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Converting to Novel Endophyte Demonstration

Grazelen Farm – Frank and Will Nolen

Project Summary

Part of the *Demonstrating conversion of wildtype to novel endophyte fescue pastures for greater livestock performance and better environmental outcomes* project.

Farm Background

Frank Nolen and his son Will produce cattle, hogs, eggs, grain and hay in Augusta County. Frank purchased the farm back in 1967. At that time, it was "mostly covered by thistles and cedar trees" says Frank. Combining "graze" and "len" from his last name, he named it Grazelen Farm. Now at last no man could call him Frank "No-land". Over the years, Frank and Will have made continuous improvements to the farm. Bluegrass and tall fescue are the primary forages in their pastures, although they also include some level of clovers and orchardgrass. Each grazing season, the Nolens observe a significant "summer slump" as their herd grazes toxic endophyte infected fescue once productivity of

the other cool season forages slows down. In the fall of 2016, after some modest prodding from their Extension agents, Matt Booher and John Benner, the Nolens decided to plant novel tall fescue with a non-toxic endophyte (Texoma Max Q II). In so doing, they hoped to improve their grazing and land management, as well as their herd's health and production. The purpose of this blog is to follow and tell the story of the conversion from wild type (i.e., toxic) endophyte-infected fescue to novel fescue on Grazelen Farm.

Field Selection

The first question a producer must answer when considering converting part of the farm to novel fescue is which field or fields should I convert? To make this decision, the Nolen's considered location and topography, and the impact to their farm operation that removing a field from active use would have during the transition.

They selected a centrally located field on the farm primarily because it had ideal topography. The central location also allowed maximum flexibility for using the novel fescue during the grazing season.

The field selected was approximately 11 acres in size and a major part of the grazing system. Thus, Will and Frank built an additional fence line to create an alley to move cattle around the field. This effectively took the field out of the rotation and was critical to allow the burndown and seeding that fall.

Figure 1 – Candidate field on September 15, 2016

Conversion Method Used

SPRAY-SMOTHER-SPRAY was the conversion method selected and is described in the graphic below. This system was selected as it provides opportunity to use an annual forage to graze during the transition. SPRAY-SMOTHER-SPRAY methods can be used either in summer (with warm-season annuals) or in fall/spring (with cool-season annuals). The annual crops also smother weed species that would otherwise opportunistically grab a foothold once the existing pasture has been burned down. For this CIG project a hybrid BMR (brown midrib = higher digestibility) pearl millet was used (King Fisher Prime 360 M BMR). The tech sheet can be accessed here: https://www.kingsagriseeds.com/wp-content/uploads/2018/02/Prime-360M-Millet.pdf

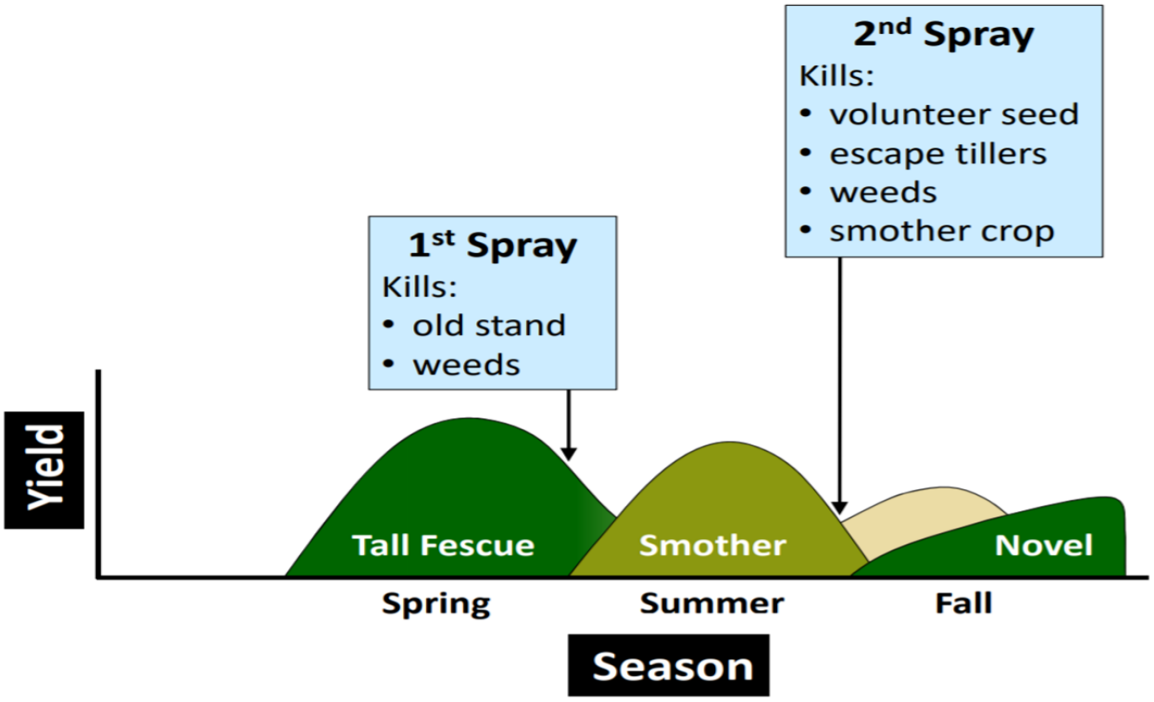

Figure 2 – Diagram of a summer-based SPRAY-SMOTHER-SPRAY conversion method used. SPRAY-SMOTHER-SPRAY approach can also be used in fall and spring (not shown). Courtesy of Alliance for Grassland Renewal.

Soil Map By Type

Soil map data and soil tests were obtained Sept. 2016 and are presented below.

Figure 3 – Soil map of field selected for novel fescue. Soil map courtesy of USDA Web Soil Survey.

Table 1 – Soil types present in candidate field.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
39	Fluvaquents, nearly level	2.5	22.7%
40C2	Frederick-Christian silt loams, 7 to 15 percent slopes, eroded	4.7	42.1%
40D2	Frederick-Christian silt loams, 15 to 25 percent slopes, eroded	0.4	3.3%
41D3	Frederick-Christian silty clay loams, 15 to 25 percent slopes, severely eroded	1.3	11.9%
45E2	Frederick-Rock outcrop complex, 15 to 45 percent slopes, eroded	0.2	2.0%
91B	Wheeling silt loam, 0 to 7 percent slopes	2.0	18.0%
Totals for Area of Interest		**11.1**	**100.0%**

Table 2 – Soil Test Results, as of Oct. 26, 2016

Soil pH	Lime Rec.	Fertilizer Recommendations, lb/A		
5.9	0.75	**N**	**P205**	**K20**
		40	140	40

Conversion Begun Spring 2017

Fertility recommendations called for both ¾ ton of lime and 140 lbs of phosphate with 40 lbs of potash. To address these needs, two tons of litter/acre were applied to the candidate field in March of 2017. After green-up in late April, cattle grazed the field until May 9. On May 10, two tons of lime per acre was applied, followed by a burndown spray of 2 quarts of glyphosate on May 16. On June 8th the pearl millet smother crop (Kings Agriseeds KF 360 BMR Hybrid) was drilled in at 21/lbs acre.

Pearl Millet Establishment and Use

Field checks were conducted on June 30 and July 21. Millet emergence began on June 23.

Figure 4 – Emergence of pearl millet – June 23, 2017

Establishment was patchy, with heavy weed pressure and competition in some areas. Drill depth and soil fertility were likely contributing factors relating to this. The litter applied in March contained 52 lbs of available N, 55lbs of P205 and 70 lbs of K2O per ton. At 2 tons an acre, phosphorus needs (140 lbs P2O5/acre; Table 2) were not met with poultry litter application. Also, most of the N in litter is in organic form and must be mineralized to be plant available. Thus, slower N availability may have hampered establishment.

Figure 5 – Pearl Millet on July 21, 2017

Figure 6 and 7 – Pearl millet, July 21, 2017.

Despite establishment challenges, the hybrid pearl millet performed fabulously, producing a high amount of biomass by the later part of July. The cow herd was introduced into the millet on July 26 and

grazed until August 7th. The herd was rotated through the field again for three more days from August 13-15. The millet provided forage for 17 grazing days. These grasses are quite productive, and with better establishment, it may have carried cows for several more days. A photo of post-grazed millet on August 7 is shown below. Forage quality samples were collected for the millet and estimates of total digestible nutrients (TDN) and crude protein (Table 3) indicate the forage was adequate for lactating cows. The high digestibility of this forage gives strong support to selecting varieties with the BMR if you are looking to use summer annuals in your forage system.

Figure 8 – Post-grazed millet residue on July 31, 2017.

Table 3 – Pearl millet nutrient analysis.

Pearl Millet KF Prime 360M BMR Hybrid

DM%	TDN%	CP%	NDF%	ADF%
20.7	70.9	15.7	50.0	28.2

Novel Fescue Establishment

After cattle were removed for the final time, the millet was sprayed with a burndown application of Roundup and 2,4-D on August 16. The field was retreated on August 19 to catch any "skips". The dead standing millet was then bush hogged on August 21 to facilitate no-till drilling the novel fescue.

The novel endophyte fescue selected was Pennington® Texoma Max Q II. Seed was no-till drilled on September 11. Areas around trees where the no-till drill method was not feasible were seeded with a broadcast seeder. After completing all the drilling/seeding operations, we calculated our seeding rate was 16 lbs/acre, which was much lighter than our intended rate of 20-25/lbs/acre. After seeding, 60 lbs of urea/acre was applied. On September 21, the field was scouted for emergence. Though generally not recommended as herbicides can negatively affect grass emergence before the 5 leaf stage, heavy weed areas were sprayed with 1qt 2,4-D and 1 qt Banvel an acre. Finally, an additional 50 lbs was drilled in using a grain drill, bringing the total seeded rate to 20lbs/acre.

Rainfall had totaled 2.46" from July 29 to September 6, 2017. After September 6, no rain fell until the middle of November. To make things worse, the cow herd broke into the field in November, at a time when the fescue seedlings were quite vulnerable. The stand did not look in good condition heading into the winter, with many open patches susceptible to weed pressure.

Novel Fescue Pasture: Year 1

Substantial moisture fell in winter and spring of 2018, giving the fescue a chance to germinate and thrive. However, with the relatively weak smother crop of millet and weak initial fescue establishment we needed to control opportunistic cool season biannual and annual weeds. This was a challenge. Spraying too early for these weeds would damage fescue seedlings but spraying too late would not control the weeds. Here are a few photos showing what the field looked like on April 27:

Figure 9 & 10 – Fescue competing with winter annual weeds on April 27, 2018.

We had to decide when to chance a broadleaf herbicide application. On May 3, 2018 Frank and Will applied 2.5 quarts of 2,4-D + 8 oz of Banvel using their Gator sprayer. The application worked! With the abundant spring moisture and cooler temperatures, the novel fescue grew tremendously. Below is a photo of the marvelous amount of growth seen from April 27 to May 17.

Figure 11 – Will Nolen shows us the novel field on May 17, 2018.

We decided to keep cattle off the field until June, to allow the stand to continue to strengthen. We hoped the maturing spring flush growth would provide seed to thicken the stand in future years, as well as smother any unwanted weed growth. We also wanted the root system of the plants to fully develop before exposing to grazing. On June 16 and 24, we took forage samples and clippings to estimate yield and quality. June 16 samples were represented as pre-turn in quality, while June 24, show post-grazing residue. The table below represents yield and quality. Total amount of growth in the field averaged 5800 lbs of dry matter forage from green up to June 16.

Figure 12 – Novel fescue stand on June 16, 2018.

Table 4 – Novel fescue (Max Q) yield and nutritional characteristics, June 2018.

Max Q Yield	Date	DM lbs	DM Tons	TDN%	CP%	NDF%	ADF%
Pre-turn in	6/16/2018	5800	2.9	65.6	14.4	58.3	33.4
Residual DM Post Grazing	6/24/2018			57.8	9.4	64.1	42.3

The field was split into three paddocks (Figure 13). The cows were let into Paddock 1 on June 17, and Paddock 2 on June 21, and were given both sections on June 24. The third paddock was partially mowed for hay.

Figure 13 – Field map of paddocks 1,2,3.

Figure 14 - Cows grazing the novel fescue.

On June 24 we put up two game cameras to observe herd grazing behavior on the novel fescue. Cattle exhibited similar behaviors on the novel and wildtype fescues. Cattle headed for shade in the middle of the day and grazed into the evening hours as temperatures cooled. However, the "washout" period for animals that have been grazing toxic fescue is 35 to 40 days – that is, it takes about that much time before the toxins in the cows' system are removed. So, it's unlikely that behavioral changes would be evident at a week after turnout.

Figure 15 – Cattle heading for shade after the morning grazing.

Figure 16 – The herd heads back out to graze during a cloudy stretch of afternoon. Rough hair coats on some cows may be a sign of toxicosis from grazing toxic fescue earlier in the season.

As stated earlier, with the abundance of dry matter, Frank and Will decided to mow hay on two swaths of Paddock 3. They rolled 5 ½ bales from the two swaths on July 27 and moved the cow herd into the paddock. On July 1, the cows were moved out of the novel fescue field entirely.

Figure 17 – Hay swaths mowed in Paddock 3, June 27.

Figure 18 – Picture showing residual forage left after cattle grazed in Paddock 2 (left) and before moving into Paddock 3 (right).

The field was rested until July 25. On July 24 the cows began grazing Paddock 1 and were rotated through the field with 4 days in each paddock and removed from the field on August 6. During this grazing we noticed that crabgrass was creeping into weaker parts of the stand. Crabgrass is highly palatable, especially when vegetative and cattle preferred grazing it over the Max Q, perhaps due to greater maturity in the fescue.

Figure 19 – The game cameras capture cows taking a break from grazing in the middle of the day on July 24.

From August 6 to November 12 the field was stockpiled for fall grazing. Some evidence of the hay swaths cut through Paddock 3 were visible during this time (Figure 20).

Figure 20. Field on August 24, showing the greater weed presence and lower recovery due to hay harvest (left). Grazing removed less fescue leaf, allowing for greater recovery/regrowth, which also reduced weed presence.

The cows grazed in the 3 parcels of the novel fescue field from Nov. 13 to December 3 after which they were removed. Table 5 presents stockpiled novel fescue nutrient data and dry matter yield in October. Stockpiled forage nutritive value was greater than typical for hay – and much cheaper.

Table 5 – Yield and nutritional characteristics of novel fescue in October 2018.

Stockpiled Yield	Date	DM lbs	DM Tons	TDN%	CP%	NDF%	ADF%
Pre-turn in	10/28/2018	4630	2.3	62.6	14.7	56.7	34.7

Cattle weights were taken before and after grazing in the field on Oct. 30 and Dec. 3 respectively (Table 6).

Table 6 – Herd Performance Data on Stockpiled Fescue

Stockpiled Fescue Animal Gain Data			
	10/30/2018	12/3/2018	Gain/Cow
AVG Cow Weight	1419	1431	12
AVG Cow BCS score	4.3	5.4	1.1
ADG lbs/day			0.36

The data behind these numbers come from only a few cows, so they are by no means definitive of expected performance. They do indicate, however, that cows do have the potential to gain body condition on stockpiled novel endophyte fescue in the fall, depending on stage of production. Calf data were not included in our summary as calves were still nursing their mothers. After December 3, the cow herd was moved from the novel fescue field to the barn lot for the winter.

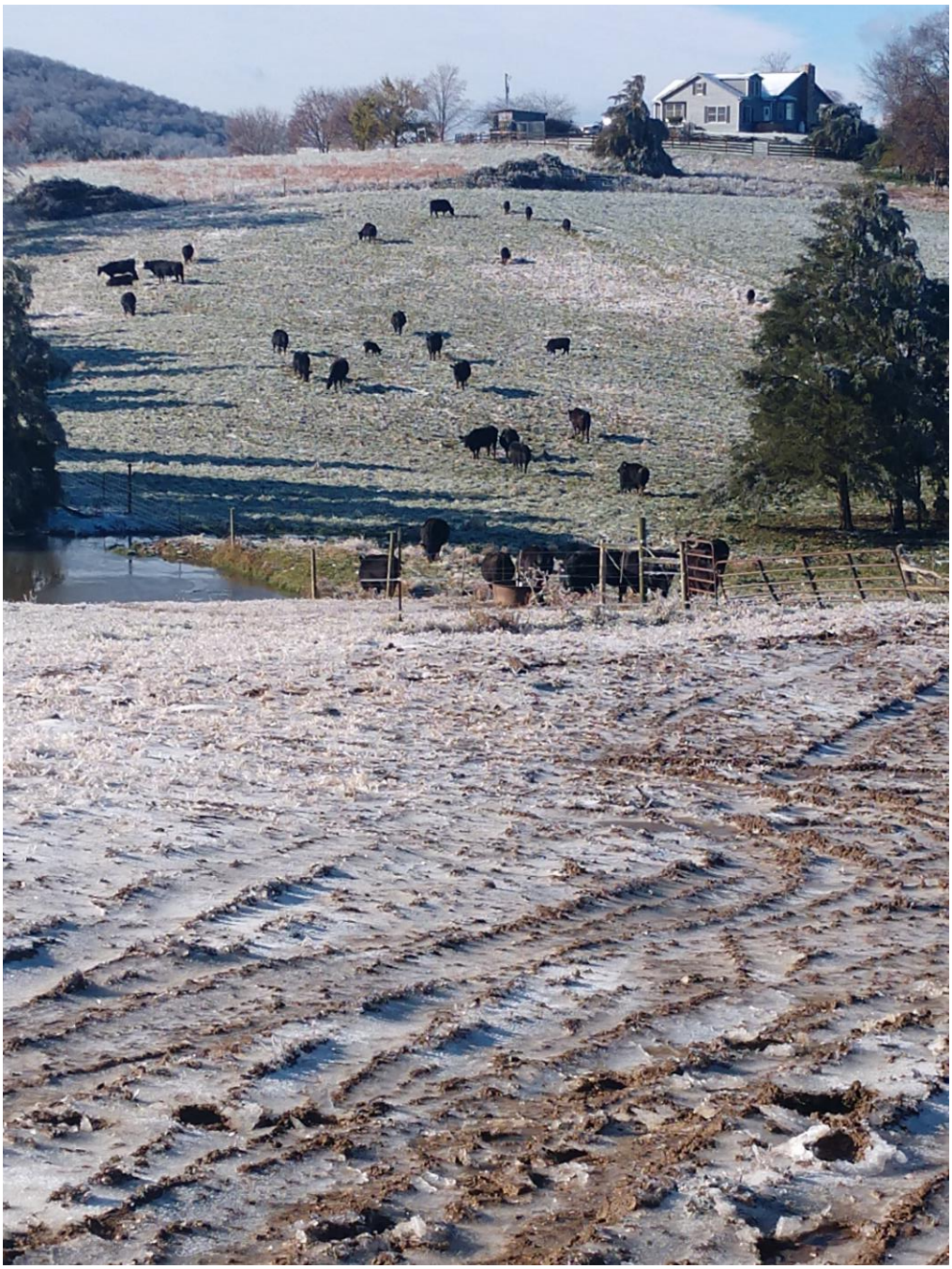

Figure 20 – Cows grazing stockpiled Jesup Max Q fescue in December 2018.

Novel Fescue Pasture Year 2:

In 2019, cows began grazing novel fescue on April 22, 2019. Cows were rotated through the three paddocks from April 22 to May 5. The second rotation began on May 31, with cows staying 5 days in

each paddock before being removed on June 16. The field was rested again until July 25. The herd grazed from July 25 to August 6 with 4 days in each paddock.

Game cameras were again set up on the farm. This year we documented existing wildtype toxic endophyte infected pastures to determine grazing patterns on existing endophyte infected fescue. Data were collected on a toxic endophyte infected pasture from May 21 to May 24, 2019.

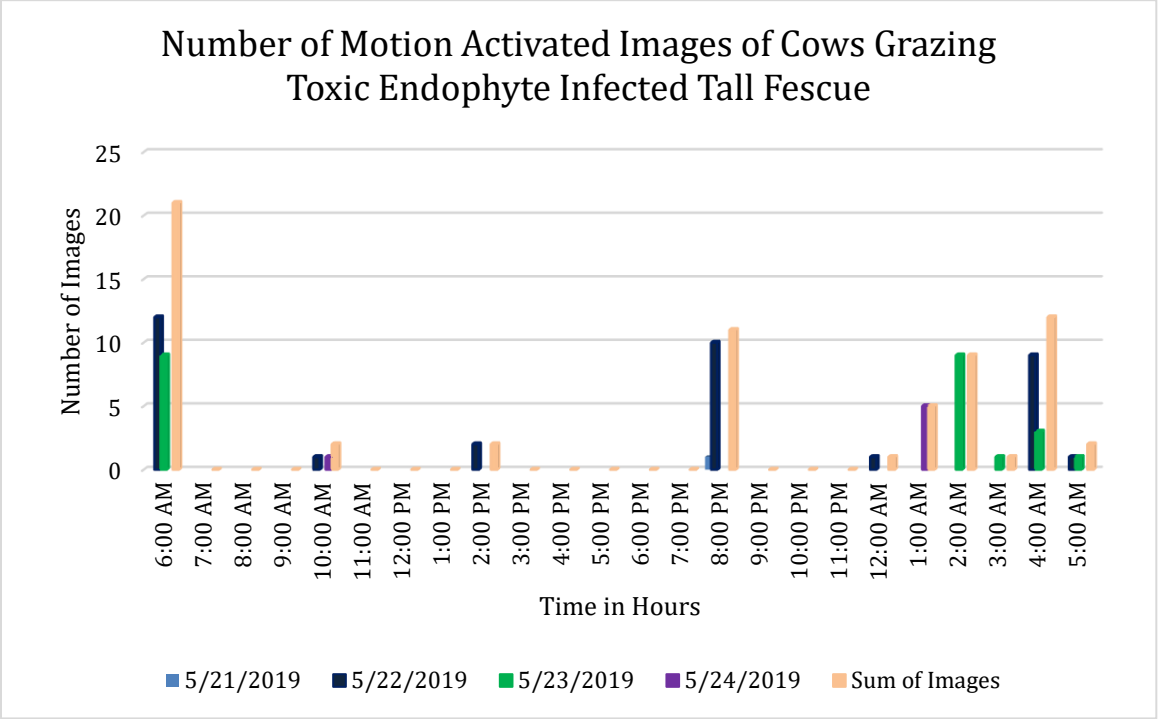

Figure 21 – Number of Motion Activated Images of Cows Grazing Toxic Endophyte Infected Tall Fescue, May 2019.

Cattle activity was highest from the hours of 8:00 pm to 6:30 am. The game cameras were motion triggered. Upon analyzing the sim cards from the cameras, we had a total of 66 images. 77% of those images of cattle activity were taken between 12:00 am and 7:00 am. 17% of images were captured between 8 pm and 12:00 am. Only 6% of images were captured between 7 am and 8 pm. This is in line with previous studies showing grazing activity is shifted to morning and evening periods and away from the middle of the day.

Figure 22 – One solitary cow venturing out into the heat to graze toxic fescue at 2:19 pm on May 22. The rest of the herd remains huddled under the tree on the left.

Soil samples were collected on August 22. Soil test results called for 90-70-0.

Table 7 – Soil Sample Results – Fall 2019

Soil pH	Lime Rec.	Fertilizer Recommendations, lb/A		
6.8	0.75	**N**	**P205**	**K20**
		90	70	0

Turkey litter containing 55-50-40 N-P2O5-K2O per ton was applied on September 30 to the tune of 1.44 tons/acre. Conditions were abnormally dry, with no beneficial rain until October 19, with limited stockpiled benefit. On November 2 the field was converted from 3 paddocks to 2, with cattle grazing

the first paddock. On November 9 cattle were removed to graze other pastures. We probably got on these pastures a little soon, as other producers observed more rapid growth with a longer rest period following the end of the drought.

In late November, we made the decision to seed in red and white clovers and alfalfa to thicken up the forage stand. We felt comfortable in doing so because broadleaf weeds by that time were limited and manageable. Below is a table showing the clover and alfalfa varieties selected and their corresponding seeding rates.

Plot A: Alfalfa 5lb/ac Plot B: Red & White Clover 5:2lb/ac Plot C: White Clover 2lb/ac

Table 8 – Interseeding Rates and Forage Varieties used December 2019

Forage	Variety	Pure Live Seed Rate (lbs/acre)	Germination%	Pure live seed%	Actual Seed Rate (lbs/acre)	# of Acres seeded
Alfalfa	Bulldog 505	5	60	65.80	12.82	2
Red Clover	Cinnamon Plus	5	70	65.67	10.86	2
Ladino	Durana	2.5	70	65.80	5.5	2

The red and white clover plot used a ratio of 5 lbs to 2 lbs red clover to white clover. The cattle were put back into the field on December 8 and left until December 18. On December 20 we sod drilled in the alfalfa and clover mix. The alfalfa rate and white clover rate was seeded as called for on both acres. The red and white clover mix was seeded only on one acre. On December 21, remaining seed mix of red and white clover was broadcast on uncovered areas.

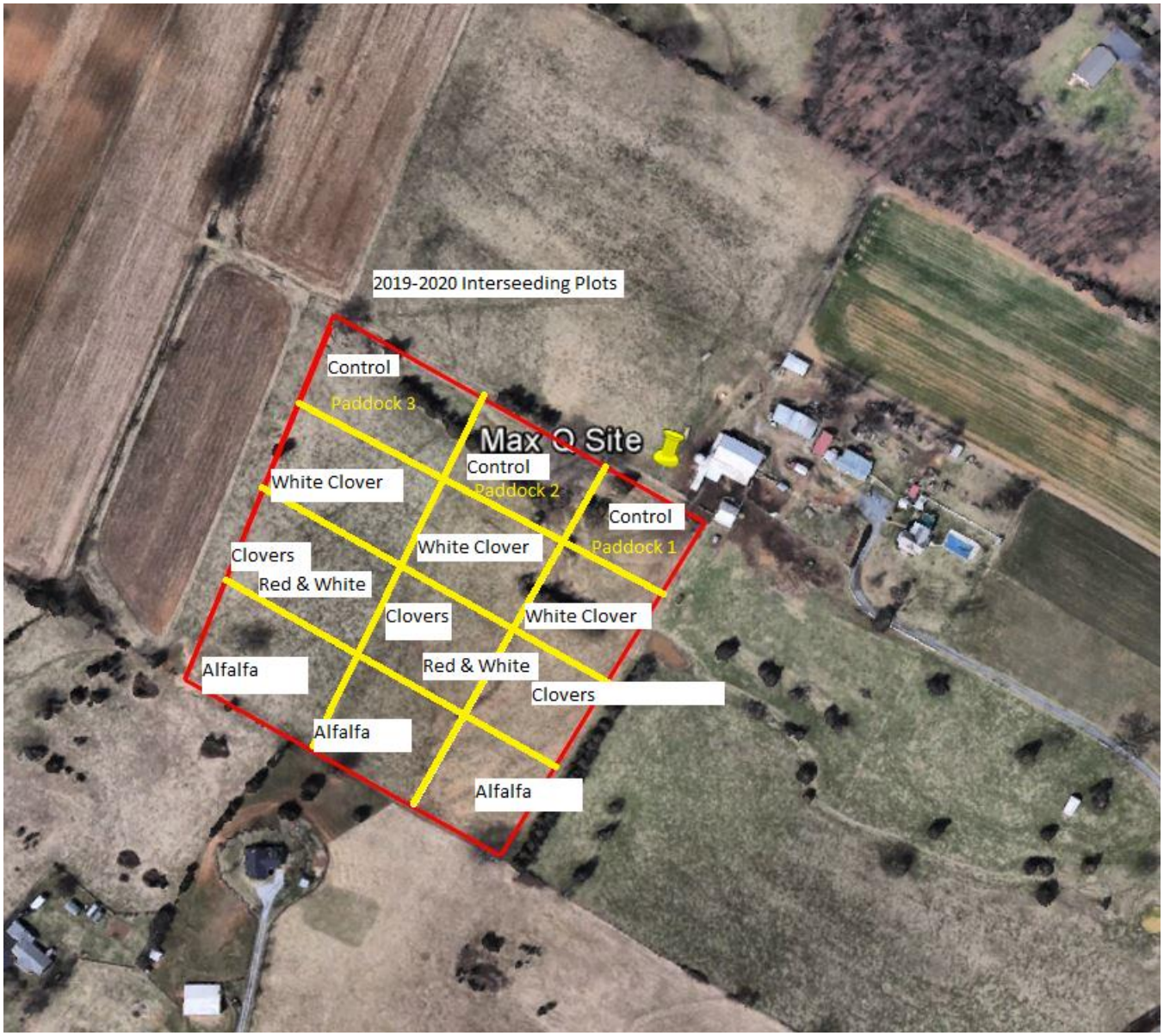

Figure 23 – Interseeding Plot Map, December 20, 2019

Figure 24 – Matt Booher checking the status of the hopper on the sod drill.

Since seeding on December 20, we have had unseasonably warm weather, making us nervous that we may have premature germination. However, we are hopeful that the seeded forages will be successful in establishing. We will follow the progress of clover and alfalfa germination and stand development this spring to document our success or failure. Stay tuned for updates and a field day to be held sometime in the future!