Virginia Tech

Shenandoah Valley Agricultural Research and Extension Center

McCormick Farm

2020 Field Day Proceedings

August 5, 2020

VIRGINIA AGRICULTURAL EXPERIMENT STATION
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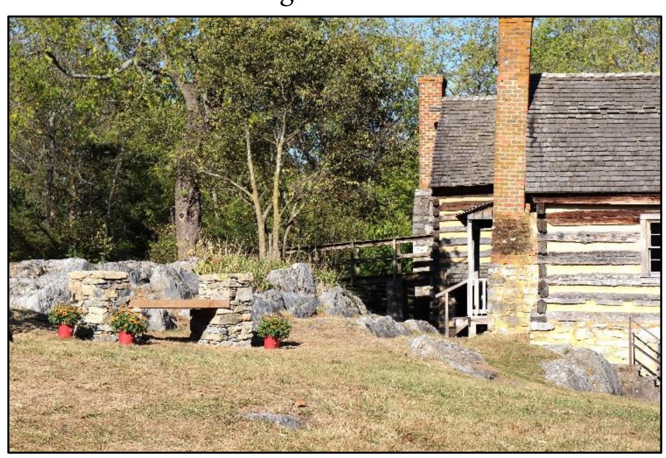
In Memory of David A. Fiske

David A. Fiske was the superintendent of the Virginia Tech Shenandoah Valley Agricultural Research and Extension Center (McCormick Farm) from 2000-2018. Under his leadership, the farm became a premier research and demonstration farm focused on beef cattle production systems, performance-tested rams, and forest management. David preserved and cared for the historic McCormick Farm, ensuring that the story of this farm would continue to be told for generations. David also served on a number of agricultural and first responder organizations, including the Virginia Forage and Grassland Council, the Raphine Volunteer Fire Company, and the Augusta County FFA/4-H Market Animal Show and Sale.

Through the generous support of members of the Virginia Forage and Grassland Council and others who appreciated David, a handcrafted stone bench honoring David Fiske has been completed. The memorial is located near the blacksmith shop at the McCormick Farm in Raphine, Virginia, and overlooks the pond and grounds of this historic site that David cared for so well. This bench blends in with the rocky outcroppings that surround it, just like David was a solid yet understated contributor to the Virginia forage industry for over two decades. David's favorite tree, a white oak, was planted next to the bench.



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Field Day Program

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ESTABLISHING AND PROTECTING TREES IN PASTURES

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Planting trees in pastures may seem counter-cultural to many forage-livestock producers, but it's receiving interest as a means to achieve several outcomes. In some cases, producers want to create a silvopasture, integrating tree production with forage-livestock systems for multiple products (e.g., tree crops and timber). In other cases, the objective may be singular, such as when trees (often just a few) are established to provide shade for livestock. Regardless of the end goal, trees can provide numerous benefits, including improvements to animal welfare and productivity, carbon sequestration, soil conservation, water quality, and wildlife habitat (Fike et al., 2016).

Removing animals from pastures until the trees are "big enough" to withstand potential damage from livestock may be an impediment for some producers. Livestock don't necessarily have to be removed from the pasture to create silvopastures. The silvopasture project at McCormick Farm (SVAREC) 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 silvopasture was developed by thinning (2014) an unmanaged timber stand full of invasive species (primarily bush honeysuckle (*Lonicera spp.*)). Ash (*Fraxinus spp*) made up 25% of the stand. Unfortunately, the emerald ash borer (*Agrilus planipennis*) arrived in the area by 2017 and wiped out all (100% mortality) of the ash in the stand. Removing the dead ash left the silvopasture with too few trees for combined timber, forage and livestock outputs.

Figure 1: Arbor Shield

To increase the number of trees to a preferred density, we planted 1-year-old seedlings using various protection methods. Protection approaches included: Arbor Shield tree guards (Figure 1), homemade tree cages (like a tomato cage) made from fixed-knot fence (Figure 2), conventional tree tubes, and no protection. The Arbor Shield product is assembled from three pieces and has barbs to deter livestock and large wildlife (such as deer) from accessing the trees. Homemade cages were constructed from 42" lengths of fixed-knot fencing and slightly larger than 12" in diameter. These and the Arbor Shield cages were secured with zip ties to three 5' rebar (1/2") stakes driven 1' into the ground. The tree tube was secured with a PVC tube rather than a rigid wooden stake with the thought that the tube and tree might better survive if secured with a "bend, don't break" approach.

Figure 2: Homemade tree cage

Each of the four protection treatments was tested on three replications of red oaks (*Quercus rubra*) and three replications of black locusts (*Robinia pseudoacacia*) within each of the site's four paddocks. The trees and treatments were established in the spring of 2018. Calves were rotationally stocked through these pastures throughout the summers. The trees and the treatments were assessed in the fall of 2018 and again in the summer of 2020. We checked each tree to see whether it was alive or dead (or couldn't be found, which incidentally was the case for many of the "do nothing" trees). We also evaluated the protection treatments for functionality or damage due to the cattle. Finally, we looked at each tree for browse damage from the livestock or wildlife (no ranking was made for trees that were dead or missing). These results are summarized in Table 1 and a breakdown of costs are in Table 2.

As logic would suggest and data support, "doing nothing", i.e., providing no protection, will not be a very successful way to establish a tree in a pasture. All of the black locusts and oaks without any protection were missing or dead. Perhaps also not surprising, the tree tubes were not an effective means of protecting trees, although we expect our PVC tubing was too short to adequately support the tree tubes. Only one of the black locust trees protected with a tube was alive, and this was the only black locust tree with a tube still intact. Only one third of the red oak trees in tree tubes were still alive, with only two of the red oak tree tubes still functional. Both the Arbor Shield and the "tomato cage" protected these young trees from livestock and withstood any trampling or rubbing by the cattle. However, some of these trees have not survived, possibly as a result of competition with grass, herbicide injury, or other stressors. In terms of browse, the black locusts were preferred, although whether by livestock or wildlife is unclear.

Table 1: Tree counts and evaluation of protection methods and browse damage after 2.5 growing seasons

Black locust	**Status**		**Protection**		**Browse damage**	
Treatment	*Alive*	*Missing/Dead*	*Functional*	*Damaged/missing*	*Evident*	*None*
No protection	0	12	.	.	.	.
Tree tube	1	11	1	11	0	1
Fixed-knot cage	9	3	12	0	9	0
Arbor Shield	11	1	12	0	10	1
Red oak	**Status**		**Protection**		**Browse damage**	
Treatment	*Alive*	*Missing/Dead*	*Functional*	*Damaged/missing*	*Evident*	*None*
No protection	0	12	.	.	.	.
Tree tube	4	8	2	10	1	3
Fixed-knot cage	7	5	12	0	3	4
Arbor Shield	11	1	12	0	2	9

Table 2: Costs for materials for one of each protection methods. Does not include time for assembly.

Item	Unit cost	Unit number	Total cost
Do nothing			*$0*
(Nothing required)	$0	0	$0
Tree tube			*$4.17*
Tube	$2.50	1	$2.50
Pipe (3/4” Sch 40)	$1.55	1	$1.55
Zip ties	$0.06	2	$0.12
Fixed-knot cage			*$8.30*
Fixed-knot fence	$0.68	4	$2.72
Rebar (0.5”)	$1.80	3	$5.40
Zip ties	$0.06	3	$0.18
Arbor Shield			*$24.68*
Tree protector	$19.10	1	$19.10
Rebar (0.5”)	$1.80	3	$5.40
Zip ties	$0.06	3	$0.18

It will be important to track trees in these protectors over time, especially as they begin to grow out of the top of the cages. We don’t expect browse damage on the scaffold branches of these trees to result in any long-term damage to their value or health, but damage to the stem leader may harm the long-term form or slow their upward growth. In discussion of long-term survival and tree vigor, two other factors should be considered: soil compaction and nutrient loading. Because trees are distributed across the paddock, these stressors are less likely. Where trees are few and far between in pastures they often exhibit stress linked to soil compaction and high nutrient concentrations as livestock routinely loaf in the shade. These should not be issues in a well-managed silvopasture where shade is evenly distributed across the pasture and livestock are rotated through the pastures for short durations and have plenty of forage (i.e., no bare ground which is more prone to compaction).

Other establishment options have been suggested since this work began. While we have not tested them, one commercial tree planter who establishes silvopastures indicates that something as simple as wrapping tree tubes with barbed wire can be effective at keeping animals from scratching on and knocking down tubes (Figure 3). As well, some producers have had success using polywire or flexnet fencing as temporary barriers for whole rows of trees (Figure 3).

Figure 3. Cattle stay off tubes wrapped with barbed wire (left photo, courtesy of Austin Unruh) and polywire or other temporary fence can keep cattle off rows of newly-panted trees (right photo, courtesy of Buck Holsinger).

As streams (and trees) are fenced off in riparian buffers, many producers find their livestock do not have sufficient shade – particularly when those animals primarily graze toxic fescue pastures. To address this issue, some producers have constructed or purchased expensive shade structures that will depreciate in value over time. For others, strategically planting trees might be the best and least cost long-term solution for heat stress abatement. In many cases, with a little extra effort, full-scale silvopastures could be established for a longer-term return on timber. Tree shade won't be available instantaneously, but our work to date suggests that with fairly simple inputs, pastures can be kept in production while the trees are being established.

References

Fike, J., A. Downing, and J. Munsell. 2016. Defining silvopastures: Integrating tree production with forage-livestock systems for economic, environmental, and aesthetic outcomes https://www.pubs.ext.vt.edu/CSES/CSES-146/CSES-146.html

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Department of Forestry: donated trees and planting expertise & labor
Conservation Services: donated tree tubes

BEE-FRIENDLY BEEF

Ben Tracy[1], Megan O'Rourke[1], Gabriel Pent[2], Shayan Ghajar[1], & Jennie Wagner[1]

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Introduction

Pasturelands provide valuable ecosystem services including: erosion protection, climate mitigation, food and products for human use, habitat for wildlife and pollinators and aesthetic value. The capacity of pastures to provide ecosystem services is limited by lack of plant biodiversity. This is especially true of many pastures in Virginia that are dominated by tall fescue (Festuca arundinacea) a non-native, cool-season grass that is typically toxic to cattle. We believe that land-sharing, where beef cattle and bees share land replete with native warm-season grasses and wildflowers, will help improve the output of ecosystem services by providing improved beef cattle production in summer and generating valuable pollination resources compared with tall fescue-dominated grassland. We recently completed preliminary studies at the Virginia Tech Shenandoah Valley AREC funded from a NRCS- Conservation Innovation Grant. This work evaluated ways to establish native warm-season grass and wildflower pastures whether more biodiverse pastures might benefit pollinators – especially bees.

Summary of Methods

In 2016/17, we renovated pastures at the Virginia Tech Shenandoah Valley AREC (SVAREC) with native warm-season grasses (e.g., switchgrass, big bluestem (NWSGs) mixed with diverse wildflowers (WF). Six, 2-acre paddocks were used for the study with 3 pastures planted to a NWSG mix and the remaining to a NWSG + wildflower mix (Table 1). Previous soil tests revealed that no fertilizer or lime was needed at the start of this study.

Site Prep and Planting: Sites were sprayed with Roundup and 2,4 D herbicide mix in mid-

September 2016 to kill existing vegetation. A barley winter cover crop (variety Nomini) was planted between Sept. 29th and Oct 5th 2016 using a no-till seed drill and a planting rate of 90lbs/ac. Grazing on the barley cover crop was first initiated in the last week of April 2017. Eight cows grazed each pasture for 3 weeks until forage became limiting. At this time, much of the forage had been trampled and the cows refused to eat plants that had gone to seed. During the first week of

June 2017 the six pastures were sprayed with Roundup and planted to either the NWSG or NWSG/wildflower mix.

Table 1. Composition of seed mixtures used in the study. The NWSG + Wildflower mix was planted only at the VT farm.

NWSG Mix	**Common Name**	**Family**	**Life Form**	**Bloom Timing**
Schizachyrium scoparium	little bluestem	Poaceae	P	n/a
Andropogon gerardi	big bluestem	Poaceae	P	n/a
Sorghastrum nutans	indiangrass	Poaceae	P	n/a
NWSG + Wildflower Mix				
Andropogon gerardi	Big bluestem	Poaceae	P	n/a
Schizachyrium scoparium	Little bluestem	Poaceae	P	n/a
Sorghastrum nutans	Indiangrass	Poaceae	P	n/a
Chamaecrista fasciculata	Partridge pea	Fabaceae	A	Mid summer
Baptisia australis	Blue False Indigo	Fabaceae	P	Early summer
Desmanthus illinoensis	Illinois bundleflower	Fabaceae	P	Late summer
Rudbeckia hirta	Black-eyed susan	Asteraceae	B	Early summer
Chrysanthemum leucanthemum	Oxeye Daisy	Asteraceae	P	Late summer
Chrysanthemum maximum	Shasta Daisy	Asteraceae	P	Late summer
Coreopsis lanceolata	Lanceleaf coreopsis	Asteraceae	P	Late summer
Echinacea purpurea	Purple coneflower	Asteraceae	P	Early summer
Ratibida pinnata	Grey-headed coneflower	Asteraceae	P	Early summer
Gaillardia pulchella	Indian blanket	Asteraceae	A	Indeterminate
Gaillardia aristata	Blanketflower	Asteraceae	P	Mid-summer
Linum perenne	Perennial Blueflax	Linaceae	P	May-June
Liatris spicata	Anise Hyssop	Lamiaceae	P	July, Aug
Agastache foeniculum	Marsh Blazing Star	Asteraceae	P	Jul-Sept
Helianthus maximiliani	Maximillion sunflower	Asteraceae	P	Late summer

Starting in 2018, each of the three NWSG pastures were grazed by 8 beef cows in a rotational stocking system. NWSG pastures were grazed on a 32-d rotation beginning in late May. Pastures were grazed for 3-4 days for each residence period depending on forage availability. The last grazing occurred in September. The NWSG + wildflower pastures were grazed in the same rotation sequence. As for measurements, plant-related variables (percent cover, species composition and yield) were taken within 1 x 2 ft quadrats at peak biomass. Pollinators (bees primarily) were assessed monthly during the growing season in 2018 and 2019. Methods included observing bees on blooms and trapping.

<u>Herbicide Trials</u>

We conducted several herbicide trials to evaluate the effectiveness of a pre/post emergent herbicide (Imazapic/Plateau) to aid in establishment of NWSG and wildflowers stands. Imazapic is often recommended for NWSG plantings as several common species are resistant to this herbicide. In the first trial, we applied Imazapic herbicide around the perimeter of each plot established at SVAREC. Herbicide was applied with a boom sprayer in a 10ft band using a rate of 2 oz/ac. Herbicide was sprayed 1 week after each plot was planted. To complement the large field plot trial, we also conducted two small plot herbicide trials using multiple rates of imazapic. In 2018, we established a trial by planting $10ft^2$ plots to either the NWSG mix or the NWSG + wildflower mix described above. After planting, each plot was assigned an imazapic application of 2, 4, 6, or 10 oz /acre. Each treatment was replicated 3x and also included a no herbicide control. Imazapic was applied 1 week after planting as in the large-scale trial. This experiment was repeated in 2019 but did not establish well so the data will not be reported.

Summary of Findings

- Grazing could not keep up with growth of barley cover crop in early spring and resulted in residual forage that was not well utilized by cattle (Figure 1).

Figure 1. Cows at SVAREC grazing fall barley cover crop in spring 2017. Note the trampled and ungrazed forage.

- Establishment of NWSG/WF stands was largely successful but variable across the six pastures in part because of weed pressure and barley residues that interfered with NWSG planting. (Figure 2)

Figure 2. Emerged NWSG seedlings approximately 6 weeks after planting in area treated with imazapic. At this time rows should be visible if seed was planted with a drill.

- NWSG/WF pastures were heavily dominated by wildflowers at the expense of NWSGs. While WF were beneficial for pollinators, grass forage was minimal for beef cattle (brown bars in graph). (Figure 3, Image 1)

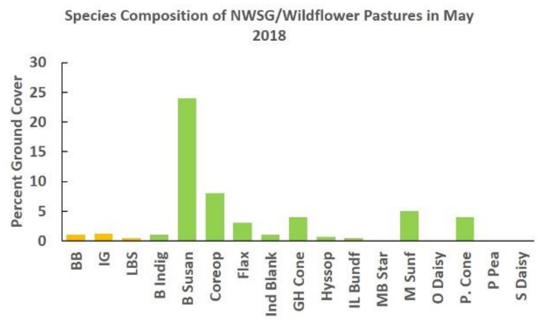

Figure 3. Percent ground cover of NWSG and wildflowers in year 2 at SVAREC.

- Application of imazapic herbicide reduced weed pressure in NWSG stands and helped to improve establishment. Imazapic suppressed wildflower establishment, however. (Figure 4).

Image 1. Native prairie grass-wildflower pasture at SVAREC research farm in 2017.

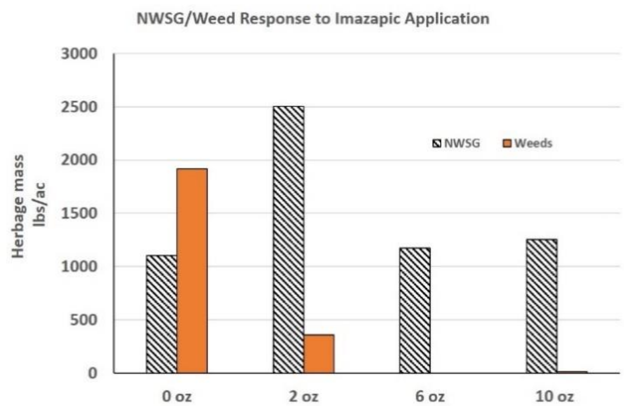

Figure 4. NWSG and weed response to four application rates of imazapic herbicide

- NWSG/WF pastures attracted more bees than nearby tall fescue pastures especially in mid-summer. Although WF species we planted attracted bees, we found than many common weeds were also attractive to bees (Figure 5)

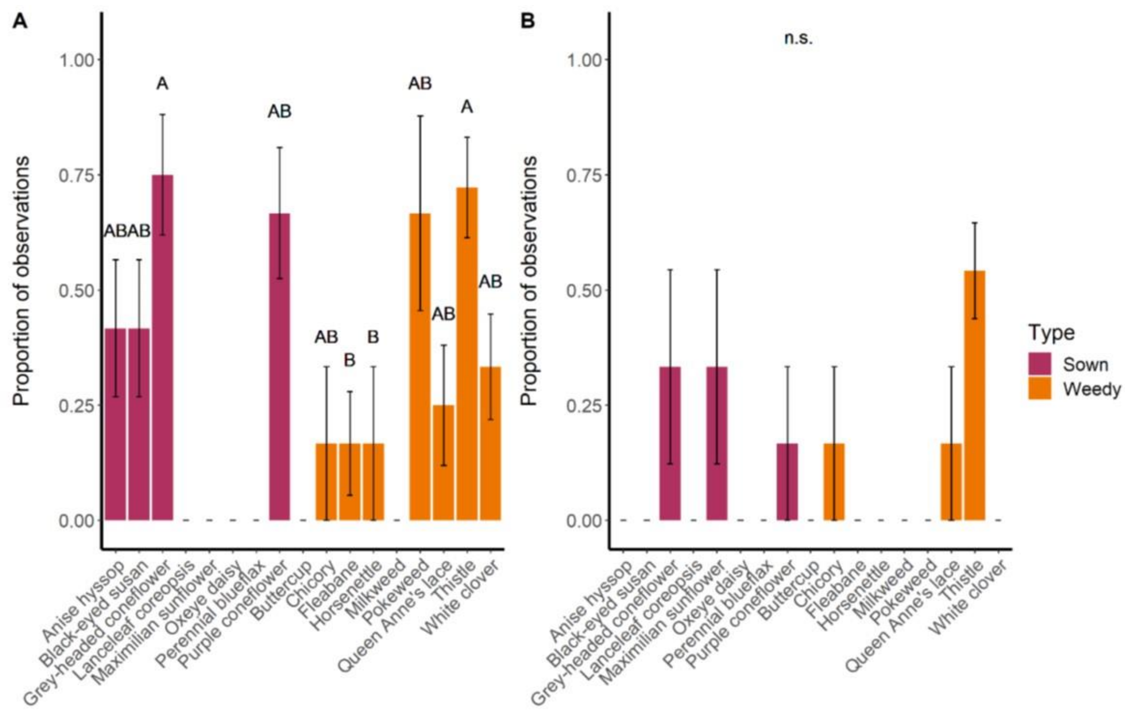

Figure 5. Proportion of observations where a bee was recorded on all blooming flower species in July (A) and August (B) 2019. Sown wildflower species are represented by maroon bars and weedy species are represented by orange bars. Letters indicate statistical differences.

Conclusions

Overall, we learned that successful NWSG pasture establishment requires both aggressive weed management and use of consistently shallow planting depths (less than 1/4 inch). At least two pre-plant herbicide applications and one post-emergence application is recommended. Imazapic herbicide is also recommended if establishing NWSG mixtures with big bluestem, Indian grass and little bluestem especially when planting into former pastureland as these situations produce the worst weed pressure. Imazapic is not recommended for wildflower establishment even though some species have apparent resistance to this herbicide. Although a fall cover crop like barley can provide supplemental grazing during NWSG conversion, producers need to prepare for rapid forage growth in spring to most efficiently use this resource. In addition to forage wastage, unused cover crop residue at planting may contribute to uneven planting depths and variable NWSG emergence. Care also needs to be taken with sowing NWSG + wildflower mixes as wildflowers can be aggressively competitive. Mixtures should be sown with a minimum 4:1 ratio of NWSG seed to WF seed to reduce WF competitiveness. Another option is to establish NWSG first in summer and overseed WF in late fall. Lastly, we found that NWSG/WF pastures attracted more bees in summer than common tall fescue pastures. Although the native wildflowers we planted attracted many bees, common weeds (e.g., thistles) were also very attractive to bees. This finding raises the question whether some weedy species should be protected in pastures to encourage bee visitation if that is a management goal. Several new studies at SVAREC will continue to explore questions about the feasibility of using biodiverse pastures to improve beef cattle production and improve pollinator habitat in Virginia.

USING SOLAR POWER TO PROVIDE WATER TO COWS

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Solar-Powered Watering Systems for Livestock for Seasonal Use on Rented Ground

According to NASS and VDACS data, beef cattle represent Virginia's second largest agricultural commodity generating approximately $413M in annual cash receipts, and approximately one-third of Virginia farmland is rented and is pasture. As a means to meet the goals of the Chesapeake Bay TMDL, Virginia's Watershed Implementation Plan II set forth a series of sector-specific best management practices (BMPs) related to improving water quality. The suite of BMP targets for the agricultural sector, included approximately 102M linear feet of additional pasture fencing proposed to be implemented by the year 2025. For some of these pastures, additional fencing may require alternative livestock watering systems. For some locations, access to grid-tied electrical power may present itself as a cost-effective option. However, for other locations the cost to extend the electrical grid to power a small water pump may prove to be prohibitively expensive. Additionally, some cost-share programs are over subscribed, require onerous provisions, or are otherwise not of interest to potentially eligible participants due to their religious or personal objections toward government funded programs. Furthermore, the installation of capital intensive and/or cost-shared livestock watering improvements can be problematic on rented acreage with annually renewable leases. Non-permanent solar photovoltaic-powered pumping systems may prove a viable option for certain applications during freeze-free months to help increase options for farmers to improve pasture management opportunities and provide off-stream water to cattle on rented ground. This project seeks to demonstrate a variety of solar-powered pumping systems and assess their performance and end-user experiences.

Demonstration System at the Shenandoah Valley Agricultural Research and Extension Center

In Spring 2020 project work focused on installation of a small solar-powered pumping demonstration system at the Shenandoah Valley Agricultural Research & Extension Center (SVAREC) in Raphine, VA. System components included a 600W solar photovoltaic system, mounting array, positive displacement submersible DC water pump, 220 Ah deep-cycle VLRA battery bank, system controller, sensor wire, above ground poly pipe, collapsible water storage reservoir, among other components. The demonstration site was strategically selected for its use in ongoing outreach events held at the center with regional agricultural producers and service providers. Center superintendent, Dr. Gabe Pent, describes initial use of the system during the first grazing rotation of approximately 60 cow-calf pairs as "*...So far everything looks good...cows seem much better distributed than I've ever seen in this pasture before...*". While the initial performance at this site is promising, more work is planned to document longer-term system performance and in particular the implications from the integration of batteries (versus increased storage) for overall system costs and operation, among other system variations. System pictures included below.

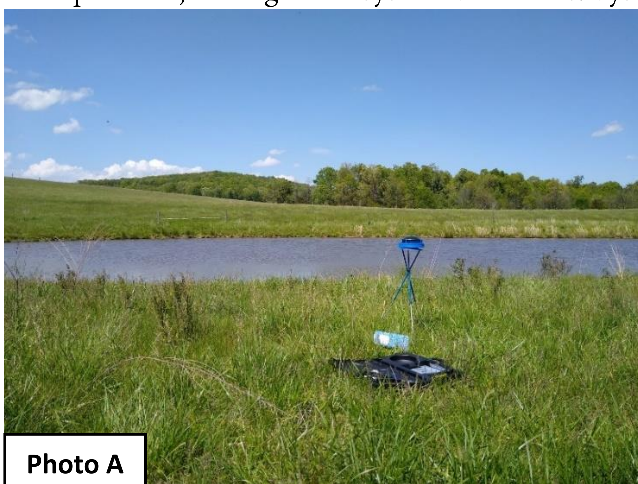
Photo A


Photo B


Photo C


Photo D

Photo A: Shading analysis as critical step in initial site assessment; **Photo B:** Pole-mounted 600W solar array and system controller; **Photo C:** Cattle approaching watering trough during first rotation June 2020; **Photo D:** System layout view from submersible pump in fenced-out farm pond, to solar PV array, to water reservoir toward top of hill (gravity flow to trough)

Summary

In 2019 demonstration system performance assessment work continued. From March 27th through December 20th, one 380W system delivered 72K gallons against approximately 120 feet of head to help meet the daily water requirements for the cattle herd, while excluding cattle from the stream and enabling the farmer to preserve options and mobility on the annually renewed lease. Remote system monitoring via SIM-enabled field cameras, helped to save farmer trips when all was well or to prompt trips when the system needed more immediate attention.

Project work will continue with performance monitoring, installation of additional demonstration sites, development of additional extension materials, a VCE Annual Conference training session, and a 2-day training session to be held in conjunction with Solar Energy International, though aspects of outreach are being adapted due to COVID-19.

Project Collaborators

- Alston Horn, Chesapeake Bay Foundation
- Matt Kowalski, Chesapeake Bay Foundation
- Matt Booher, Virginia Cooperative Extension
- Dr. Gabe Pent, Superintendent, Shenandoah Valley Agricultural Research and Extension Center
- John Ignosh, Biological System Engineering, Virginia Tech & Virginia Cooperative Extension

Project Sponsors

- Virginia Department of Mines, Minerals and Energy (2019-2020)
- National Fish and Wildlife Foundation *"Mountains to Bay"* Project (prime: Chesapeake Bay Foundation) (2019-2021)
- Virginia Agricultural Council (2018-2019)

HERBICIDES FOR GROWTH SUPPRESSION ALONG A TEMPORARY FENCE LINE

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Background

We have been looking at herbicides for tall fescue seed head suppression for four years. The investigations were initiated to screen available herbicide options to use under permanent high tensile fence lines to reduce the impact of tall fescue seed heads grounding out electric fences in June. Several products were identified which effectively reduced the number of tall fescue seed heads.

This year the concept was expanded to evaluate seed head suppression for temporary fence lines in intensively managed grazing systems. Strip grazing summer stockpiled fields allows maximum utilization of the forage. Temporary fencing must be installed through taller residue, much of which is tall fescue seed heads. Preplanning temporary fence placement would allow for suppression of the seed heads with an April herbicide application.

Methods

Three herbicides noted for seed head suppression (Table 1) were applied in a 3 foot band across a field targeted for summer stockpiling at the McCormick Farm. The herbicides were applied April 7th with a backpack sprayer to deliver 35 gallons/acre. The labels state that the products should be applied after 6 inches of new grass growth in the spring and before seed head jointing. The mild March appeared to stimulate an earlier seed head initiation so the treatments were made 1-2 weeks earlier than past years. Each treatment was replicated three times. The field was observed for initial herbicide injury and seed head suppression. Fresh weights and seed head counts were also collected for each plot.

Table 1. Treatments Used at McCormick Farm

Product	**Active Ingredients**	**Rate**
Plateau	Imazapic	2.0 oz/ac
Metsulfuron*	Metsulfuron	0.5 oz/ac
Chaparral	Aminopyralid + metsulfuron	2 oz/ac
Check	No herbicide	

*numerous generic products containing metsulfuron are available. They are formulated as 60 DF products. Some product names include: Rometsol, Plotter, MSM, Accurate and Purestand.

Results

A cold spell occurred soon after the treatments were made. Frost injury was noted on most grasses even in the untreated check plots. All three herbicides displayed a bronzing leaf injury effect on the cool season grasses which was more pronounced on the tall fescue. The initial injury from Plateau and metsulfuron was similar while the injury from Chaparral was less (Table 2). At eight weeks after application Plateau displayed the most residual injury followed by metsulfuron then Chaparral.

Table 2. Grass Injury and Suppression

Treatment	3 week injury	8 week injury	3 week growth suppression	8 week growth suppression
Plateau	3	3	2	4
Metsulfuron	3.3	2	2.3	2.3
Chaparral	2	1	1	1
Check	1	0	0	0

Injury rating: 0 = no injury 5 = severe injury

Growth suppression rating: 0 = no growth suppression 5 = severe growth suppression

Fresh clipping weights were collected 8 weeks after treatment from a 4.356 square foot area within each plot (Table 3). The clippings were dried then the seed heads were separated by species. The Plateau treatment provided a 77 percent reduction in the amount of clippings relative to the control. Metsulfuron displayed slightly less growth reduction than Plateau followed by Chaparral.

Table 3. Fresh Weight and Grass Growth Reduction From Seed Head Suppression Herbicides

Treatment	Fresh weight (tons/ac)	Growth reduction (percent)
Plateau	2.2	77
Metsulfuron	2.7	71
Chaparral	6.2	33
Check	9.3	0

Growth reduction expressed as percent less than the control

All of the herbicides decreased the number of tall fescue seed heads (Table 4). Plateau resulted in a 100% reduction in the number of tall fescue seed heads followed by an 88% reduction for metsulfuron and a 67% reduction for Chaparral. Plateau greatly reduced the number of orchardgrass seed heads in 2 replications but the third replication was the same as the check. More bluegrass seed heads were present in the Plateau plots due to reduced competition from the other species which were suppressed more.

Table 4. Number of Seed Heads By Grass Species (4.356 square feet)

Description	Tall Fescue	Orchardgrass	Bluegrass	Other	Total Seed Heads
Plateau	0	11	105	4	120
Metsulfuron	22	17	68	5	111
Chaparral	62	28	23	7	119
Check	185	34	94	5	318

The herbicide costs are compared in Table 5. The herbicide expense is reasonably cheap on an area treated basis. The costs used in the table were obtained from internet suppliers in June 2020. The smallest available packaging units were used for the comparison. The assumption was made that the herbicide products would only be purchased for fence line growth suppression and the small packaging would still allow for multiple years of treatment on most farms. The area treated per package ranged from 11 to 44 miles of fence line. A three foot width of application was assumed for growth suppression under temporary fences. Greater application widths would increase the cost proportionately.

Table 5. Product Price Comparison

Product	**Rate (oz/ac)**	**Cost**	**unit**	**$/acre**	**acre/unit**	**mile/unit**	**$/mile**
Plateau	2	$ 73	1 quart	$ 4.56	16	44	$ 1.66
Cimarron Plus	0.5	$ 35	2 ounce	$ 8.75	4	11	$ 3.18
Rometsol	0.5	$ 15	2 ounce	$ 3.75	4	11	$ 1.36
Chaparral	2	$ 128	1.25 pound	$ 12.80	10	27.5	$ 4.65

Length covered based on using a 3 foot spray width

Product pricing obtained from the internet

Rometsol is a 60 DF metsulfuron product

Summary

- The herbicide labels recommend treatment after at least 6 inches of new growth in the spring but before jointing to achieve seed head suppression.
- The mild March followed by the cool April and May resulted in more grass injury from the herbicides than observed in the past. The herbicide treatments were applied earlier in 2020 than past studies.
- All of the herbicides reduced the number of tall fescue seed heads. Plateau was the most effective in reducing tall fescue seed heads followed by metsulfuron then Chaparral.
- Plateau appeared to provide some reduction of orchardgrass seed heads.
- The pasture used for the study had good populations of orchardgrass and bluegrass. Even though the tall fescue seed heads were suppressed, numerous seed heads of other species were still present.
- Plateau caused the greatest reduction in growth and seed head numbers; however, the treatment may be too injurious for use in an open pasture. Another study initiated in April 2020 showed good seed head suppression from Plateau at 1 ounce/acre.
- Metsulfuron products may be the best compromise between seed head reduction and maintenance of desirable grasses. Metsulfuron also provides additional broadleaf weed control.
- Chaparral caused the least grass injury but was also less effective at reducing the number of tall fescue seed heads. Broadleaf weed control was also observed with Chaparral.
- All of these herbicides will injure or kill clovers.
- Cimarron Plus was not included in this study. Previous studies indicate that Cimarron Plus performs essentially the same as metsulfuron.

Notice: Because pesticide labels can change rapidly, you should read the label directions carefully before buying and using any pesticides. Regardless of the information provided here, you should always follow the latest product label when using any pesticide. If you have any doubt, please contact your local Extension Agent, VDACS regulatory inspector, or pesticide dealer for the latest information on pesticide label changes.

Virginia Cooperative Extension does not endorse these products and does not intend discrimination against other products which also may be suitable.

NEW DEVELOPMENTS IN PASTURE HERBICIDE OPTIONS

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Background: DuraCor is a new herbicide currently registered for use in pastures and hayfields.

DuraCor contains aminopyralid and florpyrauxifen-benzyl and is most similar to GrazonNext HL (aminopyralid + 2,4-D), which many are familiar with. ProClova is a new herbicide expected to be registered for use in January 2021. ProClova is a combination of florpyrauxifen-benzyl and 2,4-D. Both DuraCor and ProClova are used to control broadleaf weeds, however, a major benefit ProClova (but *not* DuraCor) is the preservation of white clover. The objective of our research was to evaluate the efficacy ProClova on broadleaf weed species and safety on white clover. Both herbicides were also evaluated for their safety on newly established forages.

Table 1. Treatments for horsenettle and Canada thistle control and fall vs. spring buttercup control.

Product(s)	Rate / Acre
ProClova	1.5 pt
GrazonNext HL	2 pt
2,4-D + Dicamba	2 + 1 pt
2,4-D	2 pt
Crossbow	2 qt
Cimarron	0.1 oz
PastureGard	1.5 pt

Weed Control Spectrum Research

Treatments (Table 1) were applied in late April for Canada thistle and early July for horsenettle.

Results: ProClova resulted in 75% control of Canada thistle, 90 days after herbicide treatment. GrazonNext provided the best control of Canada thistle 90 days after treatment (89%). Horsenettle control was greatest with GrazonNext (93%), 2,4-D + dicamba (91%), Crossbow (90%), and PastureGard (89%). Mouseear chickweed control was greatest with GrazonNext (91%), 2,4-D + dicamba (83%), and Cimarron (77%). Broadleaf plantain control was greatest with ProClova (98%), GrazonNext (93%), and 2,4-D + dicamba (90%).

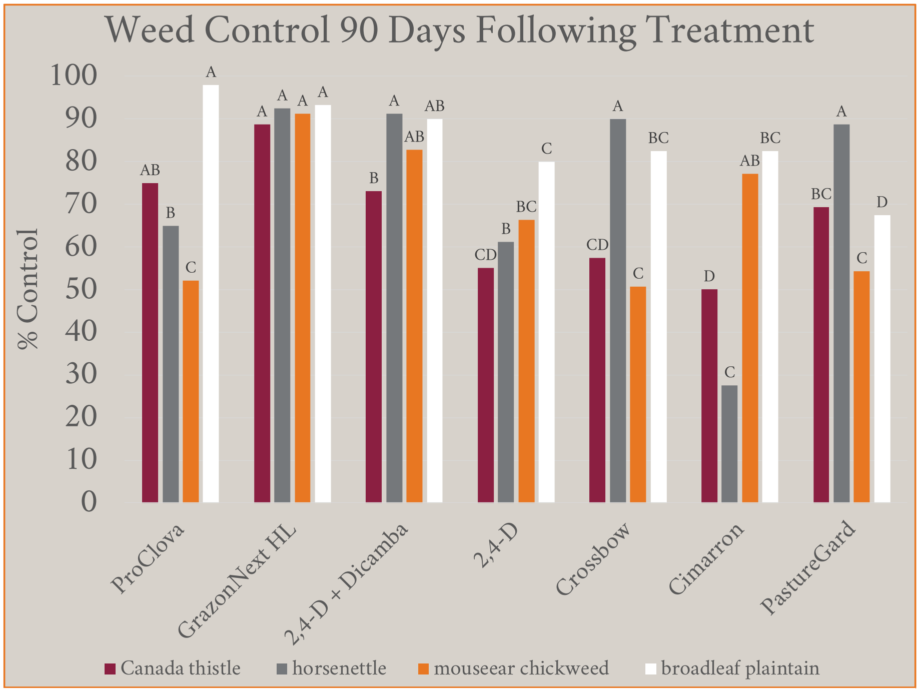

Figure 1. Weed control from treatments in Table 1 90 days after application.

Fall vs Spring Applications for Buttercup Control and White Clover Safety. All treatments (Table 1) were applied in mid-November and again to separate plots in mid-April.

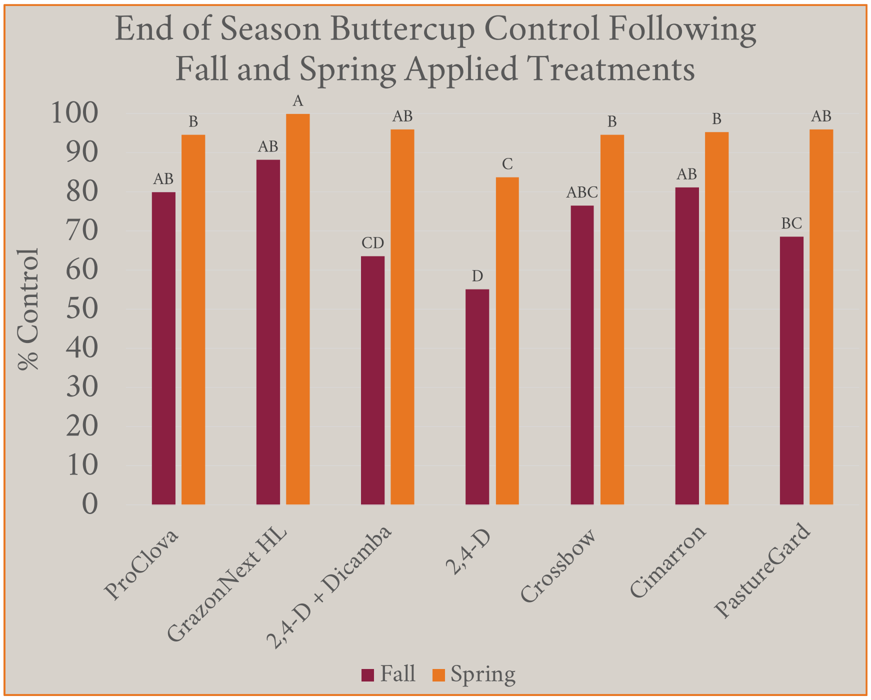

Figure 2. Buttercup control in May from various herbicides. See Table 1 for rates.

Results: In general, spring-applications provided greater buttercup control than fall (Figure 2). Of the fall-applied treatments, GrazonNext (88%), ProClova (80%), Crossbow (77%), and Cimarron (81%) provided the greatest levels of buttercup control at the end of the season (May). All of the spring-applied treatments resulted in greater than 80% buttercup control at the end of the season, with ProClova resulting in 96% control.

Following fall applications (mid-November), ProClova resulted in the lowest levels of white clover injury and GrazonNext resulted in the most injury (Figure 3). By the end of the season (May), white clover treated with ProClova in the fall had fully recovered and nearly recovered (10% injury) from 2,4-D.

ProClova applied in the spring also resulted in the least white clover injury, fully recovering by the end of the season (May). GrazonNext (96%) also resulting in the greatest levels of injury when applied in the spring (data not shown).

Tall fescue and Orchardgrass tolerance to DuraCor and ProClova During Establishment.

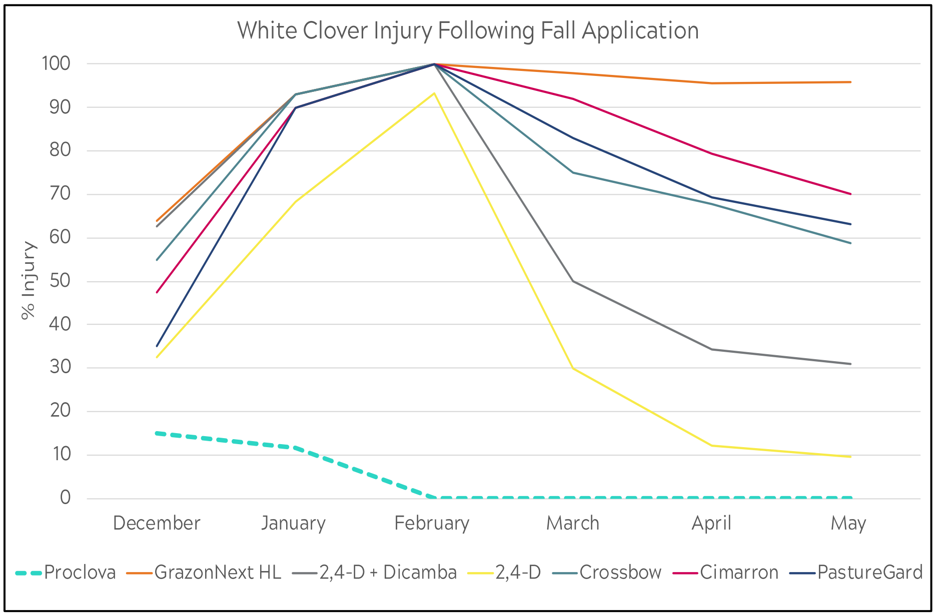

Figure 3. White clover injury from fall applications. Treatments and rates are listed in Table 1.

Seedling and establishing grasses can be sensitive to herbicides, despite the same herbicide being extremely safe to mature stands. To evaluate the safety of these herbicides during establishment, treatments in Table 2 were applied 2 weeks prior to drill seeding, at seeding, and at the 3-leaf growth stage, to separate plots at each application timing.

Results. With the exception of metsulfuron, none of the herbicides caused significant injury to tall fescue or orchardgrass, regardless of application timing. There were no differences in orchardgrass biomass between any herbicide treatment. The only herbicide application resulted in a decrease in tall fescue biomass was metsulfuron applied postemergence which caused a 23% reduction in biomass. Despite these results, we do not recommend application at seeding. Herbicide labels may have further restrictions.

Table 2. Treatments for forage grass establishment safety.

Product	Rate / Acre
ProClova	1.5 pt
GrazonNext HL	2 pt
DuraCor	12 fl oz
DuraCor	16 fl oz
Cimarron	0.1 oz
PastureGard HL	1.5pt

Ongoing research indicates that ProClova is safe to establishing white clover, but further research is needed.

Additional Resources:

Pest Management Guide: Field Crops: https://www.pubs.ext.vt.edu/456/456-016/456-016.html

Always read, understand, and follow label directions.

INCORPORATING SUMMER STOCKPILING INTO A FESCUE GRAZING SYSTEM: EFFECTS ON FORAGE QUALITY AND COW/CALF PERFORMANCE

Taylor Langford [1], Kerri Hardin[1], Adam Murray[1], Chuck Zumbaugh[1], Olivia Claire[1], David Fiske[2], Gabriel Pent[2], & Bain Wilson[1]

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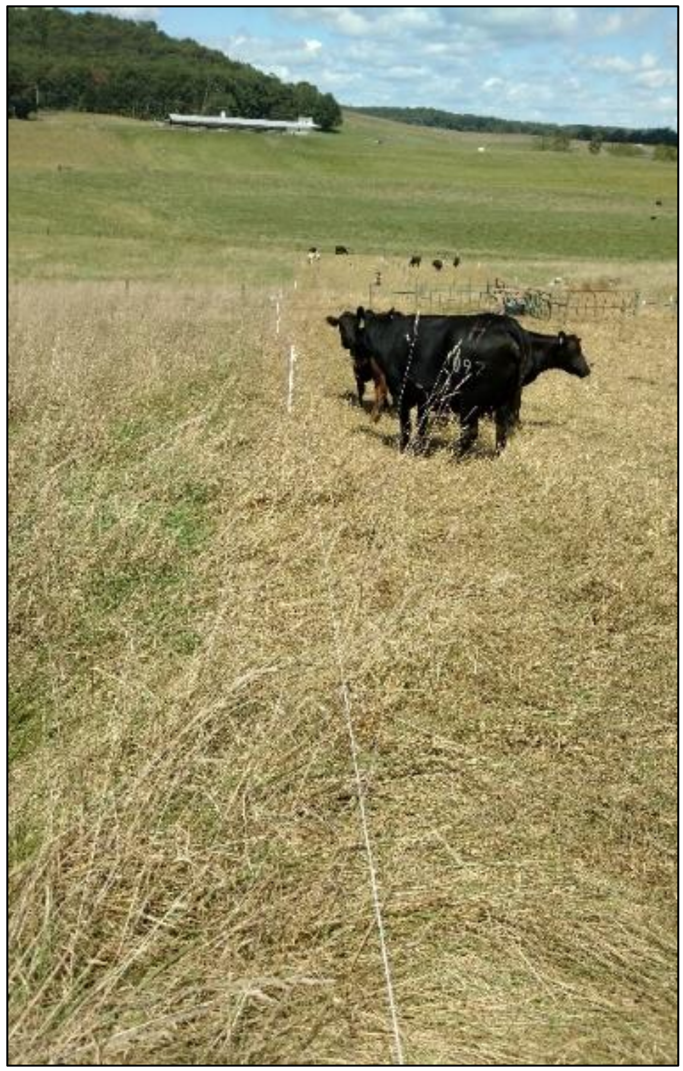

The objectives of this 2-year study were to evaluate the forage characteristics of wild-type endophyte-infected tall fescue (**KY-31**) and novel endophyte-infected tall fescue (**MaxQ**) summer stockpiled pastures and to measure the performance of fall-calving beef cow/calf pairs grazed on these pastures. Pregnant Simmental x Angus cows (128 total; 64 per year) were stratified by initial body weight, BCS, and expected calving date and allotted to 1 of 10 pasture groups. Groups were assigned to either KY-31 or MaxQ summer stockpiled pastures that were grazed at a stocking rate of 0.49 acres/cow. Forage growth accumulated from April to initiation of strip-grazing on August 31 of 2017 and 2018. During the 52 day grazing period, cows were grazed on treatment pastures from 23 ± 14 days prepartum to 29 ± 14 days postpartum and calved on treatment pastures. Forage availability was measured approximately every 7 days. Total ergot alkaloid concentrations were analyzed every 14 days for KY-31 pastures. Nutritive value (CP, TDN, ADF, NDF, Fat, and Ash) of both strains was analyzed 14 days. Cow body weight was recorded on 2 consecutive days and BCS determined at the start and end of the study. Calf body weight was recorded within 24 hours of birth and on 29 ± 14 days of age. Milk production was also estimated at 29 ± 14 days postpartum.

Table 1. Influence of fescue cultivar on forage availability and nutritive value.

	Treatment				
	KY-31			MaxQ	
Item	2017	2018		2017	2018
Forage Mass, lbs. DM/ac					
Ungrazed	6211	7032		6056	6633
Grazed	3742	4875		3670	4817
Total ergot alkaloids, ppb	1695	2819		112	632
CP, % DM	13.2	17.4		12.2	17.0
TDN, % DM	65.7	70.5		64.0	69.2
ADF, % DM	36.2	31.0		38.0	32.4
NDF, % DM	59.0	60.4		62.3	63.4
Ether Extract, % DM[1]	2.3	1.5		2.0	1.4
Ash, % DM[2]	7.0	8.0		6.3	7.8

[1] Ether extract = Crude fat concentration of plant

[2] Ash = Approximate mineral concentration of plant

After a 52 day treatment period, forage mass was similar for both fescue cultivars, with ADF, NDF, and TDN being greater in KY-31 tall fescue (Table 1.). It is hypothesized that MaxQ had greater fiber and less fat because MaxQ pastures were more recently established and had more encroachment from other forage species. Total ergot alkaloid concentrations of KY-31 pastures ranged from 1475 to 3202 ppm over time. Animal performance is shown in Table 2. Animal performance across both KY-31 and MaxQ pastures were similar, however increased milk production was observed for cows grazed on ky-31. Grazing either KY-31 or MaxQ summer stockpiled pastures had minimal effect on animal performance when cows were pre-exposed to toxic endophyte-infected tall fescue. These results indicate that pastures renovated with MaxQ can be utilized during other times of year when effects of fescue toxicosis are expected to be more severe.

More information about summer stockpiling fescue systems is available at in VCE factsheet CSES-201NP by Booher, Benner, Fiske (https://pubs.ext.vt.edu/CSES/CSES-201/CSES-201.html).

This research was funded by the Virginia Agricultural Council and the Virginia Agricultural Experiment Station.

Table 2. Influence of fescue cultivar on cow body weight, BCS, milk production, and calf body weight and ADG.			
	Treatment		
Item	KY-31	MaxQ	*P*-value
Cow body weight, lbs.			
Initial	1199	1199	0.81
End of grazing	1087	1116	0.80
Pre-breeding	1120	1118	0.83
Change initial to end of grazing	-112	-83	0.34
Change initial to pre-breeding	-79	-81	0.89
Cow BCS			
Initial	5.4	5.3	0.97
End of grazing	4.7	4.7	0.58
Pre-breeding	3.8	3.9	0.86
Change initial to end of grazing	-0.7	-0.6	0.53
Change initial to pre-breeding	-1.6	-1.4	0.62
Milk production, lbs./d	18.3	15.0	< 0.01
AI conception rate, %	66.3	57.9	0.62
Total pregnancy rate, %	88.5	94.5	0.13
Calf body weight, lbs.			
Birth	66	68	0.65
52 ± 12 d of age	124	121	0.86
Weaning	377	375	0.63
Calf ADG, lbs.			
52 ± 12 d of age	0.77	0.77	0.90
Weaning[1]	1.70	1.72	0.56

[1]Calves were weaned at 202 ± 14 d of age

IMPACTS OF SUPPLEMENTING YEAST-DERIVED PRODUCT TO FEEDLOT CATTLE CONSUMING MONENSIN

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[1]Department of Animal and Poultry Sciences, Virginia Tech

Introduction. Feed additives are included into beef cattle feedlot diets with the objective to improve cattle growth and feed efficiency, resulting in enhanced productivity and profitability in feedlot. Ionophores, and within these, monensin is the most common type of additive used in to improve rate of gain and feed efficiency by altering microbial ecology of the rumen. Other alternatives of feed additives are organic acids, enzymes and yeasts. Yeasts are natural feed additives and can be classified as probiotics (live yeast) or prebiotics (non-living yeast). Supplementing cattle with live yeast products, especially Saccharomyces cerevisiae, improves feed efficiency, feed digestibility, weight gain and immune system, due to a decrease of rumen pathogens prevalence. Non-living yeast cell wall or mannan oligosaccharides supplementation in cattle tends to improve animal performance, feed efficiency, ruminal pH, rumen function and animal health. Celmanax (Church & Dwight Co., Inc.; Princeton, NJ, USA) is a yeast (*Saccharomyces cerevisiae*) derived product composed by yeast fermented metabolites and enzymatically hydrolyzed yeast products containing non-living yeast cell walls and live yeast cells. Yeast-derived products and monensin have analogous and complementary benefits to rumen function and cattle production. Thus, the **objective** of this research was to evaluate the impacts of supplementing a yeast-derived product, Celmanax, during the finishing period on performance, physiological responses, and carcass quality of feedlot cattle.

Methods. The research was conducted in two periods, from November 2017 to April 2018, and from June to November 2018, at the Virginia Tech - Shenandoah Valley Agricultural Research and Extension Center, McCormick Farm, located in Raphine, VA. A total of 89 Angus steers (13 months of age) were classified by initial body weight (BW) and then assigned to one of two treatments: 1) a fattening diet containing 0.56 oz/steer daily (as-fed basis) of the yeast-derived product (**CEL**) or 2) a negative control without this feed additive (**CON**). Experimental period included 132.5 ± 1.2 days with *ad libitum* access to feed and water, until slaughter. Diet was a total mixed ration (TMR) composed by 22% corn silage, 70.2% ground corn, 5% soybean meal, 1.8% mineral and vitamin mix, 1% urea and monensin, included as 1.06 oz/ton of DM; with 13.9% of crude protein and 16.5% of fiber (neutral detergent fiber). The yeast-derived product was mixed with 3.5 oz of soybean meal and top-dressed daily into the TMR of CEL steers, whereas 3.5 oz of soybean meal was top-dressed daily into the TMR of CON cohorts. Animals were housed in 4 pens equipped with 12 Calan gates each, allowing to measure daily individual dry matter intake. Body weight (lb) was measured at the beginning, middle and at the end of the experimental period; blood samples were collected to measure plasma glucose, haptoglobin, insulin, leptin, and insulin-like growth factor (IGF)-I plasma concentration. Average daily gain (lb/day) and feed efficiency (oz BW gain/ lb TMR intake) was calculated for each steer. At the end of each experimental period, animals were transported to a slaughter facility and carcass characteristics and quality was determined.

Results. No treatment effects were detected for BW gain, dry matter intake, feed efficiency, and carcass quality traits (Table 1). No treatment effects were also detected for plasma concentrations of glucose, insulin, leptin, and IGF-I, whereas mean plasma haptoglobin concentrations tended to be greater in CEL steers (Table 2). Thus, no synergic effects to improve TMR intake, feed efficiency, carcass traits or overall performance was detected between monensin and Celmanax. Our results indicate that monensin could have negated the potential benefits of Celmanax. However, increased haptoglobin concentrations may be associated with heightened immune capacity in animals under stress conditions, and this yeast derived product could modulate other body functions besides the rumen such as the immune system.

Table 1. Performance parameters and carcass traits of feedlot cattle supplemented (CEL) or not (CON) with yeast derived product during the finishing period.

Item	**CON**	**CEL**	**SEM**	***P-value***
Body weight (BW) parameters				
Initial BW (lb)	978.2	983.9	15.1	0.75
Intermediate BW (lb)	1217.6	1222.9	11.8	0.82
Final BW (lb)	1388.5	1387.6	10.9	0.97
Average daily gain (initial to final, lb/day)	3.09	3.04	0.04	0.61
Dry matter intake (lb/ day)	23.35	22.86	0.13	0.25
Feed efficiency (oz/lb)	2.14	2.13	4	0.74
Carcass characteristics				
Hot carcass weight (lb)	825.2	831.4	7.7	0.64
Ribeye area (cm^2)	85.2	86.8	3.2	0.37
Marbling#	513	503	19	0.69
Yield grade	3.05	3.00	0.12	0.66
Choice + Premium carcasses (%)	88.6	82.2	5.3	0.39

Summary and Conclusion. Including Celmanax into finishing diets containing monensin did not result in additional benefits on cattle performance or carcass traits. More research is needed to test the effect of Celmanax supplementation in finishing feedlot diets on nutrient digestibility, ruminal degradability and ruminal fermentation parameters to elucidate the yeast derived product effect, as well as under heat stress conditions. Furthermore, Celmanax could be tested as a natural feed additive alternative to monensin with the objective to improve animal growth performance and health in a complete natural diet.

Table 2. Physiological responses of feedlot cattle supplemented (CEL) or not (CON) with yeast derived product during the finishing period.

Item	**CON**	**CEL**	**SEM**	***P* Value**
Plasma glucose (mg/dL)	83.1	82.7	4.8	0.87
Plasma haptoglobin (mg/mL)	0.238	0.337	0.040	0.09
Plasma IGF-I, (ng/mL)	241	234	9.0	0.39
Plasma insulin (µIU/mL)	43.0	45.4	2.6	0.51
Plasma leptin (ng/mL)	16.1	16.7	1.3	0.69

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- Church & Dwight Co., Inc.

Bibliography

Pancini, S., Cooke, R.F., Brandão, A.P., Dias, N.W., Timlin, C.L., Fontes, P.L.P., Sales, A.F.F., Wicks, J.C., Murray, A., Marques, R.S., Pohler, K.G., and Mercadante, V.R.G. 2020. Supplementing a yeast-derived product to feedlot cattle consuming monensin: Impacts on performance, physiological responses, and carcass characteristics. *Livestock Science*, *232*, p.103907.

ESTABLISHMENT OF SMARTFARM INNOVATION NETWORK NODES AT MIDDLEBURG AND SHENANDOAH VALLEY AGRICULTURAL RESEARCH AND EXTENSION CENTERS

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With the global population expected to reach 9.7 billion by 2050, our food production systems will need to exhibit remarkable improvements in productivity and resiliency to feed the human population. Feeding this growing population in a sustainable manner will require advances in productivity and efficiency of all agricultural systems. Precision animal agriculture are an array of promising technologies that leverage advances in engineering, computer science, analytics, and life sciences to address productivity and efficiency challenges incurred in the agriculture sector. Virginia Tech is well-positioned to advance the field of "smart" agriculture because of the internal strengths in engineering, computer science, and agriculture and life sciences; the technology and agricultural industry presence in the state; and the access to agricultural research and extension centers that can serve as testbed research and demonstration areas. To capitalize on this opportunity, the Virginia Tech College of Agriculture and Life Sciences has launched a SmartFarm Innovation Network. In addition, to advance the capacity development of the SmartFarm Innovation Network two testbed research and demonstration areas will be developed at the Middleburg and Shenandoah Valley Agricultural Research and Extension Centers.

These testbed research and demonstration areas will address several critical needs for the state, the university, the college, and the agricultural communities. At the state level, the governor has placed priority on promoting rural and economic development in VA. Creating these testbed research and demonstration areas will increase access to technology in rural areas and will help to: 1) increase current agriculture professionals' familiarity with available products that can help enhance livelihoods; and 2) increase youth interest in agriculture by coupling it with technology. Furthermore, establishing these testbed areas directly contributes to the tripartite Land Grant mission by promoting research, teaching, and extension activities. The data collected by the testbeds will contribute to the larger SmartFarm Innovation Network data repository and the lessons learned in establishing these testbeds can be applied to the establishment of other nodes, including a network of working farms outfitted with technology. Finally, establishing these testbeds will provide researchers across multiple colleges a rich experimentation environment within which novel and commercial technologies can be tested for their applicability in livestock production systems. Ultimately, benefiting livestock producers in VA.

Within a 2-year period the planned testbed research and demonstration areas will be developed at the Middleburg and Shenandoah Valley Agricultural Research and Extension Centers. This project involves updates on infrastructure development to ensure the testbed areas at both ARECs are fully equipped with necessary utilities. Followed by the purchase and deployment of commercially available SmartFarming technologies relevant to the testbeds, including animal sensors, electronic ID systems, smart feeders and scales. Our team of animal scientists will test the accuracy and precision of the equipment, and the computer scientist will work to create a safe but accessible data storage system to house and visualize the data collected from these technologies. In addition, we will construct and deploy novel technologies designed to test engineering research approaches to address flaws identified with the commercial technologies. Finally, we will focus our efforts on demonstrating the use of the testbed for research and Extension programming.

BENCHMARKING HERD PRODUCTION IN VIRGINIA

John Benner[1]

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Collection of accurate herd performance records and its analyses are essential for profitable commercial cow-calf production. Beef performance figures or "benchmarks" for cow-calf operations have been developed by industry and Extension to assist producers to analyze their herds' production in a standardized format for comparison across operations. These benchmarks evaluate a cow-calf operation in the important areas of reproduction and preweaning growth, two factors correlated with profitability. In addition, these benchmarks of cow-calf production can be used for standard performance analysis (SPA), to evaluate ranch enterprise profitability. In this report we will define several critical benchmarks, how to calculate them and present benchmark data from the Shenandoah Valley AREC/McCormick Farm herd.

Reproductive Measures

Pregnancy Percentage (% Pregnancy) – Percentage of the herd at pregnancy check that is reported pregnant. This number should include all cows exposed to breeding in the denominator.

$$Pregnancy\ \% = \frac{[(total\ exposed\ females - females\ not\ pregnant)]}{Number\ of\ exposed\ females}$$

Cow Herd Calving Percent (% Calving) – Percentage of the herd that calves a live calf in the production year. Adjusted exposed females includes pregnant cattle purchased less minus pregnant females that were sold or died.

$$Cow\ Herd\ Calving\ \% = \frac{[(Number\ of\ Cows\&Heifers\ Calving)]}{adjusted\ number\ of\ exposed\ females}$$

Weaning Percent (% Calving) – Percentage of cows exposed to breeding that wean a live calf at weaning.

$$Weaning\ \% = \frac{total\ calves\ weaned}{adjusted\ exposed\ females}$$

Percent of Mature Cow Herd Calving within first 21 days of Breeding Season – This percentage reflects the number of females that become pregnant in the first two estrous cycles of the breeding season. This number should be calculated separately for first calf heifers and mature cows.

$$\%Herd\ Calving\ within\ first\ 21\ days = \frac{Number\ of\ females\ Calving\ in\ first\ 21\ days}{Number\ of\ females\ calving}$$

<u>Growth and Production Measures</u>

Weaning Weight – Average weaning weight of all calves weaned within a production year

$$Weaning\ Weight = \frac{Sum\ of\ weaning\ weights\ of\ calf\ crop}{total\ number\ of\ calves\ weaned}$$

205 Day Average Adjusted Weaning Weight – Adjusted weaning weights on individual calves to a standardized age of 205 days and a mature age of dam basis. This is calculate to fairly compare individual calves weaning weights respective of their age and age of dam.

$$Adj.205\ Day\ Wean\ Wt. = \frac{Wean\ Wt. - Birth\ Wt.}{Weaning\ Age} \times 205 + Birth\ Wt + Age\ of\ Dam\ Adj.$$

Weight per Day of Age – Total calf weight divided by calf age. A measure of growth.

$$WDA = \frac{weaning\ weight}{calf\ age}$$

Pounds of Calf Weaned per Cow Exposed – Total lbs of calf crop weaned divided by the number of adjusted total cows exposed to breeding. Measure that best combines reproduction, and performance data of a cow herd.

$$Pounds\ of\ calf\ weaned\ per\ cow\ exposed = \frac{Total\ lbs\ of\ calf\ weaned}{Adjusted\ number\ of\ exposed\ females}$$

A reasonable estimation of this figure would be to multiply weaning percentage times the average calf weight weaned: $\frac{(Est.lbs\ of\ calf)}{(cow\ exposed)} = (\%\ Weaning\ \times Average\ Weaning\ Wt)$

Many of these benchmarks and other important herd production metrics can be evaluated for your operation with the aid of Virginia Cooperative Extension Publication Virginia Cow Herd Performance Check-Up 400-791:

https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/400/400-791/400-791_pdf.pdf

Selected benchmarks from Shenandoah Valley AREC/McCormick Farm are presented below from 2009-2018. Years 2010-2013 represent spring calving. Years 2014-2018 represent fall calving.

Additionally, calving distribution from the year 2016 is demonstrated graphically in Figure 1. This calving distribution is made possible by the research station's rigorous breeding program. In 2015-16 the breeding season length for heifers was one round of AI exposure (14 Day CIDR® PG and Timed AI and 36 day turnout with a clean up bull (45 day calving season). The breeding program for cows was one round of AI exposure (5 Day Co-Synch+ CIDR®) followed by turnout with clean up bulls for 55 days (65 day calving season). The 10 day break between AI and bull turn out is to aid in assistance in determining calf sire.

Table 1 – Spring Calving	Years				
Parameter	2009-2010	2010-2011	2011-2012	2012-2013	**Avg 2010-2013**
#Cows Exposed	215	170	188	171	**176**
% Calving	90%	92%	82%	96%	**90%**
% Cows Calving in first 21 days	60%	58%	57%	53%	**56%**
Number of calves weaned	176	144	149	153	**149**
Weaning % per Cow Exposed	82%	85%	79%	89%	**84%**
Actual Weaning wt avg (lbs)	474	439	457	483	**459**
Average Age of Calf at Weaning (Days)	185	181	181	203	**188**
Adj 205 Day Weaning wt	535	515	624	509	**549**
Weight Per Day of Age (lbs)	2.57	2.45	2.53	2.38	**2.45**
Lbs of calf weaned per cow exposed	388	372	360	432	**388**
Cow Age in Years	5.41	5.29	5.22	5.55	**5.37**

Table 2 – Fall Calving	Years				
Parameter	2013-2015	2014-2016	2015-2017	2016-2018	**Avg 2014-2018**
#Cows Exposed	190	203	205	213	**203**
% Calving	89%	90%	92%	88%	**90%**
% Cows Calving in first 21 days	55%	64%	44%	62%	**56%**
Number of calves weaned	166	171	181	178	**174**
Weaning % per Cow Exposed	87%	84%	88%	84%	**86%**
Actual Weaning wt avg (lbs)	498	456	473	431	**464**
Average Age of Calf at Weaning (Days)	226	202	207	202	**209**
Adj 205 Day Weaning wt	483	484	493	385	**461**
Weight Per Day of Age (lbs)	2.21	2.26	2.30	2.14	**2.23**
Lbs of calf weaned per cow exposed	435	383	418	360	**399**
Cow Age in Years	4.77	4.98	4.83	4.88	**4.87**

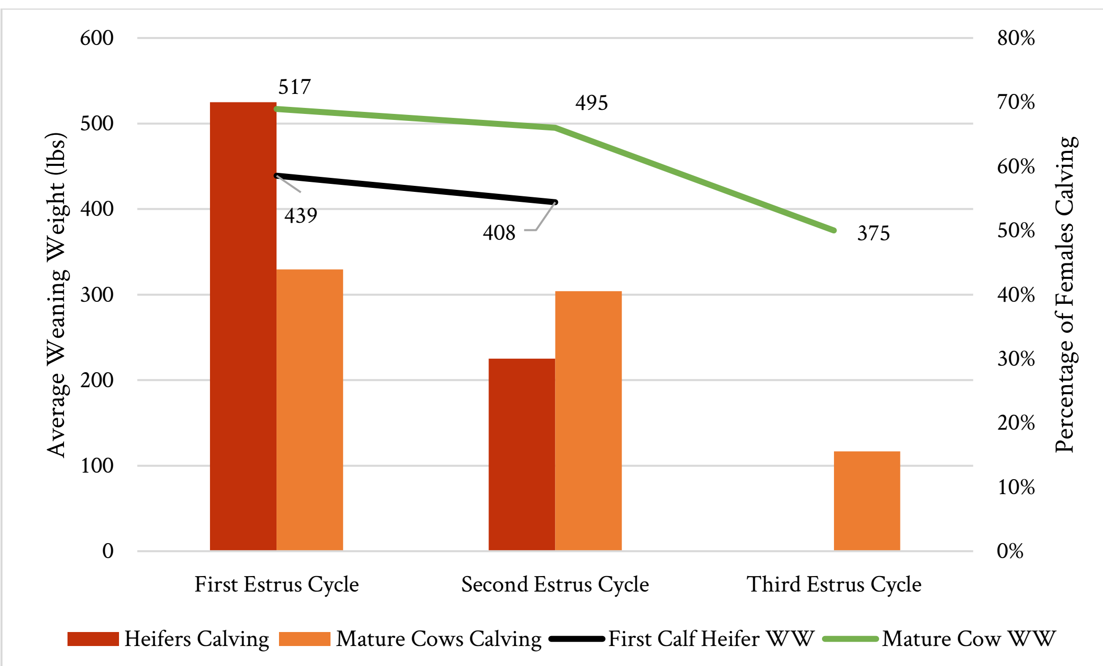

Figure 1 – Fall 2016 McCormick Farm calving distribution and average weaning weights of calves stratified by calving distribution.

References

Beef Improvement Federation. 2016. Guidelines for Uniform Beef Improvement. 9th Edition. p 14, 21-22. Accessed at: https://beefimprovement.org/wp-content/uploads/2013/07/BIFGuidelinesFinal_updated0916.pdf

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall K. A. 2017. Maximizing use of an Extension beef cattle data set: Part 1—Calving distribution. *Journal of Extension*, *55*(3), Article 3TOT5. Available at: https://joe.org/joe/2017june/tt5.php

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall K. A. 2017. Maximizing use of an Extension beef cattle data set: Part 2—Reproductive Rates. *Journal of Extension*, *55*(4), Article 4TOT6. Available at: https://www.joe.org/joe/2017august/tt6.php

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall K. A. 2017. Maximizing use of an Extension beef cattle data set: Part 3—Weights and Growth. *Journal of Extension*, *55*(5), article 5TOT7. Available at: https://www.joe.org/joe/2017october/tt5.php

Ringwall, K.A. 2017. BeefTalk: Beef Production Weaning 498 Pounds Per Cow Exposed. Accessed at: https://www.ag.ndsu.edu/news/columns/beeftalk/beeftalk-beef-production-weaning-498-pounds-per-cow-exposed/

Bevers, S., McCorckle, D. 2009. Cow Calf Enterprise Standardized Performance Analysis. Texas A&M Agrilife Extension. E-556. RM3-13.0. Accessed at: https://cdn-ext.agnet.tamu.edu/wp-content/uploads/2018/12/E-556-cow-calf-enterprise-standardized-performance-analysis.pdf

MANAGING THE ASIAN LONGHORNED TICK: CHECKLIST FOR BEST MANAGEMENT PRACTICES FOR CATTLE PRODUCERS

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Introduction

Large numbers of the Asian longhorned tick (ALT, Fig. 1) on cattle can reduce herd health and possibly spread disease. Managing the ALT can be very difficult because this tick spends most of its life on the ground off the host. ALT also reproduces without mating. The following recommendations are suggested to help reduce the impact and spread of ALT and protect your herd.

Figure 1. Asian longhorn tick (Eric Day, Virginia Tech).

Inspection

- Regularly inspect cattle for ticks. The ALT is small and may go unnoticed with only a quick look. Focus on the head and the neck, but also check the flanks and back, the armpits and groin, and under the tail. Tick larvae, nymphs, and adults may all be found at the same time on a single animal.
- Cattle with low weight gain, are lethargic or anemic, have patchy hair or generally look unthrifty should always be inspected for ticks.
- Animals may have large numbers of ALT, but only a few ALTs may be sufficient to transmit cattle disease. Submit tick samples to your local extension agent for species confirmation.
- Once ALT is confirmed on your animals, you should assume it is established in the area and that management for this tick will be an on-going process from now on.

Chemical Control

- There appears to be a high risk of cattle disease transmission by ALT in February-March and August-September. Tick control is highly recommended during these time periods, but ALTs are active during much of the year. Consider chemical control for ALT from March into November.
- A single pesticide application method may not be fully effective against ALT. Consider using pesticide-impregnated ear-tags along with backrubbers and other devices.

- Ear tags: Use abamectin or beta-cyfluthrin ear tags for low numbers of ticks. Dependency on permethrin ear tags may accelerate pesticide resistance in ALT. Rotate pesticide classes of ear tags to slow the development of resistance.
- Follow all label instructions for pesticideimpregnated ear tags. Use the number of ear tags per animal specified on the label for tick control. Tag both adults and calves if label allows. Check labels for any limitations for beef or dairy cattle. Replace ear tags following the label recommendations. Keep records of when tags were placed so you know when to replace them.
- Use backrubbers and siderubbers ("bullets") or similar devices charged with phosmet or permethrin. Hang rubs in such a way that cattle must contact the rub as they move past, spreading the pesticide along the top of their bodies. Vertical strips hung from a backrubber help apply material to the head and flanks as the cattle move past. Bullets also distribute pesticide along the head and flanks.
- Pinch points: Place backrubbers, bullets, and similar devices in a pinch point (e.g., gateways, between posts, entry to creep feeders, etc.) where cattle are forced to walk under or past on a daily basis, such as to visit a water source. Rubs hung in front of mineral feeders are helpful, but cattle do not visit these feeders every day.
- Recharge devices regularly following the pesticide label. ALT management may require recharging devices every 2-3 weeks.
- Pour-ons: Use pour-ons for heavy or extreme tick numbers. Use ivermectin at the rate of 1 ml per 22 pounds of body weight. Apply along the topline of the animal in a narrow strip. Be aware that heavy rain may wash pesticides off the animal. Increased fly burdens at several days after a heavy rain may indicate the need to retreat the animal.
- Treat all animals in a herd for ticks at the same time. Apply formulations specifically labeled for tick control. Follow all label recommendations for all pesticides (including ear tags, backrubbers, pour-ons, etc.) used, including time to retreat, withdrawal periods, beef vs. dairy, lactating vs dry, use of personal protection, etc.
- Chemical treatment of pastures is not recommended except when tick populations are extremely large. Carbaryl (Sevin) labeled for use on pastures should be restricted to sections of the pasture with the highest number of ticks. Pasture treatments should be used in conjunction with other treatments.
- Chemical control greatly reduces tick burdens on animals but does not eliminate the chance of ticks, tick bites, or acquiring tick-borne diseases.

Herd Management

- Inspect purchased cattle for ticks and treat if found before adding to the established herd.

- Consider having animals tested by a vet for tickborne disease if ticks are found on them, especially if the cattle are not gaining weight, have patchy hair, appear lethargic, or show symptoms of anemia.
- Keep pastures mowed short as long grass and brush enhance tick survival. Leaving pastures ungrazed will not control ticks as they can survive about a year without feeding. Wildlife in the ungrazed pastures will support tick survival in the absence of cattle, too.
- Mow pastures short before rotating stock back into them, even if the cattle have been treated for ticks.
- Keep cattle out of wooded areas. If possible, fence cattle 20 feet away from wooded areas.
- Wildlife, such as deer, small mammals, and birds, can serve as alternative hosts for ticks and assist their spread.
- Check pets if any ticks are found on cattle.
- People working in areas infested with ticks of any species should inspect themselves regularly for ticks.

THEILERIA ORIENTALIS IKEDA GENOTYPE IN CATTLE

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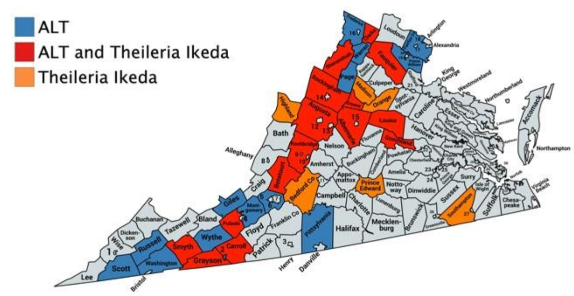
Key points:

- *Theileria orientalis* Ikeda genotype has been identified in Virginia and West Virginia
- Clinical signs are similar to anaplasmosis and include anemia, fever, lethargy
- Most clinical cases are occurring September-November and April-June but can be year round.
- Like *Anaplasma marginale*, animals have acute disease and are persistently infected.
- Some differences have been noted in that Theileria cattle may:
    - Be less aggressive than cattle with anaplasmosis
    - Have less distended spleens than anaplasmosis cattle on necropsy
    - Have ventral edema
    - Include sick calves
- *T. orientalis* Ikeda genotype has been found in 21 counties to date: Albemarle, Augusta, Bedford, Botetourt, Carroll, Clarke, Fauquier, Goochland, Grayson, Green, Highland, Louisa, Madison, Orange, Pulaski, Prince Edward, Rockbridge, Rockingham, Shenandoah, Smyth, and Southampton.



- In other countries, transmission is primarily by the Asian Longhorned tick (ALT), which has been found in Virginia along with 11 other states to date.
- There is no approved treatment for *T. orientalis* in the US.
- Collaboration between the Virginia-Maryland College of Veterinary Medicine (VMCVM) and the Virginia Department of Agriculture and Consumer Services (VDACS) is investigating the distribution and virulence of this organism.
- Virginia Tech Animal Laboratory Services has developed a duplex PCR that will detect *Theileria orientalis* and *Anaplasma marginale*. Validated sample is EDTA blood, but spleen may also be tested if needed.

In early fall of 2017, a Virginia veterinarian received a call from a beef producer with a previously healthy, adult beef cow acutely affected with severe lethargy, weakness and anemia with a history of other deaths on the farm. After a farm call, the veterinarian highly suspected anaplasmosis. Blood was negative for anaplasmosis but positive for a *Theileria* species. Follow up testing of the index animal and a representative sample of herd mates resulted in confirmation by the National Veterinary Services Laboratory (NVSL) of *Theileria orientalis*, a previously undiagnosed blood-borne parasite in Virginia. Further workup at VMCVM identified this as the virulent Ikeda genotype. https://wwwnc.cdc.gov/eid/article/25/9/19-0088_article. Most *Theileria spp.* are confined to regions in Asia and Africa associated with the geographical distribution of their vector ticks, except for the worldwide distribution of the apathogenic *T. orientalis* Buffeli genotype. The parasite has also been found in Australia and New Zealand. This disease represents no threat to human health.

Theileriae are obligate intracellular protozoan parasites. *Theileria* sporozoites are transmitted to susceptible animals in the saliva of ixodid ticks or by direct blood transmission (e.g. needles). The invasive ALT recently identified in Virginia, *Haemaphysalis longicornis,* is known to spread *Theileria* in other parts of the world. Usually, a tick must be attached for 48–72 hours before it becomes infective; however, if environmental temperatures are high, infective sporozoites can develop in ticks and may enter the host within hours of attachment. The incubation period is 8–48 days. Signs in infected cattle are those associated with severe anemia and include lethargy, lack of appetite and exercise intolerance. Clinical signs often resemble anaplasmosis and include pale mucous membranes or jaundice as the periplasms precipitate destruction of red blood cells. Fever is common throughout the course of infection. Anorexia develops and there can be severe dyspnea due to pulmonary edema. The mortality rate for theileriosis can vary from three to nearly 90 percent. After initial infection, animals become chronic carries and can relapse in periods of stress.

Work is ongoing at VMCVM to evaluate the organism, determine likely pathogenicity and investigate its distribution in the region. In the meantime, if you suspect you may have a similar case, please contact VMCVM or VDACS. Methods to reduce tick exposure or tick populations are recommended. We are looking for suspect cases in cattle. Submit an EDTA blood sample on ice along with an accession form to:

Virginia Tech Animal Laboratory Services
245 Duckpond Dr.
Blacksburg, VA 24061

Contact Dr. Kevin Lahmers (klahmers@vt.edu) at VMCVM, PMM, or VDACS if you have additional questions.

Thank you to our sponsors:

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