FALL GRAZING OF STOCKPILED VS WINDROWED ANNUAL RYEGRASS AND FORAGE ESTABLISHMENT OF WINTER FEEDING AREAS

Part 1: Evaluation Of Grazing Stockpiled Vs. Windrowed Annual Ryegrass To Extend The Fall Grazing Season In Northern Minnesota

J.M. Kelzer, R.S. Walker, S. Bird, R.D. Mathison, and P.R. Peterson

Abstract

Windrowed and stockpiled annual ryegrass as fall grazing systems were evaluated for forage quality and beef cow performance over two separate years. In 2007 and 2008, two 6-acre paddocks were seeded in early spring with annual ryegrass, rotationally grazed during summer, fertilized, and stockpiled in August. In mid-October, forage from one-half of each replicated 6-acre paddock was clipped while the other half was left standing. Two windrows in each clipped paddock were raked together 1 d following swathing to represent the windrow treatment. Non-lactating, pregnant Angus beef cows (n=32/year) averaging 1435 ± 165 lb BW, 5 ± 2 yr of age, 125 ± 22 d pregnant, and BCS of 5.5 ± 0.5 in 2007 and 1283 ± 176 lb BW, 4 ± 3 yr of age, 131 d pregnant, and BCS of 5 ± 0.4 in 2008 were assigned randomly to one of four 3-acre paddocks representing one of two grazing treatments: 1) windrowed annual ryegrass (WIN), and 2) stockpiled annual ryegrass (STO). Data for forage quality and animal performance were collected and analyzed by year. Forage CP, ADF, and NDF were greater (P < 0.05) over time, whereas percent TDN and relative feed value were lower (P < 0.05) over time for WIN vs. STO paddocks for both years. Compared to WIN, cattle on STO paddocks grazed 8 and 10 d longer (P < 0.05) in 2007 and 2008. Animal BW gain and ADG were similar for cows grazing STO and WIN paddocks in 2007 and averaged -3.2 ± 39 lb BW and 0.04 ± 1.2 lb/d; however, animal BW gain (88.6 vs. 44.6 lb BW) and ADG (2.3 vs. 1.5 lb/d) were greater (P < 0.05) for STO than WIN in 2008. Results of this study indicate nutrient concentrations of forage CP, TDN, ADF, NDF, and relative feed value are affected by fall grazing system over time. Thus, stockpile or windrow grazing annual ryegrass may be viable fall grazing systems to retain forage quality and maintain non-lactating, pregnant beef cow performance.

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Introduction: The relatively short (approximately 120 days) forage growing season in northern Minnesota limits available forage and therefore number of fall grazing days. The short grazing season increases the requirement for harvested forages or supplemental feed which comprises approximately 60% of all production cost for beef cow/calf producers (Koch et al., 1997). Utilizing cool-season annuals in grazing systems can increase the amount and quality of available forage for grazing later in the season (Haferkamp et al., 2005). To reduce winter feeding expenses, systems that employ animals to harvest forages longer into the grazing season are explored (D’Souza et al., 1990). Stockpile grazing is a fall grazing strategy used throughout the U.S. while windrow grazing is typically used in Western U.S and Canada by beef producers to increase the number of total grazing days each season. While these strategies can reduce the cost of processing and feeding hay by as much as 60-75% (Surber et al., 2001), weather impacts, such as snow accumulation, are unpredictable in the Upper Midwest and may have a significant impact on forage quality, forage utilization, and animal performance. Preliminary data in northern Minnesota indicate not only greater body weight gain (1.9 lb/head/d) but also reduced (2.5 times) feeding cost for pregnant, non-lactating beef cows grazing windrowed annual ryegrass compared to cows fed annual ryegrass haylage (Walker et al., 2007). The degree of cost reduction depends on the physiological stage of production of the cow and will decline as nutritional demands from gestation and lactation increase and forage quality decreases (Schoonmaker et al., 2003). To more fully evaluate grazing systems in northern Minnesota, a two-year study was proposed to determine if forage quality, forage utilization, length of grazing period, and pregnant, non-lactating beef cow performance are affected by grazing windrowed versus stockpiled forage in an annual ryegrass pasture system.

Materials and Methods: The experiments were conducted in fall of 2007 and 2008 at the University of Minnesota North Central Research and Outreach Center in Grand Rapids, MN.

Forage
Two renovated pastures (6 acres each) were seeded in May of 2007 and 2008 with annual ryegrass (Lolium multiflorum) using a brillion seeder at a planting rate of 25 lb/acre. The two pastures were grazed twice during the summer of 2007 and once during the summer of 2008 to a stubble height of 3-4 inches with beef cow/calf pairs. Herbicide and fertilization management simulated that used by producers in the region. Pastures were sprayed with herbicide on June 10 and August 15 (2007) and August 3 (2008) for weed control. Cattle were removed so pastures could be stockpiled beginning on August 23 (2007) and August 1 (2008), and 46 lbs of nitrogen/acre were applied on August 23 of both years. Treatments for both years included stockpiled and windrowed grazing and were obtained as follows. Each 6-acre pasture was divided in half (two 3-acre paddocks) each year, and each paddock represents one treatment replication each year. Forage on one 3-acre paddock in each pasture was swathed on October 23 (2007) and October 15 (2008), and two windrows were raked together one day after swathing to represent the windrowed grazing treatment.
Forage from the other 3-acre paddock in each pasture was left standing in both years to represent the stockpiled grazing treatment.

For analysis of forage quality, multiple wet forage samples in each treatment were collected every 20 days beginning on the day before swathing and continued throughout the experiment. Samples were analyzed for DM, CP, TDN, ADF, NDF, and relative feed value (RFV). Forage yield for both treatments were estimated at time of swathing and were used to determine animal stocking rate. In the swathed sections, forage DM loss was estimated by collecting, drying, and weighing the remaining forage left on the ground in 40’ sections from five randomly selected windrows after cows had consumed available forage. In the stockpiled sections, the remaining forage after cows had consumed available forage was cut in 20’ strips from five randomly selected locations with a three-foot Carter harvester. The cut forage was then collected, dried, and weighed to estimate forage DM loss for the treatment. Forage loss data is only reported for the year 2007 because snow accumulation in 2008 delayed remaining forage collection until spring of 2009.

**Animals**

Pregnant, non-lactating Angus beef cows were stratified by BW, body condition score (BCS, measured subjectively on a 1-9 point scale, where 1 = extremely thin and 9 = obese), age, and number of days pregnant and assigned to one of two treatment groups (replicated twice) for each year: 1) cows grazing stockpiled forage on one-half of each pasture (STO), and 2) cows grazing windrows on one-half of each pasture (WIN). On November 7 (2007) and October 21 (2008), cows were turned out to their assigned treatments. Stocking rate for both treatment groups each year was determined based on forage yield estimates at time of swathing. Cows were stocked to provide DM intake equal to 2% of BW, or consuming 27 lb DM/d for a total of 30 days. Cattle in both groups were stocked based on 10 three-day rotations and moved with electric fence to the next rotation.

Cows were allowed access (via electric fence) to 1/10th of each 3-acre paddock at one time and grazed until available forage was visually determined to be completely consumed. Cows were then given access to the next portion of the 3-acre paddock. Cow BW and BCS were measured on two consecutive days beginning with the day prior to trial initiation and on the day prior to the last estimated day of grazing for each group. Total grazing days, total weight gain, ADG, and BCS change were measured or calculated by treatment. In 2007, access to water was provided on a rotational basis. Both treatment groups in one replicated pasture had access to water from 8:00 am to 4:30 pm while both treatment groups from the second pasture had access to water from 4:30 pm to 8:00 am each day. Distance from the pasture to the water source was approximately 1320 feet (one-way). In 2008, all cows on both pastures had free choice access to water. The experiment was terminated each year when available forage was consumed in both treatment groups.
Forage data were analyzed as repeated measures using an autoregressive repeated covariance (AR 1) structure in SAS (SAS Institute, Inc., Cary, NC). Model fixed effects included time, treatment, rep, and treatment by hour interaction. Cow performance data were analyzed as a general linear model in SAS. Fixed model effects included treatment, rep, age, and days pregnant. Statistical significance was declared with $P$-values $\leq 0.05$, and trends were discussed with $P$-values $\leq 0.10$. The PDIF option was used to separate and compare differences of least squares means when the $F$-test statistic was significant.

Results and Discussion: Forage quality and animal performance results were analyzed separately and are reported by year.

Forage

Forage DM yield for all treatments and replications combined was estimated at 2142 lb/ac in 2007 and 2228 lb/ac in 2008. Initial forage DM at time of swathing was 9.4% in 2007 and 22.4% in 2008. Percent CP, TDN, ADF, NDF, and RFV in both treatment paddocks were similar at time of cutting (October) for each year. Forage quality data over time for both years is listed in Table 1. Concentrations of CP decreased over time ($P < 0.01$) for STO (22.1 to 17.5%) and WIN (22.9 to 18.7%) in 2007, whereas CP was not different ($P = 0.11$) for both STO (14.2 to 12.6%) and WIN (14.2 to 15.9%) over time in 2008. Concentrations of TDN increased over time ($P < 0.01$) for the STO group in 2007 (63.0 to 66.7%), whereas TDN decreased over time ($P < 0.01$) for the WIN group in 2008 (65.1 to 59.2%). Nutrient concentrations of ADF (33.3 to 28.4%) and NDF (54.0 to 47.7%) decreased over time ($P < 0.01$) for STO in 2007, whereas ADF for WIN in 2007 (31.8 to 34.5%) and in 2008 (30.3 to 38.1%) and NDF for WIN in 2008 (49.7 to 61.1%) increased over time ($P < 0.01$). Forage concentrations of CP, ADF, and NDF were greater ($P < 0.05$) over time while percent TDN and relative feed value were lower ($P < 0.05$) over time for WIN vs. STO paddocks for both years. Minimum nutrient requirements for maintenance (NRC, 1996) of a five-month pregnant, non-lactating beef cow for CP (8.29%) and TDN (54.1%) are lower than actual CP and TDN values of forages observed from the STO and WIN treatment groups.

Only forage loss data for 2007 will be reported since snow accumulation in fall of 2008 delayed remaining forage collection until spring of 2009. In 2007, remaining forage was measured until December 2 when a snowstorm prevented measurement of forage loss for the remainder of the grazing period. The remaining sections from each pasture group that were not collected for forage loss in fall were measured the following spring to determine how significant snow accumulation could affect forage utilization (even though measurements may not show true losses due to potential loss from deterioration of forage over winter and during the spring thaw). Forage loss during the first 25 days was slightly less for cows grazing STO (8.1%) compared to WIN (9.1%). By utilizing a rotational
grazing system with windrow grazing, forage loss can be estimated at 10% or less if grazed for less than seven days and 5% or less if grazed for one day in wintering calves (Volesky et al., 2002). However, forage loss in the sections grazed after December 2 was numerically greater for cows grazing STO (28.1%) compared to WIN (18.1%), which also increased overall percent forage loss for both treatment groups (STO = 36.2% and WIN = 27.2%).

Animal Performance

Stocking rate based on cows consuming 27 lb DM/hd/d was 2.7 hd/acre for both 2007 and 2008. In 2007, cows grazed 8 d longer ($P = 0.04$) on STO compared to WIN (39 vs. 31 d). Similarly in 2008, cattle grazed 10 d longer ($P < 0.01$) on STO compared to WIN (39 vs. 29 d). Body weight gain over the grazing period was similar ($P = 0.72$) in 2007 and averaged -3.2 ± 39 lb across treatments. However in 2008, cows grazing STO gained more ($P < 0.01$) BW than cows grazing WIN (88.6 vs. 44.6 lb) over the entire grazing period. Average daily gain (Figure 1) in 2007 was similar ($P = 0.72$) across treatments and averaged 0.04 ± 1.2 lb/d. However in 2008, ADG was greater ($P = 0.01$) for cows grazing STO compared to WIN (2.3 vs. 1.5 lb/d). Snow accumulation (17.7 in.) during the grazing period in 2007 limited forage availability and intake which likely explains the lower weight gains observed compared to 2008. Nayigihugu et al. (2007) observed similar results in pregnant cows grazing windrows when formation of an icy crust on the tops of the windrows inhibited intake. However in the 2007 study, cows grazing STO paddocks lost weight (-14.6 lb) compared to overall weight gain in cows grazing WIN (8.1 lb). To explain this observation, stockpiled forages are left standing and are not in concentrated areas like windrows; therefore, limited availability of forage in the STO treatments due to snow accumulation may have a greater impact on forage intake and overall weight gain.

Our results indicate windrow grazing and stockpile grazing can extend the grazing season for beef cattle during the fall months in northern Minnesota. Changes in forage nutrient concentrations for both systems were not significant enough to prevent annual ryegrass from providing nutrient requirements for maintenance of non-lactating, pregnant beef cows. While stockpiled forages extended the length of the grazing period longer than windrow grazing with greater weight gains (in 2008), significant snow accumulation can negatively impact forage utilization and animal performance in this system. Both of these fall grazing systems can provide options for extending the grazing season and reducing winter feeding expenses; however, awareness of typical weather conditions should be considered when managing each particular system.
Literature Cited:

Table 1. Percent crude protein, total digestible nutrients, acid detergent fiber, neutral detergent fiber, and relative feed value of annual ryegrass in response to stockpile (STO) or windrow (WIN) grazing over time.

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>October</td>
<td>December</td>
</tr>
<tr>
<td>Crude Protein</td>
<td></td>
<td></td>
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<tr>
<td>STO(^a)</td>
<td>22.1</td>
<td>17.5</td>
</tr>
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<td>WIN(^a)</td>
<td>22.9</td>
<td>18.7</td>
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<tr>
<td>Total Digestible Nutrients</td>
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<td></td>
</tr>
<tr>
<td>STO(^a)</td>
<td>63.0</td>
<td>66.7</td>
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<td>WIN(^b)</td>
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<tr>
<td>Acid Detergent Fiber</td>
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<td></td>
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<td>STO(^a)</td>
<td>33.3</td>
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<td>WIN(^{ab})</td>
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<td>Neutral Detergent Fiber</td>
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<tr>
<td>WIN(^b)</td>
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<td>53.5</td>
</tr>
<tr>
<td>Relative Feed Value</td>
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<td></td>
</tr>
<tr>
<td>STO(^a)</td>
<td>108.7</td>
<td>130.6</td>
</tr>
<tr>
<td>WIN(^b)</td>
<td>113.3</td>
<td>108.2</td>
</tr>
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</table>

\(^a\) Significant difference \((P < 0.05)\) from October to December in 2007. \(^b\) Significant difference \((P < 0.05)\) from October to November in 2008. \(^c\) Difference from October to November exhibited a trend \((0.05 < P \leq 0.10)\) in 2008.
Figure 1. Average daily gain (lb/hd/d) for cows grazing stockpiled (STO) or windrowed (WIN) forages from years 2007 and 2008.
Part 2: Forage Establishment of Winter Feeding Areas

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Summary

The objective was to compare three seeding methods with two annual grasses utilizing pastures used as winter feeding areas the previous year. In a 2x3 factorial, we evaluated three forage establishment methods: conventional seeding (with heavy tillage), no-till interseeding, and broadcast seeding followed by light tillage with two forage species: cool-season annual ryegrass (AR, Maximum) and warm-season BMR sorghum-sudangrass (SS, Hot Hemi). At three separate locations, soil samples were collected and pastures were divided and randomly assigned to a treatment. Treatments at two locations (SITES 2 and 3) were divided among 12 acres: conventional (3 acre each), no-till interseeding (1 ½ acres each), and broadcast treatment (1 ½ acres each). The third location (SITE 1) totaled six acres with one acre for each treatment. Pastures were seeded at a rate of 25 lbs/acre for both the cool and warm season paddock treatments.

Evaluation of stand establishment, forage yield, stocking rate, and total grazing days were collected at each location, based on forage establishment success (> 50%). Beef cow/calf pairs and pregnant dry beef cows were used to graze each treatment paddock and total grazing days were determined based on animal unit months (AUM). Concentrations for phosphorus (P) and potassium (K) exceeded the maximum levels (P=21ppm and K=160ppm) recommended for root growth and development and pH levels were > 6.0 at all three sites. Stand establishment for both AR and SS was successful for only the conventional treatment at SITES 2 and 3 with some interseeding success for AR at SITE 1. Forage yields were only collected at SITE 3 with the conventional AR treatment yielding 1883 lbs more total dry matter than conventional SS. At SITE 2, conventional SS provided 180 days of grazing for one AUM vs 40 days from conventional AR. At SITE 3, conventional AR provided 162 days of grazing for one AUM vs 152 days from conventional SS. Based on our results, SS and AR establishment was successful under the conventional seeding method. Establishment of both SS and AR with interseeding and broadcasting was more successful in areas with greater soil exposure versus existing sod.

Introduction

Because the forage growing season is short in the Upper Midwest, beef cattle are typically fed in smaller, more confined areas during the winter months.
feeding of cattle in a confined area for an extended period of time creates excessive manure buildup. Too much manure buildup is a concern for manure contamination running off in waters of the state. Most producers will haul off most of the manure to be used as fertilizer in pastures; however this is not a very cost-effective practice for producers and often times this manure may not be managed properly and is underutilized. By establishing annual forages in these winter feeding areas, a producer can eliminate having to haul the manure out to pastures and utilize it for the forages planted. Due to the nature of most annual forages, their vigorous growth characteristics can compete with potential weed establishment in these winter feeding areas providing a substantial amount of forage for grazing to alleviate grazing pressure on other pastures. Therefore, our object was to evaluate annual forages and forage establishment methods for grazing in winter feeding areas during the forage growing season. Our goal is to evaluate the effectiveness and efficiency of these forage establishment systems so that we can provide recommendations for renovating winter feeding areas to increase overall forage production, alleviate grazing pressure on other pastures, and reduce overall production cost.

Materials and Methods

The project was conducted at two producer farms (SITES 1 and 2) and a University of Minnesota research center (SITE 3) in Grand Rapids. At three separate locations, a 2x3 factorial design was used to evaluate three forage establishment methods: conventional seeding (with heavy tillage), no-till interseeding, and broadcast seeding followed by light tillage for seed incorporation into the soil with two forage species: cool-season annual ryegrass (AR, Maximum) and warm-season BMR sorghum-sudangrass (SS, Hot Hemi). Once cattle came off these winter feeding areas in late spring, soil samples were collected and paddocks were divided and randomly assigned to a treatment. Two locations consisted of 12 acres each: three acres for each conventional seeding treatment, one and a half acres for each no-till interseeding treatment, and one and a half acres for each broadcast seeding treatment. The third location consisted of six acres: one acre for each seeding treatment. Paddocks were seeded in late May (for cool-season treatments) and June 11 (for warm-season treatments) at all three locations at a rate of 25 lbs/acre. Evaluation of stand establishment was conducted in late June while forage yields were collected prior to each grazing period for all three locations, based on forage establishment success.

Beef cow/calf pairs and pregnant dry cows were used to graze each treatment paddock, one at a time, throughout the growing season for all three locations. Stocking rates were determined based on animal unit months (AUM) and only in paddocks that yielded greater than 50% establishment success for each location. Stocking rates were not determined prior to grazing, rather calculated based on number of cow/calf pairs available for grazing at that time. By determining
stocking rates for each grazing period, total grazing days were determined for each successfully established paddock for all three locations.

Results and Discussion

Soil samples were collected to establish critical soil nutrient values prior to pasture establishment in May. In Table 1, you can see concentrations for phosphorus (P) and potassium (K) are well above the maximum levels (P=21ppm and K=160ppm) recommended for root growth and development. The pH levels for all three project sites were > 6.0 indicating that soils were not too acidic.

<table>
<thead>
<tr>
<th>Project Location</th>
<th>Soil Type</th>
<th>pH</th>
<th>Phosphorus, ppm</th>
<th>Potassium, ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE 1</td>
<td>Clay</td>
<td>*6.1 – 7.5</td>
<td>*45 - 188</td>
<td>*595 - 2200</td>
</tr>
<tr>
<td>SITE 2</td>
<td>Sandy</td>
<td>6.1 – 6.4</td>
<td>&gt; 100</td>
<td>&gt; 300</td>
</tr>
<tr>
<td>SITE 3</td>
<td>Silty Loam</td>
<td>6.1 – 6.5</td>
<td>75 - 230</td>
<td>490 - 1185</td>
</tr>
</tbody>
</table>

*Nutrient concentrations and pH values show ranges from six samples collected from each project location.

It is evident that wintering cattle in confined feeding areas for any length of time creates rich sources of nutrients, such as P and K that can be utilized as fertilizer.

Stand establishment was evaluated for each treatment at all three project locations in mid July. For every location, each treatment was given a score from 1-5 (1=0 to 20%, 2=21 to 40%, 3=41 to 60%, 4=61 to 80%, and 5=81 to 100%). These ratings were based on visual observation of the seeding area estimating the percentage of established seed planted.

- Broadcasting method - all locations were rated a 1 with 5% or less for both forages.
- Interseeding method - SS was rated a 1 at all three locations with 10% or less actual stand establishment. Establishment of AR was only successfully at 50% or better at one location, rating a 4 (70%) at SITE 1. SITES 2 and 3 rated a 1 (5%) and 2 (25%).
- Conventional seeding method - SS establishment was successful at two locations, rating a 5 (95%) at SITE 2 and a 3 (50%) at SITE 3. SITE 1 did not have a successful establishment rating a 1 (5%). Establishment of AR was successful at all three locations rating a 5 (90 and 80%) at SITES 1 and 3 and a 4 (70%) at SITE 2.

It is evident that the broadcasting method for both AR and SS did not succeed in 2008 and the inter-seeding method had limited success with annual ryegrass and no success with sorghum-sudangrass. The conventional seeding method was the only method to have measurable success, therefore yield and grazing data was only collected for the conventional seeding treatments.
Forage yield was only collected at SITE 3 due to emergency use of pastures needed for grazing at the other two SITES, not allowing time for yields to be collected. Forage yield was collected prior to each of the two grazing periods at SITE 3. Figure 1 shows forage yield of SS alone was slightly greater (37 lbs/acre) than AR in July, but significantly less (1,920 lbs/acre) than AR in September. Annual ryegrass had a total season forage yield advantage of 1,883 lbs/acre. These numbers reflect yield of the forage species alone, without weeds. Figure 1 also shows total forage production, including weeds, was greater for the warm-season annual SS treatment during the first yield collection. This could be explained by the slow cool-season annual ryegrass response to warmer temperatures, planted in late May, and its competition with weeds for establishment, therefore yielding less total lbs of dry matter/acre at that first grazing period. Forage production of sorghum-sudangrass then tapered off due to cooler temperatures later on in the summer, offering more advantage to total forage production for the annual ryegrass treatment.

**Figure 1:** Forage yields of each annual forage, weeds, and combination of forage and weeds for the conventional tillage method collected prior to each grazing at SITE 1.

Because of the limited treatment success at SITE 1, stocking rates and total grazing days were only determined for the conventional treatment groups at both SITE 2 and 3. Based on stocking rate and number of grazing days recorded, and we assume cow and calf weights are similar for both locations, we can estimate the number of grazing days/acre that each annual forage provided for one animal unit (1 animal unit = 1000 lbs):
• At SITE 2, sorghum-sudangrass provided 180 days of grazing for one animal unit and annual ryegrass provided 40 days.
• At SITE 3, sorghum-sudangrass provided 152 days of grazing for one animal unit and annual ryegrass provided 162 days of grazing.

**Things We Learned**

Because of how the pastures were managed during the winter prior to seeding (managed as winter feeding areas) an abundance of weed growth was observed at SITE 3. During the grazing periods, cattle consumed most of the weeds present, which allowed for that paddock to provide more total grazing days during the growing period. Establishment of both sorghum and ryegrass was more successful in areas with greater soil exposure versus existing sod. Managing winter feeding areas by rotating your feeding sites evenly throughout the feeding area will expose more soil offering more success for newly seeded forages. Based on the first year’s results, conventional tillage will provide you with the greatest success for forage establishment. Inter-seeding may be a good low-cost option but will depend on a couple of important factors: exposure of soil and seeding rates.

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