



Mid-Atlantic Regional Agronomist Quarterly Newsletter

June 2011

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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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Emergency Forages for Feed

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With the very hot weather upon us and many areas of the state very short of available soil water, it is time to think about possible emergency forages for those producers with livestock. The traditional cool-season pasture and hay grasses such as orchardgrass, timothy, and tall fescue are not very productive during the summer months when high temperatures and drought limit their productivity and quality. On the other hand, the warm-season grasses do not reach their maximum growth rates until daytime temperatures rise into the 90° F. Summer annual grasses such as forage sorghum, sudangrass, sorghum-sudangrass hybrids, pearl millet, and teff can provide high quality summer grazing and sometimes emergency hay for livestock in our region. Many of these species even germinate when soil moisture conditions seem to be too dry for successful establishment although it often is difficult to know for certain if they will germinate and establish in a given situation. Although late planting limits their yield potential, many of these grasses can be planted up until late July and still produce valuable and needed animal feed although the cost of production will make the feed expensive.

The term “millet” is loosely used to refer to a variety of grass crops whose seeds can be harvested for human or animal feed. The term is used differently depending on local customs and sometimes continental influences. For example in many parts of Asia and Africa, sorghums are called millet whereas in Australia the species called broomcorn in the U.S. is called broom millet. When compared with the more commonly grown cereal grains such as corn, wheat, barley, and milo (grain sorghum), the millets are generally suited to less fertile soils and areas of drought or excess heat.

Foxtail, Italian, or German Millet:



Foxtail millet can be planted when it is too late in the season to make most other crops. It takes about 65 to 70 days to mature with summer temperatures and enough moisture to establish the crop. The crop requires warm to hot weather and matures quickly under warm conditions. It has a low water requirement although it can't stand severe drought since it is characterized by a shallow root system. This annual grass forms slender, erect but leafy stems that vary in height from 1 to 5 feet. Foxtail millet usually won't regrow following a harvest unlike pearl millet. It has been used in our region for a single harvest hay crop. Millets should be planted about two weeks after ideal corn planting time. Millets also have smaller stems and tend to be leafier than the forage sorghums, sudangrass, and sorghum-sudangrass crosses.

The primary use for foxtail millet hay is for sheep and cattle. This grass can cause problems if used as a major part of a horse's diet so as hay it should not be sold as horse hay. Problems include a laxative effect, excessive urination (cystitis), and kidney and bone or joint problems. The chemical, glucoside setaria, is found in foxtail and proso millet and is reported to cause illness and even death in horses. Foxtail or German millet also can cause oral mechanical lesions.

Pearl Millet:



Pearl millet is considered the most suitable millet species for horse grazing or hay. It has moderate to good nutritional quality if kept short (about 2.5 feet or less). Pearl millet is leafy, with an upright growth habit, and grows from 4 to 8 feet tall. There are dwarf or semidwarf types such as Tifleaf I, II, and III that are leafier and have less stem than the taller types.

Although the taller types produce more dry matter than the dwarf types, the stems make hay making more difficult. Although still requiring a mower-conditioner to crush the stems to hasten drying, the newer and leafier pearl millets are far superior to the older tall-type pearl millets. Pearl millet is more tolerant of lower pH and low fertility than the sorghum species.

Although the taller types produce more dry matter than the dwarf types, the stems make hay making more difficult.



Pearl millet does not contain glucoside setaria as does foxtail or proso millet and unlike the sorghums does not have the potential to cause prussic-acid (HCN) poisoning in animals. If raising pearl millet to feed horses, do not allow it to go to seed since a fungus can infect the seed and causes an accumulation of a toxic alkaloid (similar to alfatoxins in corn). Since pearl millet should not be harvested for hay when seeds are present (due to the very low quality of the forage),

alkaloid toxicity should not be of concern to horse hay buyers.

Japanese Millet:



Also called barnyard millet or billion dollar grass, Japanese millet is grown principally as a forage grass. It resembles barnyardgrass and probably originated from that species. It makes the most rapid growth of all the millets when conditions are favorable and can ripen grain in as little as 45 days. It should be cut for hay before heading to be palatable and to make curing easier since the plant can have thick stems. Usually it is from 2 to 4 feet tall and does best on the better soils.

Teff:



Teff is the common name for an annual lovegrass that is primarily used for grain in Africa and Europe but is also used for hay in South Africa and parts of Europe. It has excellent seedling vigor and good production and quality traits although it is somewhat shallow rooted so there is concern about grazing animals (especially horses) pulling it out of the soil. A couple of reports from this region suggest that it can be successfully grazed by horses if seeded in an existing pasture.

It has been grown as a summer annual on Delmarva and has been sold here as grass horse hay. Teff's palatability and quality vary greatly perhaps due to our lack of experience as to when to harvest the crop. As a hay crop, it can be cut and windrowed at early head (flower or seed head) emergence but you should not wait until the head is completely emerged and flowering has occurred since quality and palatability will be very much reduced.

Sorghum, Sudangrass, Sorghum-Sudangrass Crosses



For sorghum, sudangrass, sorghum-sudangrass crosses, hybrid sorghums, and other sorghum species, horses should not be allowed to graze and should not be fed hay from these species. Forage cystitis, an inflammation of the bladder can result. Sorghum species also contain prussic acid that can be metabolized or converted into cyanide. Cyanide poisoning can cause muscle weakness, urinary tract failure, neural degeneration, and death. This generally happens if the sorghum is grazed when young immature growth is present (plant height under

18 to 24 inches or regrowth occurs following a period of stress conditions or regrowth occurs during a grazing cycle) or the crop is damaged by frost or freezing weather. After a frost or freeze and until the foliage dries out (about 1 week), it should not be grazed. Regrowth after a frost or non-killing freeze should not be grazed.

It is very important to consider not only the expected yield potential from the many species and varieties of sorghum but also the digestibility of the varieties. Some BMR (brown mid-rib) sorghum varieties (see photo above) are now available and these have been shown to differ in daily average gains by as much as 0.75 lb/day. This difference in quality can translate to huge differences in the cost of producing a pound of beef. Many companies tout the high yield

potential for the various sorghums and millets and may show yields in the 6 to 7 tons/acre range. In excellent production years (plenty of heat and rainfall), these yields can be achieved but in drought years a more realistic yield expectation of 2 to 3 tons/acre (using the entire summer growing season) should be the basis of your decision. Dr. Chris Teutsch at Virginia Tech's Southern Piedmont AREC has conducted yield trials on many of these varieties so when making decisions refer to his results.

Kleingrass is also not recommended for horse since it produces a condition known as photosensitization. This is similar to that seen with alsike clover where sensitive horses can become severely sunburned.

Other Potential Problems:

Nitrate toxicity following heavy nitrogen applications can occur especially during periods of summer drought. If urea or ammonium-based fertilizers are applied to the crop, it is only a matter of time before the nitrogen fertilizer is converted by soil bacteria into the nitrate form. After nitrate is taken up by the plant, stress conditions such as dry weather can lead to the accumulation of nitrate in the lower stems of grass plants. Stress conditions include not only drought but also cloudy, cool weather following the rapid uptake of nitrates since both situations prevent the plant from transforming the accumulated nitrate into amines, amino acids, and proteins. This is generally a slightly less a concern with horses than with ruminants but nitrate levels can be in high enough concentrations that a potential toxicity problems can occur in horses.

Some species of millet can cause problems when grazed as lush pastures because they can contain significant levels of oxalates. The oxalates interfere with calcium absorption and horses can develop bone malformation and lameness. To date, this problem has primarily been seen in Australia and not in the U.S.

Getting the Most from Your Hay Operation (For Those Who Primarily Feed Their Own Hay)

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On my way to work each day, I drive by a dairy farm and often enjoy watching all the activities occurring on the farm. The thing that has struck me in particular over the years is not just how much hay has been stored along field borders and roadways and around the barnyard in the fall; but how much of that hay remained the next year and beyond (Photos 1, 2 and 3). I watched as the oldest round bales stored on the wood line gradually decayed and disappeared. This was caused in part due to on-ground storage that allowed moisture to wick into the bale (Photo 3). Being somewhat dense (on occasion), it took me a long time before I realized that he

was actually cutting hay for quantity rather than for quality; I guess the grower had in mind that some of the low quality hay could be used in the TMR feed as a fiber source while the remainder could be fed to dry cows or heifers if feed ran short.



Photo 1. Hay (6 months post harvest) stored in round bales along wood's edge on a dairy farm. This hay although in contact with the soil was stored at the top of a hill but the quality was declining and the amount of spoiled hay was rapidly increasing. (Photo by R. Taylor)



Photo 2. Hay from previous years' harvest stored along field edge on a dairy farm. Wrapped in this fashion, soil moisture was not causing spoilage although wildlife damaging the plastic was contributing to hay losses. Late in the spring this hay was actually fed to the herd. (Photo by R. Taylor)



Photo 3. Hay stored in contact with the ground along a wood's edge deteriorates with time. At another location with twine wrapped bales, I was too late to even find recognizable bales. (Photo by R. Taylor)

The next question that came to mind was whether cutting hay for quantity rather than quality is the correct way to manage this valuable resource when year after year more old hay is added to the fence line compost line. With diesel prices at or near four dollars per gallon at the pump, nitrogen and other fertilizer inputs near all time highs, and hay equipment and supplies also very expensive, producers need to place a higher value on the hay they do harvest. For dairy producers, the cost of importing feed onto the farm is another consideration when deciding whether to harvest hay for quality or quantity. That extra effort to harvest hay for quality rather than quantity can really pay premium dollars in reduced input costs and, if you sell hay, in the price you can charge customers.

Still there will be times when there's a mismatch between the weather and the forecast that results in poor quality hay lying in the field and to preserve the health of the grass or legume stand the hay must be removed. Other times, a long period of poor hay-making weather will result in an overly mature hay crop. In these cases, you may end up with "fence-row" hay. One thing you can do in these situations is to minimize your hay making inputs by using the simplest, least expensive method of removing the hay from the field. If it's still good enough, use this hay for animals with minimal nutritional requirements or advertize and sell it as mulch or compost hay. Creative marketing may just help you cover at least a portion of the input costs incurred.

Rotational Grazing Recycles Nutrients

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Due to the dramatic increase in fertilizer prices over the past six months, producers are wondering how they can get the most bang for their buck with limited funds for fertilizer and lime purchases. A current soil test takes out the guesswork and prevents the producer from under or over-applying lime and fertilizer, either of which will decrease your efficiency and profitability. Virginia Tech soil test laboratory recommendations are based on research conducted for Virginia soils and climate. Livestock producers can reduce fertilizer purchases by implementing rotational grazing systems on their farms.

Rotational grazing is a management intensive system that concentrates animals within a relatively small area (paddock) for a short period of time, e.g. 1-3 days for beef cattle. Pastures are divided into multiple paddocks using a temporary fence. Moving livestock to another paddock before over-grazing allows the forage to recover and resume growth. Animals are moved according to a flexible schedule based on herd size, the amount of land available, quality of forages in the paddock, and forage consumption.

Missouri¹ researchers estimated that grazing animals recycle 75-85% of forage nutrients consumed. An even distribution of manure throughout a paddock is required for productive plant growth. Intensity of grazing rotations affects the manure coverage in paddocks. In an intensive rotational grazing system there is an even distribution of manure because animals compete for the available forage the paddock before being moved to another paddock. The Missouri researchers calculated that under continuous grazing practices it would take 27 years to obtain one manure pile per every square yard within a pasture. Conversely, it would take 2 years to achieve the same manure pile density using a two-day rotation.²

¹ Bellows, B. 2001. Nutrient Cycling in Pastures. National Sustainable Agriculture Information Service.

² Lory, J. and C. Roberts. 2000. Managing nutrients in pastures to improve profitability and water quality. In: G. J. Bishop-Hurley, S.A. Hamilton, and R. Kallenbach (eds.), Missouri Dairy.

The location of hay feeding areas also impact the distribution of nutrients within a field with most manure being deposited near the feeding areas. Depending on weather conditions and the potential for creating ruts in the pasture, feeding areas should be moved throughout the pasture to insure a more even distribution of nutrients. Whenever hay is baled, nutrients are removed from the field and exported to the feeding area. Kentucky researchers have estimated that a ton of grass hay (fescue, orchard grass) removes the following nutrients from the soil: 12 lbs. of phosphate and 50 lbs. of potash.³ If these nutrients are not replaced, nutrient availability from the soil will be depleted over time. Consequently, there will be a reduction in hay and forage yields. Soil testing determines the amount to fertilizer that needs to be applied to maintain hay yields.

Cooperative extension educators can assist producers in the design of rotational grazing systems for their farms. Virginia Cooperative Extension work has shown that the implementation of rotational system can maximize profitability for cow/calf producers. There are Virginia livestock producers who have reported increased net profits of \$200 per head due to the implementation of rotational grazing systems on their farms. Rotational grazing systems can maximize farm profitability by recycling nutrients which results in a major reduction of purchased fertilizer inputs.

The above article was reprinted with permission from the April-May 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).

³ Smith, R. 2008. Soil Test Should Drive Fertilizer Decisions. Hay and Forage Grower.

The Management Calendar

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Listed below are the items that should be considered for inclusion on the farm business managers' calendar for spring and summer of 2011:

- Half the business year will soon be behind us and a six-month financial record check-up is in order. Updating your records through the month of June allows you to quickly gauge financial progress by comparing the farm's actual expenses and income to your budgeted amounts. If you did not develop a budget, compare your mid-year expenses and income to half the items reported on your 2010 Schedule F. Flag any items that are different from budgeted amounts. These differences are not necessarily problems, just items that need to be examined and explained.
- Watch your line-of-credit and be sure to keep in touch with your lender. They all know that we are in a time of uncertain returns. Yet, it's just good business practice to keep them informed of major changes and that you are managing the situation.
- Production records for livestock and crops should be updated for the first half of the year. Look for big changes from last year, and make sure to cross-reference these with production expenses.
- Even with the time constraints of summer activities, try to plan and hold regular staff meetings with family members and employees to discuss work plans and set priorities for the next day/week. Consider brainstorming about alternative ways to deal with problems. Use some of the time to help discuss positive outcomes of previous plans, and recognize individuals for being creative and doing a good job.
- Checking your credit rating in July should become an annual event. Independence Day should remind you that you should be independent from identity theft and credit mistakes. All individuals and business owners should annually check their credit rating. Additional information on your rights to access your credit report and links to the site for obtaining a free copy of your credit report can be found at the Federal Trade Commission's (FTC) web site at <http://www.ftc.gov/freereports>. The FTC cautions consumers to make sure they use the correct site because there are "Imposter" sites.

Selective information available that might be useful for summer reading or bookmarking:

- **Updated Livestock Budgets:** Virginia Farm Business Management Livestock Budgets were updated and posted at www.pubs.ext.vt.edu/446/446-048/446-048.html. Most of

the budgets are in both MS Excel[®] and PDF versions. The major categories are as follows:

- Beef
 - Cow-Calf Budgets
 - Pre-Conditioning Budgets
 - Finishing Budgets
 - Stocker Steer Budgets
 - Stocker Heifers Budgets
 - Horse Budgets
 - Dairy Budgets
 - Fence Budgets
 - Sheep and Feeder Lamb Budgets
 - Goat, meat
 - Pork, niche market
-
- Want to understand the U.S. vegetable industry? Take a look at the USDA-ERS publication titled “Financial Characteristics of Vegetable and Melon Farms,” by Mir Ali and Gary Lucier published in February 2011 at www.ers.usda.gov/Publications/VGS/2010/12Dec/VGS34201/VGS34201.pdf.
 - If you want to expand your knowledge on a variety of research findings from the Economic Research Service of USDA, then sign up for the “Charts of Note.” Once a day from Monday-Friday a graph or chart will be sent to you with a link highlighting one of their studies or reports. I find this a very useful tool to send me information I may not have looked for on my own. Go to <http://www.ers.usda.gov/Updates/> to sign up. This page has multiple subscription services, including Chart of Note.
 - A must read for all of us involved in agriculture is the current issue of “Choices,” published by the Agricultural and Applied Economics Association and can be found at www.choicesmagazine.org/magazine/issue.php. This is a two-part series focusing on “Fundamental Forces Affecting Agribusiness Industries” and covers a variety of topics that are important to farmers, agribusinesses, and their advisors. Selected topics are as follows:
 - Healthy Competition in the Animal Health Industry
 - Fundamental Forces Affecting Livestock Producers
 - U.S. Meatpacking: Dynamic Forces of Change in a Mature Industry
 - Impacts of Product Differentiation on the Crop Input Supply Industry
 - Market Forces and Changes in the Plant Input Supply Industry
 - Forces Affecting Change in Crop Production Agriculture
 - Increasing Coordination in the Plant and Plant Product Processing and Handling Sector
 - The Changing Face of Food Retailing

- Considering growing produce or vegetables? Getting realistic estimates of labor requirements and costs can be a difficult task. A short article by Tim Woods titled “Labor Expenses for Vegetable Production” and published in the “Economic and Policy Update” from the University of Kentucky, Department of Agricultural Economics, and can be found at <http://www.ca.uky.edu/cmsspubsclass/files/EconPolicyUpdateMay2011.pdf>.
- Wondering about profitable use of nitrogen in your hay fields, then take a look at Greg Halich’s paper titled “Profitability of Spring Hayfield Nitrogen Applications – 2011 Guide” (AEC 2011-04) is available at: www.ca.uky.edu/cmsspubsclass/files/ghalich/ProfitabilitySpringHayfieldNitrogenApplications2011.pdf.
- Interesting article from the Richmond Federal Reserve on small business lending alternatives see: www.richmondfed.org/publications/community_development/marketwise_community/2011/vol02_issue01.cfm?WT.mc_id=110012.
- Looking for information on a broad range of demographic, economic, and agricultural data on rural areas across the United States? The Atlas of Rural and Small-town America, developed by USDA’s Economic Research Service, provides county-level mapping of over 60 statistical indicators depicting conditions and trends across different types of non-metro regions. To start searching see: www.ers.usda.gov/data/ruralatlas/atlas.htm#map
- Want to understand the breadth of the U.S. beef cow-calf production system? If yes, take a look at the USDA-ERS publication, “The Diverse Structure and Organization of U.S. Beef Cow-Calf Farms” found at www.ers.usda.gov/Publications/EIB73/.

The above article was extracted with permission from the April-May and June-July 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).

Incorporating Summer Annual Grasses into Grazing Systems

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Although cool-season grasses can provide ample and high quality forage for grazing livestock in the spring and fall, forage growth during the summer months is often restricted by high temperatures (Figure 1). In contrast warm-season annual grasses are most productive during the summer months and do not reach peak growth until temperatures approach 90 degrees Fahrenheit. Summer annual grasses such as forage sorghum (*Sorghum bicolor* (L.) Moench), sudangrass (*Sorghum bicolor* (L.) Moench), sorghum-sudangrass hybrids, and pearl millet (*Pennisetum americanum* (L.) Leeke) can provide high quality summer grazing for ruminant livestock in many regions of the United States.

Not all varieties created equal. In the past, recommendations for choosing a summer annual variety were to find a reasonably priced, locally available variety, and focus on management. While good management is absolutely critical for optimizing productivity and animal performance, recent data indicates that yield potential and digestibility should also be considered. Trials conducted at Virginia Tech's Southern Piedmont Agricultural Research and Extension Center (AREC) located near Blackstone, VA have shown that the yield and digestibility of summer annual varieties can vary greatly and are in many cases not well correlated. In fact, some of the highest yielding varieties in these trials were also some of the most digestible. When the difference from average for the yield and digestibility are graphed and the graph is divided into four quadrants, varieties with above average yield and digestibility are shown in the upper hand quadrant (Figure 2). Varieties that possessed above average yield and digestibility in both the 2009 and 2010 growing seasons are listed in Table 1.

Yield impacts production costs. The cost of utilizing summer annual grasses in grazing systems can vary greatly. According to Southern Forages (2007), the expected yield of summer annual grasses can range from 2 to 6 ton/acre. While most advertisements like to talk about 6 or 7 ton/acre yields, a summary of yield data from trials conducted at Virginia Tech's Southern Piedmont AREC indicate that a more realistic yield expectation would be 3 ton/acre (Figure 3). Increasing or decreasing the yield of summer annual grasses significantly impacts the cost of production (Figure 4). As the number of grazing days/acre increases, the cost per grazing day decreases from \$1.63/day at 80 grazing days/acre to \$0.96/day at 240 grazing days/acre. In an

“average” year the cost of utilizing a summer annual grass would be in the range of \$1.20/grazing day. In this example we have made the following assumptions: 1) a grazing day is equal to the amount of forage required by one mature cow/day (28 lb DM/day), 2) nitrogen fertilization increases as grazing days increase, 3) phosphorous, potassium and lime are adequate, and 4) yields of 2, 3, 4, 5, and 6 ton/acre roughly correspond to 80, 120, 160, 200, and 240 grazing days/acre.

Forage quality impacts production costs. Along with grazing days/acre, how animals perform on a given variety can also impact production costs. In a trial conducted at Texas A and M’s Agricultural Experiment Station, Amarillo, steers grazing two different varieties of sorghum-sudangrasses, one a BMR and one a non-BMR, showed a difference in average daily gains of 0.75 lb/day (Vasconcelos et al., 2003). Using the average daily gains from this study, the calculated cost of production at 160 grazing days/acre was \$0.52 and 0.39/lb gain for the non-BMR and BMR variety, respectively (Figure 5). For a steer gaining 2.5 lb/day, the cost savings of selecting the variety with higher digestibility and animal performance would be \$0.33/day/steer. This example clearly illustrates the importance of considering not only yield, but also digestibility when selecting summer annual varieties for your summer forage program.

Assessing least cost options for the summer months. Once you have determined the costs associated with incorporating summer annual grasses into your grazing system, it is important to evaluate if they are the least cost option that will meet your needs. For example, summer annual grasses are an excellent fit for livestock classes with high nutritional requirements such as grazing dairy cows, weaned calves, and stockers. On the other hand, more cost effective alternatives may be available for livestock classes with lower nutritional needs. It is important to consider all feed alternatives and determine which one will best meet production your goals and at the same time help to control costs.

It is important to remember that adding summer annuals to a farm’s grazing system will change the entire forage management system. Additional time will be required to rework existing forage and animal management. Additional resources on summer annual grasses can be found at the AFGC’s website. They include interactive budgets for summer annuals, variety trial summaries, and a link to the TAMU study used in this article. For more information on selecting and utilizing summer annual grasses in your area, contact your local cooperative extension office.

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Table 1. Varieties that had above average yield and digestibility in both the 2009 and 2010 Summer Annual Variety Trials held at Virginia Tech’s Southern Piedmont Agricultural Research and Extension Center, Blackstone, VA.

Variety	BMR-Gene	Seed Company	Phone
Xtragraze	BMR-6	Evergreen Seed, Rice, VA	1-877-804-7333
SS2	BMR-6	Advanta, Hereford, TX	1-800-333-9084
22503	BMR-6	Advanta, Hereford, TX	1-800-333-9084
22050	BMR-6	Advanta, Hereford, TX	1-800-333-9084

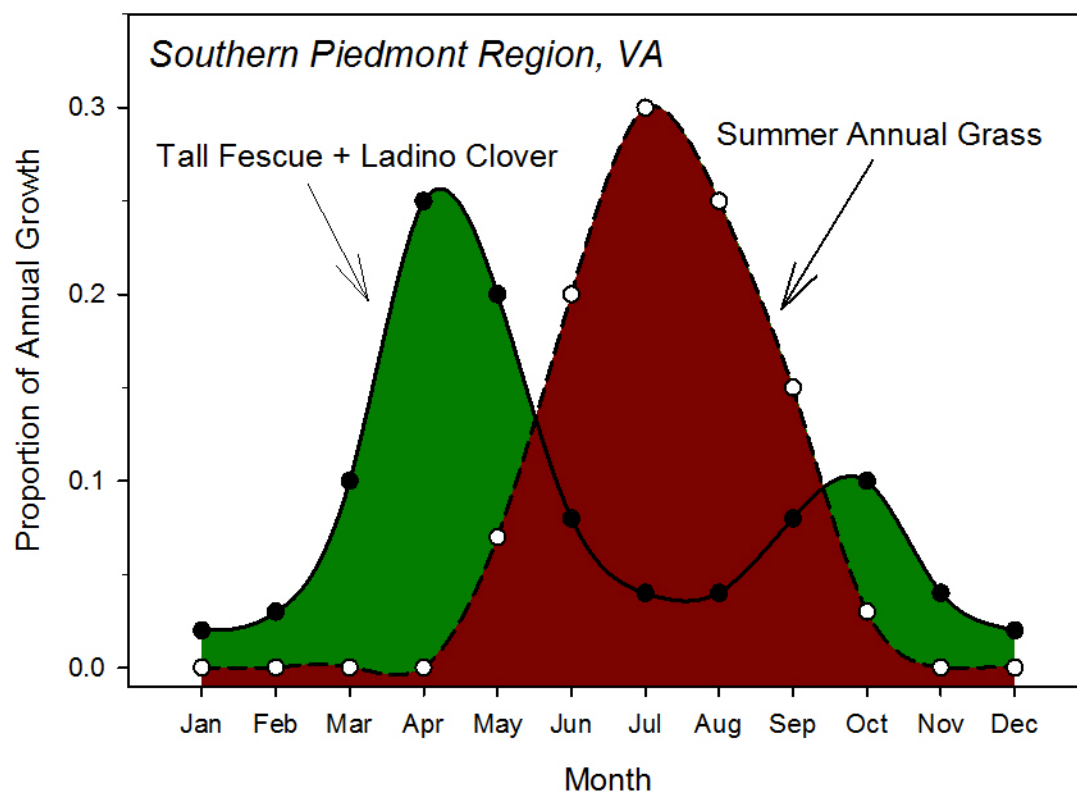


Figure 1. Growth curves for tall fescue and white clover and a summer annual such as pearl millet or sorghum-sudangrass.

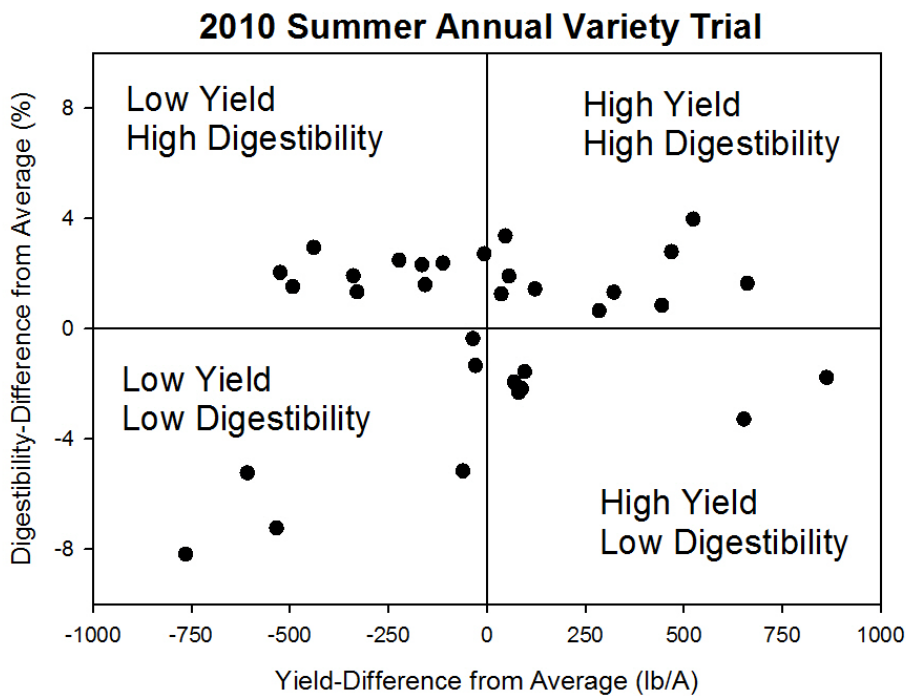
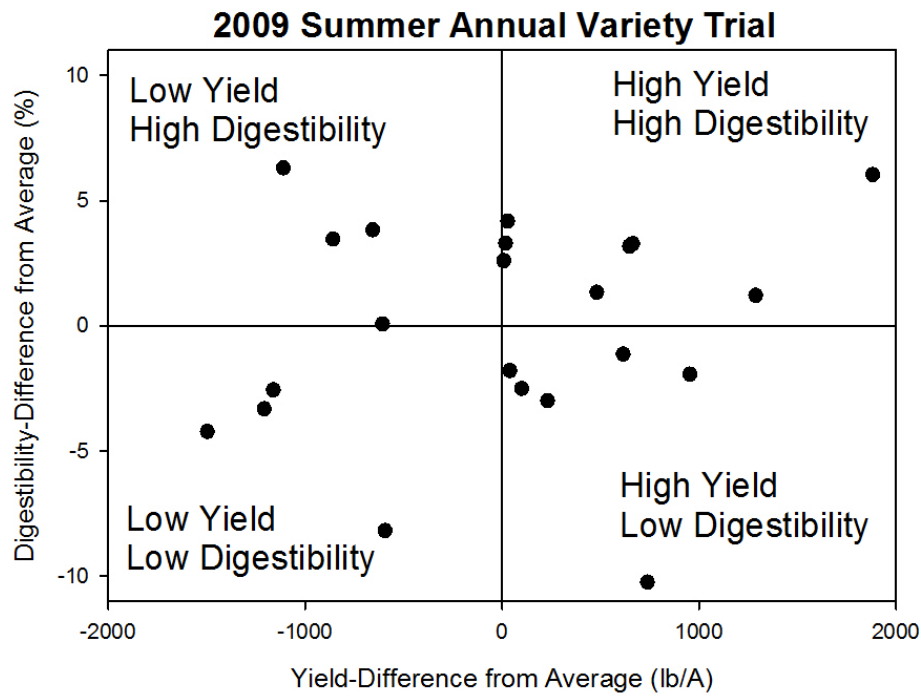


Figure 2. In this graph yield and in vitro digestibility are expressed as a difference from the average value. The value of zero represents the average value for the trial. Negative values represent a value that is below average, while positive values represent a value that is above average. Producers should try to select varieties that are above average for both yield and digestibility.

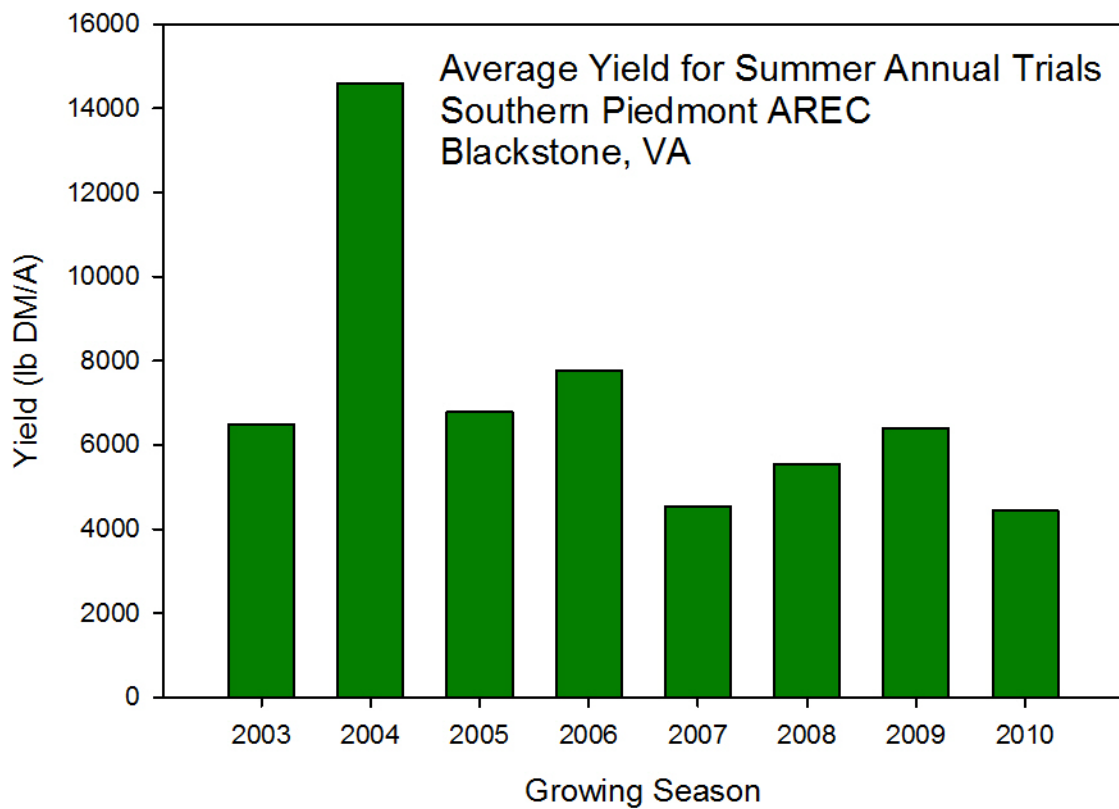


Figure 3. Summer annual varieties can yield between 2 and 6 ton DM/acre. Data from the Southern Piedmont AREC, Blackstone, VA indicates that realistic yield expectations would be around 3 ton DM/acre.

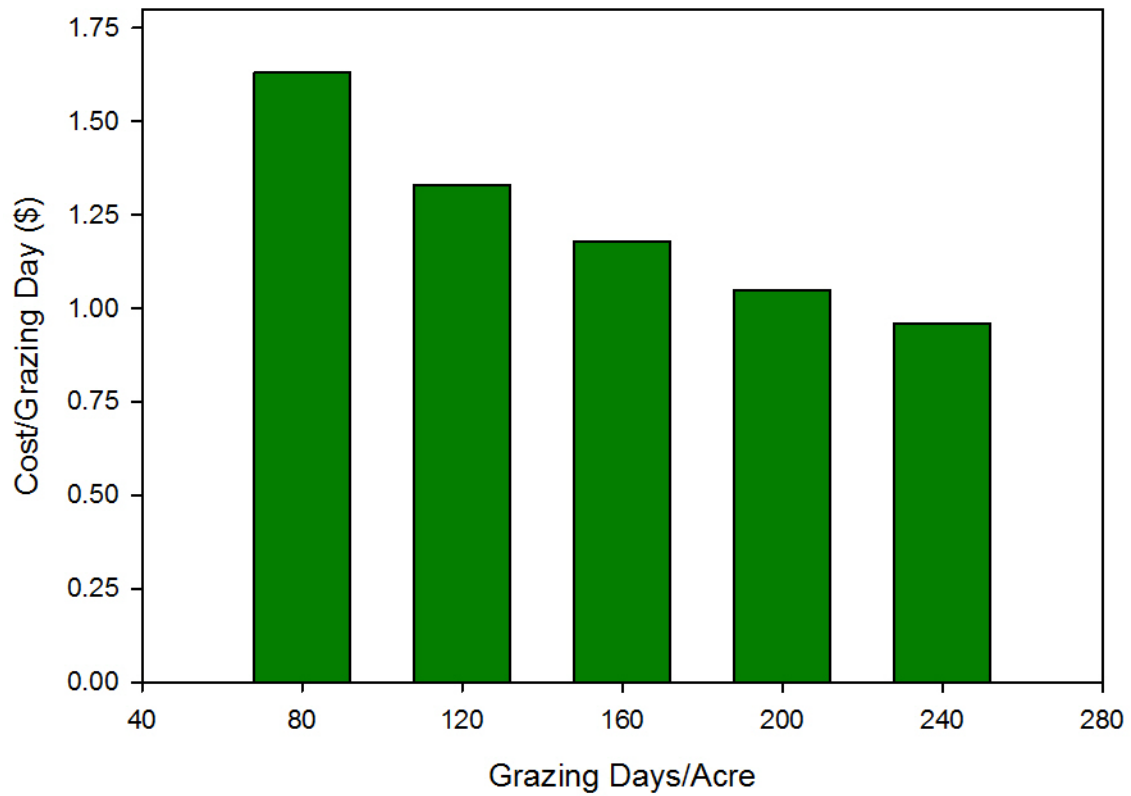


Figure 4. The cost/grazing day can be significantly impacted by factors that restrict plant growth and yield, such as drought. As the number of grazing days/acre decrease, the cost per grazing day increases.

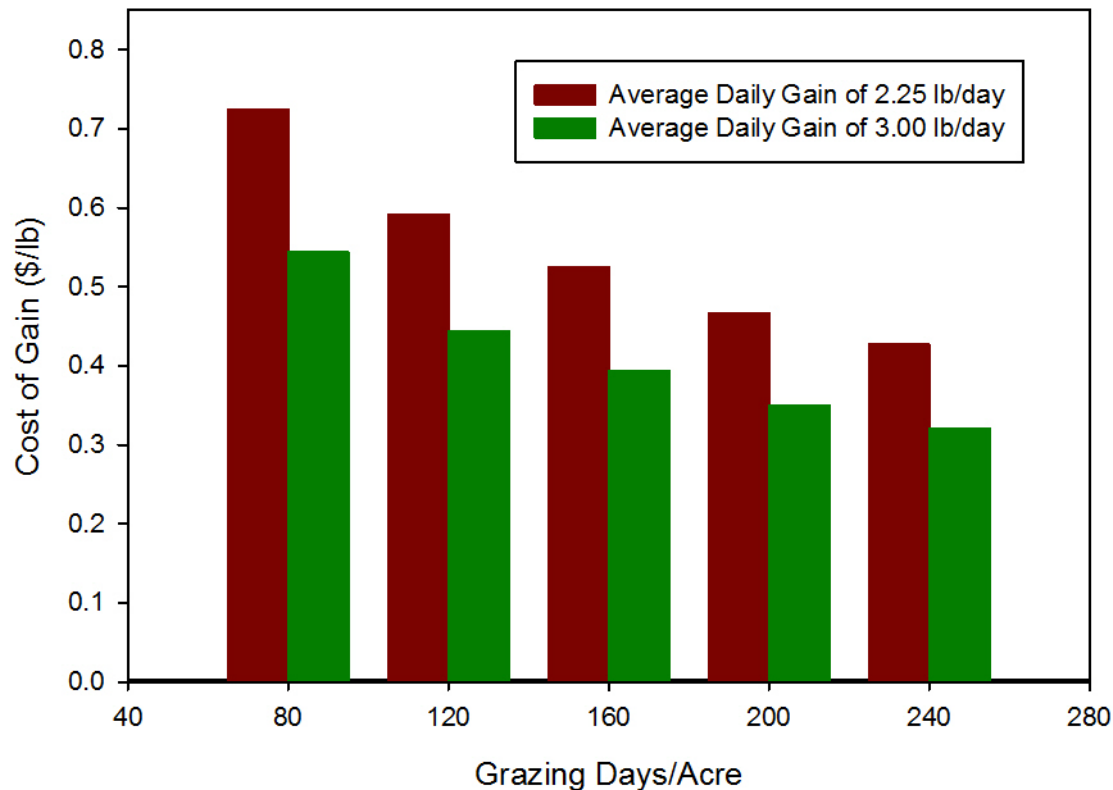


Figure 5. The cost of gain can be impacted by digestibility and animal performance of summer annual varieties. As animal performance increases, the cost of gain decreases.

Managing Nitrates in Forages

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Nitrates can accumulate to toxic levels in commonly grown forages. This most often occurs when heavy nitrogen fertilization is followed by drought. Nitrates are taken up by the plant, but not utilized since plant growth is restricted by the drought. Any factor that slows plant growth in combination with heavy nitrogen fertilization can result in nitrate accumulation. Some plants tend to accumulate nitrates at greater rate; these include, but are not limited to commonly used summer annual grasses, corn, crabgrass, small grains, annual ryegrass, bermudagrass,

johnsongrass, tall fescue, and some annual and perennial weeds commonly found in pastures and hayfields.

In cattle, nitrate is converted to nitrite in the rumen, and the nitrite is absorbed into the blood stream. Nitrite interferes with the blood's ability to carry oxygen. Symptoms of nitrate poisoning include trembling, staggering, rapid and labored breathing, rapid pulse, frequent urination followed by collapse, coma, and death. The onset of symptoms and death is rapid and usually occurs within one to two hours. Most often, animals are simply found dead. In animals affected by nitrate poisoning, the blood will take on a brownish chocolate color, giving the nonpigmented skin and mucus membranes a muddy brown color.

The following practices can help to reduce nitrate accumulation in forages and manage the risk associated with feeding high nitrate forages:

Split nitrogen applications. Applying smaller applications of nitrogen throughout the growing season will reduce the risk of nitrate accumulation in forages.

Delay harvest or grazing after a drought ending rain. Nitrates are often the highest just after plant growth resumes. Grazing or harvesting should be delayed for 7 days after a drought ending rain.

Raise cutting or grazing height. Nitrates tend to accumulate at higher concentrations near the base of the plant. Raising your cutting or grazing height from 2-4 inches to 6-8 inches can significantly reduce nitrate concentrations in the forage tissue that is being conserved or ingested.

Test all suspect forages. All forages that may contain high levels of nitrates should be tested at a qualified lab. Several labs are listed at end of this article.

Segregate all forages high in nitrates. Once identified, forages high in nitrates should be clearly marked and separated from low nitrate forages if possible.

Harvest forage as silage if possible. Ensiling high nitrate forage can reduce nitrates by 40 to 60%. Silage should be tested before feeding to confirm nitrate levels.

Nitrates are stable in hay. Nitrates do NOT decrease overtime in dry hay. This means that you can kill livestock months or even years after later. If you suspect nitrates in your hay, make sure and test it.

Avoid feeding high nitrate forage to susceptible animals. Feeding high nitrate forage to animals that are in poor condition and under stress, or are pregnant, lactating, or sick should be avoided.

Limit the intake of high nitrate forages. Guidelines for feeding high nitrate forages can be found in Table 1. The best way to feed high nitrate forages is in a total mixed ration. This reduces the animal's ability to select individual components. If feeding a total mixed ration

is not possible, then limit access to the high nitrate hay in a manner that allows livestock to consume 50% or less of their total daily dry matter requirement. A high energy supplement that is balanced for the ration should be fed PRIOR to hay feeding. Simply unrolling one bale of low nitrate hay and one bale of high nitrate hay is NOT an adequate way to feed high nitrate hay.

Supply free access to clean, nitrate-free water. In addition to clean water, make sure to provide access to high quality mineral and vitamin supplement.

Nitrates and horses. Horses, monogastrics with a functional cecum, tend to be more tolerant of nitrates in forage tissue. Although no threshold levels have been officially established, forages are generally considered safe for horses if the nitrate concentration in the plant material is below 1.5 to 2.0%. An accurate nitrate test is needed to make this assessment. Local veterinarians should be consulted before feeding high nitrate forage materials to horses.

For more information on nitrate managing nitrates in forages contact your local Cooperative Extension office or veterinarian.

Table 1. Nitrate levels in forages^a.

Nitrate Concentration ^b		Forage Status	Comments
----%----	---ppm---		
0-0.25	0-2,500	SAFE	Generally considered safe.
0.25-0.5	2,500-5,000	CAUTION	Generally safe when fed with a balanced ration. Can be a problem for pregnant and young animals. Limit to ½ of ration. Do not feed with non-protein N. Check water for nitrates.
0.5-1.5	5,000-15,000	DANGER	Limit to ¼ of ration. Supplement with energy, minerals, and vitamin A.
Over 1.5	Over 15,000	TOXIC	Forage should not be fed. If forage must be fed, limit to less than 15% of ration.

^aAdapted from Southern forages, fourth edition, 2007.

^bNitrate concentration is expressed as NO₃. To convert these values to NO₃-N multiply by 0.23.

Additional information about nitrate poisoning can be found in the following references:

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Bovine Mastitis: An Overview of Somatic Cell Counts, Bulk Tank Somatic Cell Counts, and Subclinical Infections

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Introduction

Mastitis is inflammation of the mammary gland and is the single most costly disease problem 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). Currently, the regulatory level of acceptable BTSCC is 750,000 cells/ml milk. Latest NAHMS data indicated BTSCC for 90% of producers is < 400,000 cells/ml and 300,000 cells/ml for 70% of US producers (USDA, 2008).

Prevalence of clinical mastitis is positively associated with elevated BTSCC. In addition, herds with higher BTSCC have an increased prevalence of subclinical mastitis. Across most surveys, increased prevalence of subclinical intramammary infections is associated with both increased prevalence of clinical forms of mastitis and increased SCC and BTSCC (Harmon, 1994). Losses from mastitis are incurred through increased involuntary culling and mortality, treatment costs, milk discard and most importantly loss of production potential in long term subclinically infected cows. Fetrow et al., (2002) estimated most of the annual \$300 loss per cow from mastitis was due to diminished milk yields in subclinically infected animals.

Mastitis Pathogens

Broadly speaking there are 2 major categories of mastitis pathogens. These are the so-called major pathogens and the minor pathogens. Major pathogens cause substantial changes in SCC, reductions in milk yields and economic losses due to elevated SCC and eroded quality of milk products. Major pathogens are the contagious organisms *Staphylococcus aureus*, *Streptococcus agalactia*, and the environmental organisms; *Streptococcus uberis*, *Streptococcus dysagalactia*, coliforms like *Escherichia coli* and *Klebsiella* sp., and the enterobacteria such as *Enterococcus faecium* and *Enterococcus faecalis*. Incidental organisms causing sporadic problems include *Pseudomonas aeruginosa*, *Serratia marcescens* and *Actinobacillus pyogenes*. The contagious organisms, *Staphylococcus aureus* and *Streptococcus agalactia*, reside in the udder as subclinical infections and are transmitted during the milking process. Typically, these organisms exist as subclinical intramammary infection and sporadically give rise to clinically visible disease. The

major economic loss with these contagious organisms resides with the subclinical nature of their infection. The environmental organisms typically stem from reservoirs in the immediate farm environments such as bedding, soils and stall floors and infections occur during environmental exposure between milking. In contrast to the contagious organisms, the majority of environmental and coliform infections produce acute, clinical disease.

Minor pathogens include the coagulase negative staphylococcus non-aureus and *Corynebacterium bovis* that trigger mild elevations in SCC with minor changes in milk quality and yields.

Somatic Cell Counts (SCC)

Somatic cells in the milk are inflammatory cells that have migrated from the vascular system into the alveoli and ducts of the mammary gland in response to infection. Inflammatory cells account for nearly 100% of the population of somatic cells from infected glands and 90% or more of the cells in uninfected glands. Even in late lactation, when higher numbers of mammary cells may enter the secretions, elevated SCC can be regarded as the abnormal transmural influx of inflammatory cells secondary to the presence of intramammary bacteria. If the original influx of inflammatory cells fails to eradicate the intramammary infection, then the stimulus for cellular influx remains and SCC becomes chronically elevated. Indeed, chronic SCC elevation is evidence of persistent intramammary infection. Successful resolution of an episodic intramammary infection that re-establishes intramammary sterility is often seen as a spurious spike in SCC with a rapid return to levels <200,000 cells/ml. Elevated SCC in the secretions and bulk tank (BTSCC) are prima fascia evidence of intramammary infection and the level of intramammary infection in the herd is reflected in the BTSCC.

Across all healthy, uninfected glands the average SCC is 70,000 cells /ml. The major pathogens readily elevate SCC and BTSCC to levels greater than 500,000-1,500,000 cells/ml whereas minor pathogens such as coagulase negative Staphylococcus epidermidis may elevate counts to 300,000-450,000cells/ml. Compared to the major pathogens, minor pathogens lack the pathogenic capacities to trigger enormous influx of inflammatory cells into the mammary tissues. Elevated BTSCC reflect the prevalence if elevated intramammary SCC in a herd and are regarded as indicators of the prevalence of intramammary infection in the herd (Eberhart et al., 1982.). Average bulk milk SCC is a useful approach to monitor SCC at the herd level.

BTSCC (1000 cells/ml)	% Infection Prevalence	% Production Loss
200	6	0
500	16	6
1000	32	18
1,500	48	29

Intramammary SCC fluctuates over time for normal and infected quarters. Normal SCC varies but generally fluctuates below a ceiling of 200,000 cells/ml. At the cow and quarter levels, typical SCC range between 100,000 – 200,000 cells/ ml milk within the majority of healthy first and second lactation animals. Because SCC of uninfected quarters vary

inconsistently with age and stage of lactation, a standard cutoff value that maximizes sensitivity and specificity for differentiating infected from uninfected glands is 200,000-250,000 cells/ml. SCC of infected quarters varies with time after infection and tends to diminish with time post initial infection as the immune response clears a large fraction of the bacterial challenge. SCC of infected quarters increases with stage of lactation and age and can surpass 1,000,000 cells/ml. SCC of all quarters is elevated immediately postpartum but decreases rapidly within 4-5 days in uninfected quarters.

Linear score (LS) is a widely employed descriptor of SCC and is determined as a log to the base 2 conversion of SCC expressed as cells/ μ l ($LS = \log_2 (SCC/100) + 3$). LS can range from 0.1 to 9.9. Conversion of LS to SCC is determined as $100 \times 2^{(LS-3)}$. The average monthly linear score is a reliable indicator of the probability of intramammary infection. The probability of intramammary infection by either minor or major pathogens increases with each 1.0 increase in LS. Total prevalence of intramammary infection was shown to increase 12% with each 1.0 increase in average monthly linear score (Schukken et al., 2003). In the same data set, average monthly linear score was 3.0 for all cows without intramammary infection. Minor pathogens (*Corynebacterium bovis* and coagulase negative staphylococcus non-aureus) accounted for a majority of the intramammary bacterial infections in those cows with low average monthly linear scores (between 0.1 and 2.9). Major pathogens accounted for an increasing proportion of intramammary infections in cows with average monthly linear score > 2.9 . The authors suggested a practical goal for average monthly linear score to minimize the prevalence of intramammary infection in cows might be a low 2.0 (50,000cells/ml).

Strategy for Approaching Herd Milk Quality Management

Schukken et al., (2003) suggested a reasonable approach to assess and intercede on farm milk quality management might be to follow the dynamics of a intramammary infection in the herd. The components of this dynamic were (1) introduction of infected animals into the herd, (2) onset of new intramammary infections, (3) cure rates of infected animals, and (4) cull rates.

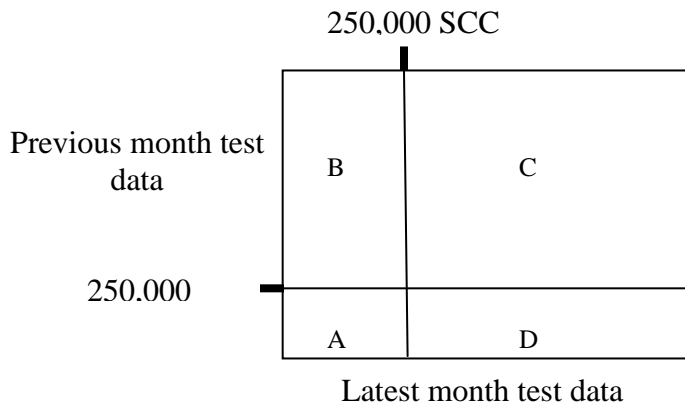
Infected new animals entering the herd: Identifying intramammary infections in new herd introductions is most reliably accomplished by culture. Incoming animals would include heifers and fresh parity 2 or greater animals and new acquisitions in open herds. A less reliable method is by SCC given the caveat that SCC varies with time and infection status and type of intramammary pathogen. A reasonable, practical target would be a SCC of 200,000 or less as the majority of these animals would be uninfected and a minority would be infected with minor mastitis pathogens. High numbers of animals entering the lactating herd with SCC $>$ than 200,000 would dictate an evaluation of heifer and dry cow management and housing programs. A reasonable goal might be to keep the proportion of animals entering the lactating herd with SCC $>$ 200,000 at $<$ 10%.

The incidence of new intramammary infections: New intramammary infections occur as the obvious clinical flare-ups and the invisible, occult subclinical infections. New *clinical cases* should be assessed by culture and recording days in milk (DIM) and parity at the onset of the clinical infection. Culture provides evidence-based proof of the type of pathogen (contagious, environmental, major or minor microbe) moving about in the herd. Assessment of new cases of

subclinical intramammary infection presents a considerably greater challenge simply because of the occult nature of newly acquired subclinical infections. The gold standard of assessment would require complete culture of all animals across the herd. In large herds this approach is costly and impractical. However, changes in SCC defined as an increase in SCC from $<200,000$ to $>250,000$ across 2 succeeding test periods provides an excellent method of assessing onset of new subclinical intramammary infections. An achievable goal would be to limit the occurrence of new subclinical infections in any month to $< 10\%$ of the lactating cows with $SCC < 200,000$ in the preceding month.

A practical approach to display this type of data is to plot previous month SCC (LS) against the latest month SCC (LS) for all lactating cows. The presentation splits the lactating herd into 4 unequal quadrants (figure 1) with $SCC > 250,000$ ($LS > 4.5$) as the break point for intramammary infection in each test period for each cow. Quadrant “A” represents all uninfected cows in both test periods, “B” is all cows with high SCC in the previous test period with low SCC in the current test period (resolved infection), “C” is all cows with high SCC in both periods (chronic unresolved infections), and “D” is all cows with low SCC in the previous test period and high SCC in the current test period (new infections).

Figure 1. Splitting the lactating herd into 4 unequal quadrants using SCC.



Further characterization might follow procedures similar to those described for clinical cases where parity number and DIM are determined for the quadrant ‘D’ cows. The results point to fresh cow, dry cow, transition cow or all lactating cows as the source of new infections and may help identify problem areas in cow demographics, management and housing where new infections are problematic.

Cure of infected cows: These cows appear in “B and represent cows where earlier intramammary infections in previous test dates (high SCC) have been resolved to generate low SCC in the current test dates. Failure to observe animals in this quadrant in conjunction with too many animals in “C” suggests treatment failures in clinical flare-ups, failure of dry cow therapy programs, or ongoing, unaddressed subclinical infection. In the dry cow programs, infected dry cows enter the dry period with subclinical infection (high SCC) but should present with a low SCC on the first test date after freshening if the subclinical infection is resolved during the dry period. Producers should expect a successful dry cow program to produce 70-80% uninfected

glands with 70-80% of the cows entering the dry cow period with high SCC emerging from the dry period with a low SCC in the first test date post freshening. Therapy during lactation can be expected to be less successful than that during the dry period but minimally producers should expect a 50-60% resolution of high SCC from flare ups during lactation. Failure to achieve these levels of high SCC resolution is a clear indication of the need for culture and sensitivity testing on some subclinical as well as all clinical infections. Antimicrobial choice for subclinical, clinical and dry cow therapy programs should be governed by newly acquired sensitivity patterns in the isolates.

Culling: Rates of culling for mastitis are important indicators of udder health and the costs of milk quality programs on the farm. Salient features derived from cull cows might be the number, the length or even the episodic nature of high SCC during a lactation and before and after the dry cow period. An elevated average linear score (AVLS) in cull cows is often an important indicator of the persistent nature of major, contagious mastitis pathogens in the herd. Recurrent, episodic periods of elevated SCC through the lactation of a few cows suggest idiosyncratic problems with the particular cow in question (damaged teat canal or sphincter). Culling decisions can be weighted by duration of high SCC particularly after therapy and more importantly after dry cow therapy. Cows targeted for culling for mastitis problems are those with high AVLS, prolonged elevations in SCC over several test dates or recurrent episodes of elevated SCC through the lactation.

Management practices designed to reduce BTSCC have been well established and will reduce levels of intramammary infection. Herds with lower BTSCC usually have higher milk production levels due in part to the negative impact of intramammary infection on milk yields (Harmon, 1994). The goal of udder health management practices is to reduce the number and duration of high SCC episodes. This is achieved by reducing the number of high SCC cows introduced into the herd and reducing the longevity of high SCC production through effective therapy and strategic culling practices.

Management practices should be targeted towards reducing transmission of contagious pathogens while converting infected cows to uninfected cows. Generally speaking, practices designed to control contagious mastitis problems and periodic, regular milking equipment maintenance drive down BTSCC (Rodrigues et al., 2005, Dufour et. al., 2011). Herds with lower BTSCC have cleaner udders, have the lowest number of treatments per clinical case of mastitis, have automatic cluster removal, use fore strip and predip practices, individual towels to dry cows, wear latex or nitrile gloves during milking, practice post milking teat disinfection, clean stall floors daily, and institute management schemes that encourage cows to remain standing after milking.

Udder hair is removed more often in herds with lower BTSCC and dry cow therapy is nearly ubiquitous in these herds (Barkema, et al., 1999). Calving stalls and stalls in general tend to be drier in herds with low BTSCC thereby reducing the risk of environmental pathogen buildup.

Herds with lower BTSCC also provide training programs and written instructions for milking protocols, and treatment of clinical mastitis (Fenlon et al., 1995, Fuhrman, 2002, Jansen et al, 2009). Milker personnel training programs tend to occur on a greater percentage of large (98%)

farms compared to medium (75%) and small (42%) farms. The frequency of training programs offered ranges from 1-5 times per year on larger operations. Written instructions provide clearly defined tasks and responsibilities that ensure increased milking efficiency and higher quality milk. In general, the longer these types of practices are in place the lower the BTSCC. Milking mastitis cows separately from the herd or at least with different equipment than the rest of the herd is an excellent method to reduce contagious pathogen transfer across cows. It is encouraging to know that 33% of all producers employ this management approach to control intramammary infections with contagious pathogens.

Culling programs in mastitis can be reactive or proactive in design. Reactive programs are those designed to remove incurable clinical mastitis problem cows and those with persistent, subclinical intramammary infection with elevated SCC. Reactive programs can eliminate the highest contributors to BTSCC but are unlikely to lower BTSCC over the long term. A proactive, well designed culling strategy can reduce BTSCC if the plan is directed toward removal of high risk cows prior to the onset of intramammary infection. Removal of cows with poor udder and teat conformation, damaged teat ends, broken medial suspensory ligaments of the udder and recurrent episodes of SCC elevation removes cows at high risk of intramammary infection prior to udder health problems that elevate BTSCC.

In the past, heifers were often viewed as free of intramammary infection and therefore a reliable source of milk with low SCC. Relatively newer data clearly indicated this is not the case because a relatively high number of heifers do freshen with elevated SCC that can persist across the entire lactation (Fox et al., 1995, Paradise et al., 2010). Prevalence of intramammary infections in heifers at the time of parturition varies widely but can range between 20-60%. Both major and minor pathogens are involved in the intramammary infection even though the minor pathogens appear to be more prevalent. Interestingly, intramammary infections by major and minor pathogens can be found in as high as 40% of breeding age heifers. Most of these infections are by minor pathogens (coagulase negative staphylococcus non-aureus) but major pathogens (coagulase positive *Staphylococcus aureus*) and environmental organisms are also present. These intramammary infections persist to parturition. The prevalence of intramammary infections also increases during the last trimester of pregnancy in heifers. Coagulase negative staphylococcus non-aureus was the most common pathogen involved in these third trimester infections (Fox et al., 1995). Heifer management programs that control intramammary infection in heifers also impact BTSCC particularly in modern herds where 30-50% of the lactating herd may be first parity animals.

Dry Cow Management

Sealants in the dry period: The goals of dry cow treatment programs are to (1) resolve pre-existing subclinical intramammary infections and (2) prevent new intramammary infections. Typically environmental pathogens present the most serious risk for new infections whereas the contagious pathogens present with relatively low risk of infection during the dry period (Bradley et al., 2004). Methods of dry cow therapy are the blanket therapy of all cows at dry off, therapy of selected cows at the time of dry off, or the use of teat sealants at the time of dry off. Clearly the mammary gland is highly susceptible to intramammary infection in the dry period. Factors driving susceptibility include increased intramammary pressure following cessation of milking,

teat conformation and teat end damage, failure to generate a complete keratin plug in the teat sphincter soon after dry off, and the amount of fecal contamination on the udder and in the dry cow environment. Damaged teats that fail to generate sufficient keratin plug soon after dry off are more prone to intramammary infection at dry off (Dingwell et al., 2003). Keratin plugs may remain incomplete for as long as 5-50 days.

Teat sealants create an immediate physical barrier to streak canal penetration by environmental and minor pathogenic bacterial threats during the dry period. Since teat sealants lack antimicrobial activity, they cannot be expected to impact subclinical infections incurred before dry off. Therefore sealants specifically address the goal of preventing new intramammary infections at dry off but will accomplish little to reduce the SCC associated with subclinical intramammary infections. Sealants are an effective alternative to dry cow therapy for prevention of new intramammary infections but must accompany intramammary antimicrobial therapy to resolve pre-existing subclinical infections. Sealants do reduce the number of intramammary infections present in the first week post-partum compared to blanket dry cow therapy with antimicrobials. They reduced the risk of new intramammary infection between dry off and parturition for major pathogens and environmental streptococci and tended to reduce the intramammary infections caused by minor pathogens. This effect reduces SCC and LS at the time of parturition even though sealants have no added effect above dry cow antimicrobial therapy on SCC or LS for cows with pre-existing subclinical infections at the time of dry off (Godden et al., 2003).

Dry cow antimicrobial therapy and prevention of new intramammary infection in the dry period: Blanket dry cow therapy was adopted 40 years ago as the method of choice for prevention and treatment of intramammary infections. Blanket dry cow antimicrobial treatment does provide protective against new intramammary infections during the dry cow period. The protection however, tends to be marginal against new intramammary infections by *Staphylococcus aureus* and the coliforms and best against the other pathogens like the streptococcus (Halsasa et al., 2009a). The differences may relate to differences in pathogen sensitivity to the antimicrobial agents in dry cow preparations and reduction in antimicrobial levels and activity in the mammary gland over the duration of the dry cow period. Intramammary infection in the dry period may be more problematic the closer the cow is to freshening because increasing intramammary pressure opens the streak canal, increasing amounts of colostrum and the progressive clearance of antimicrobial activity from the gland over time dilute existing antimicrobial activity placed in the udder at dry off. Accordingly, it follows the longer the dry period, the lower the antimicrobial protection in the gland. Diminished antimicrobial activity renders new intramammary infections less amenable to control by blanket antimicrobial therapy.

Dry cow therapy and resolution of pre-existing intramammary infections: The second objective of dry cow therapy is resolution of pre-existing intramammary infections prior to dry off. In recent extensive analysis of a variety of reports of dry cow therapy spanning several decades, the overall cure rate for pre-existing intramammary infections was 78% during blanket dry cow antimicrobial therapy across all cows (Halasa et al, 2009b). In the same report, spontaneous resolution of intramammary infection in untreated dry cows was 46%. Together, the analysis indicated dry cow therapy can be expected to resolve 3 out of 4 pre-existing

subclinical intramammary infections at the time of dry off. This is twice the level of resolution if nothing was done at dry off. Cure rates for subclinical *Staphylococcus aureus* infections was 77% and 44% for dry treated and untreated cows, respectively. These did not differ from cure rates of subclinical streptococcal infections that were 89% and 47% for dry treated and control cows respectively. Cure rates also were not affected by choice of dry treatment product. Never the less, choice of antimicrobial selection should be governed by culture and sensitivity of cows with high SCC in those herds where producers cannot document a drop in SCC in a majority of cows across the dry period.

In summary, dry cow treatment will produce high resolution rates of subclinical streptococcal and staphylococcal infections at the time of dry off. Dry cow therapy also provides good protection against new intramammary infections for streptococcal but not coagulase positive *Staphylococcal aureus* infections acquired during the dry period. Teat sealants protect against acquisition of new intramammary infections but provide no benefit in resolution of pre-existing subclinical infections at the time of dry off.

Conclusion

Mastitis pathogens represent a spectrum of microbial pathogenicity and therefore a spectrum of effects on individual cow and quarter SCC. The most ubiquitous cause of elevated SCC and therefore BTSCC is the prevalence of subclinical intramammary infection from contagious pathogens and some of the environmental streptococcal spp. Herds with elevated BTSCC have higher rates of clinical and subclinical infections, experience lowered milk yields and risk loss of milk quality premiums. Although new clinical and subclinical infections occur in lactating cows, nearly half of new intramammary infections arise during the dry period. Controlling SCC, BTSCC to improve milk quality requires strategies to recognize and understand what SCC patterns mean in the lactating herd dynamics of intramammary infection. Understanding the risk of different types of dry cow intramammary infection and the benefits and limitations of different dry cow treatment programs is also critical for controlling individual cow SCC and BTSCC. Lastly, proactive rather than reactive strategies of culling can be a valuable tool for preventing future elevations in the BTSCC.

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Conservation Methods for No-Till Pumpkin Production¹

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Introduction:

Pumpkins (*Cucurbita pepo*) are grown in every county of West Virginia, often on sloping land. Pumpkins are a popular fall, ornamental vegetable direct marketed to consumers or sold “u-pick” to consumers as a part of fall agritourism. Pumpkins are often grown by plowing and disking the land several times before planting followed by 1-2 cultivations to control weeds before the vines close canopy. Often, most if not all of the fertilizer for the crop is applied at planting. Heavy rainfall can cause significant erosion of the topsoil as well as leaching of fertilizer nutrients into streams and ponds. Since most growers do not irrigate pumpkins, late summer drought often reduces pumpkin numbers and size. Weed competition is also a significantly limiting factor in pumpkin production since there are very few herbicides labeled for pumpkins.

Diseases such as powdery mildew which infects the leaves and stem of the pumpkin can significantly lower marketable quality and yields. Fruit rots (black rot, *Fusarium*, etc.,) can be a significant problem if wet weather occurs during late summer or fall.

Growing many agronomic crops by conservation tillage or no-till has been practiced for many years, while this practice has not been widely adopted for horticulture crops in the northeast U.S. A few progressive growers in the Mid-Atlantic region have been using no-till for production of crops such as tomatoes, cabbage, pumpkins and squash for several years with some success. However, no-till vegetable crop production has not been evaluated or demonstrated in West Virginia, and thus has not been adopted by growers.

West Virginia, with sloping terrain is a suitable place to evaluate the benefits of conservation tillage. With no-till production, a cover crop is seeded in the fall or spring. Cover crops provide

¹Research funded in part by WV Dept. of Agriculture Specialty Crop Block Grant.

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The authors wish to thank the USDA Plant Materials Center for assistance with this project.

many benefits such as erosion control, weed control, nutrient retention, early field access as well as keeping the fruit cleaner and more disease free (McClurg, et al., 2003). The following spring, the cover crop is mowed or rolled and the vegetable crop seeded or transplanted into the mulch. Strip tillage, in which a narrow strip within the cover crop is tilled with a rotary tiller, could be a suitable conservation tillage practice for pumpkins. The inter-row space remains untilled and provides residue for the pumpkins to vine. In addition, fertilizer can be applied to the tilled soil at planting or as a sidedress.

Conservation tillage does present some challenges to vegetable production such as the cooler soil temperatures which can affect seed germination. A wet growing season can delay planting significantly with conservation tillage. Establishment of the cover crop must be done the fall prior to the crop year. This can be difficult to accomplish if rainfall is limiting in the fall. The purpose of this project is to evaluate conservation tillage production of pumpkins in West Virginia.

Materials and Methods

Grass/legume mixtures are often used for conservation tillage (SARE, 1998). The grass provides biomass and the legume fixes nitrogen for the subsequent crop. Rye (*Secale cereale*) and hairy vetch (*Vicia sp.*) were drilled in a 150 ft x 150 ft plot at the USDA Plant Materials Center near Alderson, WV on September 10, 2009 (Figure 1). The soil at this site was a sandy loam with a pH of 6.0. The seeding rate for cereal rye was 90 lbs/acre and hairy vetch was seeded 20 lbs/acre rate. After seeding, a deer fence was placed around the plots to prevent browsing by wildlife in the fall and winter.



Figure 1. Rye/hairy vetch over crops were established in September at the USDA Plant Materials Center near Alderson, WV.

The following spring, the rye and vetch were either rolled with a 6 ft roller/crimper unit mounted on the front of a tractor or mowed with a bush hog rotary mower and strip tilled with a 5 ft tiller (Figs. 2, 3, 4).



Figure 2. A tractor-mounted, roller-crimper was used to mechanically kill the cover crop and prepare the site for seeding.



Figure 3. The rye/hairy vetch was rolled in late May 2010, approximately 3 weeks before seeding pumpkins.



Figure 4. The strip-tilled plots were mowed with a rotary mower and tilled with a rear-mounted tiller at the time of planting.

There was some survival of the hairy vetch in the rolled plots that required an additional application of *Glyphosate* herbicide prior to seeding (Figure 5)



Figure 5. Survival of hairy vetch after rolling.

Conventional tillage was evaluated by tilling a plot adjacent to the cover crop block. This plot had no cover crop established on it the previous year. On June 15, 2010, pumpkins (cv. ‘Gladiator’) were hand-seeded into the plots. Two seeds were sown per hill. A bulb planter was used on the no-till block to make a planting hole approximately 1.5” deep. Within the strip tillage and conventional tillage plots, the pumpkins were hand-seeded by making a planting hole with a hoe. The pumpkins were spaced 4 feet between plants within the row and 8 feet between rows (Figure 6). Each tillage method had 4 rows (150 ft long) with four replications per tillage method. No fertilizer was applied at planting. At thinning, nitrogen applied as 42-0-0 was side-dressed to the plots at the rate of 50 lbs/acre, which is 50% of the recommended nitrogen rate for conventional tillage pumpkins.



Figure 6. The pumpkins were thinned to the most vigorous plant/hill.

After thinning, no weeding or irrigation was performed. No pesticides were applied. The 2010 growing season was above average for temperature and below average for rainfall. On October 25, the pumpkins were harvested. For each tillage method, green and orange pumpkins were counted and weighed. Data were analyzed using Costat statistical software.

Results and Discussion

The pumpkins growing in the no till system seemed to exhibit a slower growth rate during the first 1/3 of the growing season relative to the strip and conventional tillage pumpkins. However, these pumpkins did seem to compensate and catch up to growth observed with the other tillage methods. Weed growth was significantly reduced by the no till system (Figure 7). However, as mentioned previously, the hairy vetch which survived the rolling/crimping process had to be desiccated with an herbicide prior to planting. With strip tillage, the weeds did emerge, but fewer weeds were observed in the tilled area and more in the inter-row space where the mulch had been chopped and moved by the rotary mower. Perhaps the effectiveness of the mulch is reduced by chopping relative to rolling. Conventional tilled plots had significant weed competition.



Figure 7. Weed growth in no till versus strip till pumpkin plots.

Strip till pumpkins had a significantly larger fruit set relative to no-till pumpkins (Table 1). However, the average fruit weight was significantly greater with no tillage resulting in a larger tonnage harvested per acre with fewer pumpkins. Whether by weight or fruit count, conservation tillage increased marketable yields by more than 50% relative to conventional tillage pumpkins. Pumpkins produced using the no till system were clean and ready to market (Figure 8). The strip tillage pumpkins were slightly dirtier and may require washing before marketing.

In 2009, a variety trial which included ‘Gladiator’ in a conventional tillage system, used recommended fertilizer rates (100 lbs N /acre) and pesticides (Jett, 2009). Yields from this evaluation were 1815 pumpkins per acre, 17 t/acre with an average weight of 19 lbs/pumpkin which are very equal to no-till yields received in 2010 under more stressful growing conditions and fewer inputs.

Further evaluation of conservation tillage must be conducted. Growers and extension personnel must be introduced to the system components. In 2010, a Cover Crop Field Day was conducted which demonstrated the rolling process (Figure 9). Replacing the hairy vetch legume with a shorter stature plant that is completely killed by rolling will improve the viability of the system.



Figure 8. No-till pumpkins were clean with excellent size and quality.

Table 1. Marketable yield of pumpkins grown in conservation versus conventional tillage.

Tillage method	Avg. wt/pumpkin (lbs)	Yield/acre (tons)	No./plant	No./acre
Conventional	12.0	7.7	0.9	1266
Strip Tillage	16.8	19.8	1.7	2363
No Tillage	21.3	18.9	1.3	1777
<i>LSD</i> (0.05)	3.7	2.6	0.7	498

¹Means which differ by more than the LSD value are significantly different at P = 0.05.



Figure 8. A *Cover Crop Workshop* held in May, 2010 discussed cover crop choices and demonstrated the rolling/crimping process.

Literature Cited

Jett, L. W. 2009. Pumpkin Cultivar Evaluations for West Virginia. *Midwest Vegetable Trial Report for 2009*. pp. 104-106.

McClurg, C.A., S. Reiners, D. Riggs and R. Rouse. 2003. Cultural Practices in Pumpkin Production Guide, NRAES Publication 123.

SARE. 1998. Managing cover crops profitably. 2nd ed., Sustainable Agriculture Network handbook series.

EQIP Conservation Activity Plans – An opportunity for NRCS Technical Service Providers

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The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program for persons who are engaged in livestock, forestry or agricultural production, including organic production. Under a new provision of the 2008 Farm Bill, EQIP offers financial assistance for producers interested in obtaining the services of certified professionals who can develop resource specific Conservation Activity Plans for their eligible agricultural land.
<http://www.nrcs.usda.gov/programs/eqip/cap.html>

A conservation activity plan (CAP) is a specialized and detailed plan designed to address concerns associated with a narrowly defined resource. A CAP meets all NRCS conservation planning standards and addresses requirements including cultural resources and regulations outlined in the National Environmental Policy Act (NEPA). CAPs are most applicable for those who want to undertake a higher level of resource management for a specific purpose. Depending on your state, NRCS is accepting applications from landowners and operators requesting assistance to develop:

<u>Practice Code</u>	<u>Conservation Activity Plan</u>
102	Comprehensive Nutrient Management Plan
104	Nutrient Management Plan
106	Forest Management Plan
110	Grazing Management Plan
114	Integrated Pest Management Plan
118	Irrigation Water Management Plan
122	Agricultural Energy Management Plan-Headquarters
124	Agricultural Energy Management Plan-Landscape
126	Comprehensive Air Quality Management Plan
130	Drainage Water Management Plan
134	Conservation Plan Supporting Transition from Irrigation to Dry-land Farming Plan
138	Conservation Plan Supporting Organic Transition

142	Fish and Wildlife Habitat Management Plan
146	Pollinator Habitat Enhancement Plan
150	Oil Spill, Prevention, Control and Countermeasure (SPCC)
154	Integrated Pest Management Herbicide Resistance Weed Conservation Plan

How It Works

A landowner or producer may submit an EQIP application for financial assistance to offset the development cost of a detailed Forest Management Activity Plan or a CNMP. Participants must enroll in EQIP before their Conservation Activity Plan is developed; payment for a CAP is not retroactive.

1. A producer applies for EQIP assistance for development of a CAP. To be considered for funding, applicants must meet eligibility requirements. In addition, producers are allowed only one CAP on the same acreage at a time.
2. If approved for funding, the producer will select an approved conservation planner to develop the plan from TechReg, the online registry of certified Technical Service Providers: <http://techreg.usda.gov/index.aspx>. Potential applicants should visit the TechReg Web site before they submit an application. In order to receive funding for a conservation activity plan, a qualified TSP registered in TechReg must be available.
3. The CAP must be developed by the Technical Service Provider within 12 months.
4. After the CAP is complete, the landowner or producer submits it to NRCS. After NRCS approves the completed plan, the landowner will receive the EQIP payment for plan development. Set payment rates for CAPs are not more than 75% of the estimated incurred cost of plan development.

Contact your local NRCS office for more details on this Program.

Some Common Types of Dry Fertilizers for Pastures

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County agricultural agents often get questions from grazers on how to interpret their soil test report recommendations and which fertilizers are appropriate to use on pastures. The following summarizes dry forms of fertilizer that are available for grazers to use on their pastures and provides a couple of examples of what the soil test recommendations mean.

Fertilizers for Pastures

Ammonium Sulfate (21-0-0-24S): Contains 21% nitrogen and 24% sulfur in the dry form. Good fertilizer to apply in spring and summer. Supplies sulfur, a necessary nutrient for plant growth which can be limiting in some Delaware soils. This is one of the most acidifying fertilizers so be sure to soil test regularly and test for the surface 0 to 2 inch soil pH so lime can be applied as soon as it's needed. When legumes make up 25 to 50% of the forage available to grazing animals, nitrogen applications should be limited to no more than 25 lbs/N/application; and if legumes make up over 50% of the available forage, no nitrogen fertilizer will be needed.

Urea (46-0-0): Contains 46% nitrogen, the highest analysis of nitrogen available in dry form. Urea should be applied before rain to minimize nitrogen loss to volatilization. Works well as a spring time green-up fertilizer because of lower temperatures and increased chances for rain to reduce volatilization. Urea is completely water soluble and rapidly converts to a plant available form.

MAP-Monoammonium phosphate (11-52-0)- Contains 11% nitrogen and 46% phosphorus. Good fertilizer to blend with other components to make a custom blend. Before using MAP, a soil test should be performed to determine amount of phosphorus in soil. For environmental reasons, MAP should not be applied if soil test phosphorus levels are excessive.

Muriate of Potash or Potassium Chloride (0-0-62)- Contains 60-62% potassium. Use a soil test to determine application rates. Pastures with legumes (clovers, alfalfa, vetches, or lespedeza) require a lot of potassium which should be applied in two applications, the first in late spring and the second in late summer or early fall.

Potassium Magnesium Sulfate or K-Mag (0-0-22-11Mg-22S)- Contains 22 pounds of potassium, 11 pounds of magnesium, and 22 pounds of sulfur. Besides potassium, K-Mag supplies magnesium and sulfur and is a good fit for legume pastures, especially those with alfalfa.

Mixed Blends- There many mixed blends available as well and can be complete (containing N P₂O₅ and K₂O such as 15-15-15) or incomplete (not containing all three major nutrients such as 4-0-49). Additional nitrogen only fertilizers (ammonium sulfate, urea) may be needed to bring the amount of applied nitrogen up to 40-50 pounds nitrogen per acre (see above under ammonium sulfate for comment about legume content of pasture).

Calcium or Magnesium (Dolomitic) Limestone- Supplies calcium and magnesium depending on type of lime used. Lime is used to raise the pH of the soil for optimal growth by reducing soil acidity and increasing availability of soil nutrients. A soil sample should be taken to determine the amount of lime required to raise the pH to a desired level. If large amounts of lime are called for, the application typically occurs before pasture establishment so it can be incorporated. Small adjustments of pH can be made through topdressing of lime. Future maintenance lime applications may be needed, so pH should be checked through a soil sample (0-2 inch depth) every 2-3 years.

Example 1:

EXAMPLE 1

SOIL TEST REPORT
UNIVERSITY OF DELAWARE — SOIL TESTING LABORATORY
NEWARK, DELAWARE 19717-1309

Agent copy

FIELD NAME OR NO. _____ ACRES _____ COUNTY _____ DATE SAMPLED _____ DATE RECEIVED _____ DATE COMPLETE _____ LAB NO. _____ BAG NO. _____

TEST FOR: GROWER _____ ADDITIONAL COPY TO: COUNTY AGENT

KENT CO. EXTENSION
69 TRANSPORTATION CIRCLE
DOVER, DE 19901
302-730-4000

CLAY _____ SMWHT POOR _____ 4-6 NO TILL _____ NO _____ NO _____

SOIL NAME _____ SOIL DRAINAGE _____ SOIL COLOR _____ SOIL TEXTURE _____ SAMPLE DEPTH _____ TILLAGE _____ PRESENT COVER _____ IRRIGATION _____ PUMP _____

GRASS, GRS/CLOV PAST _____ UNKN 0.0 UNK _____

LAST CROP _____ YIELD OF LAST CROP _____ TYPE TA WHEN MAINTAIN N P₂O₅ K₂O NOS AGO TA TYPE OTHER NUTRIENTS

SOIL TEST RESULTS:

	LOW	MEDIUM	OPTIMUM	EXCESSIVE
pH	5.9	6.5-7.5	7.0-8.0	8.5-10.0
PHOSPHORUS P (NOB VALUE)	70	70-100	100-150	150-200
POTASSIUM K (NOB VALUE)	13	13-20	20-30	30-40
MAGNESIUM Mg (NOB VALUE)	56	56-70	70-100	100-150
CALCIUM Ca (NOB VALUE)	76	76-100	100-150	150-200

B	Mn	Zn	SO ₄ -S	% ORGANIC MATTER	SOL. SALTS (MMS/CC)	BUFFER pH	% Phosphorus Saturation	CEC (meq/100g)	% Base Saturation	ENCLOSURES
0.7	7.7	4.2	39.0	3.3	7.54	17.1	8.2	54.9	1,3,18	

SUGGESTED FERTILIZER PROGRAM:

CROP:	GRASS OR GRASS/CLOVER PASTURE, TOPDRESSING	YIELD GOAL: 3.0 TO 3.5 T/A HAY OR EQUIVALENT	N (LBS/A)	P ₂ O ₅ (LBS/A)	K ₂ O (LBS/A)	S (LBS/A)	B (LBS/A)
			1.0	0	0-20	160	

You take a soil sample in your established grass pasture and the report comes back showing medium-optimal levels of phosphorus and low levels of potassium. The report suggests you apply 20 pounds of phosphorus and 160 pounds of potassium per acre. The pH is 5.9 and the report calls for 1.0 tons/acre of dolomitic lime. What should you use?

Liming should occur before regrowth starts in the spring and should include dolomitic lime. The best method is to lime before seeding your pasture to raise the pH to optimal levels. It

will take a while for the lime broadcast on top of the pasture to move through the soil layer and become available for plant use. As an aside, grazers often wonder if it is safe to allow animals back on the pasture immediately after liming or fertilization. Although lime is non-toxic, we normally suggest waiting until after a rain event to put animals back on a pasture just to help the grazer feel comfortable about the application. This also applies to fertilizer applications although in the case of fertilizer the salt content (saltiness) sometimes will attract the grazing animal especially if not applied in a uniform fashion and a rain event prevents any possible problems from occurring. There are a few options to use for NPK-containing fertilizers. The first fertilizer application should take place in early spring around green up. A blend of 40 pounds of MAP and 60 pounds of urea would supply 30 pounds of nitrogen and 20 pounds of phosphorus. Supply an additional 30 pounds of actual nitrogen and half of the recommended potassium with 65 pounds of urea and 130 pounds of muriate of potash after the first couple of grazing cycles, around mid-May. The potassium helps the plant tolerate hot and dry conditions. An additional 50 pounds of nitrogen and 80 pounds of potassium should be applied using 240 pounds of ammonium sulfate and 130 pounds of muriate of potash. The last application should occur in late summer or fall to supply fall nitrogen needs should environmental conditions favor pasture growth. Splitting the potassium applications prevents creating a grass tetany problem in the spring when adding large quantities of nitrogen and potassium all at once during the cool, wet period of spring can reduce magnesium uptake by forage plants.

Example 2:

EXAMPLE 2

SOIL TEST REPORT
UNIVERSITY OF DELAWARE — SOIL TESTING LABORATORY
NEWARK, DELAWARE 19717-1303

Agent copy

FIELD NAME OR NO.	ACRES	COUNTY	DATE SAMPLED	DATE RECEIVED	DATE COMPLETE	LAB NO.	BAG NO.
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COUNTY AGENT

KENT CO. EXTENSION
 69 TRANSPORTATION CIRCLE
 DOVER, DE 19901
 302-730-4000

MOD WELL	NORMALSA LO	0-6 DISK ONLY	G/C SOD <50%	NO	NO
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SOIL NAME	SOIL DRAINAGE	SOIL COLOR	SOIL TEXTURE	SAMPLE DEPTH	TILLAGE	PRESENT COVER	IRRIGATION	IRRI PUMP
GRASS, GRS/CLOV PAST				50 100	0 0-6	1.0 MAG		
LAST CROP	YIELD OF LAST CROP	TYPE	T/A WHEN MANURE	N LAST FERTILIZER	P ₂ O ₅	K ₂ O	MOL. AGO LAST LIME	T/A TYPE OTHER NUTRIENTS

SOIL TEST RESULTS:

		LOW	MEDIUM	OPTIMUM	
pH	6.2	*****			EXCESSIVE
PHOSPHORUS P	95	*****			
POTASSIUM K	46	*****			
MAGNESIUM Mg	108	*****			
CALCIUM Ca	87	*****			

B	Mn	Zn	SO ₄ -S	% ORGANIC MATTER	SOIL SALTS MBROSCM	BUFFER PH	% Phosphorus Solubility	CFC mg/100gm	% Base Saturation	ENCLOSURES
0.9	41.7	5.9	27.0	2.1		7.73	22.7	7.9	72.7	1,3,18

SUGGESTED FERTILIZER PROGRAM:

CROP:	GRASS OR GRASS/CLOVER PASTURE TOPDRESSING	0.0	0	0	110		
YIELD GOAL:	3.0 TO 3.5 T/A HAY OR EQUIVALENT	N LBS/A	P ₂ O ₅ LBS/A	K ₂ O LBS/A	S LBS/A	B LBS/A	

You took a soil sample in your established grass/clover mix pasture and the report comes back showing a pH of 6.2, optimal levels of phosphorus and medium levels of potassium. Zero pounds of phosphorus and 110 pounds of potassium are recommended. What should you apply?

For pastures with 0-25% clover, 50 pounds of actual nitrogen should be applied using either ammonium sulfate or urea in both spring and late summer. For pastures with 25-50% clover, 25 pounds of nitrogen is recommended and for pastures with over 50% clover, no

nitrogen fertilizer is recommended. Therefore, 240 lbs of ammonium sulfate could be used or 100 pounds of urea in the 0-25% clover pasture to supply 50 pounds of actual nitrogen. An application of 120 pounds of ammonium sulfate or 50 pounds of urea could be used to supply the nitrogen in the 25-50% pasture. Muriate of potash should be applied at 90 pounds of material per acre to supply 55 pounds of actual potassium. Another nitrogen application should be scheduled in the late summer and early fall along with the remaining potassium requirements for fall growth. While spring applications have the option of using urea, summer applications should include ammonium sulfate unless rainfall is likely or irrigation can be used. The possibility of volatilization with urea is high with warm temperatures we experience in the summer. No lime is needed at this time, but should be planned in a couple years to maintain pH. Taking another soil sample every couple of years should confirm this.

Notices and Upcoming Events

June 20, 2011

Kent County Pasture Walk , Bullock Farm, 1201 Bullock Road, Harrington, DE. Contact the Kent County Extension Office at (302)-730-4000 or email carolm@udel.edu.

June 22, 2011

NE SARE Dairy Cropping Systems Field Day, State College, PA. Contact Ron Hoover at 814-865-6672 or by email at rjh7@psu.edu

June 22, 2011

2011 Weed Science Field Day, University of Delaware Research and Education Center, Georgetown, DE. Contact Dr. Mark VanGessel at 302-856-7303 x510 or by email at mjv@udel.edu

June 23, 2011

Best Management Practices for Healthy Pastures, Central Maryland Research and Education Center, Ellicott City, MD. Contact Jennifer Reynolds at 301-405-1547 or by email at jenreyn@umd.edu or visit the website: www.ansc.umd.edu/ERG

Knowing how and when to rotate, mow, harrow, and over-seed pastures can be tricky. Experts will discuss tips for keeping your pastures in top condition.

June 26-29, 2011

Northeastern Branch American Society of Agronomy Annual Meeting, Chesapeake Beach Resort and Spa, Chesapeake Beach, MD. Contact Dr. Robert Hill at 301-405-1347 or by email at rlh@umd.edu

July 14, 2011

2011 Annual Field Day Southern Piedmont Agricultural Research & Extension Center, Southern Piedmont Agricultural Research and Extension Center, Blackstone, VA. Contact Betty Mayton or Margaret Kenny at (434) 292-5331.

July 19 and 20, 2011

Field Crop Diagnostic Clinic, State College, PA. Contact Dwight Lingenfelter at 814-865-2242 or by email at Dwight@psu.edu

July 21, 2011

Weed Identification and Control, Central Maryland Research and Education Center, Ellicott City, MD. Contact Jennifer Reynolds at 301-405-1547 or by email at jenreyn@umd.edu or visit the website: www.ansc.umd.edu/ERG

What weeds are common in horse pastures and how can you control them? Develop your skills in weed identification and learn which weeds are toxic.

July 21, 2011

Weed Management in Organic Soybeans: Multiple Tactics for Success, Lower Coastal Plain Research Station, Kinston, NC. Contact Molly Hamilton at 828-273-1041 or email: molly_hamilton@ncsu.edu

Weed control is the most challenging aspect of producing organic soybeans. We have spent the last several years looking at multiple tactics that, together, can really help fight weed pressure in organic soybeans. See how seeding rate, seed size/variety, roll-kill/no-till, and cultivating can contribute to a soybean weed management plan. We will also be visiting the organic Official Variety Trials for corn and soybeans, and have time to discuss selecting varieties and hybrids for organic production.

August 3, 2011

Virginia Tech Shenandoah Valley Agricultural Research and Extension Center bi-annual Field Day, Shenandoah Valley Agricultural Research and Extension Center, 128 McCormick Farm Circle, Raphine, VA. Contact the Shenandoah Valley AREC at (540) 377-2255 by Friday, July 29th to register.

September 10, 2011

2011 Horse Pasture Management Seminar, Central Maryland Research and Education Center, Ellicott City, MD. Contact Jennifer Reynolds at 301-405-1547 or by email at jenreyn@umd.edu or visit the website: www.ansc.umd.edu/ERG

The cost of this seminar is \$25 per person and includes all materials and lunch. This full-day event will help you learn about a variety of pasture-related topics including:

- pasture management: a year-round approach
- weed control methods
- getting control of water and mud in pastures
- best suited grass species for horse pastures
- strategies for managing all that manure
- where and how to apply for money for pasture improvements
- rotational grazing

This unique opportunity will prepare you with the knowledge and resources you need to make your own managed grazing project a success.

September 10, 2011

Family and Farm Day, Virginia Tech Southern Piedmont Center near Blackstone from 9 am to 2 pm rain or shine. Contact Dr. Carol A. Wilkinson or P. J. Shepherd at 434-292-5331.

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