

# IMPROVING AND SUSTAINING FORAGE PRODUCTION IN PASTURES



NRCS



---

# IMPROVING AND SUSTAINING FORAGE PRODUCTION IN PASTURES

---

JUNE 2010



**Prepared by**  
Minnesota Department of Agriculture

**Written by**  
Howard Moechnig, Grasslands Specialist, Midwest Grasslands

**Assistance with printing was provided by**  
Minnesota Association of RC&D's  
WesMin RC&D  
Natural Resources Conservation Service

## **ABOUT THE AUTHOR:**

*Howard Moechnig graduated from North Dakota State University in 1974 with a degree in Agriculture, majoring in Soil Science. He worked for the Natural Resources Conservation Service from 1972 through 2006. For the last 10 years of his career he was a Grazing Specialist with NRCS, and was the State Grazing Specialist from 2001 through 2006.*

*After his retirement on January 3, 2007, Howard organized a consulting business, Midwest Grasslands. His business specializes in consulting with those who desire to manage their pastureland, rangelands, and grasslands in a manner that will sustain the soil, water, and plant resources. His work includes pasture and rangeland evaluation, and planning managed rotational grazing systems on pastures, rangelands, and land for wildlife habitat.*

*Howard has a small farm southeast of Cannon Falls where he raises sheep and markets grassfed lamb.*

Midwest Grasslands  
37484 - 90th Avenue  
Cannon Falls, Minnesota 55009  
(507) 263-3149  
mwgrasslands@frontiernet.net

For additional information, contact the Minnesota Department of Agriculture at (651) 201-6012 or online at:

**[www.mda.state.mn.us](http://www.mda.state.mn.us)**

In accordance with the Americans with Disabilities Act, an alternative form of communications is available upon request. TDD 1-800-627-3529

---

# TABLE OF CONTENTS

---

<b>INTRODUCTION</b> .....	7
<i>Purposes of this Publication</i> .....	7
<i>Benefits of Well Managed Pastures</i> .....	8
<i>Applicability of the Information in this Publication</i> .....	8
<b>GRAZING SYSTEM DESIGN AND LAYOUT</b> .....	9
<i>Pasture Subdivision</i> .....	9
General.....	9
<i>Significance of the Number and Size of Paddocks</i> .....	11
<i>Paddock Layout</i> .....	13
<i>Other Considerations for Determining Paddock Layout</i> .....	16
<i>Providing Livestock Water</i> .....	16
<i>Management of Sensitive Areas</i> .....	18
<b>STRATEGIES RELATED TO MANAGEMENT OF THE FORAGES</b> .....	20
<i>When to Initiate Grazing</i> .....	20
<i>Early Spring Grazing</i> .....	20
<i>Late Spring through Fall</i> .....	21
<i>Grazing Mature Stands of Forages</i> .....	22
<i>When to Terminate Grazing</i> .....	23
<i>Forages in a Vegetative Phase of Growth</i> .....	23
<i>Tall Forages and Those with Seed Heads</i> .....	24
<i>Exceptions to Guidelines for Leaving Adequate Plant Residues</i> .....	25
<i>Effect of Seasonal Stocking Rate</i> .....	25
<i>Managing a Leader-Follower Grazing System</i> .....	26
<i>High Density, Short Duration Grazing</i> .....	26
<i>Fall Grazing Management</i> .....	28
<i>Dealing with Wet Weather Conditions</i> .....	30
<i>Dealing with Dry Weather Conditions</i> .....	30
<i>Sacrificial Paddock Use and Management</i> .....	31
<i>Extended Rest</i> .....	32
<i>Managing Forage Balance</i> .....	32
<i>Maintaining Diversity in the Forage Stand</i> .....	34
<i>Managing Weeds</i> .....	35
<i>Options for Weed Control</i> .....	35
<i>Using More Than a Single Species of Livestock</i> .....	36
<i>Overwintering</i> .....	38

<i>Nutrient Management</i> .....	40
<i>Manure Management</i> .....	40
<i>High Density, Short Duration Grazing</i> .....	41
<i>Using Legumes to Add Nitrogen</i> .....	41
<i>Commercial Fertilizers</i> .....	42
<i>Soil pH Management</i> .....	42

<b>MONITORING PASTURES</b> .....	43
<i>Grazing System Evaluation for Pastures</i> .....	43
<i>Condition of the Plant Community</i> .....	43
<i>Management of the Grazing System</i> .....	44
<i>Condition of the Soil and Water Resources</i> .....	45
<i>Measuring Yield by Standard Animal Unit Grazing Days</i> .....	46

**APPENDICES**

<i>Appendix 1: Management Specific to Warm Season Grass Pastures</i> .....	47
<i>Appendix 2: Pasture Management Specific to Horses</i> .....	50
<i>Appendix 3: Pasture Management Specific to Swine</i> .....	52
<i>Appendix 4: Pasture Management Specific to Elk</i> .....	54
<i>Appendix 5: Pasture Management Specific to Bison</i> .....	55
<i>Appendix 6: Grazing System Evaluation for Pastures</i> .....	56
<i>Appendix 7: Standard Animal Unit Grazing Days</i> .....	60

<b>FOR MORE INFORMATION ON MANAGED ROTATIONAL GRAZING</b> .....	62
---------------------------------------------------------------------	----



# INTRODUCTION

As an experienced grazing specialist, I have planned hundreds of managed rotational grazing systems. These plans outline the locations of fences, water pipelines, and watering facilities, and provide basic guidance for management of the grazing system and the forages. Some of these systems were implemented with very good results. However, many did not work as well as they should have. The most common reason why managed rotational grazing systems fail to meet the full expectations of a producer is failure to implement forage management strategies that provide for

the needs of the forages in the pasture. There are several grazing systems with the entire infrastructure (fences, water pipelines, watering facilities, etc.) in place, but the forages are managed no better than before installation, or the forages are not managed in a manner that will optimize forage growth and livestock benefits. This results in wasted resources (time and money) for the producer. In addition, the benefits that should be realized are not.

## PURPOSES OF THIS PUBLICATION

Aside from adequate rainfall, the rate of growth of forages and their overall annual yield are directly related to how well the pasture has been managed, not only in recent grazing periods, but also during the previous fall and winter and even back through the entire prior grazing season. Pastures that were managed poorly during the prior year will lack the health and vigor of a well managed pasture. They will not produce the optimum quantity of forage during the current grazing season. All other factors being equal, the better a pasture is managed the more forage it will produce.

The intent of this publication is to:

- provide guidance to producers that will enable them to apply effective management strategies to improve the conditions in their pastures and lead to the benefits that a well managed grazing system ought to provide;
- provide information to avoid common mistakes in pasture and forage management, resulting in better pasture conditions which ought to lead to better livestock performance;
- be a tool that can easily be referenced by producers for management of their pastures and by service providers to use in their consultations with producers;

- provide information specific to livestock other than cattle and sheep that may be considered in a grazing system; and
- provide strategies for management of warm season grass pastures, since their management is significantly different than for cool season grasses.

With the information provided, you will be able to take an overgrazed, seemingly unproductive pasture, and develop it into a useful source of forages for livestock production. Even if your pastures are quite well managed, there may be some strategies in this document that will help you improve their condition and quality.

Always keep in mind that, even using the best management strategies, it is the capability of the soils and the site characteristics, as well as the weather conditions (primarily rainfall and temperature), that place an upper limit on the production you can expect from a given pasture.



Overgrazed, poorly managed pasture.

## BENEFITS OF WELL MANAGED PASTURES

How you manage your pastures will affect how much they will return to you. Well managed pastures will:

- produce more forage and more livestock products than poorly managed pastures;
- improve the condition of any ecologically sensitive areas;

- reduce runoff and improve rainfall infiltration;
- reduce the delivery of contaminants such as eroded soil, manure, and pathogens to surface waters, while contributing to proper nutrient management; and
- improve habitat for game birds, songbirds, and other wildlife.



Well managed rotational grazing system.

## APPLICABILITY OF THE INFORMATION IN THIS PUBLICATION

The information in this publication is limited to cool and warm season pastures that have been established by seeding.

The publication is based primarily on the use of pastures by cattle and sheep. Realizing that there are several other species of livestock on pastures in Minnesota, there are appendices that describe their grazing habits and issues related to managed rotational grazing.

It does not pertain to management of native rangelands and prairie remnants where the plant community is composed of a mixture of cool season native grasses, warm season native grasses, and native forbs (broadleaf herbaceous plants). In these situations the grazing management plan must be tailored to the specific site and specific needs of the native plant communities, as well as upon clear objectives of the landowner. In these systems timing, intensity, and duration of grazing as well as the season of use are very important considerations. These considerations are different from intensively managed pastures and are beyond the scope of this publication.

# GRAZING SYSTEM DESIGN AND LAYOUT

## PASTURE SUBDIVISION

### General

The first consideration in management of pastures for improved productivity and sustainability is to move away from grazing the pasture as one unit with the livestock having access to the entire pasture all season long. If this step is not taken, the remainder of the strategies described in this publication will not be effective, so this becomes the cornerstone of the pasture management system.

This first step involves subdividing the pasture into smaller units (paddocks) by installing fences in strategic locations (Figure 1). The result is the containment of the livestock in one of the paddocks for a relatively short period of time (grazing period) so they cannot roam the entire pasture at will. The livestock are then moved from one paddock to another throughout the grazing season. While they are contained in one paddock, they cannot access any other paddock. Movement of the livestock is sometimes facilitated by installing travel “lanes” within the pasture. In some systems the livestock are led or driven without the use of fenced lanes.

This strategy:

- allows most of the pasture to have a period of rest before being grazed again, allowing the forages to recover from a grazing event;
- improves the efficiency of harvest for the area being grazed (Table 1);
- gives plant roots the opportunity to grow to greater depths in the soil;
- increases plant food reserves so plants recover much more rapidly after grazing;
- results in forage plants that are healthier, more vigorous, and more productive;
- reduces, and can even eliminate, “spot grazing” and “zone grazing”; and
- improves livestock performance.

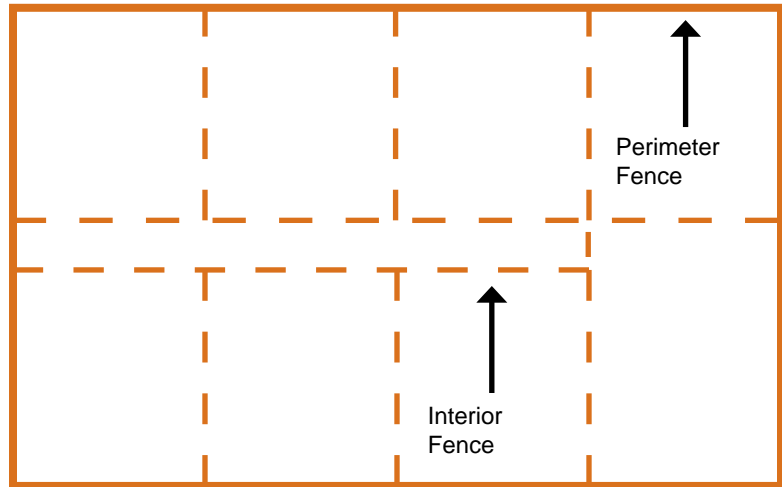


Figure 1. A pasture subdivided into eight paddocks, with a travel lane to access each of them.

Table 1. Relative grazing efficiency of several grazing system designs.

Grazing System Design	Relative Grazing Efficiency
Continuous grazing	30%
4 Paddocks	35%
8 Paddocks	50%
12 Paddocks	65%
24+ Paddocks	75%



Compared to a pasture that is allowed rest periods, a continually grazed pasture is at a distinct disadvantage for forage production.

- Forages that have been grazed do not have the opportunity to recover before being grazed again.
- Photosynthetic activity is diminished by the resulting small leaf area, so production of sugars in the plants is reduced.
- Re-growth of the forage plant depletes any stored root reserves, so the plant has to rely on photosynthesis from a greatly reduced leaf canopy.

- Through the growing season, a significant percentage of the root mass dies, restricting the ability of the plant to draw nutrients and water from the soil (forages actually go into a “producer induced” drought).
- Plant re-growth is very slow and greatly reduces the production of usable forage for livestock.
- The reduction in the health and vigor of desirable forage plants allows undesirable plants (thistles, etc.) to become established (Figure 2).

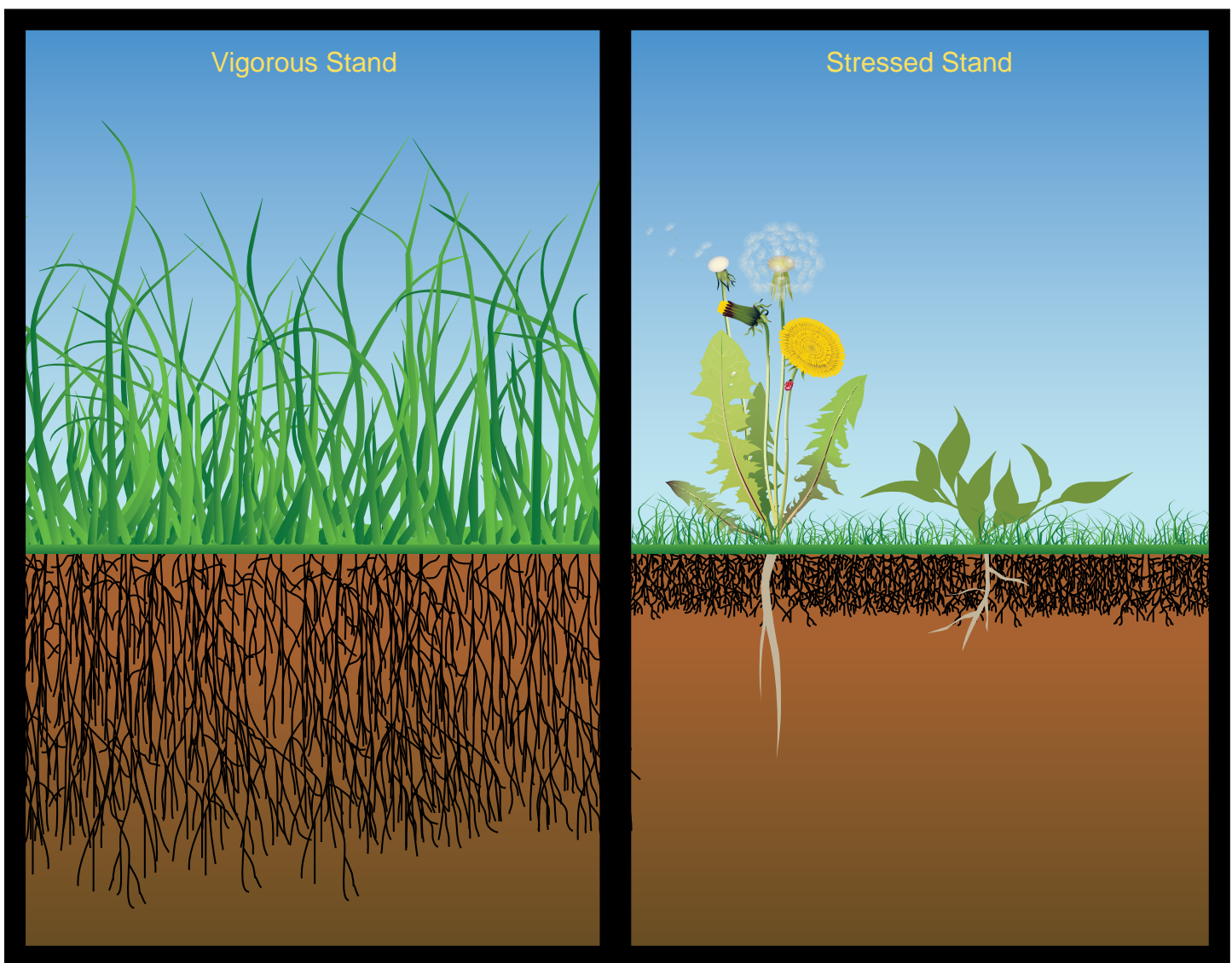


Figure 2. Comparison of vigorous forage stand vs. stressed forage stand. The vigorous stand is more productive and less prone to invasion by weeds.

## Significance of the Number and Size of Paddocks

The correct number of paddocks is very important so the forages get the rest period they need to recover from grazing events. It is central to the rotational grazing system.

Table 2 provides information on the number of paddocks to plan for your system. The shorter the planned grazing period, the more paddocks you will need. With all other things being equal, the paddocks in a system with a 6 day grazing period will be much larger than a system with a planned grazing period of 1 day. Keep in mind, you will need more paddocks on less productive pastures.

Table 2. Minimum number of paddocks required for each herd based upon the number of days in the grazing period and relative productivity of the site.

Days in grazing period	Productive site-30 days of rest (# of paddocks)	Less productive site-35 days of rest (# of paddocks)
6	8	9
5	9	10
4	11	12
3	13	15
2	16	19
1	31	36
0.5	61	71

Significant factors to consider when using this chart:

- ✦ The maximum number of days in a grazing period is 6 days. This allows for 30 days of rest.
- ✦ The number of days in the grazing period that you select for your operation will be based on the performance objectives of the livestock you are producing. For example, high production levels necessary for milk cows and cattle being finished on grass require short grazing periods (0.5 days to 1 day) to optimize performance, while beef cow/calf operations can easily go 6 days in a grazing period.
- ✦ Grazing periods longer than 3 days allow the livestock to re-graze forages that have already been grazed, weakening the desirable forages in the stand. There is really no good agronomic reason to exceed a 3 day grazing period. The reasons for planning longer grazing periods relate to available labor or time to move the livestock. Allowing grazing to occur for 6 days in a paddock is a compromise between what is best for the growing forage and the amount of time a producer has available to move livestock.
- ✦ You obviously must consider inherent soil productivity. Longer rest periods (35 days on average) are necessary for soils that are droughty (sandy or gravelly), or that are subject to higher temperatures, as on steep, south and west facing slopes. For good, arable soils a 30-day average rest period is sufficient.
- ✦ The recommended days of rest are based on averages. It is a fact that averages do not occur all that often! During periods of drought, the rest periods may need to be much longer than the average. During periods

of ideal growing conditions, the rest period may not need to be as long. Even during a normal single growing season the rest period for a paddock in the spring will not need to be as long as what is planned, and the rest period in the summer will need to be longer than what is planned.

- ✦ Important note! Using averages to develop a pasture subdivision plan will “put you in the ballpark”. It will always be necessary to fine-tune the management of your pastures based on ever changing conditions, especially the weather.

**Proper sizing of the paddocks** is necessary to prevent overutilization or underutilization of the forages. This is based upon three things:

- the daily forage requirement of the herd;
- the number of days in the grazing period; and
- the yield of the pasture.

The daily forage requirement of the herd is simply equal to 4% of the estimated herd weight. For an exception to this, refer to Appendix 4, Pasture Management Specific to Elk. This figure multiplied by the number of days in the grazing period will give you the forage requirement for the grazing period. This includes what they will eat, what they trample, what they contaminate with waste, plus a small buffer.

The yield of the pasture is more difficult to estimate, but here are some guidelines:

- A pasture in very good condition, about 10" tall, will yield approximately 1,200 lb/A (leaving a 4" residual stubble height).
- This number should be reduced for pastures with less than optimal forage stands due to poor fertility, droughty soils, or other factors that reduce yields.
- Increase the available forage estimate when stands are taller than 10", but keep in mind that livestock will tend to trample significant amounts of forages when grazing a mature stand.
- Our tendency is to overestimate the quantity of forage. Experience has shown that many pastures that appear to be in good condition, and about 10" tall, will produce about 900 lb/A of forage above the 4" residual stubble height.

If you divide the pounds of forage required for the herd during a grazing period by the yield of forage per acre, the result is the number of acres required for each paddock.

**EXAMPLE:** *A herd with an estimated total weight of 40,000 lb will require 1,600 lb of forage (on a dry matter basis) each day of the grazing period. If a 3 day grazing period is planned, the total forage required for the grazing period is 4,800 lb.*

*If the estimated forage yield is 1,000 lb/A, the number of acres of forage required for the 3 day grazing period is 4,800 lb divided by 1,000 lb/A, or 4.8 acres. This is the planned size of each of the paddocks, assuming that the yield is uniform over the entire pasture.*

In a properly sized paddock, at the end of the planned grazing period, there should be a residual stubble height of 4" in paddocks where the forages are still in a vegetative stage of growth. In paddocks where the forages are more mature and have seed heads present, there should be at least 1,500 lb/A of plant residues trampled to the ground. Refer to the section "When to Terminate Grazing-Tall Forages and Those with Seed Heads" on page 24.

**Ideally**, from a forage and pasture management point of view, the grazing period should not exceed 1 day, with the paddocks sized to provide an adequate amount of feed for the livestock for 1 day, and still leave adequate amounts of residual plant material. This will prevent re-grazing of already grazed forage plants, will minimize spot grazing and zone grazing, and will minimize soil compaction by the livestock. It will also provide significant benefits to the microorganisms in the soil, lead to increased availability of nutrients, increase organic matter in the soil, improve infiltration, and reduce runoff.

Paddock grazed to approximately 4" residual stubble height. Livestock should be moved to a new paddock.



NRCS

## Paddock Layout

Two common methods for layout of paddocks are “set paddocks” and “strip grazing”. Each of these methods has advantages and disadvantages.

### Set Paddocks

With set paddocks all of the boundaries of the paddocks are established by fences (usually permanent fences) that are kept in place. The size of each paddock is defined (“set”) by the fences and does not change. Paddock size is determined by the productivity of the soil and the site, by the quantity and quality of the forage, and by the forage requirement of the livestock (Figure 3).

Set paddocks need to be managed closely due to fluctuations in the quantity of forage available from one grazing period to the next, and because the total herd weight may change significantly during the grazing season. Without this management the forages may suffer from overutilization or underutilization. Set paddocks can be managed by:

- increasing or decreasing the time period that the livestock are kept in the paddock (duration);
- increasing or decreasing the number of head of livestock (actually the total weight of the herd) in the paddock during the desired grazing period; or
- splitting the set paddock using temporary fences (step-in posts and polywire or polytape) to redefine the paddock size in the event that you have significant changes to the herd weight or in case you reduce the number of days in the grazing period.

Advantages of set paddocks in comparison to strip grazing systems include:

- less time spent moving temporary fences and water tanks; and
- works well for particular livestock that do not respect temporary fences (deer, elk, bison, and hogs).

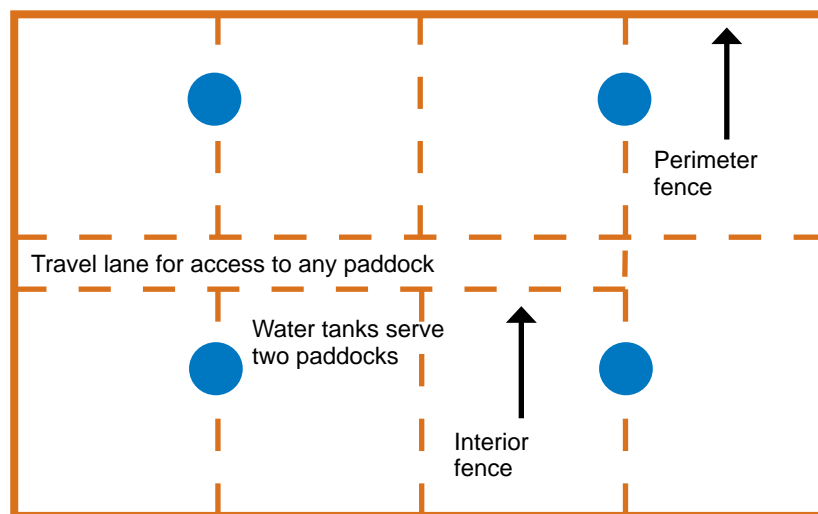


Figure 3. Set paddocks with water tanks accessible by livestock in each paddock.

### Strip Grazing

In strip grazing systems the pasture is divided into relatively long, narrow strips with fences that are kept in place (usually permanent fences). To define a paddock within these strips, you install a front fence and a back fence to confine the herd where you want them. These front and back fences are made of temporary fence materials, such as polywire or polytape, attached to step-in posts. This allows for easy installation and removal of the front and back fences. This is important because these temporary fences are moved quite often (Figure 4).

As the livestock are moved through a strip grazing system the temporary fences are also moved. Three temporary fences are required for the best control of the herd:

- the front fence that keeps the livestock from moving into the next grazing allocation (paddock);
- the back fence that keeps the livestock from going back to re-graze the paddock they had just been in; and
- a third fence that defines the next paddock for the livestock to be moved into (this used to be the back fence for the paddock the livestock just left).

These fences are moved in a “leapfrog” manner so that when the livestock are moved into a new paddock, the old front fence becomes the new back fence, and the old back fence is moved ahead to become the new front fence for the next paddock where the livestock will be moved.

In the same manner, any temporary water tanks will be moved ahead so that there will be a full tank of water waiting in the next paddock when the livestock are moved ahead. The water tank in the paddock the livestock just moved from is moved ahead, connected to the water pipeline and is ready for the next move of the livestock. Permanent water tanks can be adapted to strip grazing systems to avoid the need to move water tanks. This is sometimes necessary when the water requirement of the herd is relatively large or the water delivery system is slow.

Grazing strips do not need to have parallel sides. They can be used in situations where one edge is against a landform that dictates curved or irregular edges. Such situations include pastures that border very steep hillsides not suitable to grazing, wetlands, stream corridors, lakes, and winding roads and highways.

Grazing strips are commonly 100 to 300’ wide, depending on the size of the herd or flock, the kind/class of livestock, and the productivity of the pasture. Generally, the width is determined so that the paddock that you establish within any of the grazing strips is square or nearly so. If there is a compelling reason to make the paddock more rectangular, this can also be done.

Most beef cow/calf operations with more than 45 cows will have strips 300’ wide. Smaller herds will have narrower grazing strips.

With sheep production, the grazing strips are often defined by border fences 150’ apart so that the front and back fences can be constructed of temporary electric netting which normally comes in 164’ lengths. Having the strip a little narrower than the reach of the electrified netting allows for some “weave” in the electrified netting that crosses the strip.

One limiting factor related to strip width is the amount of temporary fencing material you can physically handle. For a person on foot, this is about 300’ of common temporary fence materials or 164’ of electrified netting.

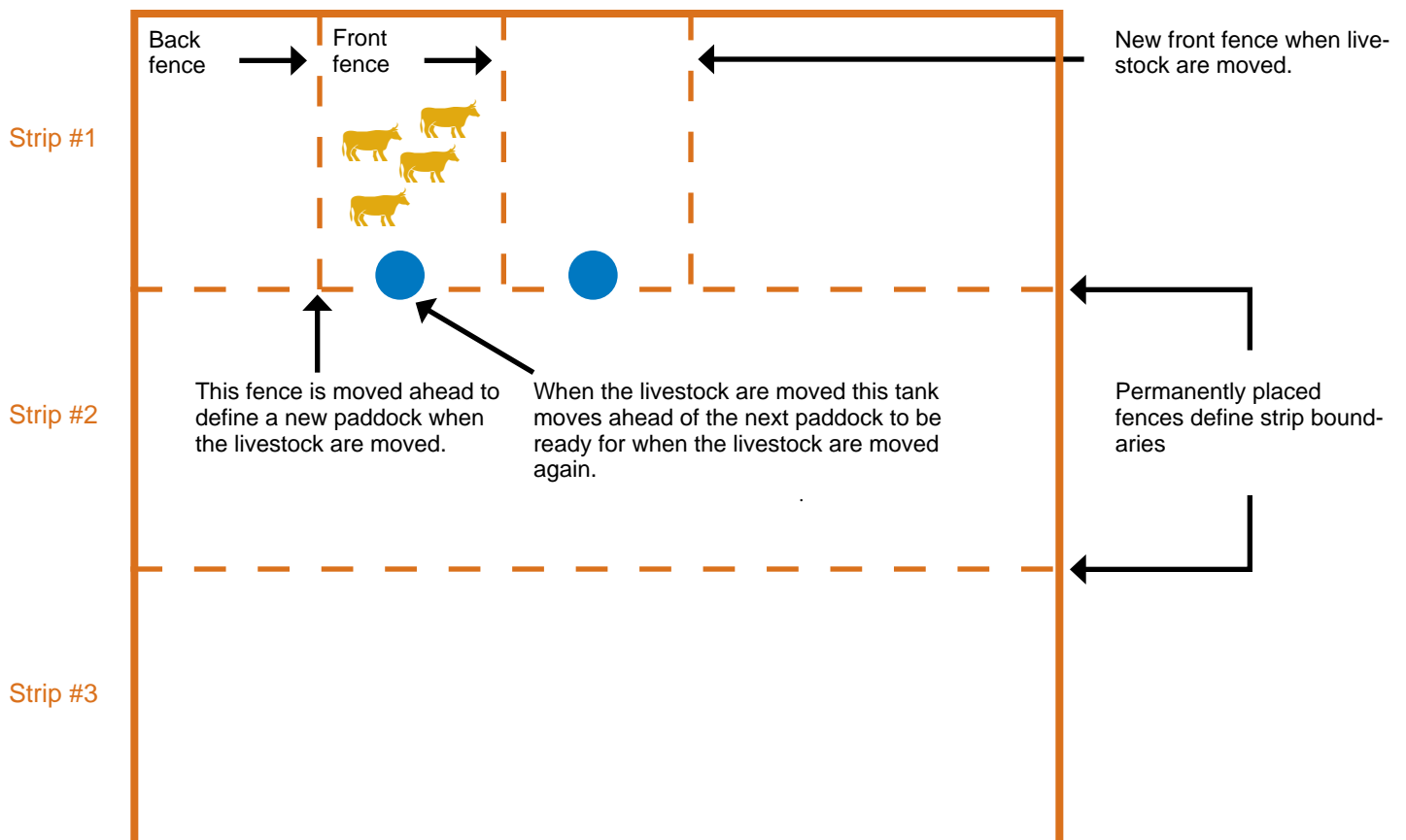


Figure 4. Strip grazing system.



Some of the advantages of strip grazing systems over set paddocks are:

- It is much easier to make hay in a strip grazing system because the paddocks are only defined for a short time, with the front and back fences easily removed so that long windrows of hay can be made. Constant turning of equipment can be minimized in a strip grazing system as compared to a set paddock system.
- This system also has the flexibility required for producers who rotate their cropland and pasture over the same acres as a regular feature of their production model. In the example in Figure 5, over a period of 8 years each paddock will have corn for 1 year, soybeans for 1 year, small grain for 1 year, hay for 2 years, and pasture for 3 years. A grazing strip can easily be converted to a field for row crops and back again to pasture in a few years. The width of the strip would be based on the width of tillage, planting, and spraying equipment.
- The size of the next paddock (grazing allocation) can easily be modified in a strip grazing system by providing a larger or smaller area to graze. This is important when the size of the herd changes significantly during the grazing season, or if the length of the grazing period needs to be flexible.
- Flexibility of the size of the next paddock is also important when there are significant differences in the production throughout the pasture. In areas of lesser production the paddock can easily be made larger to assure that the forage needs of the livestock are met.
- Areas of the pasture that have not recovered adequately can easily be passed by.
- For early spring grazing when the quantity of dry matter is generally lower, it is easy to set up a larger than usual grazing allocation to provide adequate quantities of forage. (See the section “When to Initiate Grazing” on page 20.)

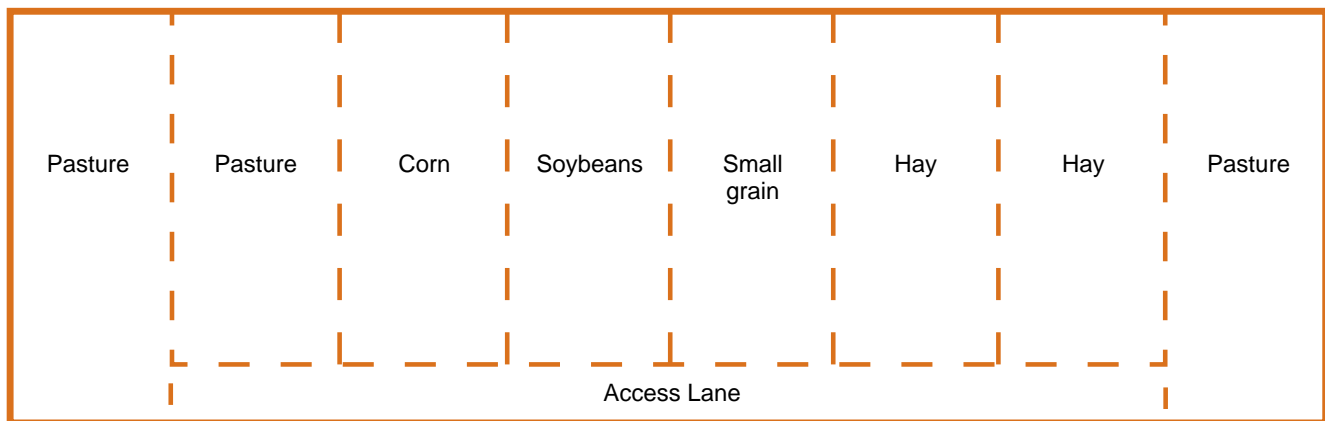


Figure 5. An example of grazing strips in a system with pasture rotated with crops. Over a period of 8 years each paddock will have corn for 1 year, soybeans for 1 year, small grain for 1 year, hay for 2 years, and pasture for 3 years.

### Other Considerations for Determining Paddock Layout

It is important to have paddocks contain areas that are somewhat homogenous to avoid differential grazing. This is caused by the preference of the livestock to graze one part of a paddock while avoiding other areas within the paddock (Figure 6). Therefore, establish paddocks to:

- contain soils of similar productivity;
- have similar topography/landforms;
- have similar slope aspect (south facing, north facing, etc.); and
- have similar plant community composition.

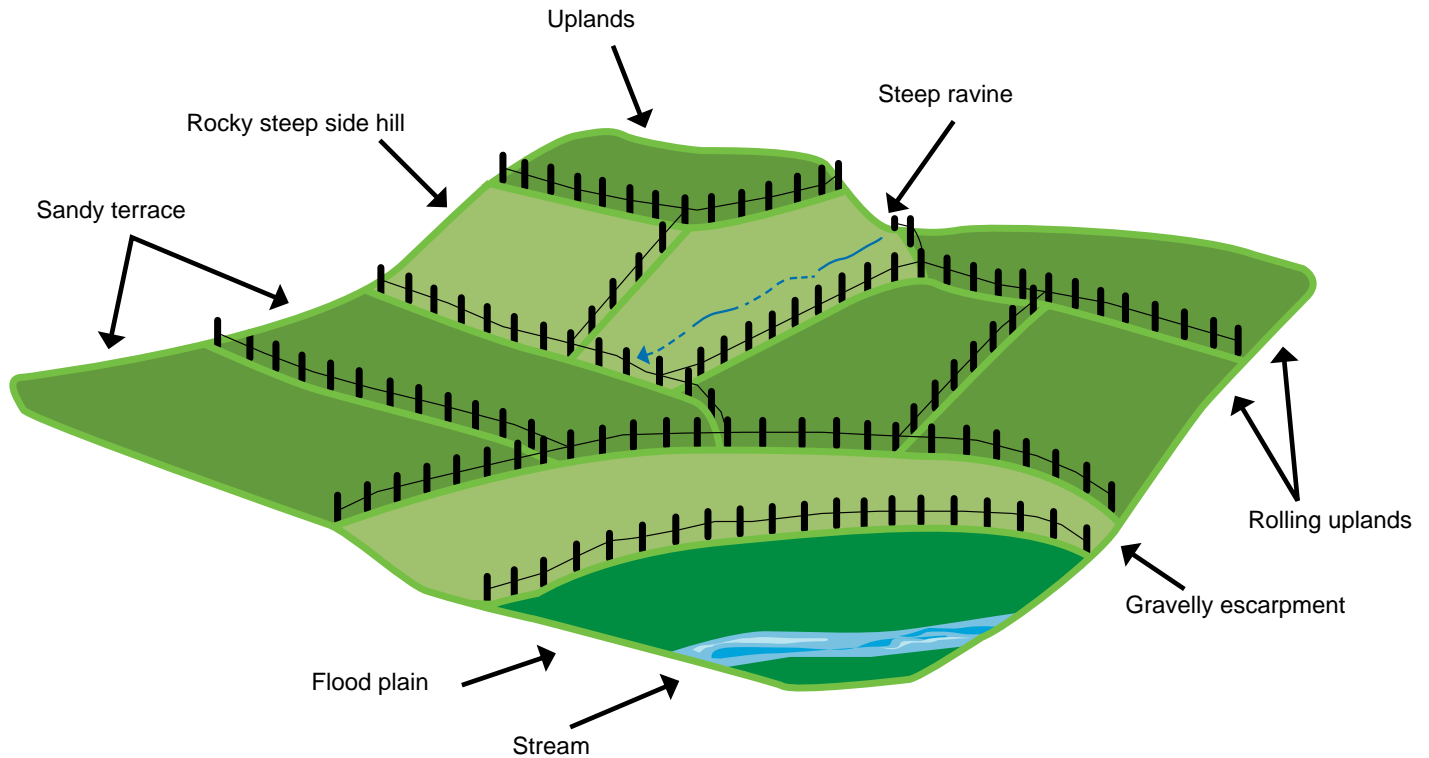


Figure 6. Paddocks established based upon soils and landscapes.

### PROVIDING LIVESTOCK WATER

The importance of having adequate watering facilities available in the pastures cannot be over emphasized. Having water in each paddock will encourage more uniform grazing, and eliminate the need for livestock to walk long distances to drink. This alone can make a managed rotational grazing system work well or fail.

The exception to having water in each paddock is for herds that return to the farmstead each day. For example, dairy cows are brought in from the pasture twice daily, so the issue of water in the pasture is not as significant for them. When livestock are brought in to the farmstead each day, there should be travel lanes set up for them to

use to prevent them from walking over areas that are not ready to be grazed or that have recently been grazed.

Adequate quantities of water are important to herd health and performance. Livestock that do not have adequate water will not gain weight or produce milk as well as they could. Adequate water helps keep livestock cool during hot weather. Forage consumption is greater and livestock performance is improved when livestock can drink water as they desire it.

Watering facilities that are inadequate, placed improperly in the grazing system, or just not provided will have an adverse impact on the management of the forages as well.

It is best to have water available in each paddock within the grazing system. This eliminates the need for livestock walking long distances to get a drink. The advantages of this include:

- The livestock will stay in the paddock you put them in and will spend their time grazing, which should be your objective.
- As the livestock graze, manure is dispersed in the paddock where it will benefit the forages. If the livestock

have to move long distances to water, they will deposit much of their manure in the travel lane on the way to and from the tank. In addition, they will spend extra time lounging in the area of the tank, depositing additional manure at that site.

Each paddock in the grazing system should have water available within a reasonable distance. For sheep, hogs, and cattle, this is within 800'. For bison and elk, water should be within 1,320' of the area they are grazing.



NRCS

Bison watering at a tank. It is not unusual to have bare soil around permanently placed tanks.

Effects of livestock traveling to farmstead for water. No water was available to the cattle in the pasture.



NRCS

## MANAGEMENT OF SENSITIVE AREAS

Many pastures in Minnesota are located on lands that are not suitable for cropland. As the land was settled and brought into production, it was logical for a diversified farm to utilize the rough, steep, infertile, rocky, and wet sites for pasture, saving the best soils for crop production.

Because of this, existing pastures are often areas that are sensitive for one of many reasons. These are often mixed in the same pasture with areas that have few limitations for use as grazing land.

A well developed and managed grazing system takes into account the various sensitive areas found within a pasture and allows for different levels of use for those areas. The benefits include reduced damage to the water and soil resources, improved production of forages in sensitive areas, improved herd health in many cases, and improved wildlife habitat. Good stewardship of the natural resources in a pasture lends itself to continued, sustainable use of those resources.

Areas of pastures that are commonly considered to be sensitive areas include:

- + wooded areas, including savanna;
- + native prairie remnants;
- + steep slopes;
- + shallow or thin soils;
- + organic soils;
- + springs or seeps;
- + riparian areas;
- + wetlands, ponds, lakes;
- + streams, rivers;
- + areas that commonly flood;
- + conservation structures;
- + areas with threatened or endangered species; and
- + areas with archeological significance.



A native prairie remnant being grazed by bison.



A riparian area in a grazing system. This stream is fenced and managed as a separate paddock.



A wetland in a pasture. Livestock have access to it only for a short time and then it is rested for at least 30 days.



Livestock will often overutilize sensitive areas when they are included in a larger paddock. Heavy use in the spring may reduce forage growth in these areas during drier times of the grazing season. This will result in a much lower forage yield on the sensitive areas than if grazing had been controlled and allowed only within the limitations of the site and its plant community. Allowing grazing only when the forages are at the proper stage of growth will improve and maintain forage health and vigor, resulting in a higher seasonal yield.

The basic management strategy for sensitive areas is to fence them as separate paddocks. This gives you control of how many livestock will use the area (intensity), when it will be used (timing), and the length of time they will be allowed to stay on the site (duration). Uneven grazing (differential grazing) will take place if sensitive areas are combined with other areas that are dissimilar, and the livestock will overutilize forages on part of the paddock and underutilize forage in other areas. The sensitive areas may be damaged from excessive livestock impact.

To create a separate paddock for a sensitive area is feasible only when the sensitive area is large enough to make it worthwhile. In most cases, where the sensitive area is small, it can be included in a larger paddock.

Fencing the sensitive areas may not be necessary if a well managed rotational grazing system is employed. During the relatively short time the livestock are in a particular paddock, they may not overutilize sensitive areas if there is adequate forage in the remainder of the paddock and if the plants in the sensitive areas are not preferred by the livestock. Fencing to exclude livestock or to minimize their access to an area should be done only when it is necessary, based on observations of the grazing habits of the livestock.

The need to fence a sensitive area is dependent on the grazing habits of the livestock, the desirability of the plants growing in the sensitive area, and the quantity of desired forages in the remainder of the paddock. Examples of sensitive areas that do not normally need to be fenced are riparian areas of smaller streams and wetlands.

Examples of sensitive areas that are often large enough to be a paddock of their own include:

- + flood plains;
- + wooded areas, including savannas;
- + steep slopes; and
- + organic soils.

The other sensitive areas from the list earlier in this section usually need to be fenced to prevent damage to the resource by livestock with uncontrolled access.

In managing sensitive areas it is important to recognize that each area needs to be assessed on its own merits and in its own situation, especially in regard to how large the area is and how much damage the livestock might cause during the normal grazing process. The above discussions only provide general guidance.

Streams, rivers, springs, seeps, and wetlands (to some degree) offer the opportunity to provide water to livestock. This is one good reason to restrict or deny livestock access to them. Being able to supply good, clean water to the animals is important to their performance level and their general health. If livestock have uncontrolled access to these sensitive areas, the value for use as livestock water is greatly diminished.

Wooded areas with a grass understory can be used for grazing. These areas make a good place to put livestock during periods of intense heat. They should be managed by making the wooded areas into separate paddock(s), doing a spring grazing, and then reserving them for grazing during periods of excessive heat. This is especially important during the breeding season. If your wooded area is fairly small, consider putting the livestock into that paddock during the heat of the day and then move them to paddocks with no shade during the evening, night, and early morning.



# STRATEGIES RELATED TO MANAGEMENT OF THE FORAGES

## WHEN TO INITIATE GRAZING

Deciding when to send livestock into a paddock is dependent on the time of the grazing season. In the early spring the answer is different than in midsummer or fall.

### Early Spring Grazing

It is quite common for the weather in the spring to be different from any spring in the past. Therefore, do not use a set calendar date for deciding when to initiate grazing. The difference in starting date can easily vary by 3-4 weeks depending on how quickly the weather warms up and on how much moisture is available.

Base the decision on when to initiate grazing on the physiological stage of growth of the forage plants. This is a time in the grazing season when cool season forage plants grow rapidly. From a forage management point of view it is desirable to start grazing the livestock through the paddocks in the spring when the forages are 4". At this time the livestock should be moved through the paddocks faster than normal to keep up with forage growth. The number of days of grazing starts out short (1-2 days) and increases as the forages mature, up to the planned length of the grazing period.

Using this strategy, the residual stubble heights of the forages in the first few paddocks will likely be below 4". As the herd progresses through the paddocks more residual height will remain because with each move they are going into a paddock with taller vegetation.

At this time of the season you want to end up with each paddock at a different stage of forage growth than the other paddocks in the pasture (staggered growth). As the season progresses forage growth will slow down and the length of the grazing period should switch over to the initial plan.

Why not wait for the grasses to get taller before initiating grazing? If you wait until the grasses are 8" tall, by the time the livestock are rotated through half of the paddocks, the forage will be quite mature and the quality will be lower than desired. Starting the grazing at 4" keeps the grass from getting ahead of the livestock.

Because the grass is shorter in the spring, there is not as much available dry matter for the livestock as there is later in the season. The livestock will need a larger area for the grazing period, or be allowed in a paddock for half of the grazing period that you planned for when you designed the grazing system.

With this system, the first paddocks that are grazed in the spring will be overutilized and may show some signs of damage from livestock hoof action. As the livestock move through the paddocks, they will be going into forages that are taller and more mature than those in the first paddocks, and the residual stubble height will be greater than 4" due to the relatively short grazing period. By the time the livestock have gone through the entire pasture, the first paddocks may not be ready for grazing, so move the livestock back through the pasture the way they came (bounce-back grazing system), allowing them to graze the forages to the allowable residual stubble height (Figure 7).

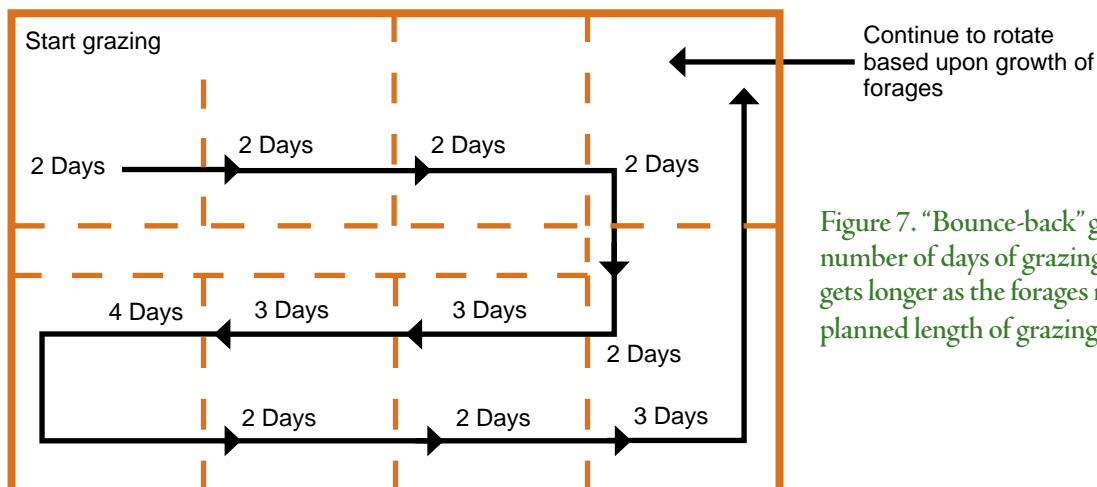


Figure 7. "Bounce-back" grazing system. The number of days of grazing starts out short and gets longer as the forages mature, up to the planned length of grazing period.

### Late Spring through Fall

As the grazing season progresses into mid to late spring, the livestock should be kept on each paddock for a longer period of time, up to the planned length of the grazing period, not to exceed 6 days.

Once the early spring flush of growth has taken place, grazing on most cool season forages should not be initiated until they are 8 to 10" tall. Refer to Table 3 for recommendations for common forage species. Re-grazing too soon does not allow the forage plants to recover fully from the previous grazing event and will significantly reduce the root mass of the plants. This results in reduced plant vigor and reduced yields.

Table 3. Minimum height of pasture species for initiating and terminating grazing.

Species	Begin Grazing		End Grazing	
	Initial grazing height in early spring * (inches)	Minimum & optimum height of vegetative growth (inches)	Minimum stubble height ** (inches)	Minimum re-growth before killing frost (inches)
Alfalfa		Bud Stage	-	6 ***
Creeping foxtail	6	8-10	3	6
Green needlegrass	4-5	6-8	3	5
Inter, wheatgrass	4-5	8-14	4	6
Kentucky bluegrass	2	4-6	2	4
Orchardgrass	3-4	6-10	3	6
Perennial ryegrass	3-4	5-7	3	4 ****
Pubescent wheatgrass	4-5	8-14	4	6
Reed canarygrass	4-5	8-8	4	6
Russian wildrye	4	5-7	3	4
Slender wheatgrass	4-5	6-12	3	6
Smooth brome	4	8-14	4	6
Tall fescue	4	6-10	3	6
Tall wheatgrass	4-5	8-14	4	6
Timothy	4	6-10	4	5
Western wheatgrass	4	6-10	4	5
Big bluestem		10-14	6	6
Indiangrass		10-14	6	6
Little bluestem		5-7	3	4
Sand bluestem		8-14	6	6
Sideoats grama		5-7	3	4
Switchgrass		12-20	8	10

Source: Minnesota NRCS Conservation Practice Standard #528A, Prescribed Grazing.

\* This applies only to the initial grazing in the spring (early May). The livestock must be moved rapidly through the paddocks during this time to prevent overgrazing and to keep the forage from "getting ahead of the livestock."

\*\* Minimum stubble height is critical if stand is to be maintained. This applies to that part of the grazing season after the initial rapid growth period in early May, as well as the end of the grazing season.

\*\*\* The last harvest of alfalfa for pasture or hay should generally be made 35-45 days prior to the time when the first hard freeze typically occurs.

\*\*\*\* Re-growth should be grazed to 2" after dormancy and prior to snow cover.

## Grazing Mature Stands of Forages

There are two schools of thought related to grazing livestock on more mature stands of forages. The first is a belief that forages need to be kept in a vegetative stage of growth at all times in order to provide the highest quality of feed for the livestock. Forages in the vegetative stage do contain relatively high levels of protein and make for a high quality feed. Often this feed is too high in protein for the nutritional needs of the livestock and requires some supplemental feed source to provide energy in the ration.

In grazing systems with the forages always in a vegetative stage, the plants must be grazed at rather close intervals. In other words, there is a relatively short rest period for the plants to recover from the prior grazing event.

Forage plants in this management scenario will not develop strong, deep root systems. They will always be attempting to get to the stage of plant development where there is excess “food” produced in the plant that can be stored, generally in the roots, for use later. Nearly all of the food produced by the plant is expended in re-growth of the vegetative parts of the plant after grazing takes place.

Annual fertilization and over-seeding/inter-seeding are common to pastures managed in this manner. This is an effort to maintain the overall plant population and vigor of the stand.

The second school of thought is to allow the forages to grow beyond the vegetative stage, even to the point of allowing the plants to produce seed heads. Even though grazing is initiated in the spring when the forages are about 4” tall, the farmer is not concerned with keeping the forages in a vegetative state through the grazing season.

When allowed to mature beyond the vegetative phase of growth, the plants have developed to a stage where there is an adequate quantity of sugars produced in the plants to allow for growth of the roots and for storage of the starches in the roots. The plant draws on these reserves when another grazing event takes place and the plant begins to re-grow. Drawing on established root reserves allows the plants to recover quickly from grazing. As long as the grazing is terminated before the livestock overgraze the paddock, this re-growth will take place without significantly reducing the root mass.

The feed offered to the livestock in this manner of grazing is not as rich in protein, is higher in energy, and has more bulk, which is important to ruminants.

Systems managed this way are less reliant on fertilization and over-seeding/inter-seeding to maintain a dense and vigorous sward.



NRCS

Replacement dairy heifers grazing more mature forages.

### *When to Terminate Grazing*

The decision to terminate grazing on a paddock is vitally important. One of the surest methods of reducing forage yields is to graze the forages too short or to remove too much of the plant material. Table 3 on page 21 indicates recommended residual stubble heights for common forage plants when grazing should be terminated.

Grazing a stand of forages too short (often called overgrazing or overutilization) has a negative effect on overall production from the overgrazed paddocks through the grazing season and it may even carry over into the next season. Grazing below recommended residual stubble heights removes active growing points that the plants have established. If the active growing points are removed, the forages will need to re-grow from buds on the roots, which requires an extra 7-10 days. This weakens the root by drawing upon stored root reserves, since the leaf area of the plant has been reduced to a point that it cannot produce enough food to allow for rapid re-growth.

### *Forages in a Vegetative Phase of Growth*

For most of the cool season forages the recommended residual stubble height is 4" (Table 3, page 21).

For many forage species, the plant parts below the 4" residual stubble height are of poorer feed quality. Overutilization of the forage plants leads to a reduction in livestock performance as expressed in lower weight gain or less milk production. It is better from a production standpoint to move the livestock to a new paddock than force them to eat the material below the minimum residual stubble height.



NRCS

Checking stubble height for when to terminate grazing.



### Tall Forages and Those with Seed Heads

As forages mature, it is best to provide a forage allocation large enough to satisfy the herd requirement for 1 day, use a 1 day grazing period. This maximizes the utilization of the forage crop.

It will be difficult to leave a particular height of forage residues in stands of forages that have developed beyond the vegetative stage of growth. Grazing livestock will trample stands in this condition as they graze the paddock. When it is time to move the livestock, the paddock will have no discernable residual stubble height to measure or observe. For cases like these, there should be approximately 1,500 lb/A of forage residue remaining. Use these two helpful indicators to estimate the quantity of residues: With this amount of residue the surface of the ground is covered with trampled plant residues, and there are little to no areas of bare soil. If there are significant areas of bare soil, the length of the grazing period should be reduced, or the area provided to the livestock for the desired amount of time should be increased.

Initially, it may appear that trampling the forages would be detrimental to the plants, but these plants have matured to the point where they have stored considerable root reserves. This allows them to re-grow quickly. A plant that has reached the early boot stage of growth, and beyond, will re-grow from root buds anyway because the growing point is removed during the grazing process (Figure 8).

Forages can get too mature to be good for grazing. This stage is reached when the seeds begin to harden and the leaves are dying. It may be best to harvest the forage for hay at that time, although some producers have the livestock eat what they can and trample in the remainder just to allow the forages to get a "fresh start". Obviously, this is a better option for livestock that

do not need high quality feed (beef cows, dry cows). It is not such a good option with livestock that require quality forage for high performance, such as milk cows and beef finishers.

There may be the situation where many of the forages are too mature for grazing, but there are other species in the understory that are not as mature. Not all forages mature at the same time so you need to consider the understory vegetation. From a distance, the entire pasture may look too mature, but a closer examination reveals much palatable forage in the understory.

In pastures with only one or two predominant species when those species are mature, the stand is too mature to provide good feed for livestock.

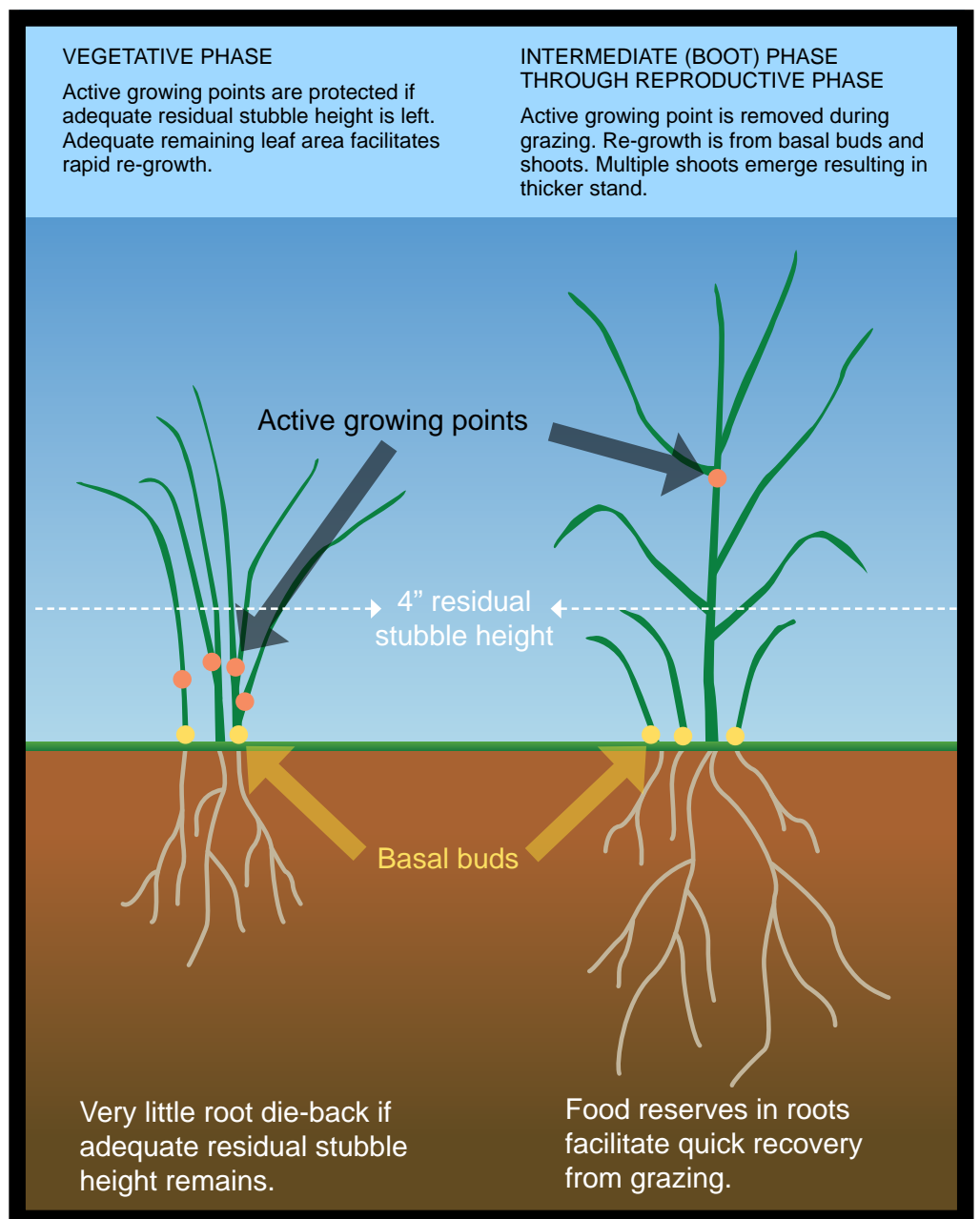


Figure 8. Relative location of growing points at different phases of grass growth.



## *Exceptions to Guidelines for Leaving Adequate Plant Residues*

There are valid reasons to allow grazing below the residual stubble heights listed in Table 3 on page 21.

When preparing to inter-seed an existing pasture, it is recommended to overgraze the pasture for the prior grazing season to weaken the existing stand. This gives the new seedlings a better opportunity to establish because of reduced competition.

When using a paddock or a portion of a paddock as a sacrificial area, you will expect the forages on the site to

be overutilized. The need for a sacrificial area may be the result of excessively wet weather, drought conditions, or shortage of forage resulting from overstocking. Refer to the section entitled “Sacrificial Paddock Use and Management” on page 31.

When intentionally overutilizing the forages on a paddock, you should have a sound plan for bringing the paddock back to an improved condition. In most cases this will be achieved by providing an extended rest period for the paddock. However, it could also require seeding an annual cover crop or it may be beneficial to seed with desirable perennial forages.

---

## **EFFECTS OF SEASONAL STOCKING RATE**

The seasonal stocking rate is described as the number of head of livestock on the pasture system for the entire grazing season.

If the stocking rate is high in relation to the amount of forage your pastures will produce, it will be difficult to provide adequate rest periods for the forages. It may be best at times to remove the herd, or a portion of it, from the pasture to provide the forages with adequate rest. This means providing the livestock with emergency feed – that which is harvested and stored on the farm. Most producers are unlikely to do this because it costs much more to feed harvested feeds than to graze the livestock. Leaving the livestock in the pasture in situations like this is detrimental to the future forage yield. The yield is reduced even into the next grazing season, so this becomes a long-term issue.

If every year, by the end of August, your livestock have grazed all of the paddocks to the recommended residual stubble height and there is no paddock ready for them to go to (one with at least 8-10” of height), you are probably overstocking. This may happen once in a while to many producers due to dry weather, but if it is recurring nearly every grazing season, even when the weather is normal, then your stocking rate is too high for the pastures you have.

With overstocking, there are generally no forages left in the pastures to support a long fall grazing period. In fact, for some operations, there are not enough forages to graze into September.

Your stocking rate may be low in relation to the amount of forages your pasture will produce if you always have more growing forages on hand than the livestock can keep up with. When this is the case, there is no problem in the summer with finding a paddock that has adequate growth for the livestock to enter, and the fall grazing period can extend into the winter.

The seasonal stocking rate for any pasture system is an ever elusive number because weather conditions change from year to year, and because of the effects of the prior season’s management on the current growth of the forages. The best way to manage stocking rate is to constantly monitor the forages that remain in the pastures. Calculating the number of days of grazing in the pasture system on a given day is a good way to determine if you will run out of forages soon or if you have adequate reserves on hand. Doing this calculation periodically will provide you with information that can prevent overutilization issues. It may even provide opportunities for expanding your herd.

## MANAGING A LEADER-FOLLOWER GRAZING SYSTEM

Leader-follower grazing systems allow two or more herds to graze the same paddock, but at different times. The livestock may be of the same species or may be different species. Some common leader-follower systems are dry dairy cows following milking cows, beef cows with calves following stock being finished on forages, sheep following beef cows, or beef cows following sheep.

The question of which group leads and which group follows is based on which group needs the best quality forage. The group that you desire to have the best performance should be the leader group, so they get the highest quality forage.

In planning this system, make the paddocks large enough to provide adequate forages for both groups of livestock. The first group grazes for a set period of time, determined

by the performance objectives of the producer. The first group is able to harvest the highest quality forages in the paddock so their performance is very good. The follower group gets the poorer remaining forages, which will meet their lower performance needs.

Residual stubble height measurements or estimates of trampled plant residues are made after the last group grazes the paddock. This will help you decide if the paddock size needs to be adjusted to match the consumption by both groups.

Avoid a long time lapse between the groups grazing on the paddock. Generally, when the first group moves out of a paddock, the second group moves in on the same day or the day after. If the delay is too long, the forages that recover quickly from the grazing by the first group will be grazed again by the follower group. This re-grazing without an adequate rest period will set back those forages, reducing their vigor.

## HIGH DENSITY, SHORT DURATION GRAZING

High density, short duration grazing (“mob grazing”) is a system of grazing in which large numbers of livestock (large herd weight) are concentrated into a relatively small area of forages for a short period of time.

Stock density is expressed as pounds of herd weight per acre of land. For high density, short duration grazing systems the minimum herd weight for one acre of pasture is 50,000 lb. Stock densities up to 200,000 lb/A are often used. Adequate forages must be provided to the livestock within the paddock for their nutritive requirements as well as to account for the amount that they trample.

“Short duration” means less than 24 hr on the same paddock. In many cases the grazing period is shorter than this. Grazing duration of 12 hr is commonly used, with some systems even using 1 hr duration.



High density, short duration grazing.

The objective of high density, short duration grazing is to have the livestock graze the forages in an allocation relatively quickly, leaving either a residual stubble height of 4” or to have adequate plant residues trampled to the ground. The plants in the allocation (paddock) are either consumed or trampled, including plants that are desirable forages and those that are not. The animals learn that there is considerable competition for feed, so they do not waste time walking over the paddock looking for the best forages to eat. You should plan on leaving about 1,500 lb/A of trampled forages on the soil surface when the livestock are moved to another paddock.

Leaving behind significant quantities of forages trampled to the ground is important. Plant residues provide the organisms in the soil with adequate nutrients so that their populations increase dramatically. This, in turn, leads to improved mineralization of the organic residues and soil particles so that nutrients are released for plant growth. In addition, the soil organic matter is much improved, water holding capacity is significantly increased, infiltration is increased, and runoff is reduced. The soils more easily exchange air with the atmosphere, providing necessary oxygen for the soil microbes as well as for the respiratory needs of the plant roots (Figure 9).

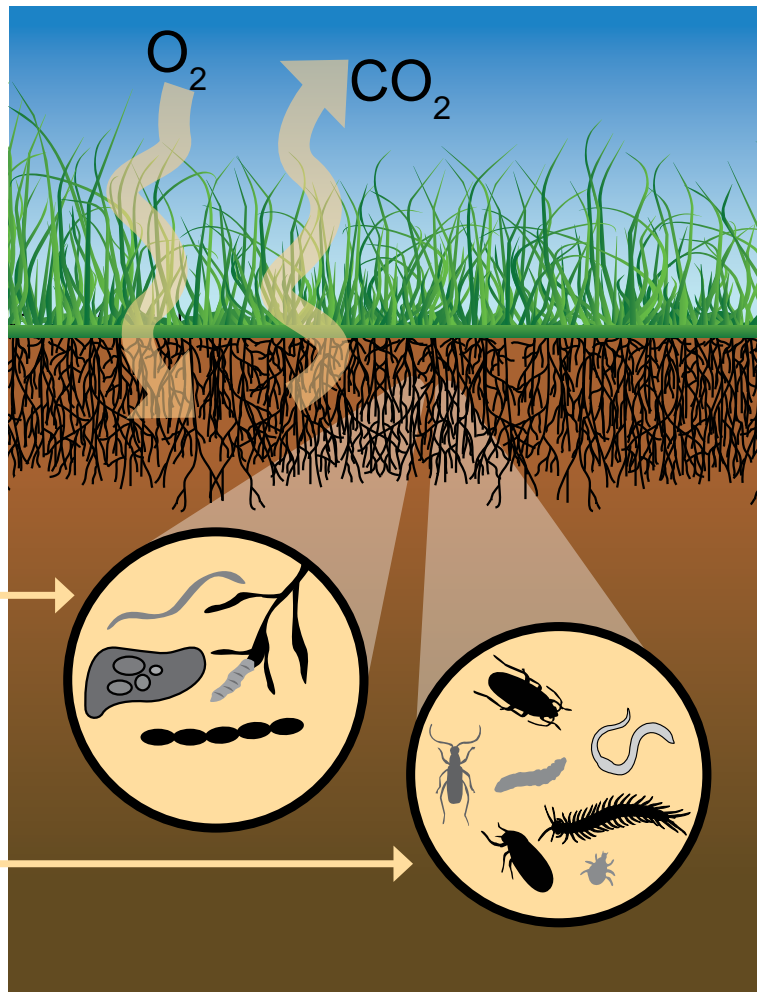


Residue trampled to the ground (left side of fence).

Figure 9. Well managed pastures have abundant life in and on the soil, good exchange of air between the atmosphere and soil, and healthy plants with deep root systems.

Earthworms, bacteria, protozoa, nematodes, fungi

Beetles, slugs, centipedes, earthworms





In mob grazing, manure is very uniformly distributed over the paddock.

The general health of the forage plants is improved so that recovery from grazing events is much faster and survival during times of stress, such as drought, is more assured. Tillering as plants recover from grazing in this manner causes the forages to become more dense.

Refer to the sections of this publication “Significance of the Number and Size of Paddocks” on page 11 and “When to Terminate Grazing” on page 23 for more information related to selection of the grazing period and when the livestock should be moved to a new paddock. Adequate amounts of plant residues need to be left

behind when the livestock are moved to a new paddock. Plant residues need to be trampled to have contact with the soil in order to feed the organisms in the soil.

This system works very well with more mature forages. Managing pastures to keep them in a constant vegetative state is no longer an issue. Livestock performance is better with more mature forages than with those in a vegetative state because the protein to energy balance is more in keeping with the natural needs of ruminants.

High density, short duration grazing does require more time and more timely operation, especially when the grazing period is less than 12 hr.

---

## FALL GRAZING MANAGEMENT

In the fall, the movement of the livestock through the grazing system needs to be controlled. It is just as important at this time of year as it is during the earlier parts of the grazing season. One of the greatest temptations in the fall is to “open the gates” and “let the livestock have the run of the pasture”. In terms of pasture for the following year, this is one of the most costly mistakes that can be made. Proper fall grazing management is essential because:

1. Adequate residual stubble (at least 4”) or adequate trampled forage residues (at least 1,500 lb/A) on the pastures at this time of the season will modify the microclimate at the soil surface for better survival of the forages through the winter. The temperature at the soil surface will be more uniform than in an overgrazed pasture. This helps new buds, which are developed in the forage plant in the fall for the following spring, to survive. Many types of forage will grow a bud on the root or crown in the fall ready for growth right away in the spring. This bud can be damaged by extreme cold, fluctuations of temperature above and below freezing, desiccation, and physical crushing by livestock hoof action.
2. Snow is trapped more effectively. Snow provides insulation for the soil surface and the new buds on the plants. The trapped snow also provides additional moisture in the spring. On average the lack of moisture is an issue more often than excess moisture in pastures. This strategy helps to create the moist conditions necessary for the plants to get a good start in the spring.

3. Plant residues are a raw source of organic material for living organisms in the soil in the early spring. Without this they would suffer from lack of materials to “feed on”. They would not effectively perform the functions of recycling nutrients and mineralizing the soil that provide fertility for the plant to grow. Pastures with adequate residues left over winter will emerge 10-14 days earlier in the spring.
4. Soil compaction is greatly reduced when the livestock are not allowed to graze large areas (in relation to the size of the herd). When the livestock have access to the entire pasture, they will walk over it again and again, selecting the best of the remaining forage. This leads to compaction because they travel over the same areas many times. It does not take much compaction to effectively reduce infiltration of rainfall or snow-melt, and to effectively reduce the exchange of air between the soil and the atmosphere. The net effect is to reduce the available moisture for plant growth and to reduce the populations of organisms in the soil.
5. Root reserves in the plants will be reduced with continued grazing in the fall. This reduces plant vigor and spring growth.



What should you do to properly manage fall forage?

1. Maintain control of the livestock through the entire year, not just during the earlier parts of the grazing season. Continue to rotate them through the pasture system, paddock by paddock, in the fall until they have used the forages to the point where there is no more available forage. At this point the paddocks should all have the proper plant residuals, either residual stubble height (4") or adequate residues trampled to the ground (1,500 lb/A).
2. DO NOT OPEN THE GATES AND LET THE LIVESTOCK HAVE THE RUN OF THE ENTIRE PASTURE! This puts a great deal of traffic pressure on the pastures and the livestock will tend to overgraze certain areas. Excess traffic causes compaction which reduces air exchange in the soil and restricts rainfall infiltration. Opening the gates will significantly reduce pasture yields for the next grazing season.
3. This is a good time to rest the paddocks that have been damaged during the grazing season due to weather conditions or factors that disrupted the rotation of the livestock through the system.
4. Select your sacrificial winter paddock. Refer to the section on "Overwintering" on page 38.
5. Ideally, the pasture should be rested during September and into October. Because it is unlikely that the entire herd will be removed from the pasture at this time of the grazing season, it is recommended that 20-25% of the pasture receive this treatment each year, rotating to different paddocks each year. Within 4-5 years, the entire pasture will be given this extended fall rest period. Livestock can continue to rotationally graze the remaining 75-80% of the pasture to a 4" residual stubble height. If there is not adequate forage, then remove the livestock from the pasture to a winter feeding area.
6. If alternative sources of forage (corn stalks or soybean residues, hayfields that will be tilled out next season, etc.) are available at this time, use them to give your pastures a longer rest period than they would normally have (Figure 10).

Pastures that are allowed to rest for 30 days prior to a killing frost will emerge from winter dormancy 10-14 days earlier in the spring. This represents a significant extension of the grazing season.

The plant growth that accumulates in those paddocks given a fall rest should not be considered wasted. After mid-October the growth can be grazed to a 4" residual stubble height. This provides adequate forage for livestock on maintenance rations, such as dry cows, ewes, or horses, while it still leaves an adequate cover to buffer the effects of winter.

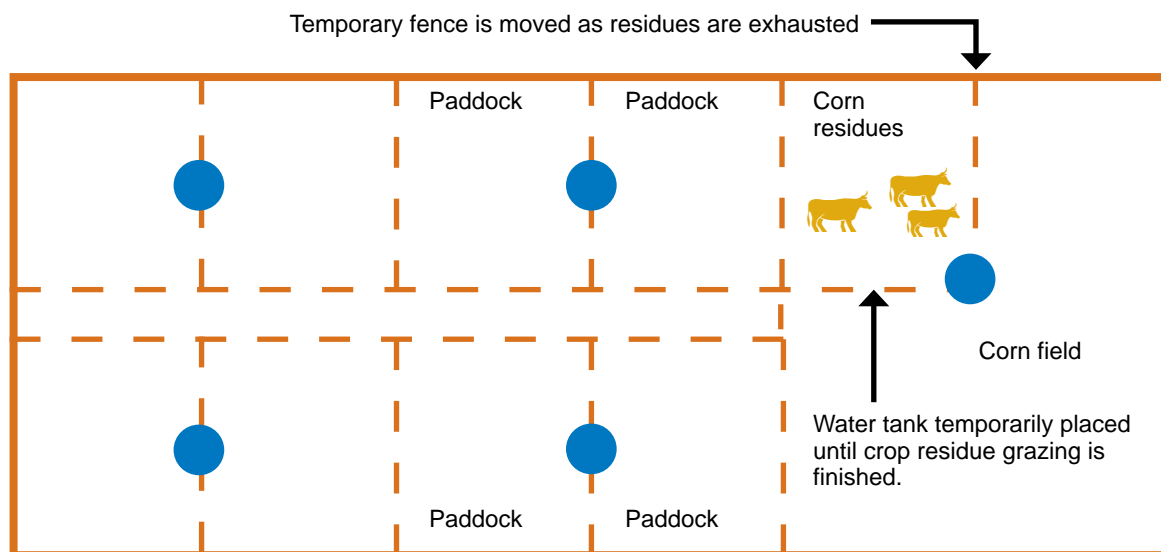


Figure 10. Livestock grazing crop residues while pastures are resting.

## DEALING WITH WET WEATHER CONDITIONS

At various times during the grazing season the weather may be wet enough that livestock traffic will cause “pugging”. This could cause soil compaction and damage the roots and crowns of the forage plants.

The extent of the damage is dependent on the soil types and forage species in the paddock. Organic soils and very sandy soils are easily damaged. Kentucky bluegrass, quackgrass, and tall fescue have very dense root systems that will stand up to some severe hoof action. Species such as timothy and perennial ryegrass are more easily damaged by livestock traffic. Also, livestock will reject forages that have mud on them, which happens when pastures are very wet during the grazing period.

Moving livestock through the rotation faster during periods of wet weather minimizes the damage to the forages and the livestock will use more of the forage. It is not unreasonable to move the livestock every day, or even more often. It is very easy to do this in a strip grazing system – just set the front fence closer to the back fence. In set paddock systems use temporary fences to subdivide the paddock to allow for 1 day grazing periods.

Another option to consider during periods of very wet weather is to move the livestock to a feedlot or to a sacrificial paddock. Provide them with stored feed until the pastures dry out to the point that you can go back to a normal rotation.



NRCS

Damage caused by livestock traffic when soils are wet.

---

## DEALING WITH DRY WEATHER CONDITIONS

At some times during the grazing season the weather may become dry enough that forage growth will be very slow. Continued grazing of the forages below the minimum residual stubble height of 4” will reduce the ability of the forages to resume their growth once the weather conditions return to normal. Excess livestock traffic will cause soil compaction and possibly damage the forage roots and crowns. Removal of the residual stubble damages the protective cover that helps to buffer the soil and forages from temperature extremes.

If the forages are grazed to the proper residual stubble height and there is not adequate growth in any of the other paddocks in the grazing system, then it is time to move the livestock to a sacrificial paddock or to a feedlot. Provide emergency feed until the weather conditions improve, forages have grown to an adequate height, and you can resume a normal rotation through the paddocks.

## SACRIFICIAL Paddock USE AND MANAGEMENT

A sacrificial paddock is an entire paddock or a portion of a paddock that will intentionally be used as a holding area while the remainder of the paddocks rest. This strategy is used when soil conditions are very wet or when forage production has diminished and no paddock is ready to graze.

Many times on farms that are operated at a high stocking rate, the pastures are unable to keep up with feed demand during the middle of the summer. When there is no available forage (forage above the 4" residual stubble height) to graze, livestock should be placed in a sacrificial paddock and fed stored feeds.

Areas used consistently as calving or lambing paddocks are also considered to be sacrificial paddocks. These normally get heavy use during birthing periods.

Areas that are used to overwinter the livestock when a feedlot is not used are considered sacrificial paddocks. Refer to the section "Overwintering" on page 38 for additional management strategies.

Sacrificial paddocks should be selected with care. Sensitive areas should not be used for sacrificial paddocks, nor should areas that are prone to erosion, that would be very difficult to rejuvenate, or that are difficult to get to with feeding equipment. In addition, water for the livestock needs to be available.

Using an area as a sacrificial paddock will almost always reduce the forage yield for the season, resulting in reduced grazing days on the site. Proper treatment of the sacrificial area will bring it back to full production in a reasonable time period. This rejuvenation treatment can be either an extended rest period or re-seeded to bring the stand back to condition for grazing in the regular rotation. Consider the possibility of the area becoming predominantly weeds and, if this is the case, re-seeding is the best option.

If the sacrificial paddock is used fairly often, it will not support perennial vegetation. In cases like this, it is advisable to seed an annual crop such as oats, sorghum-sudangrass, or a short lived forage such as annual ryegrass or perennial ryegrass after each long-term use. These crops can be grazed as part of the regular rotation as they produce forage.



MIDWEST GRASSLANDS

Winter feeding area as a sacrificial paddock.

## EXTENDED REST

Extended rest periods allow forages to develop from seedlings through maturity without interruption by the grazing process. This benefits the forage plants by allowing maximum root growth and development. With an enhanced root system, the forage plants are better able to draw nutrients and water from the soil.

Extended rest periods can be a full growing season or a portion of the growing season. To get the most benefit, a rest period should be at least 3 months.

The major benefit of this management technique is development of the root mass of the forage base, resulting in increased forage yields in the future. Additional benefits include:

- improved wildlife habitat, especially for song birds and ground nesting game birds;

- increased soil porosity because of reduced livestock traffic;
- increased soil organic matter; and
- an emergency source of feed in the event of drought.

To provide this kind of extended rest period requires planning ahead. Obviously the area given extended rest will not be available for grazing, so the forage requirements for the season must be taken into account.

It is best to intentionally decide which areas should receive an extended rest. Some areas that are good candidates for this treatment include sensitive areas that need additional rest to benefit the desired plant community, sacrificial areas, and areas of pasture that were overutilized and need the extra time to recover.

---

## MANAGING FORAGE BALANCE

The most difficult aspect of managing grazing systems is dealing with the variable rate of forage growth. Cool season forages have a rapid growth rate in the spring, dramatically slower growth in the summer, and a renewed growth period in the fall (Figure 11). Warm season forages grow slower in the spring and fall, but have a rapid rate of growth in the summer.

Most grazing systems in Minnesota rely on cool season forages. In most of these systems there is an abundance of forage in the spring and a shortage in the months of July and August. Even September is a difficult month to manage because the grasses are not growing nearly as fast as in the spring and there is normally little to no carryover of available forage from the summer months. As the seasonal stocking rate is increased, having adequate forages on hand for grazing later in the grazing season becomes more difficult.

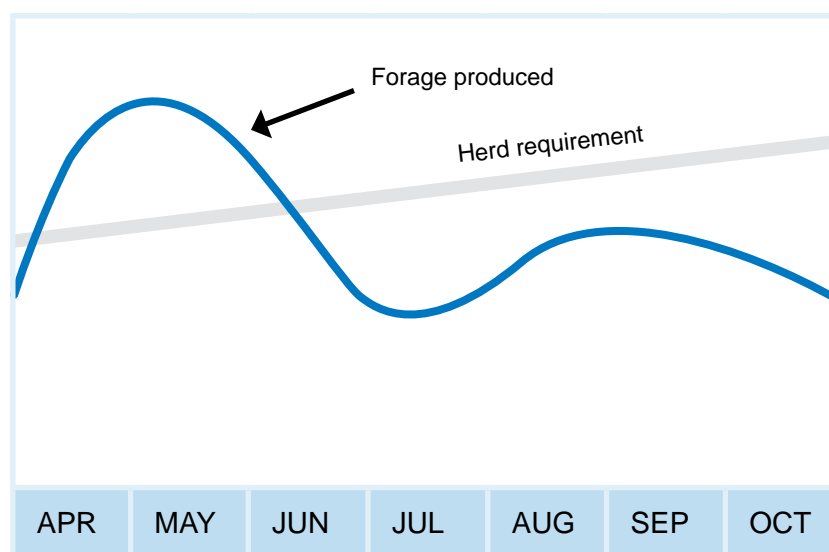


Figure 11. Cool season forage growth distribution through the grazing season.

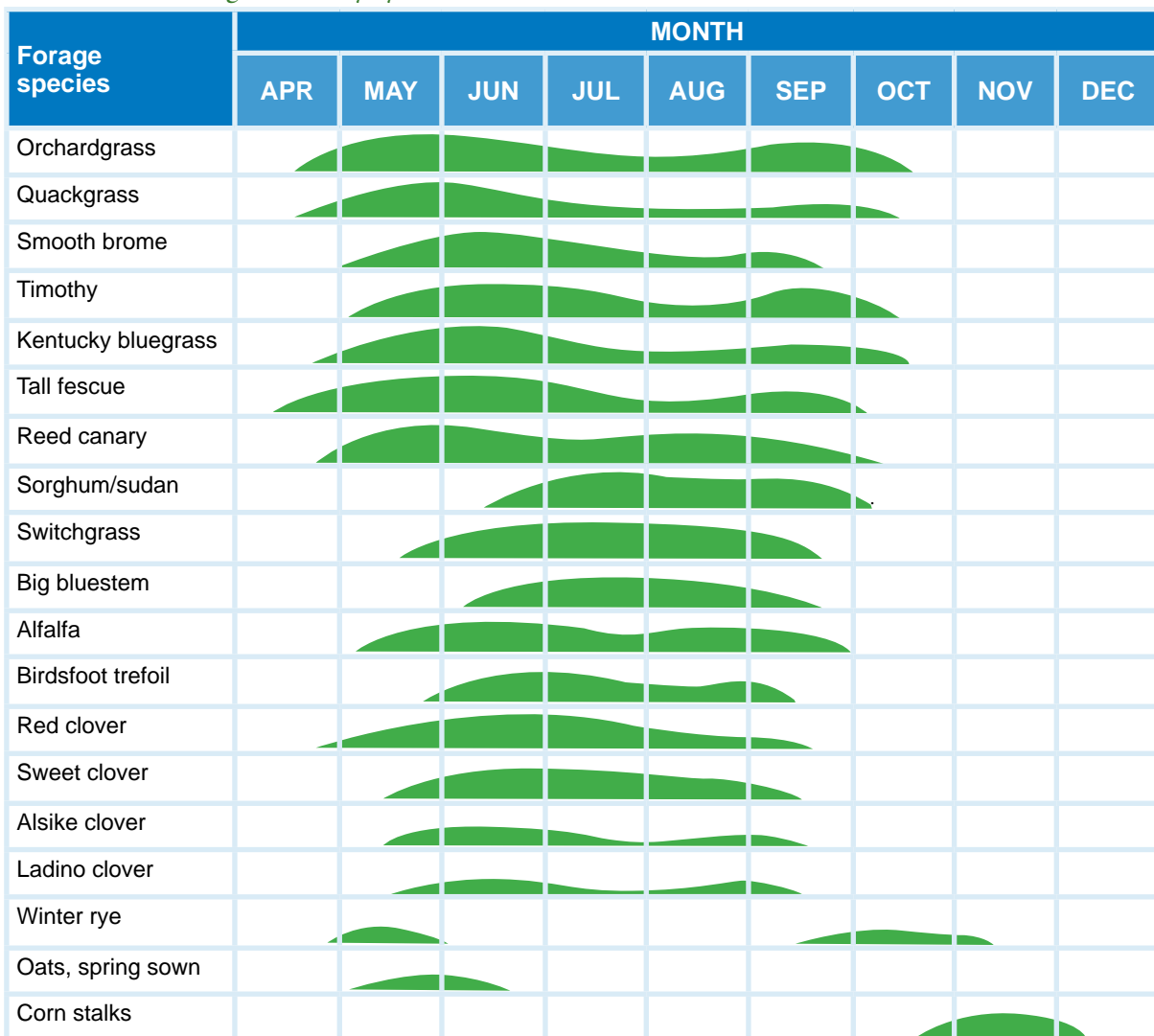


To even out the forage balance on a monthly basis, the following strategies are often used:

- Convert to a rotational grazing system to reduce the depth of the midsummer slump and delay the onset of the slump in forage production. When livestock do not have access to all the growing forage at one time, growth is allowed to accumulate for use at a later date. In addition, the grazing efficiency is increased by a well managed rotational grazing system so the livestock actually consume a larger percentage of the forage that is available.
- Use of warm season grasses will fill in the slump that normally occurs in midsummer for cool season forage based systems. Table 4 shows seasonal growth distribution for common forage species. In practical terms, one should not plan on meeting all of the

forage requirements in July and August with warm season grasses. Instead, have a couple of paddocks of warm season grasses to use to allow longer rest periods for the cool season grasses. A good rule of thumb is to have approximately 20% of the pasture planted to warm season grasses to meet the need to extend rest periods for the cool season component. Because warm season grasses are difficult to establish (usually 3 years), and because they generally have a lower dry matter yield, it may not pay to plant them as pasture. However, if they are already established and available (native prairie remnants or old CRP fields), it is a good idea to manage them to retain the warm season component and use them to augment the grazing system in the summer months. For more information on management of warm season grasses refer to Appendix 1.

Table 4. Normal forage availability by month.



- Use annually seeded crops as forage during the summer. Examples of these include oats, rape, winter rye, winter wheat, corn, sorghum and sorghum-sudan-grass, and various brassicas. These crops make excellent forage. The cost of tillage and planting each year need to be considered when using annually planted crops.
- Hayfields that have been harvested for the first crop can be used for grazing instead of taking a second hay crop. These fields will normally be ready for grazing at the time when the permanent pastures are slowing down and the forages need the extra time to rest.
- Some of the paddocks can be harvested as hay in the spring during the time of rapid forage growth. The re-growth will be ready for grazing at a time when the growth rate of the forages is slowing. Using pasture acres for hay is recommended only if there is a rather large excess of forage on the pasture. Once it is cut for hay there will be a period of 25-30 days before it can be grazed. Prior to harvesting pasture as a hay crop look at the extended weather forecast. If droughty conditions are predicted, it may be best to leave the extra forage for grazing instead of harvesting it for hay.
- Use residual growth from small grain crops or residues from corn or soybean crops to extend the grazing season and to reduce grazing pressure on pastures. To get the most efficiency from grazing these fields, it is best to subdivide them to some degree to prevent the livestock from walking over the entire field, trampling the residues into the ground.

## MAINTAINING DIVERSITY IN THE FORAGE STAND

The forage that you grow in your pastures should be based on your livestock production model and the objectives that you have for your livestock operation.

Pastures that are a monoculture or that have only two forage species are fairly common in systems where high animal performance is desired. In many cases the forage mix is a single species of grass along with a legume.

Pastures, with only one or two species, are easy to manage in terms of their predictability in growth through the season. However, there are some disadvantages, including susceptibility to extreme weather conditions such as drought, freezing temperatures, harsh winters, and cool weather during the growing season. They are also more likely to be damaged by poor pasture management that results in overutilization. If one species is damaged by one of these conditions, pasture yields can be greatly reduced.

In contrast, a diverse pasture is one that contains more than three species of forages. This offers a distinct advantage over pastures with only a couple of species.

- During extreme weather conditions, some of the species in the stand will survive better than others.
- Some will root deeper than others and provide overall resistance of the stand to drought. Deeper root-
- ing means that they will also extract nutrients from deeper in the soil.
- Some species will be more mature than others in the mixture, which provides variety in the diet of the livestock on the pasture. Even forage stands that appear to be mature from a distance will usually have an understory of forages that are less mature. This can be seen by sweeping back the upper canopy and visually observing what lies beneath.
- Having a variety of forages to choose from allows livestock to select their diet from among several plants. Each of these species of plants may supply something different to meet the nutritional needs of the animal.



A diverse pasture.

## MANAGING WEEDS

A weed in a pasture is quite different than a weed in a crop field. To be a weed in a pasture, the plant must meet one or more of the following characteristics:

- livestock will not eat or do not prefer the plant;
- livestock are harmed by ingesting the plant;
- the plant reduces pasture yield;
- the plant interferes with the livestock's ability to graze the desired forages; or
- the plant interferes with the care and maintenance of the pasture.

Many common cropland weeds are actually highly nutritious forages, some with the same protein content as alfalfa. Many are dense in other nutrients as well. Plants sometimes considered to be weeds, but readily eaten by livestock, add diversity to a pasture stand and can actually improve the diet selection for the livestock.

Thistles are the most troublesome weeds that most producers face in their pastures. They are difficult to control because they are prolific seed producers, a large percent of the seeds are viable, they are not well liked by livestock (in most cases rejected by them), and they live as perennials or as biennials.

Mowing is fairly effective for thistle control, but this must be done several times at proper intervals over a period of 2 to 3 years to obtain the desired control. Herbicides are quite effective, but will prove toxic to any legumes that

get sprayed in the process. In some cases, donkeys have proven to be useful in controlling thistles by eating the blooms.

Weed control options in pastures are: herbicides, mowing, use of other species of livestock, grazing with high stock density for short durations of time, maintaining a dense stand of forages, and in severe cases, re-establishment of the forages in the pasture.

In all cases, the control measures are only temporary if there is no change in the way the pasture is managed. Following recommendations elsewhere in this publication will help improve the health and vigor of the plants you want to keep.

### *Options for Weed Control*

#### Controlling weeds with herbicides

- Herbicides work effectively on the undesired plants but may also harm or eliminate desirable species.
- The cost of herbicide treatments is generally high.
- Application of herbicides in some pastures is difficult or impossible unless done by air because of steep slopes, wet soils, or rocky/stony conditions.
- Many herbicides are toxic to the life in the soil, which affects aeration of the soil and nutrient cycling.
- You must use correctly labeled products and watch for re-entry restrictions by livestock.



MIDWEST GRASSLANDS

Red cedar invading a pasture.



NRCS

Thistles in an overgrazed pasture.

### Controlling weeds with mowing

- Mowing may or may not be effective, depending on the stage of growth of the plants you are trying to control.
- It may be costly when considering time and equipment expenses.
- Mowing is impossible to do in some pastures because of steep slopes, wet soils, or rocky/stony conditions.

### High density, short duration grazing

- When this type of grazing is done properly, the livestock will eat or trample all of the plants within the paddock.
- For areas that are weed infested, set up temporary fence around the weed infestation and have the livestock graze or trample it to a much greater degree than normal.
- The purpose is to do physical damage to the weeds to set them back and to provide conditions that are conducive to more desirable plants.

### Maintaining a dense stand of forages

- A dense forage stand can be achieved with careful management of the pastures. This kind of treatment will also be beneficial to the overall pasture quality and yield.
- This option is less costly than most methods.

### Re-establishment of forage stands

- This is a very costly option in terms of seed, time, and the cost of tillage and seeding operations.
- Re-establishment will have no effect for more than a few years unless the management of the pastures is changed to maintain a dense stand of forages.
- The cost of this option includes the loss of the acres for grazing, normally for at least a year.

### Use of other species of livestock is discussed in the next section.

- Discussed in the next section, "Using More Than a Single Species of Livestock".

---

## USING MORE THAN A SINGLE SPECIES OF LIVESTOCK

Knowing the diet preference for different species of livestock helps to determine if dual species grazing is right for your situation. By knowing what plants in your pastures are being ignored by the present herd, you can determine what other species will implement the main herd. Table 5 lists common livestock species and their diet preferences.

It is important to control the plants that your livestock do not graze. In a normal grazing system the plants that are avoided by the livestock will thrive and be healthier and more vigorous than those plants that the livestock are eating. Eventually the plants that are rejected will begin to dominate parts of the pasture.

Introducing other species of livestock into the pasture will help control the less desirable plants that your main herd is rejecting.

Table 5. Livestock diet preference.

Livestock	% Grass	% Forbs	% Browse
Goat	20%	20%	60%
Sheep	60%	30%	10%
Cattle	70%	20%	10%
Horses	90%	4%	6%





NRCS

Goats grazing on brush and low hanging branches of trees.



MIDWEST GRASSLANDS

Wild parsnip grazed by cattle. Flowers and leaves consumed, stems remain.

Typical examples of dual species grazing systems include:

- ✦ Sheep included with cattle to consume broadleaf plants such as stinging nettle, wild parsnip, lambs-quarters, and leafy spurge.
- ✦ Donkeys eating thistle blooms.
- ✦ Goats included with cattle to control brush and leafy spurge.
- ✦ Goats included with horses for control of brush, wild parsnip, and leafy spurge.

In these examples one species was brought in to improve the pasture for the other. In most cases the second species of livestock will control the undesired plants within a grazing season. It may be desirable to find another producer who is willing to bring his livestock into your pastures just long enough to control the undesired plants. Another option is to begin running two species of livestock yourself and make the rotation of both species part of your normal farm operation.

## OVERWINTERING

The first goal for overwintering livestock is to keep them in the pasture for as long as possible, without grazing below a 4" residual stubble height.

This can be achieved by managing intentionally stockpiled forages on some of the paddocks to allow re-growth without grazing from about mid-August until the end of September. When the remainder of the pasture is grazed to the recommended residual stubble height, allow the livestock to rotate through the paddocks with stockpiled forages until the proper amount of residual remains, then remove the livestock from the pasture.

This is a good strategy for beef cows, horses, or other livestock that do not require very high quality forage. The quality of the stockpiled forages diminishes with time.

When there are no more forages to graze in the pasture, including stockpiled forages, the livestock need to be placed somewhere for the duration of the winter. They should be kept on the paddocks as long as there is forage for them to eat, but, once these are exhausted, the livestock need to be fed stored feeds. The most common methods of keeping livestock through the winter are:

- ✦ place them in a feedlot;
- ✦ feed them stored feed on a portion of the pasture; and
- ✦ feed them stored feed on cropland.

Feeding livestock on the pasture during the winter months is a practice that has several advantages. Labor costs are often lower and livestock health may actually be improved by not confining them in close quarters, especially in buildings.

The first step of this overwintering method is to place round bales of hay in a pattern on the area that is used for the overwinter site prior to the onset of winter. Temporary electric fence is used to allow livestock to have access to a predetermined number of bales at any one time. As the bales are consumed, the temporary fence is moved to allow access to additional bales (Figure 12, page 39).

The stock density of this system typically ranges from 7 to 10 head/A for mature cattle. This figure should be adjusted for other kinds and classes of livestock.

Water must be provided to the livestock, but they can walk fairly long distances to get it, up to one-half mile. This forces the livestock to move around and is better for the health of the herd. This traffic must be confined to an existing livestock travel lane, or, if that is not available, one can be constructed of temporary fencing materials for the winter.



Cattle on an overwintering site.

The overwinter site will look in very poor condition in the spring when the snow melts and prior to the time the livestock can be put into a regular rotation. In most cases, this area can be given an extended rest, normally into July, and then be grazed as part of the rotation with the other paddocks. In some cases the site may need to be leveled using a disk or drag.

Areas of the pasture used for feeding the livestock become covered with manure and feed/hay residues. This has the effect of increasing the organic matter content of the soil, improving the fertility, and even introducing new seed to the site. In many cases these areas tend to be some of the best pasture in future years, with the effects of the nutrients, organic matter, and seed being evident for up to 5 years.

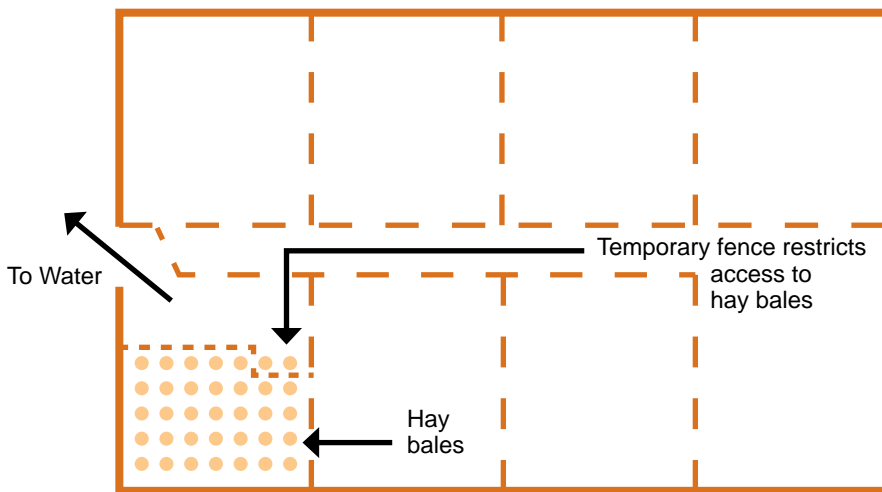


Figure 12. Set-up for overwintering livestock on a paddock.

If overwintering is done on the same site every year, it is treated as a sacrificial paddock because the perennial forages will not survive this kind of treatment. Refer to the section “Sacrificial Paddock Use and Management” on page 31 for recommendations related to managing these areas.

This method of feeding can be done on well established sod in one or more of the paddocks, and then rotated to a new site each year. Another option is to use this overwintering method on cropland. The wasted hay, manure, and urine from the livestock provide fertility for the next crop.

Typically, grazing livestock are able to withstand the climate of Minnesota winters without shelter other than that provided by the landscape. Shelter can be provided, if needed, by temporarily moving the herd to a sheltered area during times of extreme cold, by locating overwinter sites in sheltered areas, or by using portable winter shelters. Consider planting shelterbelts in strategic locations within the grazing system to provide shelter for overwintering livestock.

Overwintering site in the spring. By July 1, this site will have a dense stand of forages on it. The only preparation this site will receive is a light disking or harrowing to level the soil surface.



NRCS



## NUTRIENT MANAGEMENT

Proper nutrient management in pastures will increase forage yields. This is especially noticeable when the pastures are already in poor condition, with the forage plants stressed from overutilization. Proper management of the fertility improves the vigor of the forages, allows them to compete with undesirable plants (weeds), and improves overall yield.

Fertility in a pasture can be depleted through the removal of nutrients, mainly through the removal of livestock product, especially milk taken from milk cows and other milking animals, and through removal of the forages as a hay crop. Aside from these two situations, very few nutrients are removed by grazing livestock. In the normal course of grazing the nutrients are recycled within the pasture.

Replacing nutrients can be done by feeding livestock on the pasture (as in a sacrificial feeding area), spreading manure on pastures, applying commercial fertilizers on pastures, and through the actions of a very healthy population of soil organisms.

If your pastures are certified organic, you must be careful to select the proper methods of enhancing the fertility of the soil. Check with your organic certification agency.

### *Manure Management*

Proper manure management involves the uniform spreading of manure from storage, whether from a manure pit or a manure pack in a feedlot or barn. Ideally one would spread the manure at a rate that is based on a manure analysis and a soil test report. Unless the nutrients are injected into the soil, they should be applied at reduced rates to reduce the risk of nutrients being removed in runoff from heavy rainfall events.

Manure management also involves management of the deposition of manure from livestock grazing in pastures. A well managed rotational grazing system naturally results in better manure distribution because the travel of the livestock is restricted. This forces the livestock to deposit manure quite uniformly in all areas of each of the paddocks. Two management practices can help insure the manure is evenly distributed:

1. Provide water in every paddock so that they do not have to travel long distances to get a drink. If they travel relatively long distances they will deposit a large percentage of their manure in the lanes and at the watering facility. With water in each paddock they will drink and continue to graze, dropping their

manure on much of the paddock, eliminating manure concentrations where you do not want them. The fresh manure from the livestock is very good fertilizer, creating a “home” for the organisms in the soil where they will take up residence and recycle the nutrients into the soil.

2. Keep the grazing period short. The manure distribution is better on 12 hr rotations than on 6 day grazing periods. The shorter the grazing period is, the more uniformly the livestock will distribute the manure. They will cover the entire paddock quickly and completely to consume the forages, then be moved to the next paddock (Figure 13). The livestock do not have much opportunity to lounge in a particular area which would concentrate manure in areas near the gate, near the watering facility, under a shade tree, or by a stream.

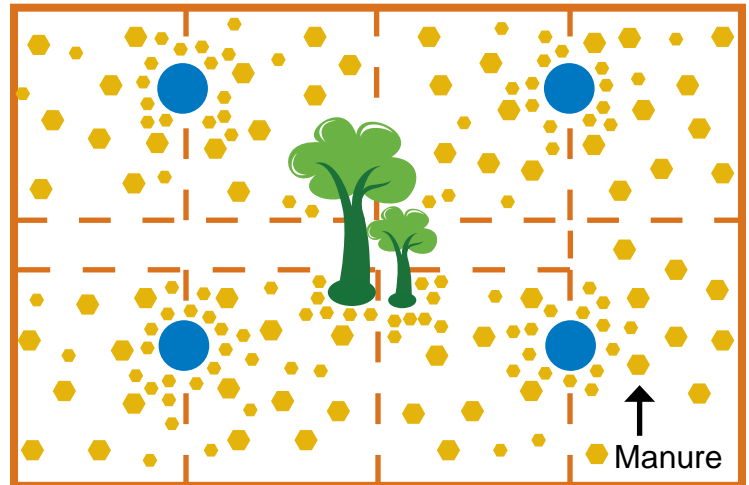


Figure 13. Manure distribution in a rotationally grazed pasture.

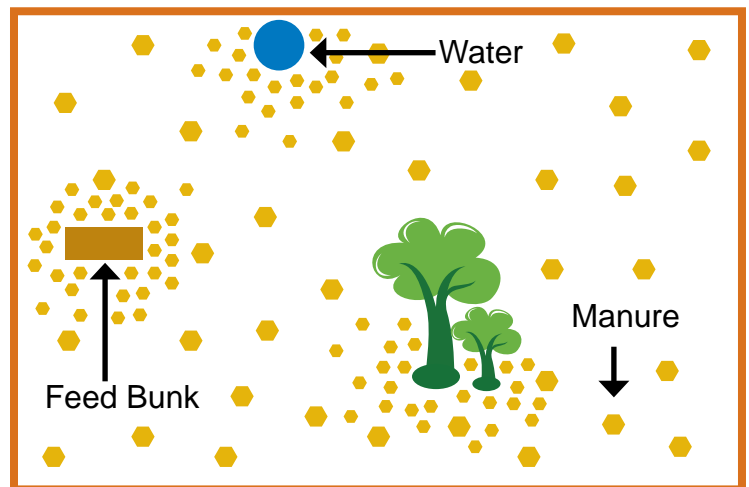


Figure 14. Manure distribution in a continuously grazed pasture.



In contrast a rotationally grazed pasture, in a continually grazed pasture the manure tends to be deposited in a few areas such as near watering facilities, feeders, shade, gates, and streams (Figure 14, page 40).

Contrary to a common belief, there is no value in breaking apart manure deposits in pastures by dragging them. It is far better to leave the deposits intact so that the “critters” in the soil can set up their homes inside the deposits and begin to break them down. If the deposits are dragged and spread, the organisms that should be recycling them do not have a place to congregate and effectively do their job.

### *High Density, Short Duration Grazing*

Refer to the section “High Density, Short Duration Grazing” on page 26. This system of grazing management has advantages to other systems in that manure is very uniformly distributed over each paddock. The trampled forages significantly increase the populations of microbes, fungi, protozoa, beetles, earthworms, and other life in and on the soil. These organisms recycle the trampled forages quickly, making the nutrients available for the new growth of forages.

### *Using Legumes to Add Nitrogen*

Another method of providing nitrogen to the forages without using commercial fertilizers is introduction of legumes such as alfalfa, clovers, or birdsfoot trefoil to the forage stand. This will improve the dry matter yield, while providing feed with higher crude protein content than straight grass forage. With at least 30% legumes in the stand (by weight) there is adequate nitrogen produced by the legume to provide the nitrogen needs of the grasses in the forage mixture.

This is one of the most economical ways of supplying nitrogen to the pastures when one considers the cost of commercial sources of nitrogen, and the benefits of the improved quality of the pasture sward. Additionally, there are benefits to the organisms in the soil, as they need nitrogen to support large populations that can recycle nutrients and mineralize soil particles.

Selection of legume depends on site conditions and the objectives of the producer.

- Use red clover if the site tends to be on the dry side or if the soils have a pH in the range of 5.5 to 7.0. Red clover does not cure well as hay.
- Use white clover (ladino clover) if the site has good moisture holding capacity and the pH ranges from 5.5 to 7.0.
- Use alsike clover on wet sites and on sites where the soil pH is as low as 5.0.
- Birdsfoot trefoil will tolerate soils that are wet and dry, and will tolerate soil pH as low as 5.0.
- Alfalfa is a good choice on droughty sites, on sites where hay will be made at times during the grazing season, and where high yields of leguminous forages are necessary for grazing during midseason. Soil pH needs to be kept above 6.5 to maintain the stand.

The primary disadvantage of using high populations of legumes is the hazard of bloat in ruminant livestock. This can be controlled in a variety of ways. The only commonly used legume that does not cause bloat is birdsfoot trefoil.

## Commercial Fertilizers

Prior to applying fertilizers or liming materials, a cost analysis should be done to determine if applying these soil amendments is cost effective.

### Phosphorus and Potassium

Phosphorus and potassium levels are rather stable in pastures. These elements are important for legume survival. These nutrients should be in the optimum to high range so the legumes can successfully compete with the grass species. Once the levels are built up in the soil no additional applications should be needed for quite some time, unless hay is removed or a milking herd is on the pasture.

### Nitrogen

Nitrogen can easily be supplied by commercial fertilizers, especially if the operator wants to maintain a grass forage base. The amount to apply is based on the predicted forage yield. Split applications are desirable, with applications in May and late August for cool season grasses. Use Table 6 to determine the quantity of actual N to apply.

Table 6. Nitrogen Application Rates for Pastures

Amount of Nitrogen to Apply Based on Yield Goal				
Expected dry matter yield (T)	2	3	4	4+
N to apply (lb/A)	60	90	120	150

### Calcium, Magnesium, and Trace Minerals

Calcium, magnesium, and trace minerals are very important to the mineral balance and availability of nutrients in the soil. Plants need these nutrients and so do the livestock grazing the forages. Soil tests and plant tissue tests can help to determine any shortages or imbalances in your pasture. Soil amendments and foliar sprays are available to help increase the nutrient availability in the soil and to improve the quality of the forages.

### Soil pH Management

Soil pH should be kept as close to neutral as practical to enhance nutrient availability and increase microbial activity in the soil.

To maintain alfalfa in the stand, soil pH needs to be maintained at 6.5 or greater. Clovers and birdsfoot trefoil can tolerate lower pH values, down to 5.5. Liming materials will take a long time to react, so if inter-seeding is planned, be sure to apply required liming materials well in advance, at least 1 year before seeding.

The cost of liming must be considered prior to application since it is quite expensive to lime a pasture. In some areas of Minnesota the soils are naturally acidic and it would take considerable lime to bring the pH to 6.5. It may be more cost effective to utilize grasses and legumes that are adapted to the existing site conditions.

Evidence of nitrogen deficiency – much greener growth near manure droppings.



---

# MONITORING PASTURES

---

Monitoring pastures is recommended to track changes in the condition of the plant community, the condition of soil and water resources, the effects of the current management of the grazing system in general, and the overall yield of the pastures.

## GRAZING SYSTEM EVALUATION FOR PASTURES

The grazing system evaluation procedure is meant to be used as a tool to identify and locate resource problems related to an entire pasture. The format is set up so that current conditions and items requiring attention are located on an aerial map and notes are written on the form. This form is included in Appendix 6.

The system is not intended to be used to “numerically score” a pasture, but is meant to be used as a basis for planning the improvements that need to be made. This system is used to identify areas of the pasture that need improvement to meet production objectives and to enhance the natural resources within the pasture, particularly the soil, water, and vegetative resources.

To be of value, it is essential to know your production goals and what kind of forages and grazing management will support those production goals. Each grazing system will have its own “Target Conditions”, therefore the worksheet is intended to be customized and is not a “one size fits all” form. You should set your own “Target Conditions” to suit the goals and objectives of your operation. You may decide not to monitor some of the items listed.

It is important to do this evaluation at least once during the grazing season. To be of more value, it should be done at about the same time each year, since conditions are different at different times of the grazing season. You may consider doing this more than once each season, but only if there is value to you in doing it that often. It is also helpful to make notes related to the prevailing weather conditions since the last assessment.

Two different monitoring worksheets follow which, if completed over the course of several years, will allow you to determine the trends in the conditions of your pasture. Use of these worksheets will help to insure that all concerns are addressed, that the results are documented for reference at a later date, and that the assessment is done with some degree of uniformity.

The worksheet (Appendix 6) has three major categories with several subcategories. An effort has been made to make this evaluation comprehensive. You can copy this form from the publication to use on your farm. It is easy enough to put into a simple spreadsheet in a computer so that you can modify it to suit your particular situation.

Use the following guidance to complete the Grazing System Evaluation:

### *Condition of the Plant Community*

1. **Population of Desirable Plants:** The target condition needs to define the species that are desired by the grazer to meet the objectives of his production model, and to specify the minimum percentage of the total plant population that he wishes to be desirable species. In most situations this target level should be 90% or more desirable plants. Desirable plants are those herbaceous plants that the livestock will readily consume. Areas of the pasture that do not meet the target condition should be outlined on a map of the pasture.
2. **Population of Undesirable Plants:** The target condition needs to specify the maximum percentage of the total plant population that is allowed to be undesirable species. In most situations the target condition should be no more than 5% undesirable plants. Undesirable plants are those that meet the criteria for “weeds” as outlined in the section of the publication “Managing Weeds” (page 35). Areas of the pasture that do not meet the target condition should be outlined on a map.

3. **Plant Density:** Specify a target ground cover for desirable species of forages. Do not consider undesirable plants in this item. Make this estimate at the allowable residual stubble height for the species involved. Refer to Table 3 on page 21 of this publication titled "Minimum Height of Pasture Species for Initiating and Terminating Grazing". In most situations the minimum ground cover target condition should be no less than 90%. Areas of the pasture that do not have adequate plant density should be outlined on a map.
4. **Plant Health and Vigor:** For desirable plants, a dark green leaf color indicates good health. A yellow leaf color is not desirable. Insect and disease damage is best judged prior to late summer when plants begin going into decline as they prepare for winter. Look closely for new seedlings and for tillering of the desirable plants, which is another indicator of a healthy and vigorous stand. A healthy stand will have rapid re-growth of recently grazed paddocks. Areas of the pasture where the plants exhibit poor health and vigor should be outlined on a map.
5. **Presence of Legumes:** The target condition should reflect the desire to have legumes in the stand. The target condition should be at least 30% legumes, by weight, in order to provide the necessary nitrogen for the forage stand. Some producers do not want legumes in the stand, so this would be their target condition. Areas of the pasture that do not meet the target condition should be outlined on a map of the pasture.
6. **Woody Plant Cover:** This item considers whether or not trees or brush are wanted in the grazing system. Whether woody species are desired or not is completely dependent upon the goals of the grazer and his production model. As an example, many producers have one or two paddocks that contain significant tree canopy which they use as a place to cool the livestock during periods of high heat index. In this case the woody plants are desired in those paddocks. The same operation may have paddocks that are growing up to young boxelder which need to be controlled. In these paddocks the young woody plants are undesirable. It is difficult to recommend a specific target condition for the above reasons. Areas where woody species are not wanted should be outlined on the map. Areas where additional trees are desired should also be noted.

### *Management of the Grazing System*

1. **Residual Stubble Heights/Forage Residues:** The target condition for management of the grazing system (considering cool season grasses) should be at least 4" of residual stubble height or 1,500 pounds of plant residues trampled to the ground. This applies to the desirable species, and can only be accurately judged on recently grazed paddocks. Make a note on the map of those paddocks that have been used more severely than this.
2. **Evidence of Spot Grazing or Zone Grazing:** Evaluate how well the livestock are grazing the forages. Spot grazing appears as uneven plant heights, with some plants grazed heavily and other plants not grazed much at all. Zone grazing is similar except that entire parts of the paddock are heavily grazed and/or some parts are grazed lightly or not at all. The target condition should be an absence of spot grazing and zone grazing. On a map outline areas that exhibit spot grazing or zone grazing, and indicate within the area which of these the outline represents.
3. **Plant Residues:** Dead and decaying plant residues on the soil surface provide organic material for the living organisms in the soil to use for growth and reproduction. Too little of this will slow the recycling of nutrients and is an indicator of overuse of the pastures. Too much dead and decaying material on the soil surface competes with new seedlings for space and light and will lower the yield of the pasture. It is also indicative of a pasture without enough livestock impact. The target condition is to have some dead and decaying plant material on the soil surface, but not so much that it interferes with tillering and establishment of new seedlings. Indicate on a map the areas that have too little or too much plant residues, and indicate which it is.
4. **Livestock Concentration Areas:** Areas of livestock concentration are unavoidable, such as at gates, watering facilities, feed bunks, and handling facilities. The target condition is to have no livestock concentration areas, including trails, except at the locations noted earlier. Common reasons that there are too many livestock concentration areas, or areas that are too large, include a lack of adequate watering facilities in the paddocks, too large an area to graze, and livestock not moved often enough. Other reasons may exist on individual pastures. Outline locations of livestock concentration on the map of the pasture.



## Condition of the Soil and Water Resources

1. Condition of Sensitive Areas: Sensitive areas may be subject to overuse because the livestock prefer these areas for various reasons. The target condition for sensitive areas should include a plant community that has not been overutilized and that is healthy and vigorous. In addition, the livestock have not created concentration areas or mudholes, or created other issues that would reduce the long-term health of the sensitive areas. Indicate on a map where sensitive areas have been damaged.
2. Soil Erosion: Visually observe the existence of wind, sheet, rill and gully erosion, and streambank erosion. In some cases there is significant erosion on livestock trails. This should be noted on the map. The target condition should indicate that soil erosion is not acceptable. Indicate on a map where erosion is occurring, and what type of erosion it is.
3. Soil Condition:
  - i. Soil Organic Matter Level: This is the primary indicator of the health of the soil in the pastures. Make this target level reflect the type of soil in the pasture. As an example, droughty sandy soils may not be able to develop the soil organic matter levels that a good silt loam soil will. Use the soil survey information for your county for guidance on this. Over time, with a well managed rotational grazing system, the organic matter level should be increasing. This indicator should be based on an actual soil test. A reasonable target condition would be to maintain the existing soil organic matter level, or to improve it by 1-2%.
  - ii. Compaction: This is one of the major limiting factors for high forage yields in pastures. The map should already indicate those factors that influence compaction. In general, if the forages are grazed to less than 2" on a continuous basis, then the compaction is serious. Zone grazing indicates that compaction is an issue in areas of the heavy use. Grazing periods longer than 6 days will lead to compaction. The target condition for this is that no areas should exhibit soil compaction.
- iii. Fertility Issues: Look for yellowish leaves and poor re-growth. Much darker green color of the forages in urine spots and dung piles indicates a nitrogen deficiency. If the height of the forages in these spots is considerably greater than the surrounding vegetation, then suspect potassium (K) deficiency. The target condition should be that there are no areas where fertility issues are evident. Outline on the map those areas that appear to have nutrient deficiencies.
- iv. Biological Activity: You can determine the activity level of the soil organisms in your pastures by observing how quickly manure deposits decompose and are incorporated into the soil. In a healthy pasture this should occur within a week to 10 days. Visually check the manure deposits to observe the number of "bugs", indications of their activity (tunnels in the piles), and the presence of earthworms. Other biological indicators to look for in the pasture are the presence of frogs, toads, and songbirds. Your target condition for this item should be that manure deposits should not last more than 10 days without visible evidence of physical breakdown and incorporation into the soil. Indicate areas on the map where this target condition is not being met.

## MEASURING YIELD BY STANDARD ANIMAL UNIT GRAZING DAYS

The yield of the pasture system is an indication of the quality of the grazing plan and the quality of the management (implementation) of the plan. Basically, how well are the forages managed? It is also a reflection of the weather conditions for the season in which the measurements were recorded.

Yield of pastures is best expressed in terms of the number of Standard Animal Unit Grazing Days provided by each paddock. This requires maintaining records for the pasture as a whole and recording the following for each of the paddocks:

- the date the herd went into the paddock;
- the date they left the paddock; and
- the number of Standard Animal Units on that paddock during that grazing period.

One Standard Animal Unit is 1,000 lb of herd weight. Recording the data as Standard Animal Grazing Days allows equivalent comparisons to be made regardless of the kind and class of livestock grazing in the pasture system.

Use the form in Appendix 7 to record the applicable data. As an alternative to this form, you can note the information on a map of your pasture system which shows all of the paddocks. Keeping this record should be simple enough so that you will do it, and done in a way that allows the data to be retrieved and analyzed easily.

Keeping a map of the pasture which shows the locations of the paddocks and indicating paddock number and acreage helps to make this a useful tool.

It is recommended that you leave adequate spaces between each paddock number so that all of the grazing events on each paddock are grouped together at the end of the season.

---

# APPENDIX 1

## Management Specific to Warm Season Grass Pastures

---

### INTRODUCTION

**Warm season grasses** have a distinctively different growth pattern than cool season grasses. Unless the characteristics of warm season grasses are understood it will be difficult, if not impossible, to maintain viable warm season grass pastures in much of Minnesota.

**Cool season grasses** have their major growth stages during periods of cool weather, in the spring and fall of the year. During the midsummer months their growth slows and their production becomes limited. This midsummer “slump” of cool season grasses is affected by:

- **Weather conditions:** The reduction in growth during the summer is greater with higher temperatures and with reduced rainfall.
- **Species of grass:** Some species have more of a reduction in growth rate than others. Reed canarygrass has less of a midsummer slump than other commonly used cool season grasses. The growth rate of timothy is greatly reduced during the midsummer. Other species fall in between the ranges suggested by these two species.
- **Management of the grazing system:** The midsummer slump is much more exaggerated in continuous grazing systems, or in poorly managed rotational grazing systems (high stocking rates, inadequate rest periods, inadequate residual stubble heights). It is less obvious in systems that have the stocking rate matched to the potential of the pasture to produce, where the forages are allowed an adequate rest period, and where residual stubble heights are closely monitored and overutilization is avoided.

Warm season grasses have their major growth period during the hottest time of the year, the opposite of cool season grasses. Generally they do not emerge from the soil until late May. Their slowest growth is during the spring and fall, and their most rapid growth rate is during the middle of the summer.

Most producers do not have adequate acreage of warm season grasses to provide a diet of warm season grasses through the months of July and August. The best management strategy is to use warm season grasses during the summer to extend the rest period of the cool season paddocks, which will typically be the primary source of forage. If interested in using warm season grasses as a major part of the grazing system, most operators find that a maximum of one-fourth to one-third of the pasture acreage should be established to warm season grasses.

The following management strategies for warm season grasses are based on their growth characteristics and, when employed in a managed grazing system, will allow a producer to effectively use and maintain them in a managed rotational grazing system.

### MAINTAIN PURITY OF THE FORAGE STAND

One of the most significant challenges to using warm season forages is invasion of cool season forages into the stand. Kentucky bluegrass, smooth brome grass, and quackgrass are three of the most problematic cool season grasses. The reason is the aggressive nature of the cool season grasses at a time of the season when warm season grasses have not come out of winter dormancy and cannot compete.

Over time, if left unchecked, the cool season grasses will become the predominant type of grass in the stand. This minimizes the advantages of having warm season grasses in the pasture system. Considering the cost and the time it takes to get warm season grasses established, it makes economic sense to care for the stand. The following management strategies will help to maintain the purity of the stand.

## Early Spring Grazing

A common method of maintaining the purity of the stand is to do an early spring intensive grazing of the warm season paddocks in the system. In the early spring when the cool season invaders are about 3" tall the livestock are moved into the paddock that requires treatment and they are allowed to graze the area very heavily. The intent is to damage the cool season grass plants by defoliating them before they can start replenishing root reserves used during their early spring emergence. The livestock are removed from the paddock at the approximate time that the warm season grasses are emerging. In a normal year that would be at about May 20. However, each year is different, so you must watch the growth of the forages. In a warm spring the livestock will have to be removed earlier than the average date, and during a cooler spring, left a little longer. The end date for this treatment has varied from April 15 to May 20 in Minnesota.

This process weakens the cool season grasses by overgrazing, which exposes the soil surface to the heat of the sun to help warm the soil more quickly, and the warm season grasses have less competition.

Some precautions are necessary for this to work without causing unwanted effects:

1. Avoid grazing to the point where livestock traffic starts to damage the soil and plants in the paddock unless the warm season grasses are well established and in healthy condition.
2. Depending on the number of livestock in relation to the size of the paddocks, this treatment may be applied to a portion of a paddock by subdividing the paddock using temporary fence materials. This treatment can be rotated to other paddocks or partial paddocks through the next grazing seasons.
3. Avoid this treatment on warm season grasses that are not yet well established. Damage to the crowns and root buds of the plants may be the result.
4. Extending this treatment longer than the above recommendations may cause damage to the warm season grasses.

## Fire

Another method of reducing the influence of cool season grasses in the warm season paddocks is to burn the paddocks in the early spring. The effects are basically the same as with heavy grazing in the spring, namely, that the cool season grasses are damaged or killed by the heat and fire.

Precautions to use with fire include:

1. Do not let the fire get too close to the fences. Fire never has a positive effect on posts, wire (especially high tensile wire), or insulators.
2. Timing is critical. Burning too early will stimulate the cool season grasses, and burning too late will damage the warm season grasses.
3. A burn plan is required to obtain the permit required to do the burn.
4. Burning is dangerous.
5. Grazing in the year prior to a burn must be done in a manner that will leave an adequate amount of fuel (dead plant materials) on the soil surface to carry a fire.
6. A fire that burns too hot will likely damage the warm season grasses. A fire that burns too cool will not have the desired effect on the cool season grasses.

## Clean Out the Livestock

Many warm season grass stands are only one or two paddocks within the entire pasture system. Rotation of livestock from the cool season paddocks to the warm season paddocks can cause invasion of cool season species if the cool season grasses were mature enough to have viable seeds. These seeds will pass through the livestock and be deposited in the warm season paddock where they will germinate and establish, contaminating the stand of warm season grasses.

It is recommended that the livestock have a 3 day period to "clean out" prior to moving them into warm season grass paddocks. During this 3 day window, the livestock should be provided seed free hay or other stored feeds that do not have seeds in them. Another option is to graze the livestock on a cool season grass paddock where seed heads have not yet emerged.



### *Avoid Winter Feeding on Warm Season Paddocks*

Feeding hay to livestock on warm season grass paddocks will contaminate the stand of warm season grasses unless the hay is clean warm season grass hay. Cool season grass hay generally has considerable viable seed that will germinate and establish in the warm season grass paddocks.

## WHEN TO INITIATE GRAZING

Warm season grass species have different recommended minimum heights to initiate grazing. Refer to Table 7.

**Table 7. Criteria for initiating and terminating grazing of warm season grasses.**

Grass species	Minimum height to initiate grazing (in)	Residual stubble height (in)
Big bluestem	10-14"	6
Indiangrass	10-14"	6
Switchgrass	12-20"	8
Little bluestem	5-7"	3
Sideoats grama	5-7"	3
Blue grama	4-5"	2

Initiating grazing too early will deplete the root reserves of the plants. Waiting too long to initiate grazing will mean the livestock will graze more mature forages of lower feed value.

## WHEN TO TERMINATE GRAZING

The height of the residual stubble, when grazing should be terminated, is dependent on the species of warm season grass that is the primary component of the forage stand. This is the "key" species, or the species you are trying to maintain. There may be more than one key species in a pasture and grazing would be terminated when any one of the key species is grazed to the desired height for that species (Table 7).

Grazing below the heights shown in Table 7 will have detrimental effects. Much of the leaf area that is required for photosynthesis (producing food for the plant to grow) will be gone. It takes additional time for adequate leaf area to grow back, effectively extending the rest period required for the plant to return to a productive state. Also, many active growing points will be removed from the plant. It takes time for these to become established again, effectively extending the required rest period for the plant to return to a productive state.

These minimum residual stubble heights should be maintained through the winter months as well as through the grazing season. It is not a good management practice to allow the livestock to graze the grasses below the recommended stubble heights. Damage to the stand will be done even though the forages are "dormant".

## FALL MANAGEMENT

Grazing of warm season grasses should end prior to August 20 in southern Minnesota and by August 10 in the northern part of the state. This allows time for the plants to store food reserves in the roots prior to going dormant. This root reserve is extremely important for rapid growth in the early part of the next season. In addition, an excess of livestock traffic on the warm season grasses in the fall will damage buds that have formed for growth next spring.

If re-growth of the grasses has been significant from the time grazing is ended to the time that a killing frost occurs, the excess growth can be harvested by the livestock. It is preferred to use a rotational method for this. The livestock should not be allowed to take the forage height below the residual stubble heights of any of the key species.

The residual stubble heights in Table 7 should be maintained throughout the winter months for quick growth response the next grazing season. It is never a good idea to open the gates in the fall and let the livestock have the run of the farm to graze it down as far as they want to.

## SACRIFICIAL Paddock USE AND MANAGEMENT

Because of the expense of establishment and the time required, warm season grass paddocks should not be used as sacrificial paddocks.

## OVERWINTERING

Because of the expense of establishment and the time required, warm season grass paddocks should not be used as overwintering sites.

---

## APPENDIX 2

# Pasture Management Specific to Horses

---

### INTRODUCTION

Horses have one requirement that other common kinds of livestock do not. They need some space to run, along with an adequate allocation of space for grazing. This is important because most horses do not get worked very hard and need the activity to maintain healthy legs and feet.

Heavily stocked pastures are usually grazed to the ground, with very short residual grass height even early in the grazing season. In lightly stocked pastures and in paddocks in a rotational grazing system, horses will develop “zones”. Refer to Figure 15.

The zones that horses establish in their pastures are:

1. Horses select an area within a pasture or paddock where they prefer to eat the forages. Often this area is eaten to a very short residual stubble height, while other surrounding areas have very decent forages that they ignore. Horses are habitual zone grazers.
2. Horses like to deposit most of their manure in a particular area of the pasture or paddock. They do not consume the forages in that area because they are repelled by their own manure. The forages in this area become very mature and undesirable from a quality point of view. It grows well because of the fertilization in that zone.

3. Horses like to lounge in the area close to the gate, or closest to the farmstead, barn, or house. This area becomes a livestock concentration area where vegetation does not grow well because of the heavy use by the horses. Often this area is bare soil. It is difficult or impossible to avoid this situation, especially when the horses are used to frequent contact with people and have a desire to be close to them.
4. The remainder of the pasture or paddock is basically ignored by the horses. The forages grow to maturity with little to no grazing pressure. This represents a significant quantity of forage that is not used, even though it is available for grazing.

The challenges, then, are to provide adequate forage for the grazing period (the time they are in a paddock), to prevent excessive grazing of the forages, to provide an adequate rest period for the forages, and to provide a large enough area to meet the needs of the horses for exercise. In order to maximize forage use you need to increase the number of sites in which the horses prefer to graze.

It is also necessary to provide adequate nutrition from the pasture for the horses. Horses will generally get all the nutritional requirements from well cared for pastures along with a mineral supplement. Even though horses are not ruminants, they have been created to thrive on grasses, forbs, and browse. Grain supplementation is only necessary when horses are worked hard on a regular basis, and even then, the diet should be primarily forages.

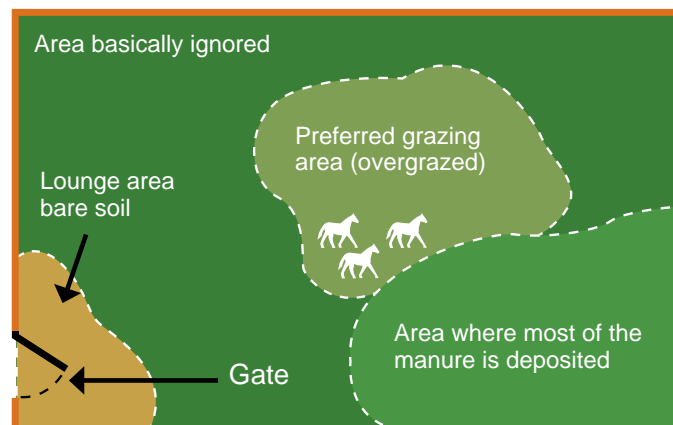


Figure 15. Zones developed within pastures grazed by horses.

## Paddock Design

Generally, what is required for horses is to set up the grazing system by subdividing the pasture into at least five paddocks, more if space permits. This allows for two 4-day grazing periods in each paddock and 36 day rest periods.

The horses are turned into a paddock and proceed to set up their zones as described above and shown in Figure 15. When the desired residual stubble height is achieved on the area they preferred to graze, this area is fenced using temporary fence materials to force them into a portion of the paddock that they had ignored (Figure 16). When that area is grazed to the desired residual stubble height the horses are moved to the next paddock.

This system effectively forces them to graze areas that they have been avoiding. However, they will most likely avoid the area in which they leave most of their waste. Do not exclude them from that area. Refer to Figure 16.

Essentially, each of the paddocks supports two grazing periods. If the paddocks are large enough, you can get another grazing period out of each paddock. The number of paddocks depends on the number of days planned for each grazing period and the desired rest period, the desired size of paddock to provide adequate room for the

horses to exercise, and the total acreage of the pasture you are using. Try to size the paddock so that there are two grazing “zones” within each. Each of these should be adequate for about 4 days of grazing. This makes a total of 8 days of grazing for each paddock.

The forages may get somewhat mature in this type of system, yet the quality will be adequate for horses. Most horses are on a maintenance diet and are not on a maximum weight gain program that requires high quality forages. Providing them with green, lush forages in a vegetative stage of growth is not necessary. They can maintain body condition, and even get fat, on more mature forages.

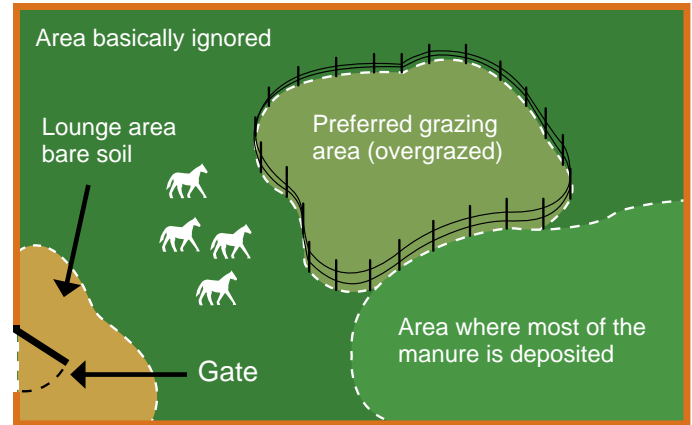


Figure 16. Use temporary fence around their favorite spot to graze, forcing them to graze areas they would otherwise ignore.

## Paddock Management

Paddocks managed as described above will develop some “issues”. As you provide rest periods for grasses you also provide rest periods for every other plant in the paddock. In Minnesota, brush can encroach pretty fast and thistles are quite common. From time to time you may have to mow the paddocks with a brush mower to keep them from getting overrun. Before doing this, it would be good to take stock of the situation by observing what the horses eat at certain times throughout the grazing season. Horses will browse woody species with some regularity, espe-

cially pioneer species such as boxelder. They even have a liking for thistle blooms. Do not mow off things they see as feed unless things are truly getting out of control.

Consideration should be given to grazing other species of livestock after the horses have moved from a paddock. Goats are preferred to follow horses because they will graze browse or broadleaf plants before grazing the grass. Sheep are marginal for this since they will tend to graze the short grass the horses left behind. This can be overcome by using temporary fences to direct their grazing where you want it.

## Other Considerations

Plan the paddock layout so that the lounging area is not on steep hillsides, wet spots, next to the trees you want to keep, or on any other sensitive areas.

Horses need access to fresh water in each paddock. Some streams are of suspect quality, especially during runoff events, and wetlands do not provide adequate water quality for maintaining herd health. Installation of a pipeline system to provide water from a well is the preferred method.

## APPENDIX 3

# Pasture Management Specific to Swine

Grazing swine on pasture is difficult to plan and is even more difficult to manage. Some points that you need to keep in mind:

- Swine tend to “root” into the soil surface. This comes naturally. You cannot change their behavior, but you can control it to some extent. Ringing their noses can help prevent rooting.
  - Make sure they have forages to eat to help prevent them from digging for roots, and to help keep the pressure off the fences.
  - Watch the available forage. This is just as important for swine as for any other species. Do not graze below allowable residual stubble heights.
- When grazing them with larger species, you should allow the swine to have the run of what would be considered three to four paddocks, while you rotate the large livestock in a much more controlled manner. This is easy to do with cattle and other large animals, but difficult to do with smaller livestock (sheep for example). Refer to Figure 17.
  - If you run swine with sheep, it is better to provide a paddock large enough to handle both species in the same paddock, or do a leader-follower system. In this system, the animals that have the highest nutritive requirements graze first, followed by those with the lesser requirement. The paddocks need to be sized for the herd weight of both herds.

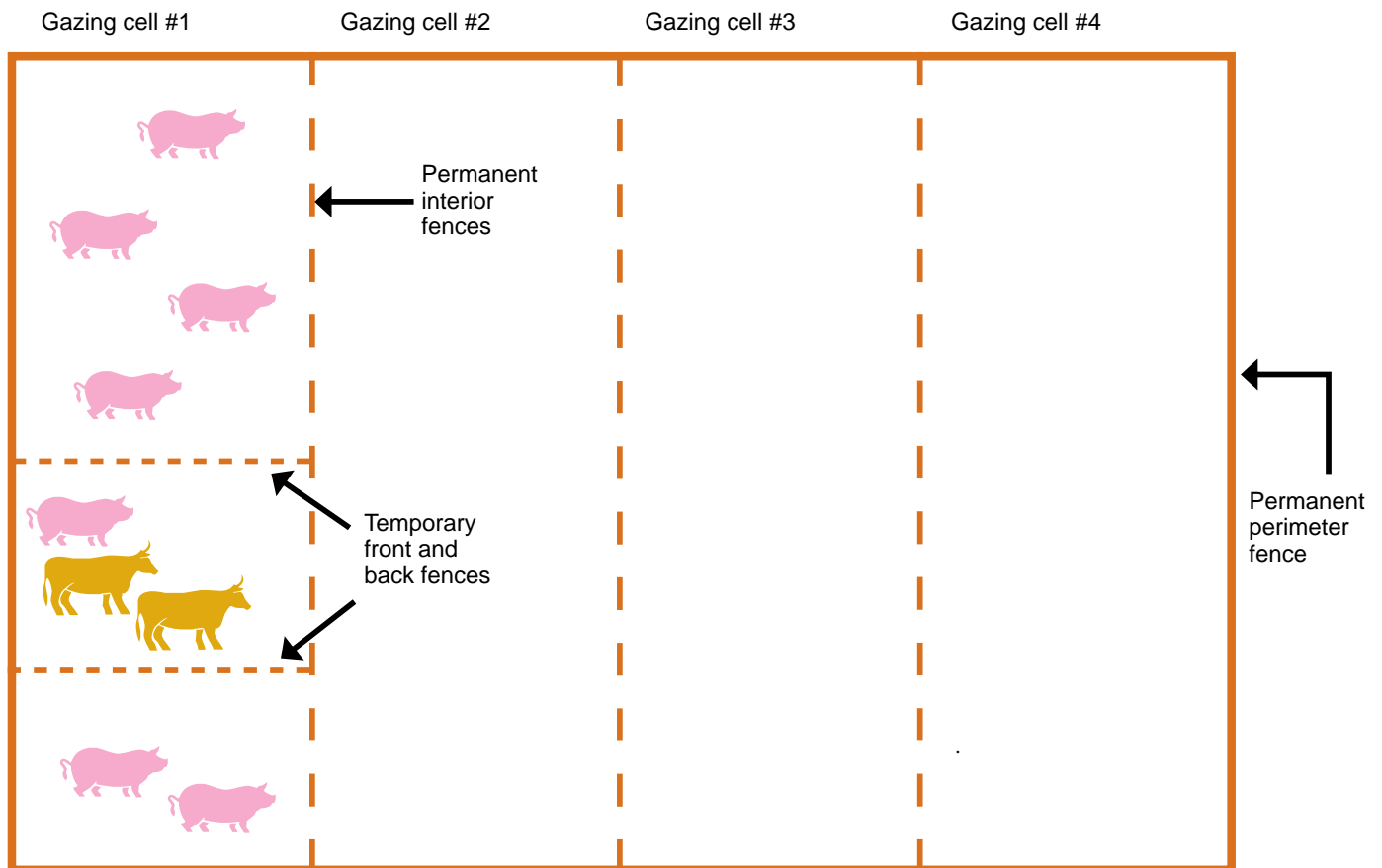


Figure 17. Managing hogs and cattle in a strip grazing system. The hogs have access to the entire grazing cell. The larger animals are restricted by the front and back temporary fences as they are rotated through the grazing cell.



- Keep the swine on better quality soils. This makes it easier to rejuvenate the ground if they dig it up more than you like. You need to be ready to periodically level the paddocks grazed by swine. This is best done by light disking followed with broadcast seeding of forage that germinates quickly, such as orchardgrass or timothy. Bromegrass is not a good option since it takes too long to establish.
- Swine will eat legumes as well as grass. They do not bloat since they have only one stomach.
- Avoid grazing swine on steep slopes or on soils that are sandy because of the damage they can do and the difficulty of rejuvenation on these sites.
- Swine are not a good option for grazing streamside paddocks because of the damage they can do to streambanks.
- Calculate the stocking rate at 5% of the herd weight for a starting point, and then adjust as you see how they graze your pastures.
- For farrowing sows, use paddocks near the farmstead. Plan on these paddocks getting some pretty hard use, as a sacrificial paddock would. Also plan on rejuvenating the paddocks. The sows with their piglets should not be sent out to pasture for a few weeks, at least until the young ones can navigate without getting lost.
- For the watering system, bury the pipeline (at least shallow bury) so that the hogs cannot play with the pipeline. They can do a lot of damage to plastic pipelines. Even where the tanks are hooked into the lines, the pipe and fittings need protection from the animals. Steel tanks are recommended.
- It is best to have perimeter fences of woven wire with an interior high tensile wire at nose height (to a hog). Use a powerful energizer – do not skimp on this. Interior fence can be high tensile wire, 3-4 strand. This same kind of fence will keep sheep in if the energizer is powerful enough and the green growth is kept off the wires.

---

## APPENDIX 4

# Pasture Management Specific to Elk

---

Grazing elk requires some things to be done differently than for other species of animals. Some of the primary considerations are:

- When planning the paddock size, keep in mind that three mature elk cows are the equivalent of one beef cow.
- It is a good idea to set up the grazing system in a manner that requires the animals to move through the handling facilities at some time during the rotation. This keeps them used to going through confined areas.
- It is beneficial to have some mature trees in the paddocks so that the elk can find shelter from the sun.
- Fences for elk, by state law in Minnesota, must be at least 8' tall. For this reason elk need to have "set paddocks". They do not normally respect temporary fences. High tensile woven wire is commonly used for establishing paddocks.
- Elk will walk the perimeters of the paddocks. Layout of the fence locations needs to consider the effect this will have on erosion along the fences.
- Moving elk cows during the calving season is difficult because the calves hide in the grass. They do not stir easily. It is easy to leave them behind when making a paddock shift. It is better to devote a paddock to a 4-6 week period for calving and then begin moving the animals through the rotation. The calving paddock will need an extensive rest to recover.
- Elk do well on a variety of forages.
- Elk need water in each paddock. They will travel farther to water without exhibiting zone grazing, so water can be up to 1,320' away and they will still do a uniform job of grazing.

---

## APPENDIX 5

# Pasture Management Specific to Bison

---

Bison have similar diets and forage preferences as cattle. There are some significant differences:

- Bison graze as they walk. They cover large areas in a day. They tend to graze the pasture from the top down and do this grazing quite uniformly.
- Bison can have water as far as 1,320' away within a paddock (farther than for cattle, which need water within 800').
- Bison do not like to be "pinched" into narrow or small areas. When planning fence locations, avoid tight corners and narrow "necks". Avoid travel lanes with bison.
- They do not normally respect temporary fences, so "set paddocks" are best.
- Watering facilities need to have large capacity so the animals do not play with the tanks. Using smaller portable tanks is not a good idea.
- Bison will create dust wallows in the paddocks.

---

## APPENDIX 6

# Grazing System Evaluation for Pastures

---

The following three pages contain the forms used for monitoring the conditions of pastures including the condition of the plant community, management of the grazing system, and the condition of the soil and water resources. Instructions for this form are on pages 43-45.



# GRAZING SYSTEM EVALUATION FOR PASTURES

Date:

Producer Name:

## CONDITION OF THE PLANT COMMUNITY

### POPULATION OF DESIRABLE PLANTS

TARGET CONDITION

At least \_\_\_\_% of the total plant population is desirable species.  
Desirable species include:

ACTUAL CONDITION

### POPULATION OF UNDESIRABLE PLANTS

TARGET CONDITION

No more than \_\_\_\_% of the total plant population is undesirable species. Undesirable species include:

ACTUAL CONDITION

### PLANT DENSITY

TARGET CONDITION

There is no less than \_\_\_\_% ground cover of desirable species of forages.

ACTUAL CONDITION

### PLANT HEALTH AND VIGOR

TARGET CONDITION

Good leaf color, large leaf area index, lack of evidence of disease and insect damage, very good rate of growth and re-growth after grazing, reproduction of desirable plants is evident (tillering and new seedlings).

ACTUAL CONDITION

### PRESENCE OF LEGUMES

TARGET CONDITION

At least \_\_\_\_% of the stand is legumes (by weight).

ACTUAL CONDITION

### WOODY PLANT COVER

TARGET CONDITION

No sign of emerging first generation species of trees or brush (boxelder, elm, etc.).

ACTUAL CONDITION

<b>MANAGEMENT OF THE GRAZING SYSTEM</b>	
<b>RESIDUAL STUBBLE HEIGHTS/FORAGE RESIDUES</b>	
TARGET CONDITION	ACTUAL CONDITION
At least 4" of residual stubble height, or 1,500 lb/A of plant residues remain when the grazing period is terminated and the livestock moved to a new paddock.	
<b>EVIDENCE OF SPOT OR ZONE GRAZING</b>	
TARGET CONDITION	ACTUAL CONDITION
All plants in each paddock are grazed to a similar height. Grazing is not concentrated in portions of paddocks, while some areas receive little use.	
<b>PLANT RESIDUES</b>	
TARGET CONDITION	ACTUAL CONDITION
Some plant residue covers the ground surface but does not interfere with new plant growth.	
<b>LIVESTOCK CONCENTRATION AREAS</b>	
TARGET CONDITION	ACTUAL CONDITION
No livestock concentration areas exist outside of small areas at gates and around watering facilities, at handling facilities, and in lanes. There are no livestock trails in the pasture.	

## CONDITION OF THE SOIL AND WATER RESOURCES

<b>CONDITION OF SENSITIVE AREAS</b>	
TARGET CONDITION	ACTUAL CONDITION
Plant community is not overutilized, is healthy and vigorous. Livestock have not created concentration areas and mudholes.	
<b>SOIL EROSION</b>	
TARGET CONDITION	ACTUAL CONDITION
No evidence of sheet and rill erosion, gully erosion, streambank erosion, or wind erosion.	
<b>SOIL CONDITION</b>	
TARGET CONDITION	ACTUAL CONDITION
<b>Soil Organic Matter level:</b> Soil organic matter level is at 3% for sandy soils, 5% for silt soils and clay soils.	
<b>Compaction:</b> Grazing periods are no longer than 6 days, spot grazing is not evident, zone grazing is not evident. Residual stubble heights are 4" or more, or plant residues are at least 1,500 lb/A when grazing is terminated.	
<b>Fertility Issues:</b> No evidence of greener areas around dung and urine spots. No evidence of K shortages. Soil tests indicate adequate fertility.	
<b>Biological Activity:</b> Beetles and earthworms are plentiful in manure drops. Manure drops are mostly decomposed within 10 days.	

---

## APPENDIX 7

# Standard Animal Unit Grazing Days

---

The following page contains the form used for measuring the yield of pastures using standard animal unit grazing days. Instructions for this form are on page 46.



# STANDARD ANIMAL UNIT (A.U) GRAZING DAYS

A	B	C	D	E	F	G	H	I	
Paddock #	Acres	Date In	Date Out	Kind/Class Livestock	Days Grazed	Standard Animal Units	Standard A.U. Grazing Days	Comments	
Standard Animal Unit Grazing Days = Column F X Column G						One Standard Animal Unit is 1,000 pounds.			

---

## FOR MORE INFORMATION ON MANAGED ROTATIONAL GRAZING

---

Grazing Systems Planning Guide by Kevin Blanchet, Howard Moechnig, and Jodi DeJong-Hughes. Revised 2003. Extension Distribution Center, 405 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108. Phone: 800-876-8636. Website: [www.extension.umn.edu](http://www.extension.umn.edu) Listed as publication BU-07606-S.

Managed Grazing in Stream Corridors by Howard Moechnig. 2007. Minnesota Department of Agriculture, 625 Robert Street North, St. Paul, MN 55155. Website: [www.mda.state.mn.us/news/publications/animals/livestockproduction/grazing.pdf](http://www.mda.state.mn.us/news/publications/animals/livestockproduction/grazing.pdf)

Managing Soils for Greater Grazing Productivity by Brad Carlson. 2008. Minnesota Department of Agriculture, and University of Minnesota Extension. Available from Minnesota Department of Agriculture, 625 Robert Street North, St. Paul, MN 55155. Website: [www.mda.state.mn.us/news/publications/animals/livestockproduction/managingsoilsforgrazing.pdf](http://www.mda.state.mn.us/news/publications/animals/livestockproduction/managingsoilsforgrazing.pdf)

Pastures for Profit: A Guide to Rotational Grazing by Dan Undersander, Beth Albert, Dennis Cosgrove, Dennis Johnson, and Paul Peterson. Revised 2002. Cooperative Extension Publications, 45 North Charter Street, Madison, WI 53715. Phone: 877-947-7827. Website: [learningstore.uwex.edu/Pastures-for-Profit-A-Guide-to-Rotational-Grazing-P96.aspx](http://learningstore.uwex.edu/Pastures-for-Profit-A-Guide-to-Rotational-Grazing-P96.aspx) Listed as publication A3529.

Understanding Grass Growth: The Key to Profitable Livestock Production by Steven S. Waller, Lowell E. Moser, and Patrick Reece. 1985. Trabon Printing Co., Inc., 430 East Bannister Road, Kansas City, MO 64131. Phone: 816-361-6270.

## **Minnesota Grazing Specialists**

Minnesota Department of Agriculture Grazing Specialist  
Wayne Monsen, 625 Robert Street North, St. Paul, MN 55155.  
Phone : 651-201-6260, E-mail: [wayne.monsen@state.mn.us](mailto:wayne.monsen@state.mn.us)

Root River Watershed Grazing Specialist  
Dean Thomas, Fillmore Soil and Water Conservation District  
900 Washington Street NW, Preston, MN 55965.  
Phone: 507-765-3878 ext 128, E-mail: [deanthomas@fillmoreswcd.org](mailto:deanthomas@fillmoreswcd.org)

## **USDA-Natural Resources Conservation Service Grazing Specialists**

John Zinn, State Grazing Specialist  
Valhalla Center, 330 Elton Hills Drive NW, Rochester, MN 55901.  
Phone: 507-289-7454, E-mail: [john.zinn@mn.usda.gov](mailto:john.zinn@mn.usda.gov)

Lance Smith, Regional Grazing Specialist  
800 East Main Street, Suite 400, Marshall, MN 56258.  
Phone: 507-537-0541 ext 106, E-mail: [lance.smith@mn.usda.gov](mailto:lance.smith@mn.usda.gov)

Mark Hayek, Regional Grazing Specialist  
2038 State Highway #1 NE, Thief River Falls, MN 56701.  
Phone: 218-681-6600 ext 108, E-mail: [mark.hayek@mn.usda.gov](mailto:mark.hayek@mn.usda.gov)

Jeff Duchene, Regional Grazing Specialist  
801 Jenny Avenue SW, Suite 2, Perham, MN 56573.  
Phone: 218-346-4260 ext 101, E-mail: [jeff.duchene@mn.usda.gov](mailto:jeff.duchene@mn.usda.gov)

Tom Gervais, Regional Grazing Specialist  
4915 Matterhorn Drive, Duluth, MN 55811.  
Phone: 218-720-5308, E-mail: [thomas.gervais@mn.usda.gov](mailto:thomas.gervais@mn.usda.gov)

## **Private Grazing Consultant**

Howard Moechnig, Grasslands Specialist, Midwest Grasslands  
37484 - 90th Avenue, Cannon Falls, MN 55009.  
Phone: 507 263-3149, E-mail: [mwgrasslands@frontiernet.net](mailto:mwgrasslands@frontiernet.net)