is dying, dead or heavily damaged – try to get the material harvested sooner than later. The chance for increased mycotoxin production in damaged fields increases as the time between damage and harvest lengthens. Thus, the longer the period of time the damaged plants are in the field before harvest the greater the chance of mycotoxins.

Material being ensiled as forage below 28 to 30 percent dry matter (DM) probably should be treated with a good inoculant containing homolactic acid bacteria or 1 to 3 pounds of a product based on buffered propionic acid. Very wet forage should not be treated with *Lactobacillus buchneri* as the chance of excessive production of acetic acid is high (only in very wet silages).

For those wanting to be creative and that have the ability (e.g., for gags and tower silos), we suggest the addition of 1 to 3 pounds of a buffered propionic-based product and a research-proven homolactic inoculant. One additive should be added at the chopper and the other at the blower or bagger. Although this might seem daunting, we have conducted research where the benefit of this combination has been documented (Kung et al., 2004 J. Dairy Science. Volume 87, pages 1310-1316 – This article can be made available to you upon request). Yes, cost is an issue but, the choice is a) an expensive treatment and salvaged crop or b) saving money on treatment and having the whole silo go to pot. Obviously, the double treatment is more difficult for those storing silage in a bunk or pile. Acid additives and microbial inoculants should never be mixed in the same tank for application!

Corn that is alive and not heavily damaged should be monitored for DM content and harvested for silage once total plant DM is 32-33%. This forage can be treated with an inoculant containing a homolactic acid organism and *L. buchneri* (these inoculants are commonly referred to a “combo products”).

We must emphasize that there are many inoculants that contain *L. buchneri* on the market that do not supply the FDA approved 400,000 colony forming units (CFU) of *L. buchneri* per gram of forage at application for making the claim of increased aerobic stability. Be wary of products supplying less than this level. We believe the 400,000 CFU application is crucial for a high probability of success. Now is not the time to skimp on your inoculant.

The speed of silo packing and final silage density will be a key to success too! The goal is to remove the air from the forage mass as rapidly as possible so that fermentation can start quickly and inhibit the growth of the yeast and molds. We suggest that compromised forage be segregated as a precautionary measure.

For growers that were intending to harvest their corn crop for grain, begin harvest as soon as the grain moisture falls below 25 to 28 percent (about 7 to 10 days after black layer with good drying conditions). We are suggesting that harvest begin at this high rain moisture level because of the risk of fungal infection and/or germination on corn ears that have been covered with flood ware or are lying on or close to the wet soil surface. We feel this risk is worth paying for grain drying or taking the penalty imposed by the elevator. Harvested grain should be immediately dried to the proper storage moisture (15%) to remove the remaining moisture and limit spoilage by molds.

Another concern to address is when grain on the ears has germinated prior to harvest. These germinated and usually lighter kernels are subject to fungal infection and can increase mycotoxin concentrations. Increasing the combine fan air speed during harvest is one way to separate out germinated kernels from undamaged kernels. Check severely downed corn carefully especially where bird or animal damage may have opened the ear husks allowing the entry of moisture. In some cases we have observed, the severity of mold infection as observed by spore formation will dictate that these areas not be harvested at all because of the risk of very high mycotoxin concentrations.

Bovine Mastitis: Cow and Microbial Demographics in Endemic Intramammary Infections with *Staphylococcus aureus*

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Introduction:

Staphylococcus aureus is one of the most important causes of contagious intramammary infection in the dairy industry. Intramammary infection triggers the influx of inflammatory cells into the mammary gland thereby elevating individual cow somatic cell counts (SCC) and the collective cell count for the herd in the bulk tank (BTSCC). Herds with higher BTSCC have increased prevalence of subclinical mastitis. Most of the annual \$300 loss per cow from mastitis is due to diminished milk yields in these subclinically infected animals and can account for over 1 billion dollars in annual losses across the industry. Controlling endemic infection requires design of therapeutic and culling strategies that are based upon factors known to impact cure and transmission rates. Early and accurate identification of subclinically infected animals is a key element in any control program and can set in motion strategies for controlling quarter to quarter and cow to cow transmission.

Endemic *Staphylococcus aureus* Intramammary Infection

Mastitis is the underlying cause of the greatest economic loss in the dairy industry. *Staphylococcus aureus* is one of the more important causal agents of endemic intramammary infection (IMI) and results in both subclinical and clinical disease that invariably is associated with elevations in both quarter and cow somatic cell counts (SCC). *Staphylococcus aureus* is a contagious agent whose transmission from quarter to quarter within as well as across cows generates endemic herd infections. The highly contagious nature of this organism results in high prevalence of subclinical IMI with or without clinical flare-ups. The resulting high incidence and prevalence of *Staphylococcus aureus* IMI inevitably leads to elevated bulk milk tank somatic cell counts (BTSCC) that reduce milk premiums and product marketability.

Some evidence has been established to show the contagious nature of this organism can result in endemic herd infections with a common, dominant strain of *Staphylococcus aureus*. Cow to cow and quarter to quarter transmission is mediated by faulty milking procedures and malfunctioning equipment. In *Staphylococcus aureus* strains shown to be causal in IMI can be isolated off the teat skin, the milking equipment, hands of milking personnel and less frequently the environment. In one study, only a few *Staphylococcus aureus* strains were retrieved (and therefore causal) in intramammary infections across farms from several continents and countries (Smith et al. 2005). These organisms all shared common genetic characteristics establishing a family of *Staphylococcus aureus* with an apparently shared common ancestral organism. Many times (but not inevitably) a single strain could be repeatedly isolated across several mastitis cows within a herd suggesting clonal-like transmission within quarters and across cows in the same

herd. This finding is consistent with the idea that certain strains of *Staphylococcus aureus* are more likely to trigger IMI than other strains. The data indicated some of the causal strains dominating IMI across herds share common genotypes and tend to respond quite poorly to antibiotic therapy. In fact, many are penicillin resistant strains of *Staphylococcus aureus*. It has been suggested these antibiotic resistant organisms evolved virulence characteristics (perhaps in conjunction with evolution of antibiotic resistance) promoting quarter to quarter and cow to cow transmission and intramammary survivability that enables the sustained IMI.

These types of studies raise the distinct possibility molecular and genotypic characterization of an endemic *Staphylococcus aureus* population infecting a herd could augment diagnostic, therapeutic and prognostic outcomes and decisions instrumental for controlling endemic herd infections in commercial herds. Genotypic markers known to be associated with Staphylococcal organisms with low therapeutic cure rates and long term stubborn IMI might dictate approaches designed to lower BTSCC that are quite different from those strains lacking these genotypic markers.

Staphylococcus aureus possesses virulence factors capable of frustrating producer attempts to control and cure IMI. *Staphylococcus aureus* survives for sustained lengths of time in epithelial cells lining the ducts and milk secretory alveoli of the mammary gland. Moreover, this organism can easily survive inside inflammatory and immune cells that otherwise migrate into the mammary gland, ingest, kill and digest bacterial pathogens. *Staphylococcus aureus* is notorious for its ability to generate micro abscesses in the mammary gland. The micro abscesses create a niche into which immune and inflammatory responses and antimicrobial agents have great difficulty penetrating. Viable *Staphylococcus aureus* bacteria can remain in the mammary gland, hidden from the antibacterial mechanisms that otherwise resolve intra-mammary infections and re-establish intra-mammary sterility.

Due to the contagious nature of *Staphylococcus aureus* infections, control of endemic disease and associated elevations in the SCC requires a reduction of the prevalence of intramammary infections (clinical and subclinical) and the rates of quarter to quarter and cow to cow transmission within the herd. Overall prevalence of intramammary infections in endemic *Staphylococcus aureus* mammary disease of closed herds is impacted by the number of infected quarters (cows) and the rate of transmission. Milking technique, properly functioning milking equipment and teat and equipment disinfection impact ease of transmission and ultimately the number of new intramammary infections. In addition, successful management approaches designed to eliminate intramammary infection not only reduce pre-existing prevalence rates of IMI but have the added benefit of reducing the rates of secondary IMI acquired by uninfected herd mates and uninfected quarters (Zodaks et al., 2002). Eliminating intramammary point sources of transmission reduces bacterial shed for other new intramammary infections that increase quarter, cow and ultimately BSCC. Dropping the prevalence of IMI has the added advantage of increasing milk yields in subclinically infected animals and avoids potential losses in milk yields incurred in otherwise uninfected herd mates by as much as 10%. These benefits are greatest in herds with higher rates of transmission. Ease of cure or probability of therapeutic success is an integral component affecting management decisions about therapeutic approaches for controlling *Staphylococcus aureus* infection. Endemic infections from strains of *Staphylococcus aureus* with high probability of therapeutic cure require shorter, less costly

regimens of antibiotic therapy that are more palatable to producers. In these cases, treatment could be cost effective because point sources of *Staphylococcus aureus* and the potential secondary infection of uninfected quarters could be eliminated in the context of lowered costs from less expensive antimicrobials and reduced milk discard. Therapeutic successes in herds with relatively high rates of transmission would generate greater benefits by reducing secondary intramammary infections of uninfected quarters and cows. Reduced rates of secondary intramammary infection in herds with relatively high rates of transmission could also justify treatment of intramammary *Staphylococcus aureus* infection with low probability of cure.

A variety of factors affect the probability of therapeutic cures of intramammary *Staphylococcus aureus* infections. The highest therapeutic efficacy of *Staphylococcus aureus* intramammary infection is achieved during the dry period where cure rates generally range between 40 to 70%. Therefore dry treatment should be a pivotal component of programs designed to remove or eradicate subclinical *Staphylococcus aureus* infections. Lower rates of cure occur in cows with higher lactation numbers, higher cow and quarter SCC and cows with multiple intramammary *Staphylococcus aureus* infections. Quarters that shed higher numbers of *Staphylococcus aureus* bacteria with greater frequency in the milk and intramammary infections of the hind quarters are generally more difficult to treat than intramammary infections of the forequarters. Quarters with a relatively greater mass of mammary tissue tend to be difficult to cure due to distribution problems of the antibiotic throughout the tissue mass. Early detection of intramammary *Staphylococcus aureus* infection is a very important determinant in therapeutic success since the longer the duration of the intramammary infection the lower the probability of cure (Sol et al., 1994, 1997).

The number of infected quarters is important to consider when deciding about intramammary therapy and curative success rates. The greater the number of *Staphylococcus aureus* infected quarters per cow the lower the chances a therapeutic program will cure any quarter as well as rendering the cow free of subclinical *Staphylococcus aureus* infections during the dry period and certainly the lactation period. Endemic infections with *Staphylococcus aureus* strains with low rates of therapeutic cure make it highly unlikely all intramammary infections across all quarters will not be cured in cows with multiple infected quarters. In these cases, any quarter rendered cured by the therapy is at higher risk for re-infection in the next lactation if one or more other quarters remain uncured. The risk occurs because any quarter left with an unresolved infection will transfer that *Staphylococcus aureus* infection to the newly cured quarter in the same cow. This problem is even greater in cows with intramammary infection in the hind quarters because hindquarter infections have lower probability of *Staphylococcus aureus* cure.

Other factors impacting the probability of therapeutic success in *Staphylococcus aureus* intramammary infections are the antimicrobial sensitivity of the organism and the duration of therapy. Penicillin resistant *Staphylococcus aureus* are associated with lowered cure rates. Moreover, it has been suggested the penicillin resistance per se may not mediate the lowered cure rate but rather serve as an indicator the organism has evolved into a bacterial strain more completely adapted to survivability in the intramammary environment. Regardless of the cause, producers should be aware endogenous intramammary infections with penicillin resistant *Staphylococcus aureus* can be stubborn infections not readily amenable to therapeutic resolution. In these cases, a different culling strategy may provide a more effective approach for controlling

subclinical infections and the associated elevation in SCC. Choice of antimicrobial agents should always be guided by culture and sensitivity of multiple isolates. Since relatively few or even one strain of *Staphylococcus aureus* may be involved in an endemic herd infection, the initial choice of antimicrobial agent could be based upon an educated choice tempered through historical patterns of therapeutic success in the past. This approach should never be relied upon to replace evidence based approaches provided by culture and sensitivity because even though single strains of *Staphylococcus aureus* occur in endemic infections, a variety of herd infections are associated with multiple variants of *Staphylococcus aureus*. Strain variation does occur within and between farms and can lead to erroneous therapeutic decisions based solely upon historical experiences with therapeutic outcomes. Many therapeutic agents have been employed against *Staphylococcus aureus* and most have resulted in medium to poor probabilities of cure that frustrate producers and veterinarians.

Longer duration of therapy has been associated with increased, though not inevitably increased probability of therapeutic success for both clinical and subclinical intramammary infections. In some cases, prolonged therapy resulted in a 6 to 8 fold increase in cure rates but therapy may have to be extended over 6-8 days (Deluyker et al., 2005). Sol et al. (2000) evaluated data from several studies and determined prolonged therapy resulted in a 2.3 fold increased cure rate of *Staphylococcus aureus* intramammary infection. A cure rate of > 40% has been proposed to be the point of no return for cost effective therapy where returns from increased milk yields and reduced SCC offset the costs of antimicrobial agents and milk discard. Multiparous cows and cows with more than one infected quarter, and those with high SCC tend to experience <20% cure rates and therefore make better cull candidates than therapeutic candidates. Regardless, producers should be aware prolonged therapeutic regimes constitute off label use of antimicrobials that requires veterinary supervision and justification. Special care must be practiced to avoid milk and beef residue violations.

Control programs must include measures designed to avoid introduction of infected cows into herds. In most closed herds this occurs when non-lactating animals become infected. Non-lactating animals can be heifers or multiparous dry cows. The greatest threat in these new *Staphylococcus aureus* intramammary infections occurs because these animals become point sources of new infection in uninfected and infected but recovered quarters across all cows in a herd. The threat is best dealt with by reducing pre-existing intramammary infections and preventing new infections during the dry period. Dry cow therapy is the mode of choice in this endeavor. Cows with low cure rates in the dry period become excellent cull cow candidates.

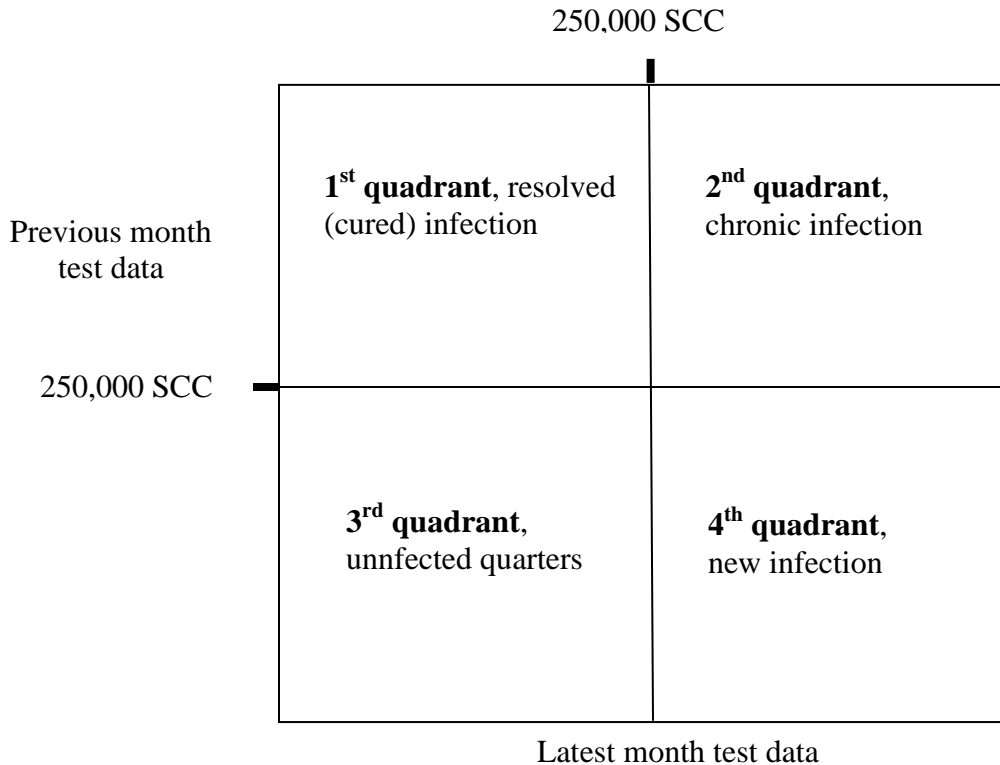
Prepartum infection in heifers has been attributed to consumption of unpasteurized mastitis milk followed by calf to calf suckling. Prepartum infections can be detected in the first year of life and can be sustained into the post-partum period a year later. Chronic prepartum infections in heifers are usually associated with streptococcal and staphylococcal microbes and rarely involve the coliforms. These bacteria are known to colonize the teat skin and the streak canal and can be isolated from secretions of yearling heifers (Nickerson et al., 2005). Both major (for example, *Staphylococcus aureus* and *Streptococcus uberis*) and a variety of minor mastitis pathogens (coagulase negative *Staphylococcus epidermitis*) constitute the causative agents in pre-partum heifer mastitis. Intramammary infections acquired by 12 months of age are sustained through pregnancy and persist into the first lactation where they elevate first lactation SCC.

Elevated SCC is most pronounced with the major pathogens but can be substantially elevated with the minor pathogens. Prepartum infection contributes to a reduction in duct and gland tissue development during the last trimester of pregnancy and often generates micro abscesses and extensive tissue fibrosis that permanently diminishes lactation potential in later lactations (Trinidad et al., 1990).

Prevalence of intramammary infections in prepartum heifers range between 10 to 60% across studies. In newer studies (Owens, et al., 2006, Barnes et al., 2006), the majority of infections in the prepartum heifer were attributed to the minor mastitis pathogens (coagulase negative *Staphylococcus epidermitis*). Never the less, the major mastitis pathogens, coagulase positive *Staphylococcus* and environmental streptococcal agents contributed to 25% of all prepartum intramammary infections. Cure rates with pre-partum antimicrobial therapy range between 30 to 70% and can be expected to be close to a highly desirable 60%. Prepartum treatment also reduces the risk of new intramammary infections during the first weeks of lactation but likely has little effect on milk yields later in the first lactation. Herds with higher SCC may experience greater reductions in SCC during the first lactation following prepartum therapy than herds with lower SCC. Prepartum intramammary therapy can be expected to reduce post-partum subclinical and clinical intramammary infections at least during the early weeks of first lactation. Therapy 10 to 20 weeks prior to parturition was reported to provide the greatest reduction in intramammary infections with coagulase positive staphylococcus and minimizes the risk of milk residue problems (Trinidad et al., 1990, Owens et al., 1991). Therapy with antimicrobial preparations designed for lactating cows also effectively reduced prepartum intramammary infections in heifers but producers should be aware of the risk of milk residues in these animals.

Successful control of endemic *Staphylococcus aureus* IMI requires a well-planned intervention strategy. Early detection and characterization of IMI infection is a key element for control of *Staphylococcus aureus* transmission across uninfected quarters (Ruegg, 2003, Sears and McCarthy, 2003, Barkema et al., 2006). Early identification of intramammary infection is most simply accomplished by monitoring monthly SCC. Cows with two or more consecutive months of elevated SCC are highly likely to have subclinical *Staphylococcal aureus* infections. Since IMI is the most important factor driving quarter and cow SCC, cows with uninfected quarters usually (but not inevitably) have SCC < 250,000 cells/ml and in many cases < 100,000 cells/ml. Quarters and cows with intramammary infection usually have SCC > 250,000 cells/ml. Scatter plots of SCC over two consecutive months of lactation (Figure 1) are enormously helpful in characterizing the extent of subclinical, chronic intramammary infections in endemically infected herds. Intramammary infections from contagious organisms like *Staphylococcus aureus* produce a high number of chronic infections because they have adapted to survival in the bovine intramammary environment. Accordingly, these infections produce a sustained elevation in SCC that persists across two or more months. Animals with these types of infections appear in the upper right quadrant of a scatter plot of consecutive SCC (Figure 1, chronic infections). If contagious organisms like *Staphylococcus aureus* are the major endemic mastitis problem on a farm, there will be few animals whose consecutive SCC scores place them in the first quadrant (Figure 1 resolved or cured infections).

Figure 1. Scatter Plot of monthly SCC.



Cows with two consecutive months of elevated SCC should be further characterized by culture and sensitivity and the cow side CMT evaluation. Once characterized by culture the cows in the 3rd quadrant should then be characterized demographically to establish the number of quarters infected, the duration of the infection, evidence of repeat infection following previous cures, age, lactation number, stage of lactation, parity, hind or fore quarter(s) infection and pregnancy status and lastly penicillin sensitivity or resistance of the infecting *Staphylococcus aureus*. An important feature for each of these cows is to establish the absolute SCC in each chronically infected quarter. Quarters with > 1,000,000 cells/ml are associated with very low cure rates and may make the cow an ideal cull candidate rather than a therapeutic candidate. Collectively, all this information can be implemented to establish a therapeutic strategy for each cow. Cows with lower probability of therapeutic cure based upon her demographics might become candidates for culling rather than therapy. Older cows, cows with large pendulous masses of mammary tissue, cows with more than one infected quarter, and quarters shedding >1,000,000 cells/ml and infected with a penicillin resistant *Staphylococcus aureus* are ideal candidates for culling rather than therapy.

Implementing practices that monitor monthly SCC followed with CMT evaluation and culture and sensitivity testing enable early detection of subclinical *Staphylococcus aureus* intramammary infections. Early detection is a pivotal element in control, particularly when BTSCC rise to undesirable levels that erase premiums and hinder marketability. Early identification and elimination of clinical or subclinical infections with well-designed culling, isolation and therapeutic strategies reduces the cascading transmission problems that accompany sustained *Staphylococcus aureus* subclinical infection.

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Hurricane Irene May Be Beneficial to Virginia Soybeans ...Still Lodging Will Lower Yield Potential

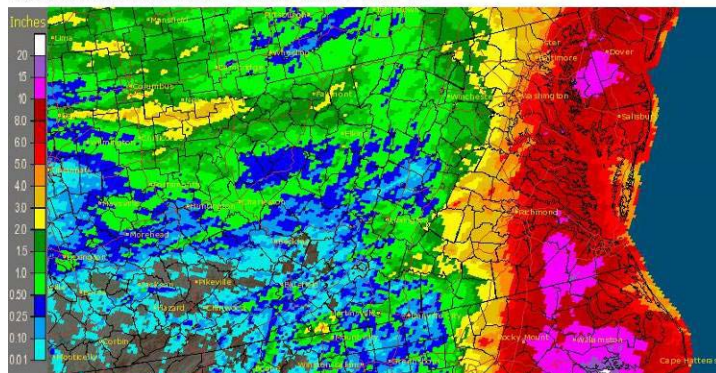
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Hurricane Irene roared along the Virginia coast with high winds and significant rainfall. The rainfall was needed, desperately needed for some parts of the Commonwealth. On the other hand, the high winds caused considerable lodging to the best looking of Virginia's crop and this lodging will likely lower yield potential. But, because the damage to soybean was not as severe as other crops such as corn, cotton, or tobacco, Virginia's soybean crop may, in the end, benefit from the storm.



Below are the National Weather Service's average estimates of rainfall received from Hurricane Irene (you can obtain these maps from <http://water.weather.gov/precip/>). The greatest

Virginia: Current 7-Day Observed Precipitation
Valid at 8/30/2011 1200 UTC - Created 8/30/11 17:59 UTC

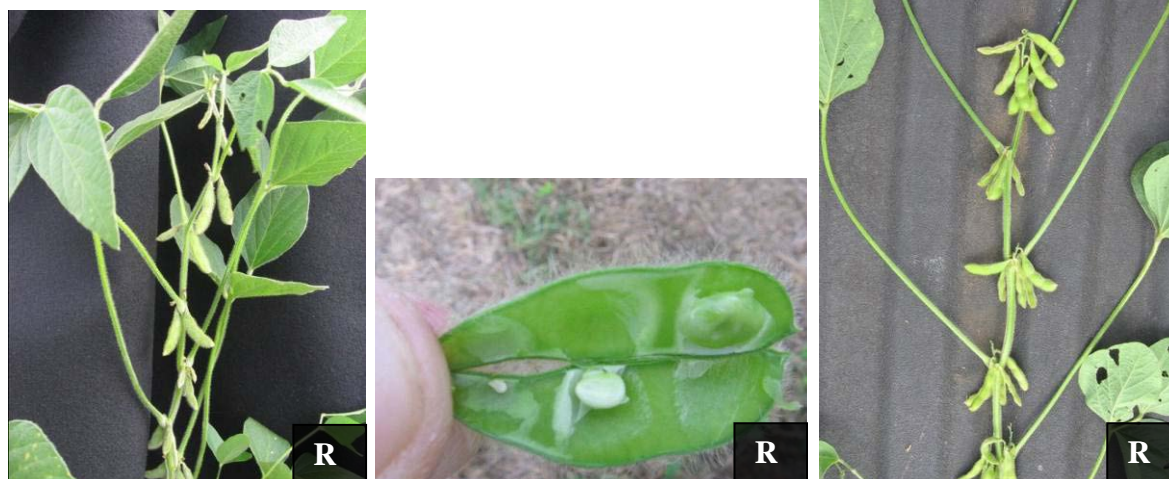


amounts occurred in eastern Virginia, but most of our soybean growing regions received rain. Ironically, the hurricane might have saved the soybean crop on the Eastern Shore, which was very dry. The rain comes at a very critical time for this year's crop. It will insure that pods and seed continue to fill and not abort due to moisture stress. In most areas, the soil profile should be full; therefore, adequate soil moisture should be

available to take us as least to the beginning of the R6 (full-seed, seed meeting each other in the pod) stage. I am not however implying that the crop is made. At the beginning of R6, only 50% of the yield is made. But, cooler temperatures and a few more timely rains should insure good yields.

Now for the down side of the hurricane – lodging. How much will the lodging from the hurricane cost us in yield? This will depend on the degree of lodging and the stage that the soybeans were in. In general, I'd say that our full-season crop is in the R5 (beginning seed) to R6 (full seed) and the double-crop soybeans are somewhere between R4 (late pod) and R5.

Yield is most severely affected when the lodging occurs at the R5 (beginning seed) development stage. Although yield is still affected at R6, yield losses are only half as severe at this stage. Many double-crop soybeans are only in the R4 stage throughout the state. Yield losses due to lodging at this stage is probably not as great as if the crop was in R5, but could be greater than if the crop was in R6 (assuming the same degree of lodging). Still, double-cropped soybeans are usually much shorter and do not have the severe lodging that the more full-canopied full-season crop has. In general, I'd expect less yield loss for the late-planted crop.



So, what's my estimate on the amount of loss that we'll incur? First, we have to distinguish harvest or traffic loss from physiological yield loss. Harvest losses can vary anywhere from 3-10% depending on many factors. In some cases, we may have to run the combine of the most severely lodged soybeans in one direction. But, with that said, I expect the soybeans to stand up quite a bit as soon as leaves begin falling. I've even seen some recovery only after a few days.

Similar to harvest losses, if we have to drive over the lodged soybean for a late insecticide or another spray, we can see some loss due to running over soybean. We have data from running over R4 stage soybean to make a fungicide application. Depending on the size of the sprayer (larger boom widths cause less loss) and row spacing (7.5-inch soybean yield losses were less than 15-inch soybean), losses ranged from 1 to 4%. Hopefully, we won't need another insecticide spray.

There is little data on physiological yield loss, but what's out there seems to be pretty consistent. What do I mean by physiological yield loss? That's the loss in yield from lodging if all of the soybeans that are now on the plant can be harvested. In controlled studies where researchers simulated lodging and compared it to a crop that was artificially supported, losses have ranged from 0% to over 30%. Why such a range in yield loss? It depends on the severity of lodging and the stage of development in which the lodging occurred.

Let's first address the severity of lodging. Soybean researchers have traditionally rated lodging on a scale of 1 to 5 as follows:

- 1.0 = almost all plants erect
- 2.0 = either all plants leaning slightly, or a few plants down

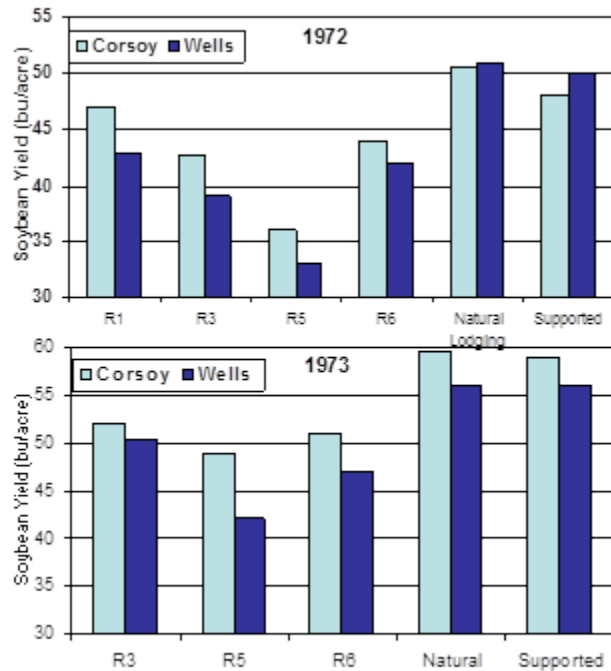
- 3.0 = either all plants leaning moderately (45° angle), or 25-50% down
- 4.0 = either all plants leaning considerably, or 50-80% down
- 5.0 = all plants down

As you may expect, a rating of 4.0 to 5.0 is very severe lodging. I have seen this in a couple of locations, but at this time I'd rate most of the lodging between 2.0 and 4.0. Yield loss will be minimal unless most plants are leaning at a 45° angle or more. Otherwise, yield losses can range from 10-35%, depending on the stage in which the lodging occurred.

Why does lodging cause yield loss? It's not completely clear, but the generally accepted reason is a reduction in net photosynthesis. With less photosynthesis, there is less energy going to the developing pods and seeds. When plants are lodged, relatively less of the upper leaves and more of the lower leaves are exposed to sunlight. The upper leaves are more photosynthetically active and the lower leaves are less active. When lodging occurs, the entire energy-producing mechanism is disturbed. In other words, we are now exposing less of the most productive leaves and more of the least productive leaves to the sun. So, yield will decline.

Let's assume that lodging rated above 3.0 will cause a 10-30% loss. Now the severity of the yield loss will depend on the development stage that the soybean plant was in. As I said earlier, there's little hard data on this subject, but a few older experiments give us some information. In a study conducted in 1972-73, S.J. Woods and M.L. Swearingin of Purdue University indicated that the R5 stage was the most critical time for lodging to occur. At this stage, yield was reduced by 18-32%. At stages R3 and R6, yield was reduced by 12-18% and 13-15%, respectively. Details of that experiment are shown to the right.

In that study, the plots were manually lodged with a long aluminum bar at the indicated soybean stage. Although lodging ratings were not given, I would consider it to be in the 3.5 to 4.0 range from the description given. Two varieties were tested. 'Corsoy' was more susceptible to lodging, but was able to branch more; therefore, it yielded higher when lodged. 'Wells' is more resistant to lodging, but did not branch as much; therefore, was unable to compensate as much for the lodging. In the natural lodged plots, only slight (2.0 or less) lodging occurred.



Woods, S.J. and M.L. Seeringin. 1977. Influence of simulated early lodging upon soybean seed yield and its components. *Agron. J.* 69:239-242.

From the above data and a few other studies, I'd estimate that where we had moderate to severe lodging and the soybean were in the R4 or R6 stage, we'll probably lower our yield

potential by 10-15%. If the plants were in the R5 stage and lodging was severe, then losses could be 15-25%. But, most of our lodging was not likely as severe as in the study. In general double-cropped soybeans are not as lodged due to their smaller height, therefore will not suffer as much damage.



One more thing must be mentioned. If soybeans were in even later stages (mid-R6), then yield loss will be less. Our full-season maturity group 3 soybeans planted in mid-May are getting close to physiological maturity (R7, one pod reaching its final brown color) and some early-maturing group 4 soybeans are well into the R6 stage. Once a plant reaches physiological maturity, 100% of the dry matter has accumulated; so there will be no yield loss. Plus, the plants with fewer leaves lodged less.

In summary, there will be some loss in yield potential due to Hurricane Irene. I must stress that this is loss in yield potential, which is the yield that soybeans would have made after receiving the rain from Irene, but not the wind that caused lodging. In dry spots or in places that were becoming dry, the hurricane likely benefitted the soybean crop more than it hurt. Overall, average yields may now be greater than before Irene.

Thinking of Renovating or Planting a New Pasture or Hay Field?

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Part 1: The Pre-Planning Process

I have received several requests over the past several weeks concerning overseeding or renovating pasture and hay fields and feel it's a good time to begin a discussion on the process. All too often, we find ourselves moving into mid- to late-fall without having taken the time to really consider all decisions that have to go into improving the odds that the planting will be successful. You need to keep in mind that seed costs alone can equate to a hundred dollar an acre investment; and, if we really take into account all the variable costs, that new pasture or hay field can easily represent an investment of hundreds of dollars per acre.

So in the pre-planning process, what's first? I know many get tired of hearing the phrase but testing the fertility of your soil far ahead of time is still the number one issue. If the field will not be tilled and you have not been applying significant quantities of commercial nitrogen (N) fertilizer to the field, sampling from 0 to 4 inches deep in each field or management zone (an area of the field treated in a similar fashion and not much different from other areas of the field in soil type) is the depth that should be sampled.

If you have used large quantities of commercial N fertilizer in the past, you really should take both a 0-2 inch depth sample for determining the soil acidity in the upper soil layer as well as a 0 to 4 inch depth sample for nutrient content (phosphorus, potassium, calcium, magnesium and other essential elements).

The reason for this distinction is that the ammonium or urea N forms that we apply as fertilizer are converted by soil bacteria into nitrate and in the process acidity is released into the soil. Since the N is all surface applied, the release of acidity near the soil surface can create a condition known as 'acid roof' where the top inch or two of soil is much more acidic than the deeper layers of soil. A second reason involves the very slow movement of limestone down through the soil. Studies on pastures in Connecticut many decades ago showed that lime moves at a rate of about 1 inch per year so it takes a very long time to have an impact on the entire rooting zone of forage grass and legume plants.

For fields that will be tilled and a new planting established, the traditional plow layer sample (0 to 8 inches) for both soil pH (acidity) and essential nutrient status will be the correct choice. If the soil sample indicates that the soil must be limed, apply the recommended amount of limestone and work it into the soil as soon as possible to allow time for the limestone to neutralize soil acidity before planting time. Although if it remains dry lime may not completely react, a second soil test still would be useful to determine if any additional lime will be needed. Additional agricultural lime and the recommended phosphorus (P) and potassium (K) and any other needed nutrients can be applied and worked into the soil shortly before planting the field.

Everyone asks the question of whether to apply N at the time you plant a new field or seed a field you are renovating. My preference is that you should wait until the new grass is several inches tall and has enough biomass and roots to compete for the applied N and to store any extra N for future growth. Until forage plants have enough leaf area to rapidly capture the sun's energy and convert it into more plant tissue or into sugars for storage, weeds in new plantings or the current vegetation in renovations are likely to outcompete the new seedlings for N and then for light, water, and other nutrients. When waiting to apply N although weeds and current vegetation will still be present, the new seedlings will at least be in a better competitive position when the N is finally available to stimulate growth.

Now that you've taken care of any soil fertility issues that can reduce the chance for a successful stand, the next decision involves choosing the right seed to plant. I've had the opportunity over the years to read many seed labels on various pasture mixes offered for sale. I understand the convenience of buying a prepared pasture mix and the allure of these mixes. The buyer often assumes that the seller has spent the time and energy studying the issue and has come up with a mixture that in their opinion and experience has the best chance of success. I certainly can't speak to motivation of the seller but keep in mind that from a business point of view, seed that is mixed and offered for sale need to be sold over as large an area as possible to justify the expense of wholesaling large quantities of seed, blending, packaging, and labeling the seed. In my opinion, this nullifies the expectation that the seller has designed the mix for your particular field or location.

After looking at the species of forages used in the prepared pasture mixes, I find that these mixes are more like a shotgun approach to seeding where you plant a little of everything in hopes that something will establish in all areas of the field. Usually they contain a quick establishing grass such as ryegrass that can germinate in as little as 5 to 7 days so the buyer can feel comfortable with the new seeding. The mixes also usually contain the feel-good or highly recognized grasses such as timothy and Kentucky bluegrass in horse pasture mixes and at least some orchardgrass and probably an endophyte-free tall fescue to provide more permanent cover. Finally, a legume such as white or ladino clover, red clover, or alsike clover will be in a pasture mix to provide the N-fixing legume everyone would like in a pasture.

The convenience of these mixtures comes from not having to mix them yourself before you fill the seed drill and the allure comes from not having to make a decision other than how much seed per acre to plant and not having to choose individual species to plant. For most buyers, the convenience and allure end up costing them many, many dollars per acre in seed costs for seed of grasses that won't survive in grazing situations or won't survive more than a season or two at best or will be unproductive for much of the grazing season.

So what should you do? I prefer going with a simpler mixture using forage species that are adapted to our region. In most cases, the only species that will survive for many years in our transitional zone climate is tall fescue. Because of endophyte (an fungus growing in some tall fescue plants) issues, many growers have tried the endophyte-free tall fescue varieties and some have had success with keeping a stand for many years while others have seed stands decline or disappear quickly. The newest chapter in this issue has been the development of novel or friendly endophyte tall fescue varieties. The novel endophyte tall fescue varieties do not produce the chemical compound (alkaloids) that interfere with animal performance but still provide benefits to the tall fescue plants helping them survive in many stressful environments. A limitation still in evidence with these new tall fescue varieties is that horse owners who breed horses do not all accept tall fescue as a feed source for their animals. This limits tall fescue's acceptance.

What other species can you include in your simple mixture? Orchardgrass is another grass that many producers like to include in a pasture mixture but you should be aware that many orchardgrass fields are failing due to a disease/insect/environment/management complex interaction we've been calling orchardgrass decline. If you choose to include orchardgrass, keep it as a small proportion of your mixture. The other grass to include at least on the heavier soils is Kentucky bluegrass. Be sure to include several varieties of the Kentucky bluegrass to help with disease resistance. It will be most productive early in the year (early spring to early summer) and mid- to late-fall. Finally, add in a legume to help with providing N for the grass to use as well as to improve the protein and forage digestibility of the pasture. For grazing, most people prefer a ladino-type of white clover. Although slobbers (the animal produces excessive amounts of saliva) is a potential concern with all clovers, it seems to be mostly associated with red clover. Often included in commercially sold horse pasture mixtures, alsike clover is known to cause photosensitivity (sunburn) especially in horses and should not be included in your pasture mix.

You will find it useful to talk to your seed dealer about the various varieties of each species that are available. Once you decide on the varieties to use and you purchase seed, you can mix

your own pasture mix by either purchasing or renting a cement mixer and combining the seed in the proportions you decide are best for your purpose and field. Since many legumes now come pre-inoculated with the N-fixing bacteria and often are coated with a fine limestone, do not over mix the seed and when you re-bag it store it where it is protected from high temperatures and humidity. Stored properly, the seed can be held over the winter if something prevents you from seeding this fall but you should plan to plant as soon as possible after purchasing seed. Not only are the N-fixing bacteria alive; but, if you use a novel endophyte tall fescue variety, the endophyte has a limited storage time (around a year under good conditions) before it should be planted. Although the tall fescue seed will germinate after longer storage times, the endophyte fungus may no longer be alive. The fungus only lives in the plant and is not soil-borne.

Next, I'll cover some of the other management issues to consider such as planting date.

Part II: Planning to Planting

Now it's on to the planning and planting process. One of the biggest challenges these days especially if you have a low acreage field is finding someone with both the right sized equipment to fit the field and a willingness to do the job for you in a timely fashion. Of course even if you're lucky enough to find the equipment and operator, cost is going to be a critical factor when making the decisions of what parts of the plan are actually doable. Another factor that's come up recently is the availability of forage seed. Many of the forage seed producers have eliminated production fields in favor of corn or soybeans which now sell for very alluring prices.

In planning the whole procedure, your time will be a valuable asset. With high prices, limited seed supplied, and challenges in finding equipment and help to fertilize, lime, control weeds, and plant seeds, the time you take to shop around should pay big benefits and August is the month to do these chores because planting season is rapidly approaching.

For planting date, forage agronomists often list from mid-August through September as being the time to plant as long as soil moisture is adequate. Soil moisture for many hay producers and grazers in the state and region really will be at critically low levels for much of August. This can extend late into September due to the drought and hot weather conditions we usually experience during July and August. With all our pre-planning and planning activities, the final decision on when to plant and even whether to plant on time will be determined by the weather conditions during August and September. You may be tempted to plant as soon as the field receives the first rainfall in the planting window but you should keep in mind that if the deeper layers of soil are deficient in moisture the new planting will likely fail if fall turns dry. Use a shovel or your soil probe to test the soil for moisture at the 6 to 12 inch depth. If the field hasn't received enough rainfall to supply this soil depth with at least some water, a new planting will be very much at risk if rain events do not continue from planting until winter dormancy takes hold. Only you know the amount of risk you are willing to take to establish the new seeding this season and none of us know what the future weather will be.

What if enough rain to supply water to the deeper soil layers doesn't fall until very late in September? Certain species, such as low alkaloid reed canary grass, require a specific amount of time between planting and first frost (six weeks minimum for reed canary grass) but almost all

species will not only yield less the following year but take a lot more time to reach full establishment if planted late. Again, the hay producer or grazer must evaluate the amount of risk they are willing to take on when deciding to plant after September.

You should maintain frequent contact with your fertilizer/lime dealer, seed dealer, equipment supplier, and others who will be helping you with the process of planting the new pasture or hay field. If you will be using equipment provided through the county conservation districts, be sure to get your name on the list as early as possible since many folks may want to seed about the same time when moisture conditions become favorable.

What's the best means of seeding fields, no-till or conventional tillage (a prepared, weed-free, firm seedbed)? As with any choice, there are advantages and disadvantages to each method. Both seeding methods allow for weed control activities before seeding but no-till is limited only to herbicide applications. Whenever deciding on an herbicide to use, read the label carefully to be sure there are no rotation restrictions of what can be seeded following the herbicide application or how many days or months must separate the application and seeding activities. Also use the label to determine if a single application will be all that is needed or whether you will need follow-up applications and if you will at what stage of growth must the new seedlings reach before the next application is applied. This latter concern is especially important for perennial and hard to kill weeds such as hemp dogbane, Canada thistle, horsenettle, and others.

No-till drills must be calibrated properly to deliver the correct amount of seed per acre as well as be set to place the seed at the correct seeding depth with adequate soil to seed contact for fast germination and emergence. Never assume that the last person to use the drill set it up properly for your seeding. When you spend a hundred or more dollars per acre just for seed, you need to be sure the seed is being planted as best as possible to ensure a successful establishment. No-till drills also place the seed in rows usually from 7 to 10 inches apart so it often is useful to cover the seeded area in two directions making a cross hatch pattern over the field to help the plants fill in the space quicker. Brillion seeders that broadcast seed over a prepared seedbed and then press the seed into the soil have the advantage of achieving canopy closure much sooner than no-till seedings.

Canopy closure is when the new plants get large enough that they are able to shade the underlying soil and therefore reduce the ability of weeds from germinating and establishing in the field. Fields seeded with no-till drills can be many years (if ever) filling in so that a full canopy exists during normal grazing activity. This is one disadvantage to the no-till drill although it is offset by the soil conservation advantage of no-till when a field has enough slope to allow significant water erosion or enough exposure to allow wind erosion problems if the weather turns dry again.

Which method is best? Since each has both advantages and disadvantages, it will depend on your situation. No-till helps conserve the soil in situations where soil can be lost; it reduces moisture loss since the soil is not disturbed; it doesn't encourage new weed growth since buried weed seeds are brought to the surface; it does not introduce oxygen into the soil causing the soil organic matter to be reduced via oxidation; and when done correctly it ensures rapid germination

and emergence since seeds are placed in the soil and soil is firmed around the seeds. From the negative side, no-till does not allow nutrients and lime to be worked into the soil profile; no-till does not help break up compaction issues from previous grazing or haying equipment use; and no-till seedings are often in rows that can be seen for years in some cases.

Conventional tillage does allow nutrients and lime to be incorporated in the soil; it allows tillage during the summer to help with weed control issues; it allows for the summer establishment of annual smother crops for weed control and to introduce organic matter into the soil; it allows you to rip fields to help alleviate compaction issues; and it allows seed to be broadcast to ensure rapid canopy closure. Some of the disadvantages include the loss of soil moisture during the tillage operation as well as the loss of soil organic matter during tillage. The above lists of advantages and disadvantages are not meant to be exhaustive but to point to some of the important factors you should consider when deciding on seeding method.

Part III: Pasture and Hay Planting Time Has Arrived

In the earlier sections of this article, I discussed some of the decisions and planning that need to be taken ahead of planting hay and pasture fields. Now consider that you have entered the ideal planting time for forage grasses and legumes. This holds true at least for those parts of the state that have received enough rainfall to recharge the topsoil with moisture although some areas each year will likely not have adequate soil moisture levels to even think about seeding new forage fields. For those areas that have remained dry and do not receive rain in a timely fashion, the decision to plant will have to be delayed until adequate surface and subsoil moisture is present or put off until the following year.

Some species such as reed canarygrass have specific requirements that limit how late in the fall you can plant. For example, reed canarygrass requires at least six weeks between planting and the average date of the first frost, otherwise the crop can be winterkilled or be severely weakened over the winter so that it's unable to compete with the usual weed competition crops experience in the spring. Other species, such as Kentucky bluegrass, just take a very long time (21 to 28 days) to germinate and begin fall growth and so should not be planted very late in the fall. Before deciding to plant a species or mixture, be sure to study the species in question to avoid problems with late plantings.

In other areas of the state that received some of the recent downpours and that now have adequate soil moisture reserves, planting can begin. Early planting can lead to well established forage seedings that will be able to survive the winter and get off to an early vigorous start the following spring. Early planted stands are much better at competing against weeds the next spring and will often yields much better as well. Work by Dr. Marvin Hall at the Pennsylvania State University showed significant yield decreases for all forage species tested as the date of fall planting was delayed with higher losses occurring the further north the site was located.

If planting into a prepared/tilled seedbed, be sure that all weeds have been killed during soil preparation and that a good smooth (clod-free), firm (your shoe should not sink deeper than the sole level) seedbed is prepared for planting. Seed can then be broadcast over the seedbed and then firmed into the soil with any number of devices but seed should only be pressed into the soil

and not buried more than 1/8 to 1/4 inch deep. Covering the seed is idea since the seed will be able to take in water from the soil but not be quickly dried out again by the sun's rays. Seed can also be planted using a Brillion seeder followed by a cultipacker or roller or seed can be placed in the soil using a drill. Since drills place the seed in rows from 4 to 8 inches apart, depending on the drill, I generally recommend that you drill at half the recommended seeding rate and run the drill at about a 45 degree angle across the field. This will help bring the rows closer together and allow the seedlings to more rapidly fill in the space so competing weeds can't find space to grow.

Another method of seeding is to use a no-till drill following an herbicide burndown program. This is especially useful when perennial weeds with underground rhizome systems are present. Examples of these weeds are hemp dogbane, Canada thistle, and horsenettle. Although several herbicide treatments are often needed to get these weeds under control, one of the best times to apply herbicide is in the fall when the weeds are sending carbohydrates (sugars) down into the underground storage organs (rhizomes). If a systemic herbicide that can move in the plant is used, it will be taken with the sugars down to the rhizomes and help kill the meristem buds or next year's growing sites in the weed. Read the herbicide label for exact requirements between treatment and seeding but generally for Roundup® or glyphosate you should wait several weeks after herbicide application before planting.

The no-till drills are similar to other grain drills in that the seed is placed in rows and then the open slot in the soil is closed with some type of packer wheels. I again recommend that you calibrate the drill for half the seeding rate and go over the area twice at a 45 degree angle to minimize the distance between rows.

In all cases I've talked about, be certain to calibrate your seeding equipment and make sure the drills or other equipment is clean and functional before entering the field. These days forage seed is quite expensive so make the most of the money you spend by accurately calibrating your equipment. This involves the following procedure: weigh out some seed to add to the planting equipment, determine the width of area covered with seed by the equipment (in feet), run it for a certain number of feet (the length—say 50 or 100 feet); multiplying the two numbers together to get the number of square feet covered by the seed; divide that number by 43,560 (number of square feet in one acre); and finally weigh the amount of seed remaining in the equipment. Subtract the final weight from initial weight and divide that number by the number of acres you covered (usually this will be a number such as 0.15 or even 0.015 or other very small number). If your seed weights were in pounds of seed then the number you calculate at the end will be in pounds per acre or if you had access to an egg scale or something that measures in grams then divide the number of grams of seed used by 454 (grams per pound) to obtain pounds of seed and then divide that number by the number of acres planted in the calibration test. If all else fails, email me or give me a call and I'll help you do the calculations.

A Comparative Analysis between Virginia and North Carolina's Wine Industries

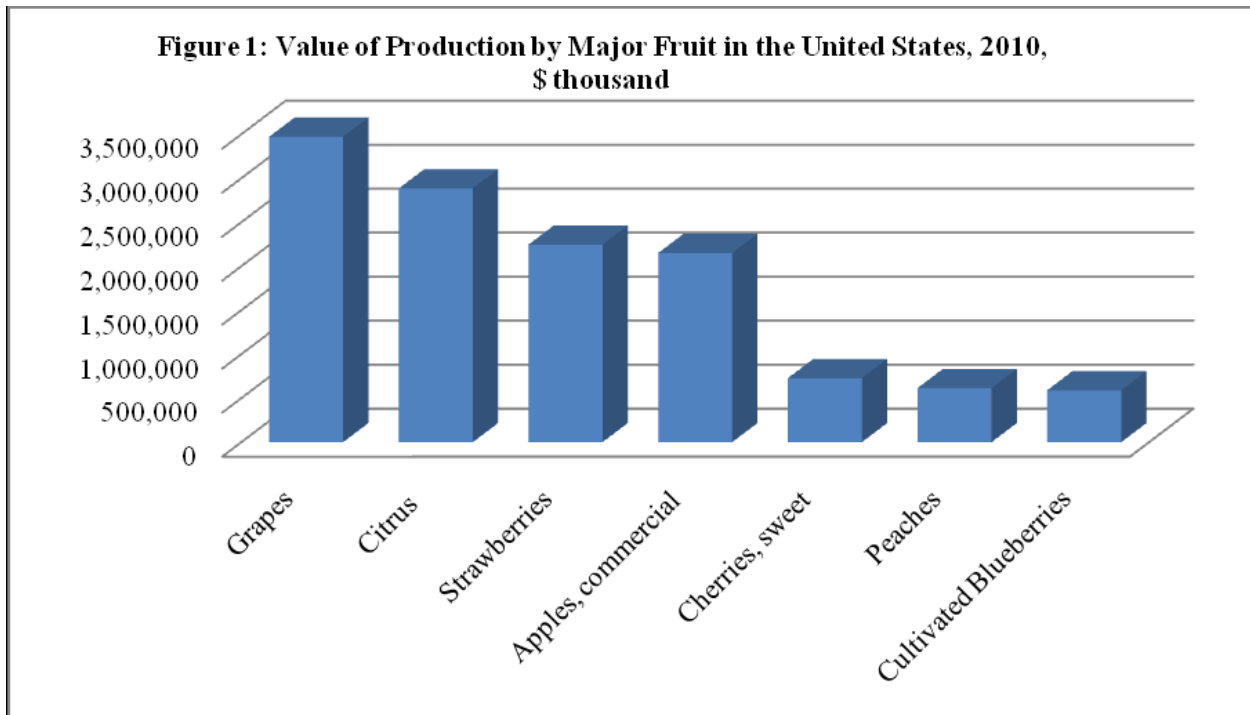
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The Economic Impact of the Wine Industry in the United States

The economic importance of the grape and wine sector has increased in recent decades, and in 2007 the U.S. wine, grape, and grape product had an estimated \$162 billion economic impact on the American economy. The sector also accounted for more than one million jobs in the U.S., for a payroll of almost \$33 billion (MFK, 2007). Today, the grape and wine production is spread across all 50 states, and is carried primarily by family and multi-generational businesses. However, the state of California alone accounts for close to 90 percent of total U.S. wine production.

Unlike what has been happening in other parts of the World, the U.S. wine industry has witnessed consistent growth on both the supply and demand sides. From 1999 to 2007, the national number of bounded wineries increased by 83 percent, from 2,688 to 4,929. Furthermore, the sales of domestic wine accounted for almost two-thirds of the 2005 total sales of wine in the U.S. In terms of international trade, this industry still plays a relatively modest role with 35 percent of grapes and only 6 percent of wine produced in the U.S. being exported (MFK, 2007). On the demand side, the U.S. has been the only major growing market for mid-priced and more expensive wines. In 2010, a total of 784 million gallons were consumed in the U.S. in comparison to 267 million in 1970. The wine per capita consumption in the U.S. went from 1.31 gallons in 1970 to 2.54 gallons of wine in 2010 (The Wine Institute, 2011). These positive trends indicate that, despite the current saturation in the World wine market, the U.S. still is an appealing and promising market for domestic wine producers.

Wine grapes produced in the U.S. can be broadly categorized in three different groups: (1) *Vitis vinifera* – the traditional European wine grape; (2) *V. labrusca* – wine grapes native to the North American continent; (3) and interspecific hybrid grapes. Figure 1 shows that grapes are the highest value fruit crop produced in the United States. However, the industry often goes through surplus and shortages cycles and it is characterized for high volatility and price swings. For example, during times in where the demand for specific wine grapes far exceeds supply, prices will soar. Producers will respond to it by increasing their production of those particular grapes, and consequently increase its supply. At one point in time, supply will exceed demand, which will depress grape prices and send a signal to producers that they need reduce production of those grapes. This will likely lead to another shortage in the future and a similar cycle will start over again.



Source: NASS

An Overview of the Wine Industry in Virginia and North Carolina

Virginia's wine industry dates back to the early seventeenth century at the Jamestown Colony and continued with the efforts of Thomas Jefferson, George Washington, and James Madison to promote the development of an American wine industry. The number of wineries and production of wine has been steadily growing, particularly since the mid-1990s. Virginia has a major competitive advantage over North Carolina, and that is its geographic proximity to affluent and densely populated areas that include Washington D.C., Richmond, and Norfolk/Virginia Beach. Virginia wine producers should fully explore these market opportunities, and be ready to meet increases in the demand for wine in these areas. In North Carolina, commercial wine consumption and wine production can be traced back to the state's first winery in Halifax County that grew a native Muscadine varietal (Scuppernon). It was not until the early 1970s that Vinifera grapes began to be planted for wine production in North Carolina (MFK, 2005).

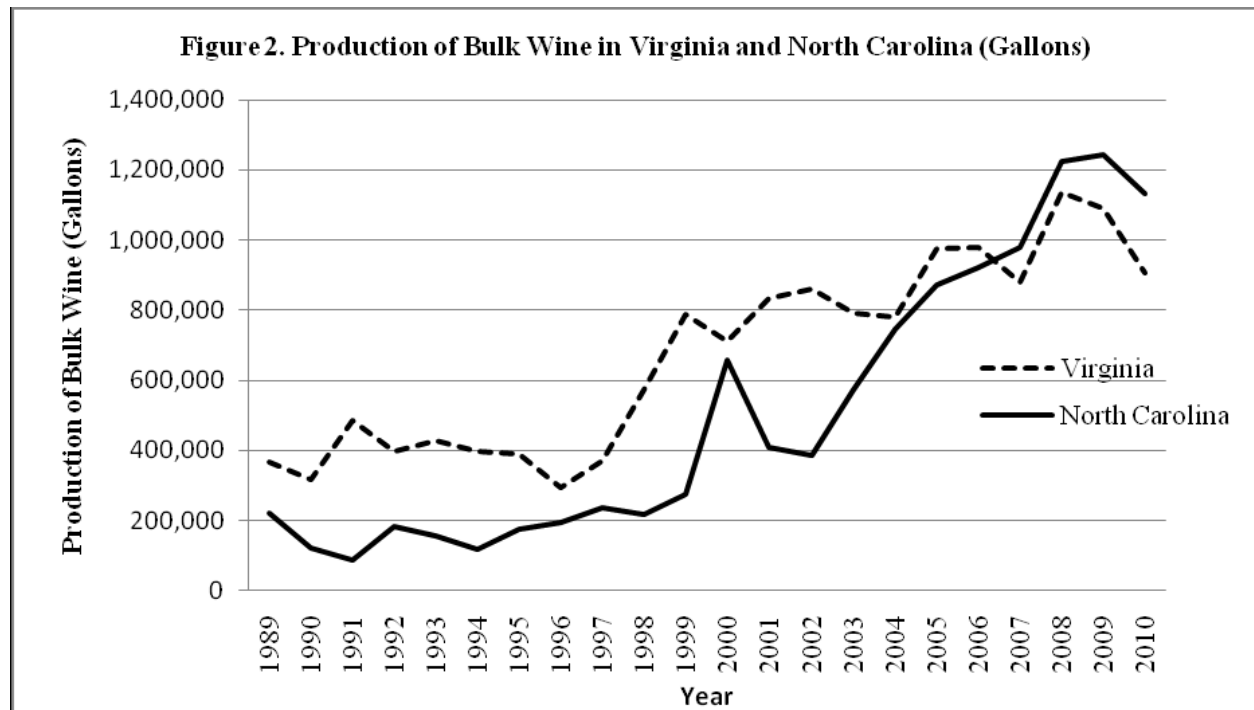
In both Virginia and North Carolina, increasing wine production has contributed to the diversification of agriculture and local economies, employment creation, and the development of new market opportunities in rural communities. This has been particularly important for areas that suffered from a change in market structure resulting in the decline of traditional crops and farming practices, for example tobacco or apples. For instance, starting in 1999, the North Carolina's Golden LEAF Foundation has supported those farmers who wanted to shift from tobacco to wine production (MFK, 2005).

The wine industries of Virginia and North Carolina are comparable in many dimensions due to the geographic proximity and a set of similar challenges and opportunities that both share.

This paper does a comparative analysis of the wine industry in both states by looking at four specific issues: (1) grape varieties and viticultural areas in both states; (2) marketing and distribution issues; (3) wine-related tourism; and (4) shortages of skilled labor.

A Comparison of the Virginia and North Carolina Wine Industries

Both states are located in the Eastern Coast and, despite recent expansion, can be considered “peripheral” and “regional” given their volume of production (Rape, 2008). Virginia is currently home to 192 wineries in comparison to 107 in 2005, and only a handful in 1980. North Carolina has currently 104 wineries, compared to 55 wineries in 2005, and 21 in 2000. In both cases most of their wineries are characterized as small scale producers (producing less than 5,000 cases per year). Based on data from the Alcohol and Tobacco Tax Trade Bureau (TTB), Figure 2 shows how Virginia has produced slightly more bulk wine than North Carolina until 2007. Since that year, North Carolina’s wineries have outperformed Virginia’s, and North Carolina has managed to climb up a few positions in the national ranking of wine producing states. In 2010, North Carolina ranked 8th and Virginia 13th in terms of production of bulk wine. For the same year, North Carolina ranked 9th at the national level in the production of bottled wine, while Virginia ranked 15th. These figures indicate sustained growth of the wine industry in both states for the last two decades. However, they also show that North Carolina has experienced a more rapid growth that allowed its industry to “catch up” and actually surpass Virginia’s.



Grape Varietal and Viticultural Areas

Both regions rely heavily on the production of varieties of red (Cabernet Franc, Merlot, and Cabernet Sauvignon) and white (Chardonnay, Vidal blanc, and Viognier) grapes. North Carolina also produces a noteworthy quantity of native grape varieties (Muscadine, Norton, and Niagara) that favor the hot and humid weather of North Carolina’s coastal region, and tend to be more resistant to fungal attacks, namely the Pierce’s Disease (MFK, 2005). Many wineries in the U.S. struggle financially in part due to the lack of a *varietal focus*. Wineries that produce different grapes and wines in an attempt to reach a broader customer base may not be able to concentrate their limited resources on a specific product and then develop expertise and a marketing image (MFK, 2007). For example, the state of Oregon has successfully pursued a long-term grape and wine specialization strategy with the Pinot Noir and Pinot Gris varieties, and it seems reasonable to argue that North Carolina and Virginia would benefit from a similar approach. According to a study, Virginia has been fairly successful in building up a wine state identity via varieties that perform particularly well there such as Viognier and Cabernet Franc (MFK, 2007).

As Table 1 shows, both North Carolina and Virginia have a number of wine producing regions that have been designated as American Viticulture Areas (AVA). More specifically, the TTB has approved six viticultural areas in the state of Virginia since the mid-eighties, and more recently it recognized three areas in North Carolina. In Virginia most of the wineries are located at the Northern Virginia Region, the Shenandoah Valley, and the Monticello AVAs. In North Carolina there is a great concentration of wineries, in particular at the Yadkin Valley and Swan Creek AVAs – which includes the Western and Piedmont regions of the estate. Finally, North Carolina and Virginia are characterized by relatively high costs in the production of *Vinifera* due to small volume produced, and to the expenses associated with wine grape cultivation in this region.

Table 1. List of American Viticultural Areas approved by the TTB in North Carolina and Virginia.

State	Name	Effective Date
North Carolina	Haw River Valley	2009
North Carolina	Swan Creek	2009
North Carolina	Yadkin Valley	2003
Virginia	Virginia's Eastern Shore	1991
Virginia	Rocky Knob	1987
Virginia	North Fork of Roanoke	1987
Virginia	Northern Neck George Washington Birthplace	1987
Virginia	Shenandoah Valley	1987
Virginia	Monticello	1984

Source: Alcohol and Tobacco Tax Trade Bureau

Marketing and Distribution

The Alcoholic beverages industry and the sales of wine in the U.S. are ruled by a series of complex regulations and structures that vary by state. This system is commonly known as the “three-tier-system” in where wineries sell to licensed distributors, which in turn sell to retail or

restaurant outlets. The three-tier-system represents a major obstacle to smaller wineries that normally do not produce enough quantity to convince wine distributors to commercialize their products – especially in the current overcrowded wine market. Another issue is that this system may be too expensive for smaller wineries because they typically have to sell their products to a distributor for 50 percent of the retailer price. In contrast, wineries are able to receive the full retail value when selling in tasting rooms, and between 65 to 80 percent of the final retail price when selling directly to a restaurant or retailer outlet (MFK, 2007).

In Virginia, by 1980, the General Assembly adopted a series of measures to give Virginia wineries the right to bypass the three-tier system, and thus self-distribute their products. Such system was very favorable for small and family-owned wineries and allowed them to sell their bottles directly to restaurants and retail outlets without the need of middlemen. However, in 2005, an adverse federal court opinion ended this self-distribution system, and self-distribution became illegal in July of 2006. In order to help small producers, in 2007 the General Assembly came up with an alternative scheme and passed legislation that allows the Virginia Department of Agriculture and Consumer Services to serve as a wholesaler. More specifically, the Virginia Winery Distribution Company – a non-profit, non-stock corporation – was created to provide wholesale wine distribution services for Virginia farm wineries. Currently, more than 100 wineries use this organization to distribute as many as 3,000 cases of their own wine each year to retail and restaurant outlets.

In contrast, the North Carolina General Assembly passed five laws in 2005 that streamlined distribution and allowed wineries to ship their products directly to consumers – both within state and nationally. Consequently, North Carolina’s wineries can choose between self-distributing their wine, selling it directly to restaurant or retail stores or simply using distributors (Ofori-Boady et al, 2010). Such flexibility has been vital in the development of direct marketing strategies within established businesses, and opens the way for the creation of new smaller wineries. For larger wineries this is not a critical issue because they often use distributors to market their wine. In summary, smaller wineries in Virginia are in clear disadvantage with respect to its peers in North Carolina, and many of them cannot afford to receive as little as 50 percent of the retail price or are too small in volume to be distributed into the wider marketplace. In the past, Virginia wineries have relied on wine festivals to sell their wine directly to consumers. However, even this market has become crowded with new competitors, making it more difficult for wineries to get included in the festivals or to differentiate themselves (MFK, 2007).

Wine Tourism

Wine-related tourism and recreation have been a growing industry in the past decade, and wineries have proven to be important players in the tourism industries as they became effective tourist magnets. Increasing number of visitors to wineries will likely support other local businesses such as hotels, bed & breakfasts, restaurants, and other shops (MFK, 2007). Wine tourism is important not only in terms of promotion and marketing, but most importantly, it is a necessary condition for financial survival of many small wineries. This is because direct sales from the tasting room and gift shops are a major source of income to the industry. A 2007 national survey sponsored by the Travel Industry Association (TIA) in partnership with the

Gourmet magazine and the International Culinary Tourism Association (ICTA) ranked both North Carolina and Virginia in the top-twelve destinations for wine related travel – although North Carolina ranked slightly higher than Virginia (TIA, 2007).

The promotion of wine tourism in North Carolina has been very effective and North Carolina wineries were visited by at least 800,000 tourists in 2005 (MFK, 2005). Moreover, the promotion of wine tourism in North Carolina can count on a very recognizable name, the Biltmore Estate, which is the most visited winery in the U.S. (Franson, 2004). Data on the number of visitors in Virginia was not available, but in 2008 the state spent \$387,000 to market its wine (Raper, 2008). The wineries located in the northern part of the state should benefit from their proximity to the Washington D.C. metro area, which includes parts of Maryland and Northern Virginia. This area has over five million residents and includes population segments with higher than average income levels. Hence, the northern Virginia wineries should strive towards attracting consumers from this market to their tasting rooms, and develop strong market relationships with restaurant and retail stores in the metro area. One study pointed at the fact that many wineries in Virginia struggle to attract significant number of visitors due to lack of concentration of wineries (MFK, 2007). In North Carolina, there is a high concentration of wineries at the Yadkin Valley and the Swan Creek area. This reduces the travelling distances for those tourists who plan to visit several wineries in a specific period of time. In sum, there is little doubt that both states should strongly support wine tourism activities in order to increase the number of visitors to the wineries and the direct sales to consumers.

Shortage of Skilled Labor Force

Finally, as the vineyard acreage increases in both states, producers have had to deal with shortages in trained and skilled labor force (i.e. viticulturists and winemakers). This problem has become a major challenge for vineyard management, and often wineries end up hiring professionals from other states. Both states have made efforts to overcome this problem and invested in the creation of new education programs in universities and community colleges. Since 2000 North Carolina has developed a strong program at Surry Community College, and more recently, set up viticulture and enology programs at North Carolina State University and Appalachian State University (MFK, 2005). The College of Agriculture and Life Sciences at Virginia Tech does not offer a program in enology or viticulture but Agricultural Experiment Station has developed the Viticulture Research Program and Enology-grape Chemistry program to support the state's wineries. When compared, it appears that North Carolina has been more proactive in educating a new generation of professionals that will work in the state's vineyards and wineries. As a short-term solution for this problem, different parties in the local wine industry may encourage the dissemination of knowledge and experiences within wineries, and organize workshops and seminars. This could develop synergies that may help smaller wineries owners, who do not have the resources to hire professionals from out of state, to acquire some important production and management skills.

Conclusion

The wine industries in North Carolina and Virginia are quite similar in several domains and they face common challenges. In the case of Virginia, smaller wineries may need to press for a more favorable distribution system that would allow them to obtain reasonable profit margins and reach larger markets. Moreover, Virginia should also push for the development of further educational programs preparing skilled professionals for the industry. The wine industry in North Carolina could benefit from a shift in production towards very specific varieties that perform well in the region. This would be an important step in the building of a wine state identity. Finally, wine tourism in North Carolina and Virginia should continue to be promoted via nationwide marketing campaigns and through the creation of recognizable “wine routes.” This can only be achieved with the involvement of hotels, travel agencies, bed & breakfasts, state and local governments.

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When to Worry about Hay Safety

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Back in the summer of 2007 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. With the limited hay supply available across the country and with quality hay in very short supply, this is a good time to review the topic of hay safety that originally appeared in the 2007 September issue of the Mid-Atlantic Regional Agronomist Quarterly Newsletter.

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 neither you, your hay dealer, nor 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 relatively 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 and a new soft leafed tall fescue called BarOptima PLUS E34) that do not produce the toxic alkaloids but do help the plants survive. The new novel endophyte tall fescues are mostly used for pastures but you may find hay for sale that comes from novel/friendly endophyte tall fescue (Photo 1). With orchardgrass stand decline becoming a serious problem in orchardgrass in this region, many hay producers may not have an alternative to using the novel endophyte tall fescue varieties unless they resign themselves to replanting hay fields annually or every other year (Photos 2 to 4).

Photo 1-4. MaxQ tall fescue, a novel endophyte infected tall fescue, orchardgrass stand decline from disease, bluegrass billbug, and white grubs. (Photos by Richard W. Taylor)



At this point it is worth pointing out that in times of hay shortages, growers in many parts of the country mow and bale hay from abandoned areas, grass waterways for drainage control, and even highway borders or medians (with permission, of course). The hay from these areas may contain a large proportion of tall fescue and even toxic weeds. Although this type of hay is usually considered ‘cow hay’, it sometimes can enter the hay markets and be sold unknowingly as ‘grass horse hay’ or ‘pasture grass’ and end up being fed to horses. This is another reason to know or have a good relationship with your hay provider.

A few years ago 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*) (Photos 5 to 8), an annual grass weed common to our area; 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. 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 you hay producer and express your concern that this species should not be in hay sold to you.

Photo 5-8. Fall panicum in pasture, with characteristic white stripe down the mid rib of the leaf blade, and an open panicle seed head. (Photos by Richard W. Taylor)



Another perennial problem, albeit more likely a pasture problem, occurs when alsike clover (*Trifolium hybridum*) is present in a hay production field (see Photos 9 to 12). 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.

Photo 9-12. Alsike flowers begin almost white and gradually darken to a light pink. The branching tap roots and abundant nodules help the plant provide nitrogen to the companion grasses. Leaves are hairless unlike red clover and plants grow mostly upright unlike white or Ladino clover in which the stems grow horizontally along the soil surface. (Photos by Richard W. Taylor)



Another example of a 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*) and these cause problems since the barbs can penetrate and become imbedded in skin and mucus membranes causing ulcerations, infections, and abscesses (Photos 13 to 16). Crimson clover dried seedheads can cause similar problems or can become imbedded in the eyes causing great discomfort to the animal.

Photo 13-16. Left to right, seed capsule barbs visible on mature crimson clover seed head, crimson clover showing both crimson and white seed heads sometime seen, and various foxtail weed species showing awns that can cause injury especially to mucous membranes. (Photos by Richard W. Taylor)



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 and hay sources, a good resource to contact is your state's Extension forage specialist or your local county agricultural agent. If they don't have an immediate answer for you, they usually can find the answers you need.

Equine Laminitis

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Laminitis is one of the most serious hoof conditions affecting horses. It can strike adult horses of all breeds and can be severely debilitating, resulting in excruciating pain, loss of usefulness, and in some cases necessitating euthanasia. Due to the complex nature of the disease, prevention and treatment of laminitis have often been causes of confusion and controversy. However, as research increases the understanding of the pathophysiology of the disease, more effective preventive and therapeutic strategies have also been developed.

A simple definition of laminitis is inflammation of the sensitive laminae and structural damage of the insensitive laminae of the foot, though this is perhaps an over simplification of a complicated condition (Stashak 2002). The laminae are folded connective tissues that serve to attach the distal phalanx or coffin bone to the inner hoof wall. When the attachment fails, a horse is considered to have laminitis (for a review of hoof anatomy visit http://www.thehorse.com/images/content/hoof_anatomy.html). There are three phases of laminitis: developmental, acute, and chronic. The developmental phase begins with the initiation of subclinical pathological changes in the laminae and ends with the emergence of clinical signs of laminitis. There are generally no signs of laminitis present during the developmental phase. The acute phase is considered the time between the onset of lameness and the failure of digital support by the laminae. In the acute phase of laminitis, the laminae fail at the basal cell layer; this “basement membrane zone” appears to be the weak link in the anatomy of the laminae (Dyson and Ross 2003). Loss of interdigitation may result in rotation and/or displacement, and in some cases sinkage of the coffin bone (Stashak 2002). Without the laminae to secure it, the coffin bone is driven into the hoof capsule by the weight of the horse, forces of locomotion and the pulling force of the deep digital flexor tendon. In the chronic phase of laminitis, there has been displacement of the coffin bone with or without intermittent recurrent active inflammation of the laminae, depending on the severity of the disease and whether or not the foot has been stabilized and the initiating condition adequately treated.

The acute phase of laminitis involves onset of variable lameness in one or more feet. Usually both front feet are affected, but unilateral lameness as well as hind foot lameness may occur. Horses with laminitis will be extremely reluctant to move and if forced to do so will move with a short gait in which the hind limbs are placed unusually far underneath the body. Lameness is worse when the ground is hard. The digital pulse of a horse with acute laminitis is described as “bounding” due to increased systolic and decreased diastolic pressures, resulting in a pulse that is

much easier to feel than it would be in a normal horse. The pulse rate (number of beats per minute) will also be increased in response to pain. Pressure applied to the feet might cause pain, but the response to hoof testers is variable. The sole of the foot may be flat or convex (bulging downward) instead of the normal concave shape and in the most severe cases, the tip of the coffin bone and associated soft tissues can penetrate the sole. Palpation of the coronary band may reveal swelling, serum seepage, and/or an unusual depression associated with sinking (Dyson and Ross 2003). When standing, the hind feet are tucked underneath the body in an attempt to take weight off of the front feet (Higgins and Synder 2006). The horse may lie down more frequently or for extended periods, which can eventually lead to decubital ulcers (“bed sores”). Some horses are anxious, have muscle tremors, increased respiration, and an elevation in rectal temperature (Stashak 2002).

The risk factors for the development of laminitis vary widely and include inflammatory conditions of the gastrointestinal tract, grain overload, grazing on rich and/or frosted pasture, retained placenta, pleuropneumonia, endotoxemia or sepsis, Cushing’s disease, obesity and associated Metabolic Syndrome, prolonged weight bearing on one limb, exposure to black walnut wood shavings, exercising on hard surfaces and the administration of large doses of corticosteroids. No association between age, breed, or sex has been established for the development of acute laminitis although generally older horses are affected by chronic laminitis (Stashak 2002). However, a correlation between obesity, hyperinsulinemia, and laminitis has been established and breeds that are more prone to obesity, such as pony breeds, Morgans, and others, are considered to be at greater risk of developing laminitis (Treiber et al., 2006).

Despite substantial research in the last few decades, laminitis and its complex physiologic cascade are still not completely understood and are likely to differ depending on cause. Laminitis frequently develops secondary to a disease occurring elsewhere in the body and it is therefore vital that the primary disease is treated (Stashak 2002). Researchers at the University of Queensland have shown that during the developmental phase of laminitis, cryotherapy, or therapeutic cooling of the tissue, may be useful to induce digital vasoconstriction and to reduce the activity of the enzymes that degrade the basement membrane that attaches the insensitive laminae to the sensitive laminae (van Eps et al., 2004). In the study, continuous cryotherapy during the developmental phase was successful in markedly reducing the severity of acute laminitis in horses known to be at high risk for developing the condition.

The metabolic related form of laminitis can occur as a result of insulin resistance (IR) and hyperinsulinemia in horses and ponies. Obesity also has been associated with an increased risk for laminitis, likely as a result of insulin resistance. In these horses, dietary factors, particularly the amount of nonstructural carbohydrates (NSC) in the diet, should be considered. High levels of NSC can increase the risk of developing laminitis because they can trigger insulin resistance or gastrointestinal disturbances in the hind gut that induce laminitis. Specific dietary management strategies to lessen the risk for laminitis include caloric restriction to promote weight loss and improve insulin sensitivity in obese animals, and strict control of NSC in the diet. Grains and sweet feeds should be removed from the diet and obese horses or those with insulin resistance should have their access to rich pastures that may be high in NSC restricted (Geor and Harris 2009). Daily aerobic exercise for obese horses or those with insulin resistance

is also important and when combined with changes in diet can play a significant role in improvement of body condition and in insulin sensitivity (Orsini et al 2009).

The diagnosis of laminitis is made largely on clinical signs (Stashak 2002). If the onset of acute laminitis cannot be prevented through cryotherapy, diet or other therapeutic strategies, non-steroidal anti-inflammatory drugs can be used to reduce inflammation and pain. Acute laminitis should always be considered a medical emergency. Horses with acute laminitis should be confined and placed in a stall with soft bedding. Frog pads or Styrofoam pads can be used to relieve pressure on the hoof wall by placing more pressure on the frog and heels. Radiographic examination is necessary for establishing both prognosis and treatment protocol. Radiographic abnormalities include rotation or sinking of the coffin bone. Horses with a rotated coffin bone should have their feet trimmed to realign the hoof capsule with the coffin bone. Therapeutic shoeing is important in the treatment of laminitis as different types of shoes can serve to support the frog and coffin bone and decrease the pull of the deep digital flexor tendon. However, shoeing in the acute phase (first 24-48 hours) should be avoided so that there is no further injury to the laminae (Dyson and Ross 2003). Making a prognosis for horses with acute laminitis is difficult, though the degree of rotation, lameness severity, and response to treatment can be used as predictors. The lamellar damage is never completely reversed and horses that have developed laminitis are at increased risk of developing it in the future (Stashak 2002). In cases with severe rotation, sinking or extensive infection, humane euthanasia may be necessary (Higgins and Synder 2006). Preventative measures are vital due to the devastating nature of the disease.

While there is still much that remains unknown about laminitis, researchers continue to investigate the causes and are working to develop improved treatment and prevention strategies. For further information regarding laminitis, please speak with your veterinarian. The references listed in this fact sheet are provided as additional sources of information related to laminitis in horses.

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For Further Reading:

See the Horse.com, Free Reports, Factsheets, Laminitis.
<http://www.thehorse.com/Free-Reports/Fact-Sheets.aspx>

Notices and Upcoming Events

November 15-17, 2011

Mid-Atlantic Crop Management School, Princess Royale, Ocean City, Maryland. Contact Gail Knapp at 302-831-2214 or by email: glanius@udel.edu or visit the registration website at: https://crayola.hcs.udel.edu/conf/registration/crop_management.

January 16, 2012

Delmarva Evening Hay and Pasture Conference, Ag Commodities Building, Delaware State Fairgrounds, Harrington, Delaware. Contact Dr. Richard Taylor at 302-831-2395 or by email: rtaylor@udel.edu or visit the Delaware Ag Week website at: <http://www.rec.udel.edu/AgWeek/home.htm>.

January 17, 2012

Delmarva Hay and Pasture Conference (All Day), Dover Building, Delaware State Fairgrounds, Harrington, Delaware. Contact Dr. Richard Taylor at 302-831-2395 or by email: rtaylor@udel.edu or visit the Delaware Ag Week website at: <http://www.rec.udel.edu/AgWeek/home.htm>.

January 19, 2012

Agronomy/Soybean Day, Dover Building, Delaware State Fairgrounds, Harrington, Delaware. Contact Dr. Richard Taylor at 302-831-2395 or by email: rtaylor@udel.edu or visit the Delaware Ag Week website at: <http://www.rec.udel.edu/AgWeek/home.htm>.

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/> Look for Mid-Atlantic Regional Agronomy Newsletter

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