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Dear Forage Producer,

Thank you for your interest in the first edition of the UMN Forage Team's Quarterly Newsletter. I would like to take this opportunity to introduce myself as the newly appointed Forage and Cropping Specialist. As the Forage and Cropping Specialist, I will work closely with Regional and Local Extension Educators, State Specialist, USDA-ARS, and University Researchers in developing a research program that provides innovative approaches and technologies that improve the productivity and sustainability of Minnesota's forage systems. In addition to providing statewide leadership in research that provides solutions to current and future issues in forage production, I will leverage the results to produce high-quality research-based educational programs. The educational programing will take many forms, including the Forage Quarterly Newsletter, YouTube videos, online webinars and classes, along with traditional field days and winter workshops. Please feel free to contact your Regional and Local Educators with questions and concerns associated with forage production.

Hope you find our first edition of the Forage Quarterly helpful.

Sincerely,

M. Scott Wells

University of Minnesota Forage Team

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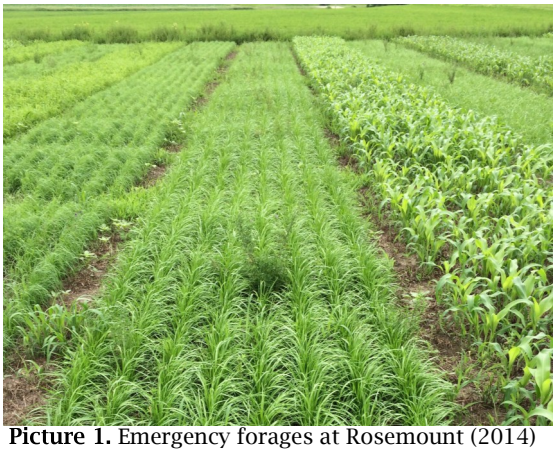
Emergency Forages: Research Update

As hay prices and demand for forages remain high, there is greater incentives to increase the productivity in forage systems, especially alfalfa. In an effort to maximize forage production during the relatively short growing seasons of the upper Midwest, semi-dormant alfalfa varieties have been heavily promoted and widely adopted which can increase the chance of winter injury and winterkill. During the 2012-2013 winter, significant acres of alfalfa in the state of Minnesota experienced winter injury and winterkill.

In years where alfalfa is injured by the winter, and cool wet springs persist, options to replant both annual row crops and forages can become more limited. Warm season grasses could provide an alternative emergency forage during such years. Since many of the warm season grasses species require warmer soils for germination, planting as late as July can provide forage during a reduced growing season.

Initial trials of the emergency forage program were conducted near Rosemount, MN in 2013. This research assessed the following six warm-season grasses on yield potential and response to N fertilization and cutting management: Japanese millet, Siberian foxtail millet, Teff, Brown midrib (BMR) sorghum, annual ryegrass, and perennial ryegrass. Grasses were cut (i.e. early vegetative) one month after the June 5th planting date and again at the first of September.



Picture 1. Emergency forages at Rosemount (2014)

Emergency Forages: Research Update (Continued from page 1)

In 2013, brown midrib sorghum yielded the highest of all the grasses, producing over 6 tons ac^{-1} dry matter. Teff, a warm-weather annual grass adapted to moisture regimes ranging from low desert sands to waterlogged clays, produced above 5 tons ac^{-1}, whereas perennial ryegrass was among the lowest yielding species at 1.7 tons ac^{-1}. Based on NDFd (neutral detergent fiber digestibility), BRM sorghum was among the highest quality grasses, while Siberian millet was among the lowest. To assess N credit from the previous winterkilled alfalfa, nitrogen fertilization had no effect on total dry matter production (i.e. yield tons ac^{-1}) across all seven species, which indicated that the winterkilled alfalfa supplied enough N to meet the needs of all grasses.

Similar in 2013, harvest intervals this year began 30 days after planting and will continue every 30 days, concluding in early September. According to forage performance in the initial year, this experiment continues to utilize Japanese millet, teff, BMR sorghum, and annual ryegrass, with the introduction of sudangrass, sorghum sudangrass, Italian ryegrass, and a red clover/annual ryegrass biculture.

Yield data from the first harvest in Rosemount (2014) is available, providing insight to preliminary results (Figure 1). Sudangrass produced the greatest

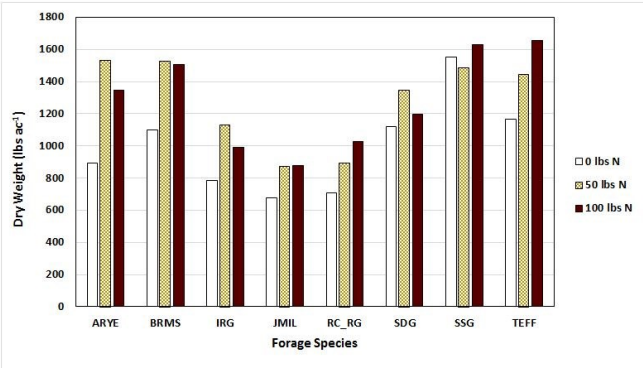


Figure 1. Emergency forage yields reported on a dry weight basis from first cutting at Rosemount (July 7, 2014).Abbreviations: Annual ryegrass, ARYE; brown midrib sorghum, BRMS; Italian ryegrass, IRG; Japanese millet, JPM; Annual ryegrass + red clover, RC&RG; Sorghum sudangrass, SSG; Sudangrass, SDG; Teff, TEFF.

average yield across N rates at 1.41 tons ac^{-1}, closely followed by BMR sorghum (1.40 tons ac^{-1}). Japanese millet returned the lowest average yield potential (0.67 tons ac^{-1}). BMR sorghum, Italian ryegrass, red clover/annual ryegrass mix, and teff showed consistent yield

Picture 1. Weed pressures after simulated winterkill via glyphosate.

response to increased N (Figure 1). BMR sorghum with 100 lbs N ac^{-1} produced the greatest treatment yield (1.64 tons ac^{-1}).

Field observations at Waseca indicate that intensive weed management may be critical to stand establishment (Picture 1). Sudangrass and Teff appear to have established and maintained the strongest persistence despite heavy weed pressure in all treatments. Teff responded very well to the high seeding rate, with great germination and stand establishment. It produced relatively tight, dense growth, inhibiting weed encroachment and establishment. Although competitive and well-established, Teff did not yield as high, due to its low growth habit and the cutting height used. Sudangrass also displayed strong and competitive establishment potential, and closed canopy quickly enough with tall, broad leaves to shade out most competition.

Higher fertilized treatments of BMR sorghum and Japanese millet also appear to be producing relatively well. Sorghum sudangrass, annual ryegrass, Italian ryegrass, and the red clover/ryegrass mixture have generally performed very poorly in this weedy location thus far. This emergency no-till forage research will continue over the next few years with the express goal of developing a set of tools for producers faced with extreme winterkill in alfalfa or prevented planting. As the study progresses, future results will be presented at University of Minnesota Extension Forage Website http://www.extension.umn.edu/agriculture/forages/

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When Does Corn Following Alfalfa Need Nitrogen?

Over the past 5 years, researchers from the University of Minnesota and USDA-Agricultural Research Service partnered with over 40 Minnesota growers to conduct on-farm research trials to determine optimal N fertilizer rates for the first- and second-crop of corn following alfalfa and to confirm alfalfa N credits for modern, high-yielding corn hybrids. Current guidelines indicate that about 10, 60, and 110 lb N/acre should be applied to first-year corn following good (4 or more plants/ft^2), average (2-3 plants/ft^2), or poor alfalfa stands (1 or fewer plants/ft^2), respectively. Similarly, the guidelines for second-year corn are 85, 110, and 160 lb N/acre when following good, average, and poor alfalfa stands.

In 2012, after 31 on-farm trials in first-year corn had been completed, results showed that only 3 of 31 fields required N fertilizer to increase corn grain or silage yield. For the three fields with a response to N, the economically optimum N rate was <80 lb N/acre. Surprisingly, these three responsive fields did not have poor alfalfa stands at termination. In fact, they had good stands while some other non-responsive fields had average stands. These results led to the initial conclusions that: i) first-year corn rarely responds to N fertilizer, ii) the response to N is not related to alfalfa stand density, and iii) more research is needed to determine when first-year corn requires N fertilizer.

Picture 1. Corn (brown) and alfalfa strips (green).

Similar conclusions were reached for second-year corn following alfalfa in 2013. Results from 11 on-farm trials of second-year corn showed that: i) 3 of 11 corn fields required no N fertilizer for maximum yield; ii) the optimum N rate was 65 lb N/acre on five fields; and iii) the remaining three fields needed 175 lb N/acre. What was most striking about these results was that 3 of 11 fields did not require N fertilizer for maximum yield. Alfalfa stand density again did not relate well to the size of the alfalfa N credit.

Table 1. Summary of grain yield response to N fertilizer in 259 trials of first-year corn following alfalfa.

Soil texture	Alfalfa termination time	Alfalfa age (years)	Alfalfa seeding method	Sites responsive to N fertilizer	Total sites
Coarse				96%	11
Medium	Fall	1	Direct	56%	16
Medium	Fall	2	With oats	35%	54
Medium	Fall	2	Direct	8%	25
Medium	Fall	3+		5%	86
Medium	Spring	3+		17%	48
Fine				53%	19

In order to identify when corn following alfalfa requires N fertilizer and how much N is needed on responsive fields, we combined the data from our on-farm trials with that from all other trials available in the literature and from other researchers. With 259 first-year corn trials, we found that combinations of soil textural class (fine, medium, or coarse), age of alfalfa at termination, alfalfa termination timing (fall vs. spring), and weather conditions between alfalfa termination and corn planting affect the frequency and level of N response in corn (Table 1). These factors were used in predictive equations to estimate when corn will respond to N and what the optimum N rate will be. These predictive equations are currently being validated with 15 on-farm trials across Minnesota this year. The same approach is being used with 200 trials of second-year corn following alfalfa and is expected to be completed later this year.

These ongoing efforts should be able to identify when corn following alfalfa will need N fertilizer and what N rates to apply.

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Wrapping Hay

Weather predictions are easy to make but carry a poor warranty. But with advances in computer modeling of weather patterns, developing a long range forecast has gotten better, but still tend to be very general and not site specific. Mark Seeley, University of Minnesota Climatologist, says the latest models are suggesting a weather pattern for Minnesota a bit like last year, wetter in the early part of part of the summer and dryer later on.

If the models are correct, that adds another challenge to preserving quality forage if you typically make dry hay. To harvest quality dry hay, several consecutive days of favorable weather are necessary. If Dr. Seeley's predictions come to fruition, harvesting a quality product from the first cutting of hay may be challenging.

Rain on cut hay can significantly reduce yield and quality. Depending on amount and duration, rain after cutting can reduce yield – and forage quality -- by up to 40 percent. The decline will likely be greatest if the rain falls on dry hay, considerably less if rain occurs on freshly cut hay.

Waiting for better weather also reduces quality, but increases yield. Alfalfa yield increases about 100 lbs per acre per day if growing conditions are "average", except for the latest cuttings. The quality of first cutting changes at the fastest rate while later cuttings change in fiber and digestibility at a slower rate. The first cutting decreases about 5 pts RFV per

day, second cutting decreases 2 to 3 points per day and third and fourth cutting during the growing season decline 1 to 2 points per day. The late fall growth may change little in forage quality during mid to late September and early October. Relative Forage Quality (RFQ) will change about the same as RFV on first cutting and then decline about 4 points per day on 2nd, 3rd and 4th cuttings during the growing season.

To deal with a potential loss in forage yield or quality, livestock producers have adopted large bale silage as a method of harvesting their hay crop. Putting up silage bales -- or "baleage" as many producers call it -- that will store longer with less dry matter loss is one key to efficient harvest. Baleage is an alternative to storing dry hay and may be exceedingly helpful during rainy periods of the haying season.

Silage bales are easy to transport short distances and make a flexible addition into most feeding programs. Feeding baleage is similar to feeding dry hay, but will have less storage waste. But, baleage may not be as feasible if long distance transportation is needed to market the hay. Since baleage can be as much as half water, transportation costs often become excessive.

The ideal moisture content for baleage is between 40%-55%. This will create a condition for proper fermentation and longer-term storage when the bales are wrapped. Dry matter losses will be lower when harvesting at these moisture levels. However, many producers end up in a moisture range between 20%-35% known as "tough hay". Bales in this lower moisture range need to be wrapped to avoid spoilage, but may not ferment as readily. The key with all moisture levels is to keep the air out. It's a bit like canning pickles or tomatoes; one will ferment, the other will not, but the key to both is excluding the oxygen.

Research in Wisconsin has found that at least 6mil, preferably 8mil, of plastic wrap cover the bale. This can be accomplished by wrapping 6 times with 1ml plastic or 4 times with 1.5 mil plastic. With 4mils of plastic, oxygen was found leaking through the plastic to support continued microbial growth and spoilage. Total plastic thickness, not the number of wraps appears to be the most important factor to resist oxygen from reaching the feed. Line wrappers provide an opportunity to reduce plastic costs and wrapping time when compared to individually wrapped bales.

For optimum preservation, bales should be wrapped within 24 hours using 6-8mil thick plastic. In a Wisconsin study, bales were wrapped at 12-hour intervals up to 96 hours after baling. Bales left unwrapped or wrapping delayed more than 48 hours exceeded internal temperatures of 130 degrees. These bales tended to have lower forage quality and greater mold throughout the bales.

An important factor to remember is to make bales

Wrapping Hay (Continued) and Reduce Storage Losses of Round–Bales

the size and weight for the wrapper and your loader. Most wrappers have an optimum length for bales of 4 to 6.5 feet. If moisture in bales is quite high, these bales can be quite heavy, so be sure your loader can handle the extra weight. Heavier bales have more problems with plastic tears and holes while wrapping, stacking, and in storage. With continuous wrapping (sausage style), this may be less of a concern. When you handle large individually wrapped bales, use a bale grabber instead of a spear unless you plan to feed immediately.

Silage bales should be placed on a smooth surface free of sharp objects or crop stubble. Mowing a grassy, well-drained area is a great place to store silage bales. Be sure the area is away from fence lines and other obstructions so removal is not hampered.

Harvesting high quality forage can be challenging during periods of rainy weather, but wrapping bales "wet" for bale silage offers producers one more option to achieve this goal.

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Reduce Storage Losses of Round–Bales

Hay waste can occur during both storage and feeding. Research has shown outdoor hay storage losses of round-bales can range from 5 to 35% depending on precipitation, storage site, and original condition of the bale. For example, the outer 4" layer of a 6' diameter round-bale contains about 25% of the total bale volume, and is most likely to be damaged by weather if stored improperly or unprotected.

There are a number of techniques that minimize outdoor storage losses of round-bales:

1. Bale (or buy) a dense bale as the bales will sag less and have less surface area in contact with the ground.
2. Use plastic wrap, net wrap, or plastic twine. Research has shown that net wrapped bales reduced grass hay dry matter losses by 32% compared with twine bales when stored outside.
3. Store bales on a well-drained surface. A well-drained, 4-6" coarse rock base will minimize bottom spoilage, as well as using wood pallets.
4. Never store bales under trees.

5. Store round-bales end-to-end when storing outside. Position round-bales as tightly as possible in long lines on a well-drained site. If more than one line of bales is needed, space adjacent lines at least 3 feet apart. This will increase air flow and allows sunlight to penetrate the bales. In a South Dakota study, dry matter losses of round-bales were 4% for round-bales stacked individually and less than 1% for round-bales stacked end to end.
6. When storing round-bales outside without cover, never stack round-bales in a pyramid. Stacking tends to trap moisture and limits drying action from sunlight and wind. A South Dakota study reported dry matter losses of round-bales stacked in pyramids at more than 10% after one year of storage.
7. Storage losses are usually reduced by approximately two-thirds with indoor storage and by one-half with good plastic covering (i.e. a tarp) outdoors.

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Pricing and Using Alternative Forages

The 2014 corn silage harvest will be upon us, which represents the primary harvest and storage of forage supply for the next twelve months. If you anticipating a reduction in forage production this year, due to late planting or prevented planting, some alternative forage supplies may be of benefit to your farming operation. Livestock farms should have a plan to ensure that forages stockpiles provide continuous supply from fall of 2014 through the fall of 2015. Having an accurate representation of forage inventory now, is an essential first step in planning out your needs for the feeding year. The

Pricing and using alternative forages for your farm (Continued from page 5)

next step is to build a feed and forage needs budget to estimate feed needs for your farm. After determining a reasonable feed needs budget estimate, then proceed in calculating any additional forage needs to quickly identify and secure potential sources of forage or feed alternatives. For dairy, allocate the highest quality forage for the milking herd and youngest heifers. For beef cows, you may choose to save some for calving time.

With the reduction in corn grain market prices some farms may find the opportunity to purchase some late planted corn to add to the supply of corn silage that they grew. Fields of late planted corn may be something that livestock farms can purchase from crop producers who are looking to reduce risk if these fields do not mature before this year's killing frost. In some cases, farms may have planted beyond the crop insurance planting date requirements leaving these fields exposed to a huge risk. How to price that crop is always a question that needs to be answered before harvest begins. One way is to price the forage based on a forage test post-harvest and with the known amount of forage harvested.

There are a number of ways to closely estimate the amount of silage. Silos and bags are easier to calculate than a pile but each can be done. For ease of calculating silage needs, start by estimating wet tons of silage using 65% moisture, then adjust from there. It is also best to put a minimum price floor if using a post-harvest test, to cover the value of fertility and organic matter. Along with establishing a price floor, consideration must be giving to harvest cost. Typically, harvest cost average \$100 ac^{-1} depending on rather the crop is harvested as silage or grain. To give a frame of reference between corn grain and corn silage in assessing value, the value of the corn grain per ton of silage is approximately 7

-8 bushels of corn per wet ton of silage. Later planting dates will lower the previous estimate. The value of the fodder is usually based on some alternative forage such as straw or stover. But making this comparison is difficult because the corn plant is much more digestible if harvested at 65% moisture than is dry straw or stover. Comparing that portion to high quality grass forage would be a better estimate of forage value and a better pricing guide. There are several spreadsheets available to help calculate values. Go to our UM Extension website for more help at www.extension.umn.edu/dairy.

Sweet corn silage or cannery waste can offer low cost forage alternatives in certain areas of Minnesota and the Upper Midwest. The table below compares favorably with regular corn silage in feeding

Table 1. Summary of forage quality.

	Corn Silage	Sweet Corn	Small Grain	BMR Sorghum	Corn Stover
Quality	————————%————————				
CP	8.5	9	16	14	5
NDF	45	55	50	55	65
TDN	70	67	65	70	45

value. It will be lower in starch, as many of these other forage can be. With all of these alternative forages, it is a good investment to get digestibility rates and estimations for NDF and the undigested NDF. There is a potential to overestimate energy content of forage if the NDF of the forage digests slower than we estimate.

Alternative forages could include cover crops that were planted on prevented plant acres and could be available for harvest after November first. While these can be very risky to rely on, the forage value as either harvested or grazed forage can be relatively high. Pricing these are difficult. Cover crop forages will usually be priced based on alfalfa haylage as a starting point and also compared to small grain silages. In many cases, depending on maturity, they will compare favorably with either forage. Again, forage tests and estimated yields are critical. For many of these different types of cover crops and alternative forages, a wet chemistry forage test will need to be done to obtain a more accurate forage analysis.

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