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Shenandoah Valley Agricultural Research and Extension Center
McCormick Farm

2015 Field Day Proceedings

August 5, 2015

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Field Day Program

Shenandoah Valley Agricultural Research and Extension Center
Wednesday, August 5, 2015

12:00 – 1:00	**Registration and visit with sponsors**
1:00 – 1:10	**Welcome**, *David Fiske, Superintendent, Shenandoah Valley Agricultural Research and Extension Center*
1:10 – 1:20	Load wagons and travel to first stop
1:20 – 1:45	**Establishing Silvopasture: A Mid-way Progress Assessment** – *Adam Downing, Virginia Cooperative Extension and Dr. John Fike, Crop and Soil Environmental Sciences, Virginia Tech*
1:45– 1:55	Load wagons and travel to Forage Plot area
1:55 – 2:40	**Summer Annual Options for Grazing, Hay, or Cut & Wilt Ensiling –** *Matt Booher, Virginia Cooperative Extension, Augusta County*
	New Legume Crop for Virginia: Mungbean Adaptation and Cultural Practices – *Dr. Ozzie Abaye, Crop and Soil Environmental Sciences, Virginia Tech*
	View Demonstration and Research Forage Plots
2:40 – 2:50	Load wagons and travel to Big Meadow area
2:50 – 3:10	**Mob Grazing Research Update –** *Dr. Ben Tracy, Crop and Soil Environmental Sciences, Virginia Tech*
3:10 – 3:30	**Does Land Application of Biosolids Pose Health Concerns for Grazing Livestock?** – *Dr. Greg Evanylo, Crop and Soil Environmental Sciences, Virginia Tech*
3:30 – 3:50	**Considerations for an AI Synchronization Program in your Beef Herd –** *Dr. Terry Swecker, VA-MD Regional College of Veterinary Medicine, Virginia Tech*
3:50 – 4:10	**Phosphorus Supplementation for Beef Cattle** – *Dr. Mark McCann, Department of Animal and Poultry Sciences, Virginia Tech*
4:10 – 4:30	**Summer Stockpiling Fescue for Late-summer Pasture –** *Matt Booher, Virginia Cooperative Extension, Augusta County and John Benner, Virginia Cooperative Extension, Augusta County*
4:30 – 4:50	**Managing Tall Fescue with Alternative Legumes** – *Dr. Ben Tracy, Crop and Soil Environmental Sciences, Virginia Tech*
4:50 – 5:10	**Fescue Genetics- Is the Solution in Selection? -** *Dr. Brian Campbell, DSM Nutritional Products and Dr. Chris Teutsch, Virginia Tech Southern Piedmont Agricultural Research & Extension Center*
5:10 – 5:20	Load wagons and travel back to Bank Barn
5:20 – 6:00	**Visit with Sponsors –** Bank Barn
6:00 – 6:30	**Introductions and Comments from Special Guests –** ***Memorial grounds picnic area***
6:30	**Dinner –** ***Memorial grounds picnic area***

Establishing Silvopasture: A Mid-way Progress Assessment

John Fike,[1] Adam Downing[2]

Background

Silvopasture is the purposeful and managed integration of trees, forages, and livestock. With appropriate management, these intensive, integrated management systems create beneficial interactions among the system components that result in more efficient resource use and greater economic output over the life of the system. Benefits of silvopastures can include increased forage yield or quality, reduced animal stress, improved tree growth and quality, greater farm product and ecosystem diversity and a number of conservation gains (Fike et al. 2004).

The intentional integration of trees and forages has been practiced in different parts of the world for decades or even centuries (Cubbage et al. 2012). In the U.S., this practice is most typically associated with pine systems in the Southeast coastal plain, but the practice is used in the Pacific Northwest under spruce as well as in hardwood growing regions of the country.

Silvopasture adoption by Virginia producers has been rather limited, especially in hardwood settings. However, interest and application of these systems is beginning to pick up. The potential benefits shown by early Virginia research, along with concerns for animal welfare, increased extension efforts, and the addition of silvopastures to the list of accepted NRCS conservation practices all are contributing to greater awareness of these systems. Because of Virginia's varied climate, soil and specific site conditions, the application of this practice on any given farm will differ.

This SVAREC silvopasture project aims to demonstrate how a degraded hardwood stand on a medium quality site might be converted into a mixed-use forage and timber producing silvopasture.

The goals of this project are to:

1) improve the overall productivity of the site,

Demonstration site, pre- (top) and post- thin (bottom).

Images available from the Virginia Information Technologies Agency (http://www.vita.virginia.gov/isp/default.aspx?id=8412) *and the FSA's National Ag Imagery Program* (http://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/naip-imagery/index).

2) provide shaded foraging/loafing for heat-stressed animals,
3) provide long term timber value,
4) remove invasive species, and
5) maintain certain ecosystem benefits of natural habitats

Stand and Site Description

Prior to thinning, the wooded area was a mixture of various hardwoods namely green ash, black cherry, black walnut and hickory. Other species included: white oak, black oak, black locust, and American elm. The understory was dominated by non-native bush honeysuckle, multiflora rose, and spicebush. There was very little tree regeneration present. Along with an old home site, evidence suggests the area was pastured in the past, and some very large, mature white oak trees were present. The site (4.8 acres) had been fenced to exclude all livestock since the late 1990s. Most of the trees in the stand were smaller pulpwood sized trees, with an average diameter of 10.2”. The area was considered fully stocked (an indication of full site utilization).

Soils within this area are in the Frederick-Christian silt loam series. The area closer to the road is in the Frederick Rock-outcrop series. This soil type is derived from the weathered products of dolomitic and cherty limestone. This soil is typically fine in texture, rocky and very prone to erosion. Overall soil quality is moderately good in texture and fertility but several rock ridges run through the acreage making traditional forage management a challenge. This soil type is suited for growing fair quality trees, mainly black walnut, ash, black locust, yellow poplar, and eastern white pine. Average soil pH was above 6, with low levels of P, moderate K, and high Ca.

Forest manipulation

Prior to harvest, the site was a mixture of trees and invasive species such as bush honeysuckle and autumn olive. Thinning this site presented the opportunity to meet our production goals both for timber and for forages and livestock while also removing a reservoir of invasive species seeds. While the thinning operation and subsequent site preparation (discussed later) removed many invasive species, follow-up treatments continue to be necessary to treat sprouting root systems as well as a few bushes that were too close to residual trees for large machinery to access.

Visual condition: **Pre-harvest** **Post-harvest**

Finding a balance of the right quality and quantity of light to support forages under an overstory of partial tree shade is the aimed-for (and delicate) balance. To achieve this, the stand was thinned to approximately 50 percent of its current basal area. Basal area is a measure used to describe tree stocking in a given area, a sort of density measurement that accounts for tree size. Specifically, the basal area of a tree is the cross section of a stem (trunk) measured at breast height (4' 6" above ground) and expressed in square units per area. Thinning to 50% of the original basal area is generally considered a reasonable goal when converting hardwood forests to silvopasture (personal communication Tom Ward (NRCS, 2012).

The basal area of this site averaged around 100 ft^2 /acre. In choosing how many trees to leave behind, we considered three factors: species, stem quality and spacing. Our goal was to leave well-spaced trees of suitable quality and characteristics and a residual basal area of about 50 ft^2/ac (50% of 100 ft^2/ac). Black walnut and white ash comprise the majority of the selected species. Of the 196 trees in the residual stand, 39% are black walnut and 25% are white ash. Following harvest, the residual stand's average diameter was 9.8" (at 4.5 feet above the ground).

Along with producing nuts and high value wood, walnut has good silvopasture characteristics in terms of late leaf-out, early leaf-drop and a diffuse canopy. Such features allow more light to the forage understory. Ash has similar leaf shape and timing but is of lower timber value, so it is neither a preferred nor discouraged silvopasture species. The limitations of the site and the existing stand gave us these trees to work with. Both species are at risk for new non-native pests. Both the emerald ash borer and the thousands cankers disease of walnut are fatal pathogens and are currently present in various parts of Virginia. Neither is known to exist in Augusta or Rockingham Counties, though emerald ash borer is as close as Bath County. Data suggest thousand cankers may be present on most walnut trees but is not a lethal problem unless trees are subject to prolonged drought stress, and high degrees of recovery have been observed following return to normal precipitation (Griffin, 2014). Thus, site placement will be important if planting walnuts for silvopasture

Trees were evaluated before and after harvest to assess residual damage from harvest and clearing operations. Of the 196 residual trees, 20% received some sort of mechanical damage, which is acceptable by standard forest operations. This damage will be monitored for wound closure over the next several years but is expected to be an insignificant factor in overall vigor. Burning of brush piles resulted in some damage as well. One nice hickory was completely killed and a large relic oak was also severely damaged though this tree was already in decline and would not have had much market value. Two trees received damage to their crown from burning, 8 trunks were partially burned and 3 root plates received burn damage. The lesson here is that if burn piles are needed, keep them small and away from trees.

The most significant damage to the residual stand appears to be in response to the thinning. While thinning a forest can provide the "leave" trees with greater resources (light, water, nutrients) for growth, it can be stressful as well, especially when the stand is thinned heavily.

There are at least two concerns when supporting/sheltering trees are removed from the stand. First, if the crown or the leave trees are heavy and the trunks are weak, trees may be more sensitive to wind damage (either snapping or falling). This can be more of a problem for shallower-rooted species such as northern red oak and on sites that have little protection from high winds. Younger, more flexible trees also may be less sensitive to this type of damage in heavily thinned sites. So far we have had no loss due to wind throw.

Epicormic sprout on white ash
Photo Credit: USFS

Epicormic sprouting is a second concern. Sprouting is often a response to stress (see example in Figure). When forest grown trees are suddenly opened up, sprouting often increases because the heat from direct sun on tree boles/trunks, stimulates growth of otherwise latent buds that are under the bark. Epicormic sprouting can reduce timber grade on high quality logs, but this may be abated with tree selection – by leaving more dominant trees that are self-shading. As well, if the sprouts form higher up the trunk, this is better in terms of maintaining saw log quality on the "butt" log which contains the most volume and generally the highest value. At best, epicormic sprouting may have little or no economic consequence if there would never be opportunity to market the trees as saw logs. At its worst, epicormic sprouting may be a harbinger of a gradual decline in over-stressed trees. Time will tell how well we managed this aspect of thinning.

Implementation Schedule

Date	Season	Activity
2013	June	Marked for harvest (marked keep trees)
2014	Summer	Commercial harvest (removal of all non-marked material ≥ 2")
	August	Forest mulching on 2 acres (northern end)
	September	Brush pushing (with skidder) and burning on 2 acres (southern end)
	October	Hardwood sprout control, on "pushed" 2 acres with 2% Garlon 4
	Early November	Broadcast forage mixture
2015	23 April	Spot reseeding of forage mixture in bare and light areas
	14 May	Herbaceous weed control, 4 acres with Banvel 1 pint/acre

Forage introduction

Prior to seeding, the site was divided in half, with the northern half receiving a "forest mulching" treatment and the southern half receiving a more traditional "pushing" type with the blade on the log skidder. The objective of both was to create a suitable seedbed for grass seed by removing or masticating any remaining slash and woody debris.

The forest mulcher is a machine similar to a stump-grinder but with teeth on a drum, rather than a disk and mounted on the front of a skid-steer like machine. This turns wood material (dead or alive) into woodchips/mulch. One benefit of this method is the retention of organic matter on the site rather than lost to burn piles. In this case, some burn piles were also created as mulching everything would have resulted in mulch 3-4 inches thick… too thick to sow grass seed over and expect it to achieve contact with the mineral soil.

The more traditional method of pushing brush into burn piles does not necessarily require special equipment and in this case simply used what was on the site, the timber cutter's log skidder with the basic 6 foot non-articulating blade. A risk with putting a blade to work on agronomic land is the potential disturbance and loss of top soil. Being careful of this, the skidder operator moved the bulk of the woody debris but enough was left behind. We used manual labor to additionally clean-up the site with picking up residual slash and woody debris and adding them to burn piles.

Original intent was to plant one or two cool season grasses, but we have little information about forage species suitability within shaded sites. Thus the decision was made to plant a blend of species – but it took time to get the seed, so this delayed the planting until early November.

The seed mixture included:

- 'Select' endophyte free tall fescue
- 'Benchmark' orchardgrass
- 'Remington' perennial ryegrass
- 'Baron' bluegrass
- 'Pradel' meadow fescue.

Each forage species was seeded at 5 lb./acre along with cereal rye at 10 lb./acre (totaling 40 lb./acre). Shade tolerance of these species is not well known and may vary by variety within species, so this seeding is a bit of a "stab in the dark". Meadow fescue has high digestibility and is considered to have relatively good shade tolerance. Reed canarygrass is another shade tolerant species of interest, but seed of low alkaloid varieties were not available for planting.

The late seeding was problematic and may have contributed to some of the weed pressures observed this spring. Because grass seedlings were newly emerged and facing competition with broad leaved herbaceous and wood vegetation, we treated the site with Banvel (a selective herbicide that does not kill grass at low concentrations). Cheat grass in portions of this site may be a future challenge. Cheat is a cool season annual that creates a significant mat, at times overwhelming grass seedling establishment. An earlier planting may have reduced cheat competition. Empirical observations from this and other sites suggest that cheat may be a problem where soil N is low. This sometimes happens under walnut trees because walnuts may reduce forage legume populations. Long term, we may test different legumes to see

Possible increased seedling recruitment where "mulch" caught and held seed.

what works best in these systems.

Seedling recruitment also was challenged by the broadcast application. A grass drill places grass seed in good contact with mineral soil but was not possible in this site with rocks and stumps. A possible alternative in certain settings is to introduce livestock to work seed into the ground. That was not feasible in this case because fence and water infrastructure were not in place. We do think we are observing better seed establishment where the site was mulched. This may in part reflect greater weed control, but likely the improvement reflects that seed "catch", falling into (and staying in) contact with soil.

Citations

Cubbage, F., G. Balmelli, A. Bussoni, E. Noellemeyer, A.N. Pachas, H. Fassola, L. Colcombet, B. Rossner, G. Frey, F. Dube, M. Lopes de Silva, H. Stevenson, J. Hamilton, and W. Hubbard. 2012. Comparing silvopastoral systems and prospects in eight regions of the world. Agroforestry Systems 86: 303-314.

Fike, J. H., Buergler, A. L., Burger, J. A., and Kallenbach, R. L. 2004. Considerations for establishing and managing silvopastures. Online. Forage and Grazinglands doi:10.1094/FG-2004-1209-01-RV. Viewed July 5, 2013. Available at http://www.plantmanagementnetwork.org/pub/fg/review/2004/silvo/

Griffin, G. 2014. Status of thousand cankers disease on eastern black walnut in the eastern United States at two locations over 3 years. Volume 45, Issue 3. Online. Forest Pathology. Viewed July 1, 2014. Available at http://onlinelibrary.wiley.com/doi/10.1111/efp.12154/full

Appendix

The following brochures, articles and factsheets are available from the USDA National Agroforestry Center: http://nac.unl.edu/silvopasture.htm

- What is silvopasture?
- Mitigating Heat Stress in Cattle
- Agroforestry Notes
    - The Biology Of Silvopastoralism
    - From A Pine Forest To Silvopasture
    - From A Pasture To A Silvopasture System

Authors

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Summary Annual Forages

Matt Booher, Virginia Cooperative Extension, Crop Agent
David Fiske, Superintendent, Shenandoah Valley AREC

These demonstration plots were established to provide farmers with a look at some of the many species, hybrids, and varieties available for summer annual forage. Many of these forages can be a valuable tool when rotating a crop field into fall-seeded pasture, or as a targeted way to provide grazing during the summer slump. These plots were planted on June 17th and fertilized with 50 lbs. of nitrogen per acre (cowpeas were inoculated, and not fertilized).

Notes:

Ray's Crazy mix is a diverse mixture created for dual purpose grazing and soil health improvement. It contains 7-10 various species including grasses, legumes and brassicas.

'Moxie' Teff
Teff is a very small seeded warm season grass that has fine leaves and stems, rapid regrowth, and is useful for annual pasture or hay. Quality, similarly to all grasses, depends mostly on maturity. Teff can be difficult to establish due to its small size.

'Exceed' BMR pearl millet.
Millets are lower yielding and slower growing than sorghum-type plants. However, they have smaller stems and are leafier. They do not present a risk of prussic acid poisoning.
Pearl millet is the preferred species for grazing since it has the ability to regrow well from multiple tillers. Forage quality will run about 60% TDN, 12% CP prior to heading. Grazing should begin at about 20" and stop at about 9-12". Dwarf varieties of pearl millet are shorter, with a higher leaf/stem ratio. 'Exceed' BMR pearl millet is a new, low lignin variety with a higher digestibility than non-BMR pearl millets.

'T-raptor' hybrid brassicas.
Brassicas are non-legumous forbs that can be used for cool or warm season grazing. They grow very rapidly when moisture is adequate, and produce highly nutritious forage, often testing 20%+ CP and 70% TDN. Brassicas should be seeded at around 2-5 lb./ac, 1/4" deep. 'T-raptor' is a turnip-like hybrid that works well for multiple grazings and does not produce a bulb.

'AS9301' Sudangrass.
Sudangrasses can be harvested as pasture, green chop or silage, but are best used for pasture. Yields of 3 to 4 tons/acre of dry matter or 10 to 12 tons/acre of green feed or silage are possible. It can be pastured 5 to 6 weeks after planting and may be cut or grazed multiple times (when regrowth reaches 18 to 20 in.) For best results, it should be grazed rotationally with a sufficiently heavy stocking rate to remove forage down to a 6 to 8 inch height in a few days. The pasture will grow rapidly when the cattle are removed for more total tonnage. Additionally, if the grazing period is short, cattle will be less likely to be grazing regrowth that is high in prussic acid. It can be very difficult to dry for hay- a good strategy is to harvest early when plants reach around 30 in. tall. For silage, harvest in the medium dough stage at 65-70% moisture. Nutritional

quality is good when plants are immature (about 70% TDN, 17% CP) and drops with maturity to around 55% TDN, 11% CP. The 'AS9301' variety is a gene 6 BMR.

'AS6402' Sorghum-sudangrass.
Sorghum-sudangrass hybrids are taller, have larger stems and can be higher yielding than sudangrass. Sorghum-sudangrass hybrids are normally harvested for green chop or silage (medium dough stage) but may be used for pasture or hay if planted at a high seeding rate and harvested at 18 to 24 in. tall (regrowth is good but not as good as Sudangrass). The sorghum-sudangrass hybrids usually yield less than forage sorghums. Forage quality will be around 65 TDN, 16% CP in the vegetative state; as the plant matures quality will drop to around 55 TDN, 11% CP. The 'AS6402' hybrid is a gene 6 BMR, Brachytic dwarf with excellent standability.

'Iron clay' cowpea is a summer annual legume that is high producing and high forage quality. Probably best suited for grazing,

Forage sorghums *are not represented in this demonstration but should be mentioned. They are best harvested as silage, and should be harvested at the mid dough stage. 9%CP, 60% TDN. Most forage sorghums and forage sorghum hybrids are medium to late maturing; some long season and/or non-flowering types will need to be killed by frost to dry down enough for ensiling. Forage sorghums and sorghum hybrids can cause prussic acid poisoning under certain environmental conditions- mainly when grazed or fed as green chop. The energy value of sorghum silage is about 90% that of corn silage (60% TDN, 9% CP).*

Prussic Acid

Sorghum and sudangrass plants contain a compound called dhurrin, which can break down to release prussic acid (hydrogen cyanide, HCN). Sudangrass has low levels of this compound and rarely kills animals. Sorghum has the highest levels and sorghum-sudangrasses are intermediate. There is also considerable varietal difference in prussic acid content for all types of sorghums.

Dhurrin content is highest in young plants. Therefore, the recommendation is not to graze or cut for green chop until the plant is 18 to 20 inches tall. This also applies to young regrowth in pastures. After a drought, new shoots may appear and the grazing cattle will switch from the taller forage to the new tender shoots. In addition, do not graze or green chop for 10 days after a killing frost.

High levels of nitrogen fertilizer or manure will increase the likelihood of prussic acid poisoning as well as nitrate poisoning. Very dark green plant growth often contains higher levels of prussic acid.

Most prussic acid is lost during the curing process. Therefore, hay and silage are seldom toxic even if the original forage was. Do not leave green chop in a wagon overnight and then feed. The heat that occurs will release prussic acid and increase likelihood of toxicity in the feed.

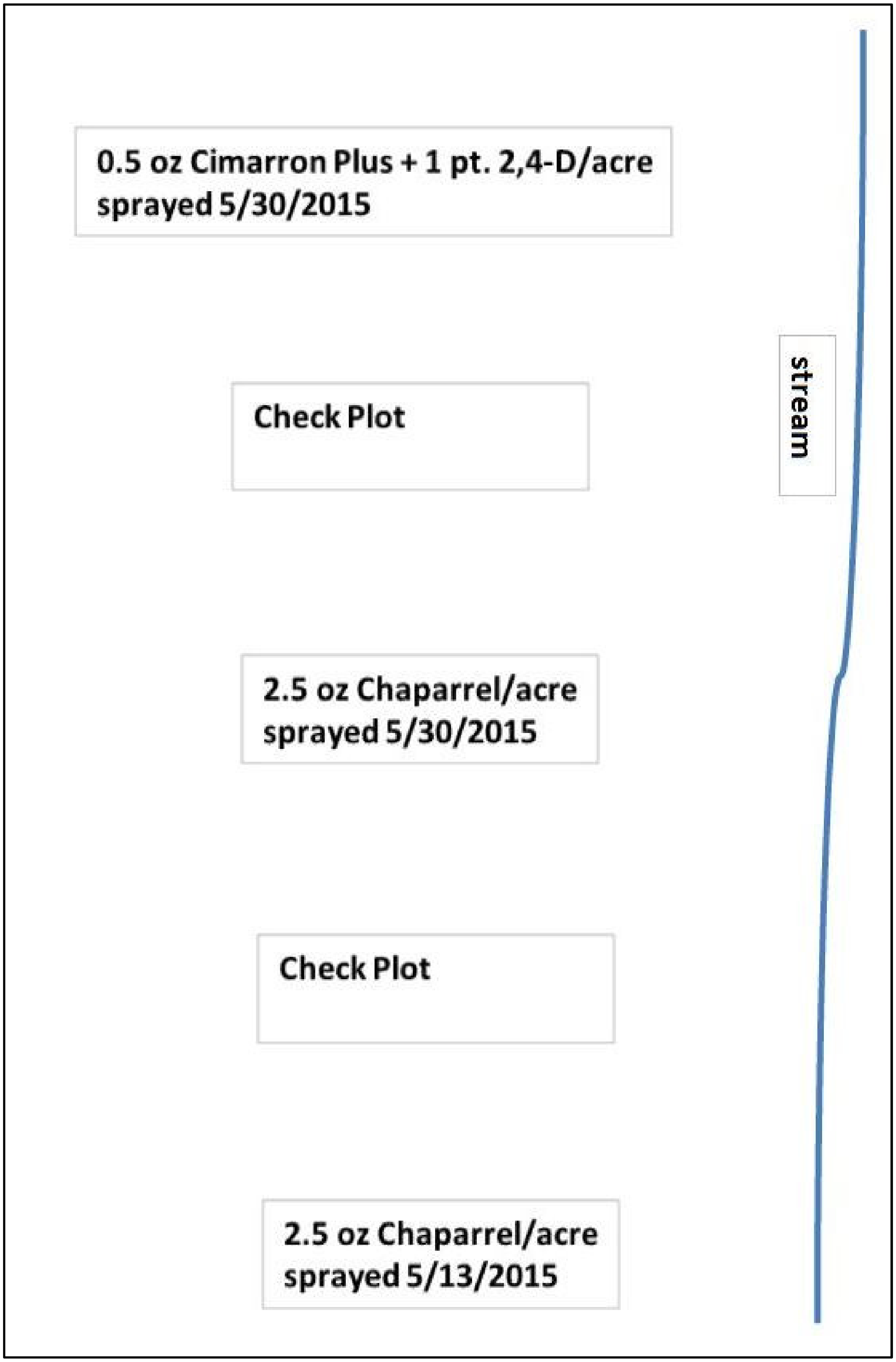
- *'Prussic Acid Concerns' Dan Undersander, University of Wisconsin*

Thanks are due to King's Agriseeds for supplying much of the seed for this demonstration.

King's Agriseeds Inc., 6o N. Ronks Rd., Suite K, Ronks, PA 17572 - 717-891-2343

Cimarron Plus Spray Plot Map

Matt Booher, Crop and Soil Sciences Extension Agent, Augusta County



New Legume Crop for Virginia: Mungbean Adaptation and Cultural practices

For food/feed/cover crop

Mungbean plant and sprout

The Life of a Mungbean Plant: Origin, Adaptation, and Cultural Practices

Ozzie Abaye

Mungbean (*Vigna radiata* (L.) Wilczek), a warm-season legume native to India, is still grown widely there. It is also cultivated in several other countries in Asia as well as Africa (especially East Africa) and South America. In the United States, most mungbean is grown in Oklahoma (one of the southern states). In 2005, Senegal researchers screened over 34 cultivars of mungbean from several countries (Taiwan, Tanzania, and New Zealand). The beans were screened for a potential export market. The first phase of the study focused on screening for yield performance and quality. The cultivars screened were grown on sandy soil at Ndiol research station, 25 km from Saint-Louis (Cisee, et al., 2011). All cultivars yielded at least 1500 kg ha^{-1}, with a peak of 2222 kg ha^{-1} for one of the cultivars. Higher yields have been reported elsewhere.

The Mungbean Plant

Mungbean plants look more like garden beans than soybeans and grow 61 to 76 cm tall. Plants are generally branched and grow in an upright bush habit, but some cultivars have a vining growth habit. The plants produce an abundance of yellow or white (depending on variety) flowers in clusters of up to 15 flowers at the end of each stem. Once they begin to flower, they continue to produce flowers throughout the early and mid-summer months, i.e., they are indeterminate. The seed pods are 8 to 10 cm long, each having approximately 10 to 12 seeds. Depending on cultivar and growing conditions, a plant can produce 30 to 40 pods. Due to the indeterminate flowering pattern, the pod production is staggered, with some pods maturing early for harvest and others developing later. Harvest usually takes place when at least one-half of the pods have reached maturity. The pods turn darker as they mature.


Mungbean Seed


Showing purple to white flowers (Santamba) – 50 days after planting


Showing seed pods (Samba))
– 58-60 days after planting

Only a few cultivars of mungbean are available in the US. Berken, a new cultivar (and one we are using for a cover crop in Toubacuta), is the main cultivar grown in the US. Berken produces small, olive-green beans in 8-cm pods. Each pod holds approximately 12 beans, which mature about 80 days after planting. Berken seeds typically sprout in 3 to 5 days. (In Tobucouta, we had good sprouts in 3 days.) This cultivar has been widely used as a "sprout" bean.

Soil and Climate Adaptation

Mungbean is well adapted to sandy or sandy loam soils. However, it does not do well in "heavier", or more clayey, soils. Mungbean's appealing qualities include its ability to tolerate drought and to grow on marginal soils. It does poorly in alkaline conditions where it will quickly develop symptoms of severe iron chlorosis, such as yellowing leaves. Mungbeans prefer a slightly acidic to neutral soil with a pH of 6.2 to 7.2. The mungbean belongs to the legume family and has the ability to fix its own nitrogen; but it requires additional nutrients, such as phosphorus, calcium, magnesium, potassium, and sulfur for optimum growth. For successful nodulation and maximum nitrogen fixation, mungbean (like most legumes) must be inoculated with the proper strain of *Rhizobium*. Mungbean can be cross-inoculated with cowpea rhizobia. The mungbean plant requires well-drained soils. It will not tolerate a wet root system, which can cause disease. A lack of moisture -- especially during the critical flowering and pod-filing period can reduce yields significantly. It is a short-day plant (flower initiation requires exposure to nights longer than some critical period), but mungbean can be grown over a wide range of latitudes, provided minimum temperatures exceed 15^{O}C.

Planting

In Senegal Mungbean can be cultivated under rainy as well as under irrigated conditions. Generally, mungbean should be planted soon after the rainy season begins in Senegal (end of June to early July). Mungbean is a short-season, warm-season food legume that requires 80 to 110 days from seeding to harvest. Therefore, for optimum grain yield, mungbean should be planted as soon as the rainy season begins. Mungbeans planted in Toubacouta in the first week of July began flowering the third week of August (50+ days after planting). However, crops planted in August may not have adequate rain to produce seed and might need to be irrigated. Cisee et al. (2011) planted mungbean in March during the hot, dry season in Senegal (Saint Lauis). Under irrigation, the seeds emerged 5 days after planting. The researchers placed seeds at 3 to 5 cm depth with equidistant spacing (50 x 50 cm), giving 40,000 plants/ha. The vining type mungbean can be seeded at a lower rate with wider spacing.

Use and Nutritional Value

Mungbean has high nutritive value with high protein content about three to four times that of cereals. It is used as a food, feed (forage), or cover crop. As a food, dried beans may be eaten whole or split, cooked, fermented, or milled into flour to make pastas, soups, porridges, confections, and alcoholic beverages. Mungbeans are known for their sweet flavor, and mungbean paste is used in some Asian countries to make frozen ice desserts. In western cultures, the beans are popular for sprouting, with major use as a fresh salad vegetable. (Sprouts are young seedlings just after seed germination.) The most common sprout marketed is mungbean. On a dry-weight basis, mungbeans contain 25 to 28% protein, 1 to 1.5% fat, 3.5 to 4.5% fiber, 4.5 to

5.5 % ash and 60 to 65% carbohydrate. The multiple uses of mungbean as both feed and food can help the farmer distribute economic risk and diversify his farm income.

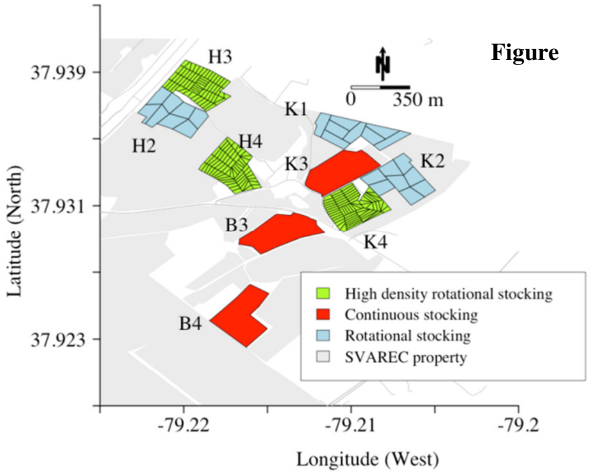
Reference:

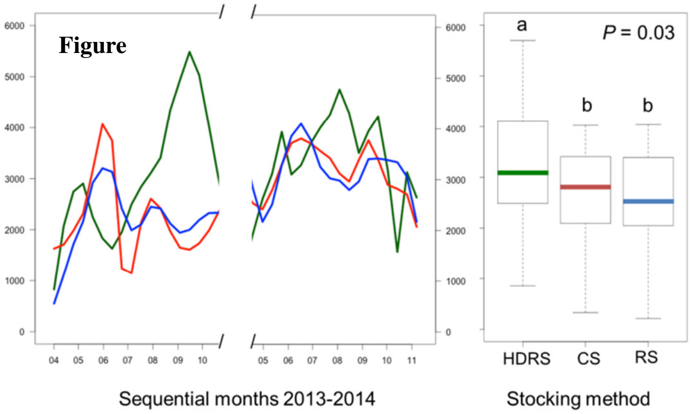
Cisse M., M. Diouf, T. Gueye, and A Fall, 2011. Linking policy, research, agribusiness and processing enterprise to develop mungbean *(Vigna radiata)* production as an export crop from Senegal River Valley. In: Innovations as Key to the Green Revolution in Africa. Bationo, A.; Waswa, B.; Okeyo, J.M.; Maina, F.; Kihara, J.M. (Eds.).

Mob Grazing Research Update

Dr. Ben Tracy and Robert Bauer. Associate Professor and Graduate Student, respectively, Department of Crop and Soil Environmental Sciences, Virginia Tech.
Contact email: bftracy@vt.edu

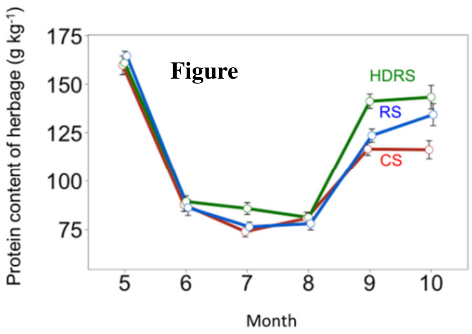
Here at the Shenandoah Valley AREC, we are in the midst of a study comparing three grazing systems that involve low, medium and high levels of management intensification. We are testing the idea that managing the spatial and temporal movements of cattle in more intensive ways will help increase forage supplies and build soil organic matter. We suggest these changes will not only improve the productivity of pasturelands, but make them more resilient in response to climate fluctuations. The methods of stocking beef cattle employed in this study are: 1) Mob or High density rotational stocking (HDRS), 2) rotational stocking, and 3) continuous stocking. High density rotational stocking is considered the most intensive management system where cattle graze paddocks at high densities but are moved rapidly to new grass - sometimes multiple times each day. For example, cattle in the SVAREC HDRS system graze a system of 64, 0.25 acre paddocks housed within three replicated 16 acre plots (Figure 1). Cattle are moved to a new paddock every 24 h so each is rested for a fixed period of 64-d. A stocking density of ~ 50,000 lbs. live BW/acre is maintained on paddocks. Rotational stocking is less intensive but still involves moving cattle through a series paddocks although less frequently and at much lower stocking densities than HDRS. Continuous stocking involves minimal management of cattle movement allowing them to grazing freely and continuously across a pasture.

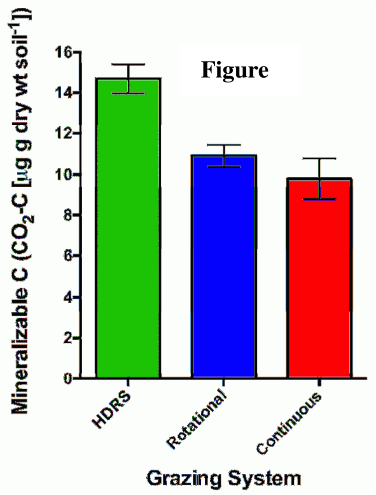


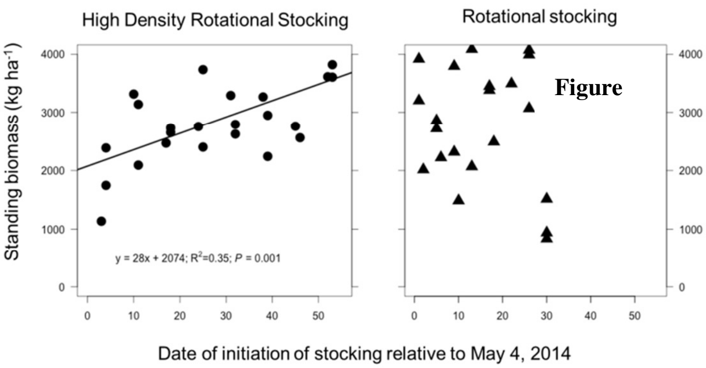


Preliminary data has been collected from SVAREC and at two on-farm demonstrations sites in Raphine and Blacksburg where the same systems are in place.

Pasture Productivity: Forage biomass was collected monthly for 2 years at the on-farm sites**.** As Figure 2 shows, forage mass was significantly greater under HDRS compared with the other grazing systems. Greater forage mass likely resulted from a combination of two factors: 1) higher forage growth during late summer, and 2) cattle consuming less forage because much of the forage base was trampled. We also found intriguing findings related to the nutritional value of forage under HDRS. Figure 3 shows forage protein concentration over the 2014 growing season at SVAREC. This location experienced a summer drought that was alleviated by good rainfall in September and October. Protein concentrations were low in all grazing systems during summer drought, but forage in HDRS grasslands had higher levels in July. Protein content also was elevated more under HDRS that fall following late season rains. The higher forage protein content could have resulted from multiple factors. Most likely, greater nitrogen availability due to more even distribution of manure and urine patches combined with extended rest between grazing events probably improved the growth status of HDRS pastures and allowed them to resume growth more quickly during cooler fall conditions. This preliminary data suggests pastures with HDRS may be more resilient and recover faster from drought than less intensively managed systems. Additionally, the elevated forage protein content in HDRS grasslands should be indicative of higher photosynthesis rates and the potential for increased C inputs below ground. Our preliminary data on soil mineralizable C, which is an indicator of microbial available C, points to this possibility (Figure 4). Soils under HDRS showed a 33% increase in mineralizable C compared with continuous stocking. More mineralizable C should ultimately lead to increases in slower cycling pools of soil C will that promote carbon sequestration. Lastly, we have learned that the timing at which grazing is initiated in the HDRS system can affect forage production. As Figure 5 shows, the first paddocks grazed in spring produced less forage over the growing season than paddocks grazed later in the rotation. Interestingly, this did not happen under rotational grazing. So this suggests that under high density/ mob grazing it is probably best to delay grazing initiation until grasses have at least 6-8 inches of growth – or about 1 week later than usual turn out time. Overall, our preliminary findings suggest that HDRS/mob stocking can promote high forage productivity, resilience in response to drought, and greater carbon sequestration potential compared with continuous stocking. A downside is that high density grazing in early spring may suppress grass growth under some conditions.







Does Land Application of Biosolids Pose Health Concerns for Grazing Livestock?

Shenandoah Valley Agricultural Research and Extension Center Field Day

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Introduction

Biosolids are solid, semi-solid or liquid materials, resulting from treatment of domestic sewage sludge that has been sufficiently processed to permit safe land-application. Sewage sludge consists mainly of partially decomposed organic matter and plant nutrients, including nitrogen, phosphorus, sulfur, calcium, magnesium, and micronutrients (iron, copper, manganese, zinc, nickel, boron, cobalt, and molybdenum). Undesirable constituents present in trace amounts in biosolids are heavy metals, trace organic compounds, and pathogens.

Regulations

On February 19, 1993, the United States Environmental Protection Agency (EPA) published 40 CFR Part 503 (USEPA, 1993; www.epa.gov/owm/bio/503rule), a risk-based regulation designed to protect public health and the environment from any pollutants that might be present in biosolids. The term 'biosolids' is now a formally defined term that requires sewage sludge to be treated to certain minimum standards for pathogen control and vector attraction and contain acceptable levels of pollutants before it can be recycled.

At the direction of the Virginia General Assembly, the Virginia Department of Health (VDH) promulgated in 1995 and revised in 1997 the Biosolids Use Regulations (12 VAC 5-585; www.biosolids.state.va.us/regulations.htm). The Virginia Department of Environmental Quality (DEQ) assumed regulatory oversight of all land application of treated biosolids in 2008 via the Virginia Pollution Abatement (VPA) and Virginia Pollutant Discharge Elimination System (VPDES) permit regulations. Anyone who applies biosolids must meet all the requirements of the DEQ Biosolids Use Regulations (http://www.deq.virginia.gov/Programs/Water/LandApplicationBeneficialReuse/SewageSludgeBiosolids.aspx). These regulations incorporated the Federal 503 rule requirements and established more restrictive site-specific practices dealing with such topics as agronomic rates, slope restrictions, buffer distances, soil pH, nutrient management, and tracking, distribution, and marketing of exceptional quality biosolids.

Biosolids quality is categorized according to several criteria: pathogen (bacteria, viruses, parasites) concentration, vector attraction reduction (characteristics that attract animals that can spread disease), and pollutant (mostly heavy metals) concentrations. Class A and Class B refer to the pathogen contents following sludge treatment and vector attraction reduction requirements. Class A designation requires greater reduction in pathogens than Class B, whose use requires more stringent site restrictions. Chemical parameters in both the biosolids and the soil are measured to ensure that the maximum safe levels as established by EPA's risk assessment are never reached. The trace elements for which standards have been set include arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), and zinc (Zn). Standards for trace organic compounds, such as industrial chemicals, pharmaceuticals and personal care products (PPCPs), and pesticides, were considered but were not included in the regulations because they are found at such low concentrations in biosolids that the U.S. EPA concluded they do not pose significant health or environmental concerns. Although no organic pollutants are included in the current federal biosolids regulations, further assessment of many of these compounds continues to be conducted as has been recommended by the National Research Council (2002).

Land Application: Risks and Benefits

Under Part 503 (USEPA, 1995), land application of sewage sludge shall not exceed the "agronomic rate," which is the application rate designed to provide the crop nitrogen (N) requirement and minimize the amount of N that passes below the root zone of the crop or vegetation grown on the land to the ground water. The agronomic rate requires knowledge of the crop N requirement, the available N in the biosolids and soil conditions at the site. In order to prevent phosphorus (P) pollution of surface water, the Virginia Department of Conservation and Recreation (DCR) and DEQ have included P-based nutrient management plans for biosolids application. For lime-stabilized biosolids, agronomic rate must also ensure that soil pH does not rise excessively.

The contents of organic matter, nitrogen, phosphorus, and micronutrients make biosolids valuable as a fertilizer and soil conditioner. Forages grown on biosolids-amended lands have been utilized by grazing ruminants, principally beef cattle, while grain crops fertilized with biosolids have been fed to both monogastrics and ruminants. No significant difference in health has been observed between domestic animals grazing forages on biosolids-amended and unamended soils.

Heavy metals in biosolids have elicited some concern; however, the forms of metals in biosolids are found in chemical forms that reduce their availability to plants and animals. Reduced metal availability is observed even when biosolids are consumed directly by animals (Cottenie et al., 1984). Another mechanism whereby biosolids metals are rendered harmless is the "soil-plant barrier" (Logan and Chaney, 1983). This is exemplified by soil immobilization or antagonism with other elements (and reduced plant uptake) of potentially toxic metals. For example, the presence of adequate concentrations of soil Zn reduces the absorption of Cd by plants. Another protective mechanism is "phytotoxicity," by which some metals (e.g., Cu, Ni, and Zn) will stunt plant growth before the plant will accumulate enough of the element to be toxic to feeding animals.

Biosolids can contain numerous anthropogenic trace organic chemicals, a legitimate concern when applying biosolids to soils to produce feed for livestock. However, the risk assessment by the EPA has demonstrated that bioavailability of trace organic compounds to plants and animals is low, especially at the rates at which biosolids are applied to land (USEPA, 1993). Direct consumption of biosolids-amended soil is probably a greater concern than consumption of forages/feeds grown on such soils.

Research at sites whose sewage sludge application history pre-dates the Part 503 regulations provided useful data for assessing the risk of biosolids to grazing livestock: the former Lowry Bombing Range operated by the City of Denver (Baxter et al., 1983), a site in Fulton County (IL) operated by the City of Chicago (Lue-Hing et al., 1986), and the Rosemont Watershed study owned by the University of Minnesota that used sludge from local towns (Knuteson et al., 1988). At the Fulton County site, cattle were allowed to graze for up to 8 years on pastures on which anaerobically digested sludge was applied. Cows on both control and biosolids treatments calved normally without complications. Zinc, Cu, and Cd increased in the livers of cows in treatment herds but remained below tolerable levels for food products. Long-term results from the Rosemont and Denver sites, where it was shown that negligible amounts of trace elements are removed by crops grown on sludge-amended soils, have been similar. Numerous studies from the 1970s and 1980s have shown accumulation of trace elements (esp., Cd) in kidney and liver but not in muscle of cattle grazing sludge-amended pastures (National Research Council, 1996). However, the concentrations of trace metals in the sludge were considerably higher than found in today's biosolids.

Researchers have fed biosolids directly to beef and dairy cattle at 10 percent to 20 percent of their diet with no negative health results (Baxter et al., 1983). Other research studies also show that there is not a significant health risk to beef or dairy cattle from consuming feed grown on biosolids amended soils (Dowdy et al., 1984). The use of best management practices will reduce the potential for direct ingestion of biosolids while grazing cattle on biosolids-amended pastures.

Dorn eta l. (1985) conducted a 3-year epidemiologic study on 47 farms receiving annual applications of treated sludge (average of 2–10 dry metric tons/ha/year) and 46 control farms in three geographic areas of Ohio. There were no differences between disease occurrence in domestic animals on sludge and on control farms.

A workshop on emerging infectious disease gents and issues associated with sewage sludge, animal manures, and other organic by-products (Smith et al., 2005) summarized the knowledge in this area relevant to this topic as:

"There are currently available treatment technologies that per se adequately disinfect sewage sludge of existing and emerging pathogenic microorganisms to a degree that has consistently resulted in no clinically-documented outbreaks of illness that were associated with land application of treated sewage sludge;" and
"The current sewage sludge and animal manure treatment technologies can be expected to affect antibiotic resistant as well as nonresistant strains of bacteria equally. Furthermore, after land application the inherent capacity of these bacteria to maintain antibiotic resistance can be expected to diminish as the concentrations of corresponding antibiotics decrease in the soil environment."

Knowledge about the origin and treatment of sludges applied to soils for forage or crop production will remain important. Numerous research trials and long-term experience with soil application of sludge to forage and crop lands have shown that natural soil-plant-animal barriers act to minimize risks from toxic trace elements, organic compounds, and pathogenic organism in sludge. Stringent analysis and control of these potentially toxic factors in sludge at the treatment sites make most problems manageable.

A National Academy of Sciences study completed in July 2002 concluded that there is no documented scientific evidence that the Part 503 rule has failed to protect public health; however, additional scientific work is needed to reduce persistent uncertainty about the potential for adverse human health effects from exposure to biosolids. There have been anecdotal allegations of disease, and many scientific advances have occurred since the Part 503 rule was promulgated. To assure the public and to protect public health, there is a critical need to update the scientific basis of the rule to (1) ensure that the chemical and pathogen standards are supported by current scientific data and risk-assessment methods, (2) demonstrate effective enforcement of the Part 503 rule, and (3) validate the effectiveness of biosolids-management practices.

Despite the requirements mandated by the regulations to protect the environment and the health and safety of the public and the farmer, there are several practices that livestock farmers can adopt to ensure that biosolids application is beneficial. The following sections are designed to alert farmers to some potential problems that could arise from the use of biosolids and what steps to take in order to prevent them.

<u>Potential Problem:</u> Liquid sludge application to pastures may increase risk of toxic intake.

Most biosolids currently generated are dewatered to limit the mass that must be transported to an application site. Dewatered biosolids (usually containing 25-30% solids) applied onto pastures are dry enough so as not to adhere to the vegetation; thus, the solids from dewatered biosolids falls onto the soil surface as the plant grows and comprises a low percentage of the diet (usually <2.5%) that poses insignificant risk to the livestock when time-dependent access restrictions are followed (i.e., 60 days for lactating dairy cattle, 30 days for all other cattle). Liquid sludge that is sprayed onto pastures adheres to the leaf surface and usually comprises a greater portion of the diet of the livestock than estimated in the risk assessment. Pollutants (e.g., heavy metals, organic chemicals) are more likely to be ingested by livestock grazing on pastures fertilized with liquid sludge than dewatered sludge.

<u>Solution:</u> In order to minimize the risk of ingestion of pollutants and pathogens, 1) graze livestock on pastures fertilized with dewatered biosolids; or 2) ensure that pasture or hay vegetation has been mowed to a few inches before the liquid sludge application, thereby allowing enough time for the vegetation to grow to a height to adequately dilute the adhering biosolids.

<u>Potential Problem:</u> Molybdenum (Mo) and sulfur (S)-induced Cu deficiency.

Molybdenosis, or Mo-induced Cu deficiency in ruminants, is caused by an imbalance in dietary Mo, Cu and S. Lime-treated biosolids may exacerbate this health problem by increasing plant availability of soil Mo and reducing the availability of Cu, both situations which are promoted at higher (e.g., >7) soil pH. Research in Florida (O'Connor et al., 2001) has demonstrated that under a very narrow set of conditions, the concentrations of Mo in forages could be raised to levels that might cause a Mo-induced Cu deficiency; however, the combined set of conditions (e.g., excessive uptake rate of Mo by plants, high feeding rate/proportion of biosolids-amended grain and forage in animal diet, extremely low Cu availability in certain soil types without the typically-practiced supplementing of trace elements to the livestock) are highly improbable. This scientifically peer-reviewed research was employed as the basis for establishing safe Mo concentration and application rate standards.

<u>Solution:</u> To prevent molybdenosis, (1) maintain soil pH within the optimum range of 5.8 to 6.5, especially on sandy coastal plain soils; (2) do not feed to livestock a diet comprised entirely of biosolids-fertilized forage; and (3) provide supplemental trace elements for livestock (as is the normal practice).

<u>Potential Problem:</u> Grass tetany.

Grass tetany is a magnesium (Mg) deficiency (hypomagnesium) of ruminants usually associated with their grazing of cool-season grasses during the spring. Hypomagnesium is often observed in pastures due to an excess amount of soil potassium (K) relative to soil Mg. In biosolids-amended pastures, hypomagnesium may be caused by other factors because biosolids typically contain low concentrations of K. Lime-stabilized biosolids are produced with quicklime (CaO) rather than with a mixed Ca-Mg liming product. Repeated applications of lime-stabilized biosolids without supplementation with a Mg-containing product (e.g., dolomitic limestone, Sul-Po-Mag) can reduce soil Mg concentration enough to cause grass tetany. In addition, high rates of nitrogen (N) that may be applied in biosolids can exacerbate this condition.

Solution: 1) Have soil tested annually if using lime-stabilized biosolids, and apply Mg if soil Mg is low; 2) alternate lime-stabilized biosolids and dolomite as a liming sources; or 3) use a non lime-stabilized biosolids (e.g., anaerobically digested, heat dried). Splitting the biosolids application can reduce the risk of grass tetany by providing less nitrogen at any one time.

Potential Problem: Micronutrient deficiency of forage.

The repeated use of a lime-stabilized biosolids can raise soil pH to levels above the agronomically optimum range (i.e., 5.8 to 6.5) if regular soil testing is not implemented and/or biosolids are applied based on crop N rather than soil pH limitations. The pH is apt to rise higher and more rapidly with the application of a liming agent to a coarse-textured (i.e., sandy) than a fine-textured (i.e., clayey and silty) soil. Furthermore, coarse-textured soils are more susceptible to deficiencies of certain micronutrients (e.g., Cu, Mn, Zn) at high soil pH because these soils normally contain lower concentrations of such trace elements than do fine-textured soils.

Solution: In order to avoid micronutrient deficiencies of Cu, Mn, and Zn, ensure that the rate of a lime-stabilized biosolid is applied to maintain soil pH within the ideal agronomic range. The soil testing lab should use a soil buffer pH test to calculate the exact rate required to adjust the soil pH to an appropriate level. Where the pH of the soil is already high, do not use lime-stabilized biosolids. Crops showing deficiencies of Mn, Cu, or Zn can be treated with foliar applications of these elements to ensure vigorous plant growth.

Potential Problem: Nitrate toxicity.

Toxicity in livestock that consume excessive concentrations of nitrates in forages has been well-documented. Nitrates can accumulate in plants heavily fertilized with N during or just after a drought; during cool, cloudy weather; or following a frost. Plants known to have considerable potential for accumulation of toxic levels of nitrates are sudangrass, sorghum-sudan hybrids, pearl millet, corn, wheat, and oats. Certain weeds (e.g., pigweed, smartweed, ragweed, lambsquarter, goldenrod, nightshades, bindweed, Canada thistle, and stinging nettle) may also accumulate toxic levels of nitrates. In addition, the application of 2,4-D herbicide can increase nitrate levels in plants.

Nitrate N is the main form of plant available N taken up by crops. Under optimum environmental conditions (i.e., full sun, adequate soil moisture), the nitrate form of the N is converted to protein in the plant. Environmental conditions that limit plant growth (e.g., drought, shade) limit the conversion of nitrate to protein and cause nitrate to accumulate in the plant. This accumulation of nitrate is most prevalent where high rates of N fertilizer are applied. These can include commercial fertilizer, animal manure, biosolids, and green manure crops. For this reason, nitrate testing of forages during drought is a commonly recommended practice, even where biosolids have not been applied.

Biosolids MAY pose a greater risk of nitrate toxicity than fertilizer because:

1) Biosolids are often applied to pastures and hayland at rates designed to supply an entire year of N, whereas commercial fertilizers are usually applied in incremental rates after each cutting or grazing period; thus, there will likely be a larger amount of nitrate N available to the crop at the beginning of the growing season where biosolids are used.
2) Mineralization rates used to estimate N availability of any organic material (i.e., biosolids, manure, plant residue) vary with climate; thus, more (or less) nitrate than anticipated may actually become available for crops.
3) The variability in the concentration of N in biosolids may result in higher (or lower) than expected concentrations of nitrate in some fields. The concentration of N in biosolids used to calculate the amount of plant available N is estimated from a series of samples, some of which may have been collected as much as 6 months before the generation of the biosolids actually applied. In most cases, the concentrations of N in biosolids are fairly constant, but normal variability will nearly always result in nitrogen concentrations somewhat higher or lower than that actually being applied.

Solution: In order to reduce the risk for accumulating high concentrations of nitrate during deleterious climatic conditions, biosolids rates should be applied to forage and hay crops based on well-designed nutrient management plans that either (a) recommend annual 60% agronomic N rate applications or (b) split biosolids applications where the field will receive 100% agronomic N rate during the year of application.

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Considerations for an AI Synchronization Program in your Beef Herd

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1. What are the pros and cons of an Artificial Insemination (AI) program?
    a. Pros
        i. Wider selection of bulls with better genetics
        ii. Uniformity in the calf crop
        iii. Ability to individually mate cows
            1. Example – growth bull for mature cows
            2. Calving ease for yearling heifers
    b. Cons
        i. Must have the cow in heat when bred
            1. Heat detection takes time
        ii. Must be able to handle insemination
            1. Semen handling from the tank to cow
            2. Deposit semen in the correct place
2. What are the pros and cons of a synchronization or timed breeding program?
    a. Pros
        i. More calves early in the calving season
            1. Average calf will be 10 days older and 20 lbs. bigger
        ii. Do not need to detect heat in cows
        iii. Efficient use of labor
    b. Cons
        i. More calves early in the calving season
            1. Are you prepared to have 50% of your cows calve in a 10 day period
        ii. Timing is essential
            1. Can't wait until tomorrow to give the injection if the weather is bad, the help is absent, or the cows break the corral
        iii. Injection technique is critical
            1. Must be able to give the exact amount in the correct location, there is a difference between
                a. Out of the bottle
                b. Out of the syringe
                c. In the cow in the correct location
            2. Follow BQA guidelines
                a. IM in the neck for most injections
3. What success rate should I expect?
    a. Across the country, researchers report average pregnancy rates of 50-55% in cows, on the higher end on heifers, lower end for cows
        i. The range in conception rates between herds is 30-70% in controlled trials
4. What facilities and personnel do I need?
    a. Good chutes and corrals with good footing
        i. Once you commit to the protocol, you must ignore the weather

    b. Ability to get access to the neck of the cow (injections) and behind the cow if you use CIDRs
    c. Personnel that can accurately deliver the dose of the drugs
5. Where can I find the protocols?
    a. Estrus Synchronization Planner v15 – excel worksheet
        i. http://www.iowabeefcenter.org/estrus_synch.html
6. What are the drugs used in the protocols?
    a. GnRH (gonadotropin releasing hormone)
        i. Examples Cytorellin or Factrel
        ii. This drug causes the brain to release hormones that will make a cow ovulate. It is given on the front end of some protocols to get all of the cows to remove the dominant follicle, start a new follicular wave and hopefully form a CL (corpus luteum). It is given on the back end of some protocols to help all cows ovulate in a short time period
    b. Prostaglandin
        i. Examples: Lutalyse, or Estrumate
        ii. This drug lyses or eliminates a functional CL. Once the CL is gone, any ovulation should be potentially fertile
    c. Progesterone
        i. Examples: CIDR (vaginal insert) or MGA (added to feed)
        ii. This drug keeps a cow from coming into heat, this is the same compound that is produced by the CL on
        iii. Progesterone may “jump start” cows that have not started cycling yet after calving
        iv. CIDRs are easy to insert and progesterone goes down quickly after removal
            1. Some cows will pull out the CIRD from another cow
        v. MGA is usually added to a full ration or a limit fed supplement
            1. Make sure each cows gets the same amount
7. What causes synch programs to fail
    a. Incorrect injection technique
        i. Drugs are administered SC rather than IM
        ii. Incorrect dose
    b. Incorrect timing of injections
    c. Poor facilities
    d. Poor semen handling
    e. Poor body condition on cows (< 5)
8. Where do I get help if I want to use a synchronization program?
    a. Contact your veterinarian, extension agent, or semen supplier
    b. Many of the drugs are prescription only, thus you will need a veterinarian for drug procurement

Strategic Phosphorus Supplementation for Beef Cattle

M. A. McCann, S. J. Neil and D. D. Harmon

Phosphorus supplementation of beef cattle is a standard part of most herd nutrition programs and is generally accomplished by selecting a free choice mineral with the desired level pf phosphorus. Traditionally, phosphorus was thought to positively impact reproduction and 20-30 years ago, some complete mineral mixes contained as much as 6-8% phosphorus. During the last decade, higher phosphorus prices have resulted in lower inclusion rates in minerals, but livestock producers still associate phosphorus with reproduction. Further examination of those trials has revealed that most were conducted in arid and semi-arid range areas with very different soil types, forage species and rainfall than those of the eastern U.S.
Phosphorus has also gained notoriety because phosphorus runoff in surface waters is a contributing factor to algal blooms and aquatic plant growth which can reduce water oxygen levels and at times have detrimental effects on fish and other aquatic life. Agricultural runoff from crop fields and manure is a contributing factor to phosphorus levels in surface waters. As such, land application of phosphorus fertilizer and manure is monitored. Concentrated animal feeding operations (CAFOs) are also monitored because of the amount of manure produced. The majority of CAFOs in the Chesapeake Bay watershed are dairy and poultry operations. However, the feces of grazing beef cattle can also contribute to phosphorus runoff. A significant portion of the fecal phosphorus is in the inorganic form (Pi) which is water soluble. Over time, Pi is capable of binding to soil particles and becoming less soluble. Until this occurs, however, Pi can contribute to increased P runoff during rain events.

Phosphorus is the most expensive macro-mineral added to complete mineral mixes. Opportunity currently exists within grazing beef cow/calf production systems to limit phosphorus inputs and thus increase economic benefits while minimizing environmental impacts. Recent research at Virginia Tech has focused on examining varying phosphorus intake levels and the impact of phosphorus level of fecal excretion of phosphorus and the form in which it is excreted. Additionally, on-the-farm sampling of forage and feces was conducted from 120 locations from 11 counties in the Bay watershed (N = 168). Sixty seven producers completed a survey instrument in addition to the full complement of forage and fecal samples

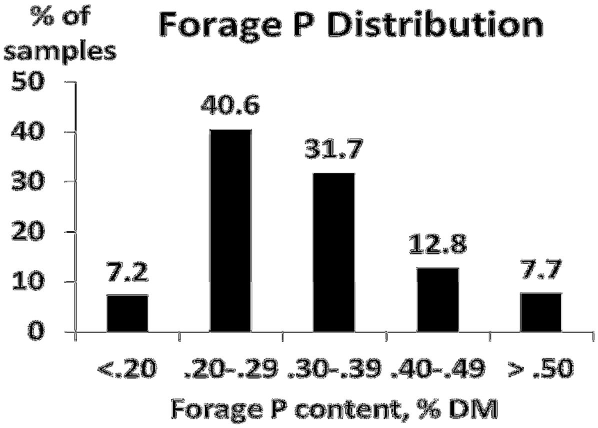
Beef cattle phosphorus requirements

Historically, beef cattle requirements have been expressed as percent phosphorus of the animal's daily dry matter intake (Table 1). Expressing requirements in this way has been well received and easily incorporated from a nutritional formulation standpoint as phosphorus and dry matter intakes are directly proportional, allowing it to be used consistently for cattle of varying weights. More recently, phosphorus requirements have been expressed as the amount of available (absorbed) required by the animal to meet the needs of various physiological functions, including maintenance, growth and lactation. The major factors affecting beef cow phosphorus requirements include stage of production, fetal growth and milk production. True phosphorus absorption of 68 percent was used to then express animal requirements in terms of dietary concentration. As expected, young, lightweight and fast-growing cattle have greater phosphorus requirements when compared to older, heavier weight cattle that are growing less rapidly, which is primarily attributable differences in the rate of tissue and skeletal growth.

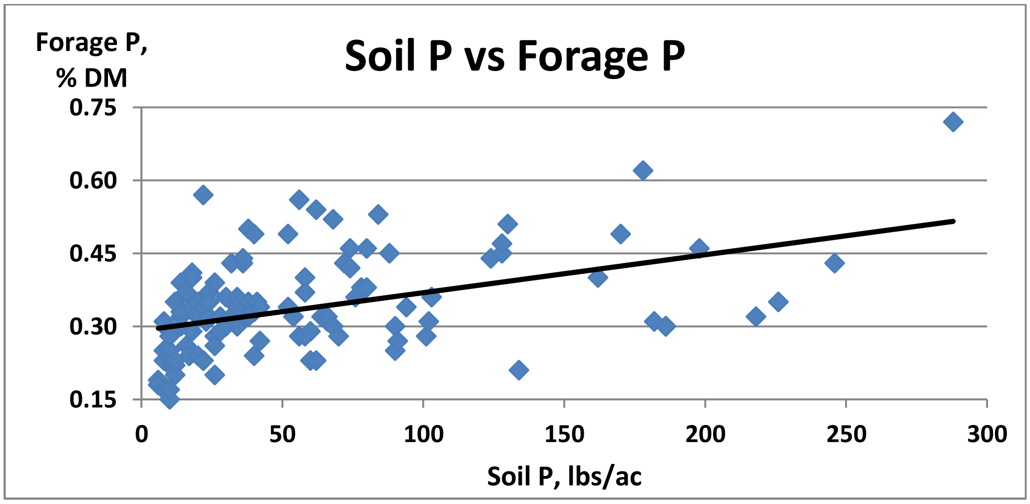
Table 1. Phosphorus requirement of beef cows and growing stockers

Beef cow	% P	Stockers	% P
Late gestation	0.16	1.0 lb/d	.19-.21
Early lactation	.20-.25	2.0 lb/d	.21-.26
Late lactation	.15-.17	3.0 lb/d	.26-.37
Dry	0.13		

The summary of farm forage samples are displayed in the figure below and would suggest the forage on the majority of farms meet the requirements of lactating cows and stockers gaining 2lb/d.



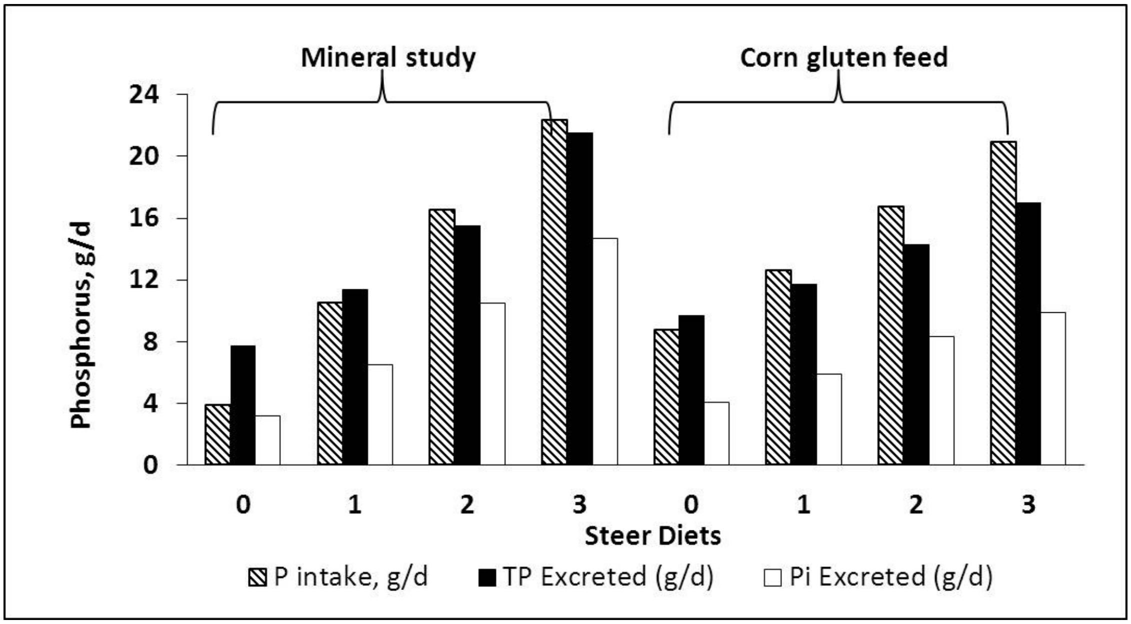
While soil testing for phosphorus is common practice, forage testing for phosphorus content is far less common. The following figure shows the relationship between soil phosphorus and forage phosphorus from the farm samples. Although it is a positive relationship there is considerable variation. Forage phosphorus content is affected by soil levels, pH, rainfall and stage of forage maturity.



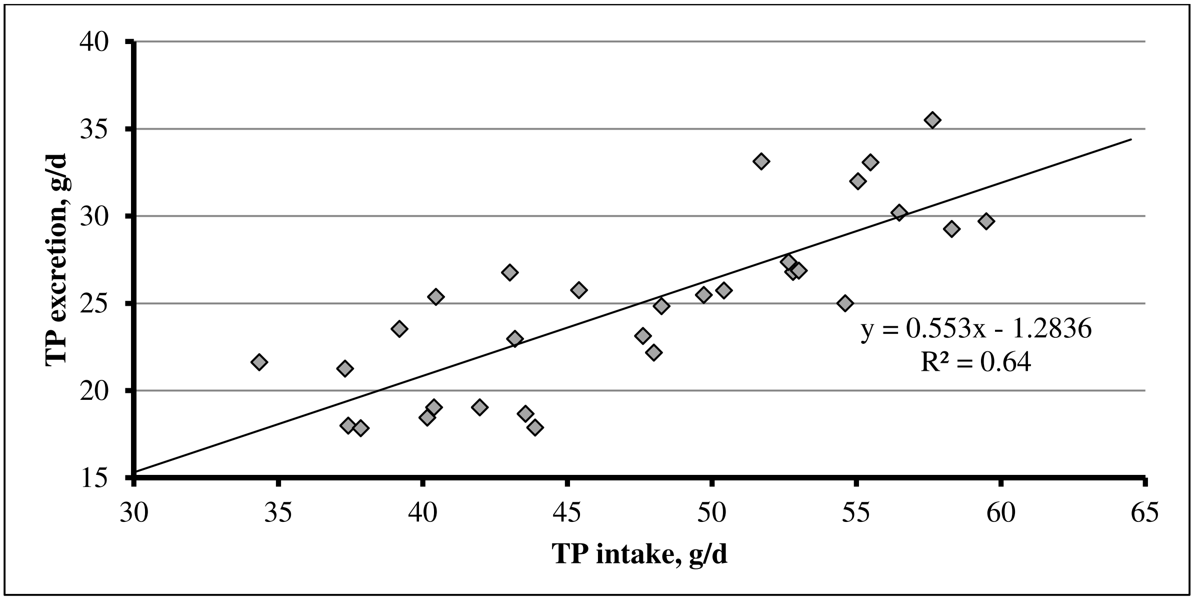
Phosphorus excretion

The feeding studies indicated that as greater amounts of phosphorus were fed, greater amounts of phosphorus were excreted via the feces. This relationship held true regardless of the source of supplemental phosphorus (mineral vs corn gluten). Additionally, as greater amounts of P were fed and excreted, the fraction of inorganic P excreted in the feces also increased (figure below). This would suggest that as the amount of phosphorus supplemented exceeds cattle requirements, the amount of inorganic or water soluble P excreted also increases. The net result of feeding phosphorus above cattle nutrient needs is that a greater amount of phosphorus is excreted and a larger portion of the excreted phosphorus is in a form more vulnerable to runoff.

Phosphorus intake and excretion as influenced by amount of supplemental P



In the grazing experiment, stockpiled pastures were utilized and were very high in phosphorus content (.48%). The relationship between total phosphorus (TP) intake and excretion is displayed in the following figure. As with the feeding experiments, the addition of phosphorus was related to greater phosphorus excretion.

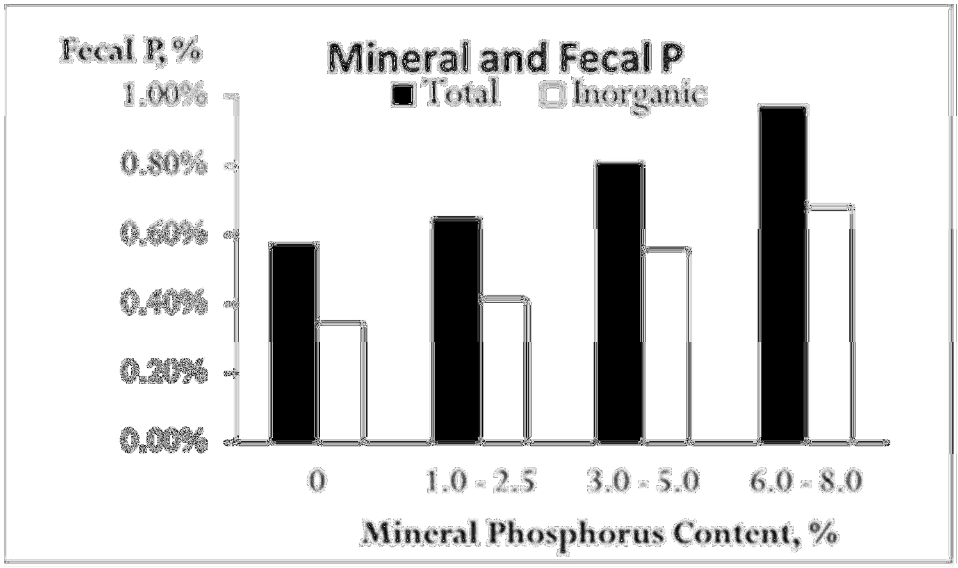


Steps to assess your herd's P status

A couple of basic questions need to be addressed to determine the phosphorus status of beef cattle and decide if and how much supplementation is warranted.

1) Soil samples and forage samples are the most logical place to start in getting a handle on your phosphorus status. Soil levels provide a foundation of the amount of phosphorus that is available for plant growth. Soil phosphorus content at the medium level (12-35 lbs. /ac) will not require additional phosphorus and should not limit forage phosphorus content. Be mindful that hay production will remove phosphorus and hay fields could need additional phosphorus to stay at the medium level.

2) Forage phosphorus levels are the best gauge in determining which level of phosphorus to include in a free-choice mineral. You will need a minimum of fresh forage and a hay sample to represent both grazed and stored forage. Lab results can be compared to the phosphorus requirements to determine if supplementation is needed. If you are feeding a supplement during the winter, the phosphorus content of the supplement needs to be considered in conjunction with the hay. The figure below displays the relationship between fecal phosphorus levels as compared to the phosphorus level in the free choice mineral in the on-farm sampling



In conclusion, P status of our waterways is affected by agricultural and non-agricultural activities in the watershed. Overfeeding phosphorus to beef cattle simply leads to greater fecal phosphorus excretion; much of which is in the higher risk, P_i form. Through a combination of monitoring forage phosphorus and selecting the correct mineral, fecal phosphorus excretion can be minimized at both an environmental and economic benefit.

Summer Stockpiling Fescue for Late-summer Pasture

Matt Booher, Crop and Soil Sciences Extension Agent, Augusta County
John Benner, Animal Sciences Extension Agent, Augusta County

Summer-stockpiling is a technique where producers defer grazing on a portion of pasture acres from spring-greenup through late-summer as a way to store forage in the field for emergency pasture and/or to assist in stockpiling fall growth of pasture for winter. Summer stockpiling may prove to be a low-input, cost-effective technique for Virginia producers to reduce winter feed costs and to better manage grazing on their farms.

The current procedure for summer stockpiling which is being evaluated here is as follows:

1. Defer grazing from a portion of pasture –around 25% of acres – using temporary electric fencing. Allow growth to accumulate from early-spring through about mid-August.

2. Strip-graze summer stockpile forage using temporary electric fencing, giving cattle access to about 3 days-worth of grazing per move.

3. Fertilize and fall stockpile previously-grazed (during spring and summer) pasture while strip grazing the summer stockpile.

While many managers currently make hay on a portion of pasture acres to capture excess spring growth, followed by summer grazing, very few practice summer stockpiling as described above. We are evaluating the summer stockpiling technique to determine forage quality, pasture toxicity, and grazable yield of the stockpile.

Past testing of whole plant stockpile (*entire plant-not accounting for animal selection*) has shown yields of 4,500-7,000 lbs. /acre, crude protein of 9-15%, and total digestible nutrients (energy) of 50-60%. Using this information, we would currently only recommend summer stockpiled forage for dry or pregnant cows. A large part of this project, however, will be to gather more precise nutritional data; we will use steers fitted with esophageal fistulas to sample and test only the plant parts selected by the animal. Testing will include nutritional measures as well as alkaloid levels to measure toxicity of the stockpile (as a result of tall fescue in the pasture). With more accurate nutritional data, we will be able to recommend a supplementation program to allow the grazing of lactating cows or growing animals on summer stockpiled pasture – or we may find that forage quality alone is sufficient. We will also record the grazing days provided by the summer stockpile system.

Managing Tall Fescue with Alternative Legumes

*Drs. Ben Tracy and John Fike. Department of Crop and Soil Environmental Sciences,
Virginia Tech. Contact email: bftracy@vt.edu*

Tall fescue is the most important perennial, cool-season forage grass in the southeast US. Although stress tolerant, most tall fescue plants are infected with an endophyte fungus that produces toxins that negatively affect livestock, often producing a malady termed fescue toxicosis. Revenue lost to the livestock industry due to fescue toxicosis is estimated at over $600 million per year. Managing endophyte-infected tall fescue to minimize fescue toxicosis is difficult. Replacing tall fescue pasture is possible, but suitable alternative forages are limited and the process is expensive.

Recent evidence suggests that certain legumes may prove useful for mitigating fescue toxicosis. These legumes produce chemicals called condensed tannins that, when consumed by livestock, may help detoxify fescue toxins. Probably the most well adapted tannin containing legume in this region is sericea lespedeza (*Lespedeza cuneata*). Lespedeza and other tannin-containing legumes also benefit livestock health in other ways by preventing bloat and having de-worming medicinal effects. Environmentally, consumption of tannins by livestock also may reduce methane production in the rumen. Methane is an important greenhouse gas linked to global warming. Overall, we believe that incorporating tannin-containing legumes like lespedeza into forage-livestock systems offers potential to benefit animal health and possibly the environment. Lespedeza has not been well studied in grazing systems, however, and limited information is available about how to manage this legume in a sustainable way.

Here at SVAREC, we have initiated a study to evaluate incorporation of sericea lespedeza into tall fescue based grazing systems. The experiment will use twenty-four, one acre pastures and have six treatments with four replications. Pasture treatments include: 1) Toxic tall fescue alone, 2) Non-toxic tall fescue alone, 3) Toxic tall fescue planted with alfalfa, 4)Non-toxic tall fescue planted with alfalfa, 5)Toxic tall fescue toxic planted with sericea, and 6)Non-toxic tall fescue planted with sericea. Starting in spring 2016, two beef steers will be assigned to each pasture. Animal performance and other pasture variables will be evaluted. We also plan to evaluate lespedeza performance at three cooperating farms near SVAREC.

Fescue Genetics - Is the Solution in Selection?

Dr. Brian Campbell, DSM Nutritional Products and Dr. Chris Teutsch,
Virginia Tech Southern Piedmont Agricultural Research & Extension Center

Tall Fescue Toxicosis is a serious issue that still impacts beef producers across the state of Virginia and much of the South Eastern United States. This syndrome is caused by cattle ingesting plants infected by an endophytic fungus (Neotyphodium Cenophealium). This fungus produces an ergot alkaloid (Ergovaline) which causes a range of maladies including reduced weight gain, dry matter intake, and reproductive rates while increasing internal body temperature, heat stress, and respiration rate. To complicate matters more the syndrome also causes animals to retain their winter hair coats into the summer months increasing the heat stress even more.

There have been many attempts to find cure for tall fescue toxicosis but at this point in time no silver bullet has been found. These have included adding binders to minerals, removing the endophyte from the plant, or adding seaweed to the feed. Unfortunately all of these either did not work or proved to have a major flaw in their efficacy. There have been two very promising treatments, the first is the drug domparidone. This acts on the pituitary gland and increases production of dopamine which alleviates tall fescue toxicosis. This drug is ideally used in horses, but due to cost and the frequency of treatment needed is not feasible for cattle. The other solution has been to replace the toxic endophyte with a novel endophyte which does not produce the toxins. This method works well, but the seed is expensive and the cost of reduced production during reestablishment is great so adoption of this forage has been slow. It should also be noted that with the novel endophyte there is no reduction in dry matter intake so stocking rate must be reduced by approximately 25% to prevent overgrazing and stand loss.

We know that we can change the plant to reduce the issues with tall fescue. The other option is to change the cattle and this is what we will be discussing today. It has long been known that different cattle respond differently to the toxins that they ingest. The first time this difference was noted in a scientific journal was in the early 40's by Cunningham in a paper titled "Tall Fescue Grass is Poison for Cattle". In this he noted that cattle within the same herd were greatly impacted with tails and hooves sloughing off or were not impacted at all. This observation along with others led to the belief that a genetic component to tall fescue toxicossis was there and some cattle would be resistant to the toxins while others suffered.

A research study was conducted at The University of Tennessee to try to identify a genetic marker for resistance to tall fescue toxicosis. Hair samples were taken from all cows in two herds, one a spring calving Angus herd and one a fall calving Angus herd. Production records from these two herds were compared for weight gain, weaning weight, birth weight and age at first calving. The records were then compared to the genetic profile of the cattle using a 50k SNP Chip. This device looks at the alleles of 50 thousand snps that are spread across the bovine genome. The individual genes were then analyzed to see if they had any impact on the production of the cattle. Twenty three single nucleotide polymorphisms were identified as possible markers. These SNPS were then examined further SNPS on two different genes proved to be worthwhile as genetic markers. One is located on the Dopamine D2 gene and the other is on XKR4.

Cattle which are resistant at these markers have been shown to have higher average daily gain, reduced body temperature and will calve earlier in their lifetime, which is an indicator of overall reproductive efficiency than their susceptible counter parts. With these advances dealing with tall fescue may soon be as simple as pulling a hair from an animal, running a test and determining if it stays in the herd or is culled.

This is not a true silver bullet as resistance to tall fescue toxicosis is not the same as not being impacted at all. While these animals are better able to handle the toxins it sill impacts them in some ways. Best management practices should still be used, a good mineral program, rotational grazing, hay testing and culling the cattle that do not perform well on your farm will all help your farm improve.

TAKE HOME MESSAGES

- Some cattle are resistant to tall fescue toxicosis
- Cattle which are raised on tall fescue toxicosis for generations are more likely to be resistant
- Pick your bulls and replacement heifers wisely
- Do Not Single Trait Select
- Unfortunately this test is not commercially available

Thanks for attending

and have a safe trip home

Next Field Day

Wednesday, August 2, 2017

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