Forage Crop Production Guide

Forage Species Selection

Selection of an appropriate forage species is an important first step in successful forage production. Factors such as soil type, salinity, flooding, desired season of use, longevity of species, end use, quality, yield potential and invasiveness should be considered to make the best choice possible. Descriptions of several forage species adapted to Saskatchewan growing conditions are given below. Refer to the fact sheet *Forages – Relative Cultivar Yields* for Perennial Species for information regarding cultivar performance.

Grasses

Smooth bromegrass (*Bromus inermis*) is a long-lived, aggressively creeping grass best suited to hay production. It is tolerant of moderate periods of spring fl ooding, saturated soils and saline conditions. It is recommended for use in the Dark Brown, Black and Grey soil zones (Figure 2). Smooth bromegrass can be invasive in some areas, spreading by seed and rootstocks. As the integrity of natural areas is compromised when invaded by introduced species, consider planting a less aggressive species when seeding adjacent to natural areas and rangeland.

Timothy (Phleum pratense)

Meadow bromegrass (*Bromus riparius*) is a weakly creeping pasture grass with rapid regrowth characteristics. Meadow bromegrass can be used for hay, but harvest can be difficult due to its basal growth form. It is similar in adaptation to smooth bromegrass, but not quite as hardy under stress conditions. Because few seed heads are produced in older stands, feed quality remains high. Hybrid bromegrass is the result of a cross between smooth bromegrass and meadow bromegrass.

Hybrid bromegrass has growth characteristics and adaptation intermediate to its parental lines. Hybrid bromegrass regrows more rapidly than smooth bromegrass and has greater hay yields than meadow bromegrass.

Altai wildrye grass (*Leymus angustus*) is a long-lived, hardy, saline-tolerant pasture grass that is moderately creeping, but has a bunched appearance in the field. It is well adapted to medium and heavy textured soils, but is intolerant of spring flooding and saturated soils. It is drought tolerant and adapted to all soil zones. Altai wildrye grass cures well for good fall and winter forage quality. It is difficult to establish, due to poor seedling vigour.

Dahurian wildrye grass *(Elymus dahuricus)* is a productive, short-lived, shallow-rooted bunchgrass. It is highly competitive and quick to establish, is adapted to all soil zones and is productive under saline conditions. With good growing conditions, it can produce a crop in the year of seeding.

Russian wildrye grass *(Psathyrostachys juncea)* is a long-lived, drought tolerant, hardy pasture grass. It has good salt and drought tolerance, but poor tolerance to spring flooding and saturated soils. Although this grass begins growth early in spring, it provides good late-season forage, due to its ability to maintain feed quality. It is difficult to establish, as seedlings do not compete well with weeds or cover crops. Swift, and to a lesser degree, Tetracan, have exhibited improved seedling vigour over other varieties. It is adapted to all soil zones.

Crested wheatgrass *(Agropyron cristatum)* is a hardy, long-lived and drought tolerant bunchgrass. It is particularly well adapted to sandy soils and is intolerant of spring flooding and saturated soils. Crested wheatgrass is moderately salt tolerant. It can be used for hay or pasture, and is especially useful as early-spring pasture. The palatability of crested wheatgrass declines as the growing season advances.

Fairway-Parkway types are finer-stemmed and tolerate more moisture, making them better suited to the Black and Grey soil zones than Summit-Nordan types. In some areas, crested wheatgrass spreads by seed onto adjacent rangeland. Since biodiversity and function of natural areas are compromised when invaded by introduced species, consider planting a less aggressive species when seeding adjacent to natural areas and rangeland.

Intermediate wheatgrass *(Thinopyrum intermedium)* is a high-yielding, creeping-rooted hay grass that matures slowly, making it an ideal candidate for hay mixes containing alfalfa. Adapted to all soil zones, it is moderately tolerant of salinity, spring flooding and saturated soils. It is short-lived under intensive use.

Slender wheatgrass *(Elymus trachycaulus)* is a short-lived native grass that is moderately salt tolerant. It has moderate to good spring flooding tolerance and is moderately tolerant of saturated soils. It establishes very quickly, although it is not very palatable to livestock.

Streambank wheatgrass *(Elymus lanceolatus subsp. riparium)* is a vigorous, low-growing native sod former. This wheatgrass has good spring flooding and drought tolerance, and is moderately tolerant of salinity and saturated soils. It is mainly used for reclamation.

Western wheatgrass *(Pascopyrum smithii)* is a native sod former with good flooding, salinity and drought tolerance. Its forage quality is good and is good summer and fall pasture. It is adapted to all soil zones.

Northern wheatgrass *(Elymus lanceolatus)* is a native sod former with good drought tolerance that is adapted to all soil zones. Its forage has high energy levels and cures well on the stem, making it suitable for late season and winter pasture.

Green Wheatgrass is a natural hybrid originating in Turkey. It retains forage qualities close to those of intermediate wheatgrass, is palatable to livestock, and has salinity tolerance about equal to that of tall wheatgrass. The variety AC Saltlander was selected at the Semiarid Prairie Agriculture Research Centre - Agriculture and Agri-food Canada (SPARC - AAFC) in Swift Current for adaptation to western Canadian conditions in sites with moderate to severe salinity.

Tall wheatgrass *(Thinopyrum ponticum)* is a long-lived bunchgrass that is very tolerant to salinity, spring flooding and saturated soil. It is suited to areas with high salinity levels. It can be cut for hay, but has low palatability.

Reed canarygrass *(Phalaris arundinacea)* is a long-lived flood and saturated-soil tolerant native sod former. It is not salt tolerant, but is a high yielder with good palatability when a low alkaloid variety is used.

Timothy *(Phleum pratense)* is a spring-flooding and saturated-soil tolerant bunchgrass that is well suited to peat soils. It is not drought or salinity tolerant. It is moderately persistent in Black and Grey soil zones and under irrigation in Saskatchewan.

Creeping red fescue *(Festuca rubra)* is a strongly-creeping, low-growing pasture grass. It is intolerant of drought conditions and is moderately persistent in the Black and Grey soil zones and irrigation.

Kentucky bluegrass *(Poa pratensis)* is a long-lived, low-growing and creeping-rooted grass that is adapted to high moisture conditions. It is grazing tolerant and increases on overgrazed pastures in the parkland.

Orchardgrass *(Dactylis glomerata)* is a highly palatable bunchgrass with excellent regrowth and mid-season production potential. It is persistent only under irrigation and high-moisture conditions.

Meadow foxtail *(Alopecurus pratensis)* is a long-lived, somewhat sod-forming grass adapted to cool, moist sites. Very early growing, it has excellent flooding tolerance but is not salt tolerant.

Creeping foxtail *(Alopecurus arundinaceus)* is a long-lived, strongly creeping rooted grass. It begins growth early, and has excellent flooding tolerance, but is not drought tolerant. It resembles meadow foxtail, but has longer rhizomes and wider leaves.

Tall fescue *(Festuca arudniacea)* is a widely-adapted pasture grass that is tolerant of alkaline, acidic and saline soils. It is drought tolerant, but is best suited to cool growing conditions. It is not winter hardy in all areas of Saskatchewan. Animal health problems can occur due to high alkaloid levels in some varieties.

Legumes

Alfalfa *(Medicago sativa)* is a widely-adapted productive legume. Tap-rooted types are well suited to hay production, while creeping-rooted types are hardier and more persistent under grazing or harsh growing conditions. After establishment, alfalfa is moderately saline tolerant but is intolerant of acidity, spring flooding and saturated soils. Alfalfa can cause bloat in livestock.

Sainfoin *(Onobrychis viciifolia)* is a bloat-safe, perennial legume with good drought tolerance. It is adapted to areas where alfalfa grows, but is not as persistent. Sainfoin is intolerant of salinity, spring flooding and saturated soils. It has slow regrowth, but is a highly palatable hay or pasture crop. Its production potential is 80 - 85 per cent of alfalfa.

Birdsfoot trefoil *(Lotus corniculatus)* is a bloat-safe, moderately persistent, perennial legume that has moderate salinity tolerance and good tolerance to spring flooding, saturated and acid soils. It is not competitive with weeds or other forage species.

Alsike clover *(Trifolium hybridum)* is a short-lived perennial legume with high tolerance to spring flooding and saturated or acid soils. It is not tolerant of drought or salinity, and is adapted to the Grey soil zone. Alsike clover can cause bloat in livestock.

Red clover *(Trifolium pratense)* is a short-lived, acid soil-tolerant perennial legume. It is moderately tolerant of spring flooding and saturated soils, but is intolerant of drought and salinity. It is not persistent as pasture, and hay is slow-drying, due to the high water content of the foliage. Red clover is adapted to the Grey soil zone. Red clover can cause bloat in livestock.

Sweet clover *(Melilotus ssp.)* is hardy, drought tolerant and has slight to moderate salinity tolerance. This biennial adapted to a wide range of soil types. It is intolerant of spring flooding and saturated soils. Low-coumarin varieties should be used to reduce the risk of bleeding disease in livestock. Sweet clover can cause bloat in livestock.

Cicer milkvetch *(Astragalus cicer)* is a long-lived, non-bloat legume adapted to the moist Dark Brown, Black and Grey soil zones. Cicer milkvetch is slow to establish but persists under grazing.

Table 1:
Recommended Seeding Rates for Saskatchewan Soil Zones

Soil Zone (see map page 12)	Crops	Seeding Rate	
		kg/ha	lb./ac.
1. Brown	**Hay Crops (seed grass and legume in alternate rows)**		
	Crested wheatgrass and alfalfa	3.4 + 2.2	3 + 2
	Intermediate wheatgrass and alfalfa	4.5 + 2.2	4 + 2
	Alfalfa	4.5	4
	Sweet clover	9	8
	Pastures (cross-seed)		
	Altai wildrye grass and alfalfa (high water table or saline seep areas only)	9 + 1.1	8 + 1
	Crested wheatgrass and alfalfa	3.4 + 1.1	3 + 1
	Russian wildrye grass and alfalfa	3.4 + 1.1	3 + 1
	Meadow bromegrass and alfalfa	9 + 1.1	8 + 1
2. Dark Brown	**Hay Crops**		
	Smooth bromegrass and alfalfa	5.6 + 4.5	5 + 4
	Hybrid bromegrass and alfalfa	6.7 + 4.5	6 + 4
	Crested wheatgrass and alfalfa	5.6 + 2.2	5 + 2
	Intermediate wheatgrass and alfalfa	9 + 2.2	8 + 2
	Alfalfa	9	8
	Sweet clover	9	8
	Pastures (cross-seed)		
	Altai wildrye grass and alfalfa (high water table or saline seep areas only)	9 + 1.1	8 + 1
	Crested wheatgrass and alfalfa	4.5 + 1.1	4 + 1
	Russian wildrye grass and alfalfa	3.4 + 1.1	3 + 1
	Meadow bromegrass and alfalfa	10 + 1.1	9 + 1
	Smooth bromegrass and alfalfa	7.8 + 1.1	7 + 1
	Hybrid bromegrass and alfalfa	7.8 + 1.1	7 + 1
	Alfalfa (Caution: risk of bloat)	9	8
3. Black and Grey	**Hay Crops**		
	Smooth bromegrass and alfalfa	4.5 + 5.6	4 + 5
	Crested wheatgrass and alfalfa	6.7 + 3.4	6 + 3
	Intermediate wheatgrass and alfalfa	12.3 + 3.4	11 + 3
	Alfalfa	9	8
	Sweet clover	9	8
	Hybrid bromegrass	9	8
	Meadow bromegrass	13.4	12
	Meadow bromegrass and alfalfa	11.2 + 2.2	10 + 2
	Pastures		
	Meadow bromegrass and alfalfa	11.2 + 1.1	10 + 1
	Meadow bromegrass	13.4	12
	Smooth bromegrass and alfalfa	7.8 + 1.1	7 + 1
	Hybrid bromegrass and alfalfa	9 + 1.1	8 + 1
	Crested wheatgrass and alfalfa	6.7 +	6 + 1
	Intermediate wheatgrass and alfalfa	12.3 + 1.1	11 + 1
	Russian wildrye grass	6.7	6
	Sainfoin (non-bloating)	33.6	30
	Birdsfoot trefoil (non-bloating)	4.5	4
Irrigation	**Hay Crops**		
	Smooth bromegrass and alfalfa	6.7 + 5.6	6 + 5
	Intermediate wheatgrass and alfalfa	12.3 + 5.6	11 + 5
	Alfalfa	9	8
	Pastures	11.2 + 1.1	10 + 1
	Bromegrass and alfalfa	8 + 1.1	8 + 1
	Intermediate wheatgrass and alfalfa	12.3 + 1.1	11 + 1
	Kentucky bluegrass and alfalfa	2.2 + 1.1	2 + 1
	Meadow bromegrass	13.4	12
	Orchardgrass	11.2	10

Notes:

- Seeding rates can be varied based on seed quality and cost, seeding conditions and end use of the crop.
- When seeding grass alone for pasture in the Brown and Dark Brown soil zones, increase grass recommended seeding rate by 1.5 times. If Tetracan Russian wildrye grass is used, increase seeding rate by two times. If Fairway or Parkway crested wheatgrass is used, reduce seeding rates by 20 per cent. Higher seeding rates may be appropriate where alfalfa is sown for dehydration, or where a thick stand of fine-stemmed alfalfa is required. However, research in Saskatchewan, Manitoba and North Dakota indicates that seeding more than about 3.6 kg (8 lb./ac.) does not result in greater forage yields in alfalfa.

Table 2:
Comparative seed size of forage species

Species	Approximate number of seeds/kg	Approximate number of seeds/lb.	Species	Approximate number of seeds/kg	Approximate number of seeds/lb.
LEGUMES			Pubescent wheatgrass	220,000	100,000
Alfalfa	440,000	200,000	Slender wheatgrass	352,000	160,000
Sweetclover	572,000	260,000	Streambank wheatgrass	344,000	156,000
Alsike clover	1,540,000	700,000	Tall wheatgrass	174,000	79,900
Red clover	605,000	275,000	Kentucky bluegrass	4,800,000	2,182,000
White clover	1,760,000	800,000	Smooth bromegrass	300,000	136,000
Birdsfoot trefoil	825,000	375,000	Meadow bromegrass	176,000	80,000
Sainfoin	66,000	30,000	Hybrid bromegrass	200,000	90,900
Cicer milkvetch	286,000	130,.000	Creeping red fescue	1,353,000	615,000
GRASSES			Meadow fescue	506,000	230,000
Russian wildrye grass (diploid)	385,000	175,000	Tall fescue	500,000	227,000
Russian wildrye grass (tetraploid)	220,000	100,000	Meadow foxtail	1,270,000	577,000
Altai wildrye grass	112,000	51,000	Creeping foxtail	1,657,000	753,000
Crested wheatgrass (diploid)	485,000	220,000	Orchardgrass	1,439,000	654,000
Crested wheatgrass (tetraploid)	385,000	175,000	Timothy	2,710,000	1,232,000
Dahurian wildrye grass	175,000	80,000	Reed canarygrass	1,175,000	534,000
Northern wheatgrass	341,000	155,000	Italian ryegrass (Maris Ledger)	210,000	105,000
Western wheatgrass	242,000	110,000	Westerwolds ryegrass	210,000	105,000
Intermediate wheatgrass	194,000	88,000			

Forage Mixtures

Forages can be planted in monocultures or mixtures. Mixtures can be simple or complex, with two or many species composing a mix. Planting a forage mixture often provides advantages to seeding a single species. Some advantages of forage mixtures include:

- better adaptation across fields that have diverse topography, soil types, or salinity levels;
- forage production is more consistent across the season, because each species' production peaks at different dates;
- more efficient use of soil moisture and nutrients;
- animal gains may be greater due to a more balanced diet;
- mixed stands may have greater longevity, with more adapted species replacing less-suited species over time; and
- less susceptibility to insect and disease infestations.

Forage monocultures have advantages compared to forage mixtures:

- easier to seed;
- more uniform palatability, thereby reducing selective grazing;
- uniform growth and regrowth characteristics;
- more stable plant composition;
- more predictable peak production date; and
- often, only one species may be fully adapted to the site or intended use.

Generally, monoculture forage crops are easier to manage successfully than forage mixtures. The most important point to remember when selecting a forage mixture is to select only species that are adapted to the site and complement the production characteristics of other species in the mix.

Alfalfa Cutting Management

Improper cutting management of alfalfa hay stands can lead to winter kill. Understanding alfalfa physiology can help avoid this problem.

Energy is produced in alfalfa leaves and used to fuel plant growth. Energy in excess of requirements is stored in various plant structures, such as the crown. The energy is used as stored fuel for regrowth following cutting, plant maintenance over winter, and growth during early spring.

When an alfalfa plant is cut, few leaves remain and the plant may draw on stored energy reserves for regrowth. Generally, the plant will need six weeks to replace leaves and replenish stored reserves to pre-cutting levels.

Plants cut after August 15 may not obtain six weeks of good growing weather to replenish stored reserves before a hard frost, and can go into winter with low energy levels. If the winter is severe, winter injury can result.

To reduce alfalfa winter injury:

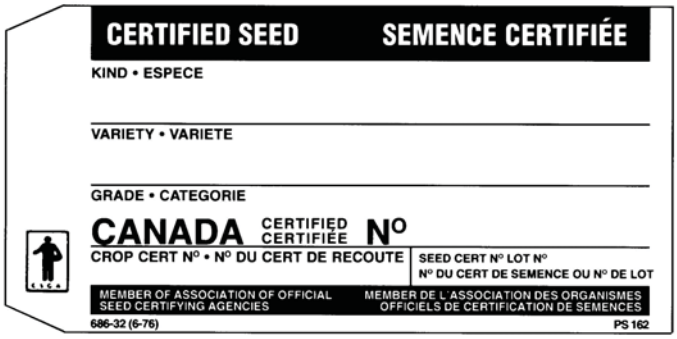
- avoid cutting between August 15 and the first killing frost;
- seed recommended, winter hardy varieties;
- inoculate seed properly and maintain adequate soil phosphorous; and
- manage stubble for maximum snow cover.

Seed Quality

Seed quality has a large impact on establishment success and subsequent forage yields. Certified seed will have good germination and seedling vigour, low amounts of weed seeds present, and be of a recognized variety. Certified seed assures seed quality and characteristics of the variety, such as relative yield, disease resistance and winter hardiness. This allows for selection of characteristics best suited for existing growing conditions.

Crop Certificate Number

All certified seed has a tag attached with a crop certificate number. The first two digits of the crop certificate number represent the year in which the crop was produced. The third through ninth digits inclusive represent the identification number of the grower who produced the seed. The tenth digit represents the code for the generation or class issued to the crop that produced the seed. The eleventh digit represents the number of different certificates of the same status issued to the grower.



Seed Certificate Number

This number is assigned by the Canadian Food Inspection Agency, Agriculture and Agri-Food Canada, for each lot of seed tagged by a seed inspector. There is a different number for each lot of seed.

Calculating Seeding Rates

Seeding rates should be calculated on the basis of Pure Live Seed (PLS). PLS determines the amount of viable seed in a seed lot by allowing for impurities and the germination percentage of the seed lot. PLS is calculated as follows:

PLS = (per cent germination) x (per cent purity)

For example, if a seed lot has 15 per cent impurities and a germination of 89 per cent, PLS would be: PLS = (0.89 x 0.85) = 0.76. Therefore, seeding rates should be increased by 24 per cent to obtain the desired density of viable seed. If 20 to 30 seeds per linear foot of row are desired, determine the number of seeds per pound of forage species in Table 2. The number of linear feet per acre will be determined by row spacing as indicated in Table 3.

Table 3.

Row Spacing	Linear feet/acre
6”	87,120
12”	43,560
18”	29,040
24”	21,780
X	43,560 x 12/X

Sample Calculation

Appropriate seeding rates will differ, depending on the soil zone. Generally, lower seeding rates are desirable in dry locations, to reduce inter-plant competition. Target seeding rates in Saskatchewan range from 20 seeds per square foot in the Brown soil zone, to over 40 in irrigated fields.

1. Alfalfa in high moisture area with six-inch row spacing:

$$\frac{87{,}120 \text{ linear ft./ac.} \times 20 \text{ seeds/linear ft.}}{200{,}000 \text{ seeds/lb.}} = 9 \text{ lb./ac.}$$

2. Alfalfa in high moisture area with 12-inch row spacing:

$$\frac{43{,}560 \text{ linear ft./ac.} \times 30 \text{ seeds/linear ft.}}{200{,}000 \text{ seeds/lb.}} = 7 \text{ lb./ac.}$$

3. Tetraploid crested wheatgrass and alfalfa in same row with 18-inch row spacing:

CWG – $\frac{29{,}040 \text{ linear ft./ac.} \times 15 \text{ seeds/linear ft.}}{175{,}000 \text{ seeds/lb.}} = 3 \text{ lb./ac.}$

Alfalfa:

$$\frac{29{,}040 \text{ linerar ft./ac.} \times 15 \text{ seeds/linear ft.}}{200{,}000 \text{ seeds/lb.}} = 2 \text{ lb./ac.}$$

Steps to Successful Seeding

1. Use quality seed. Clean seed with high germination will result in rapid establishment and reduced weed problems in the establishing crop.

2. Place seed at the correct depth. Most forage species should not be seeded deeper than 12 mm (1/2 in.). Some small seeded species, such as birdsfoot trefoil and timothy, should be seeded at one-quarter inch deep or less.

3. Seed into a firm seedbed. Good seed to soil contact is required for rapid germination of forage seeds. Soil should be firm enough that a footprint will leave virtually no depression in the soil. Clean, unworked stubble makes a good seed bed.

4. Meter seed accurately. Most forage seeds are small and/or chaffy, and are seeded at low rates. Seeding implements must be able to consistently apply seed. Mixing chaffy seed with cracked grain, cover crop seed, or fertilizer (not with inoculated legumes) can improve flow of seed.

5. Control weeds. Clean up fields prior to planting, paying particular attention to perennial weeds. Control weeds in-crop in the year of establishment using cultural or chemical means (consult the Saskatchewan Ministry of Agriculture publication, *Guide to Crop Protection).*

6. Use appropriate seeding rates (Table 1). Ideal seeding rates vary with average available precipitation. Seeding rates will be lower in drier parts of the province.

7. Seed at the correct row spacing. Thirty cm (12 in.) row spacings are recommended for the Dark Brown and Black soil zones. Forty-five cm (18 in.) row spacings are recommended for the Brown soil zone and 15 cm (six in.) row spacings are recommended for irrigation. Cross-seeding rows, or alternate row seeding of mixtures when seeding two species can also reduce competition.

8. Carefully consider the use of cover crops. Cover crops can protect forage seedlings from wind damage and provide an economic return in the year of establishment. However, cover crops compete with forage seedlings for moisture, light and nutrients. Cover crops reduce establishment success and usually reduce the subsequent yield of the forage. The negative impacts of cover crops on forage seedlings become more apparent under dry conditions, and may result in the forage failing to establish. Cover crops are not recommended in the Brown soil zone.

9. Remember that forages are slow to establish and may require over a year to do so.

Seeding Dates

Forages should be sown to coincide with moisture and weather conditions (Figure 1) that will assist germination and establishment. In general, perennial forages may be sown at three different times of the year.

Spring Seeding: Forage plantings are most likely to be successful when seeded in spring. Soil moisture conditions are generally good. About 15 to 30 cm (six to 12 in.) of moist soil is considered adequate for establishment. In the Brown and Dark Brown soil zones, seeding is recommended from early April to mid-May.

In the Black and Grey soil zones, forage seedings may be successfully completed as late as mid-June. Usually early seeding is best, but consideration must also be given to field conditions, weed control and potential insect problems.

Late Fall Seeding: Seeding forage crops from October 15 until freeze-up generally ensures that no germination will occur until the following spring. Mean daily and soil temperatures should be 5 C or less before fall seeding. Spring soil moisture conditions will likely be favourable from the infiltration of moisture from melted snow.

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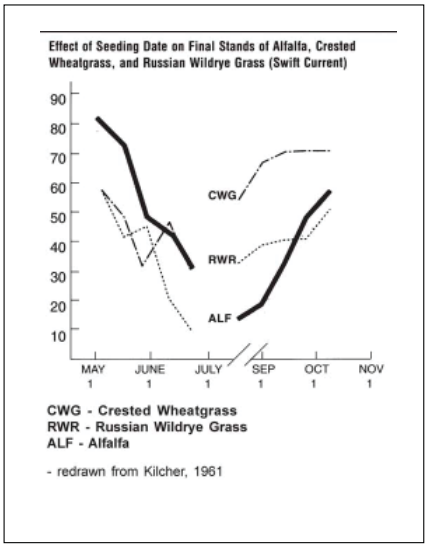
There is often more time in late fall than in early spring to prepare appropriate seeding equipment to seed for forage crops. Another advantage to dormant seeding is that some land areas may not be accessible in the early spring, such as land subject to flooding, saline areas or peaty soils that remain wet in the summer. However, some crops such as sweet clover cannot be sown successfully in the late fall. Also, some land may be subject to soil crusting, resulting in poor emergence.

Figure 1



Early Fall Seeding: In some years there may be a window of opportunity to seed forage crops in the early fall. Growing conditions must be correct for quick establishment as the plants must be developed to a stage to survive the winter.

Seedling legumes are much more susceptible to winterkill than seedling grasses. Alfalfa should be sown by mid-August. There is little information on seeding legumes, other than alfalfa, at this time of year. Grasses may be sown as late as September 10, in the Brown soil zone. Insects such as grasshoppers can be a threat to seedling forages in the fall.

Row Spacing

In the Brown soil zone, hay yields can be increased in dry years by seeding at 45 to 60 cm (18 to 24 in.) row spacing. This increases crop height, making harvesting easier, compared to narrower row spacings. Row spacing of 90 cm (36 in.) should only be used in seed production fields. On saline sites, 15 cm (six in.) row spacings should be used.

Weed Control in Forage Crops

Nearly all forages have slowly developing, non-competitive seedlings. Weeds can easily out-compete forage seedlings for moisture and nutrients. Good weed control prior to and during establishment is essential to get a rapidly established, clean forage stand.

Weed competition results in increased time required for forage establishment, increased weediness of the subsequent forage stand, and increased risk of establishment failure. In-crop chemical weed control options can be limited in forages, particularly for perennial weeds such as quackgrass, Canada thistle and dandelion. Therefore, plan and implement a weed control strategy at least a year prior to seeding the forage crop. Herbicides and tillage in the year prior to establishment can be used to control annual and perennial weeds. However, excessive cultivation loosens the seedbed and dries the soil.

Once the crop has been seeded, cultural and chemical methods can be used to control weeds. Forage crops are often weedy in the establishment year, due to lack of competition from the crop. If pre-establishment weed control was successful, the weeds present in the establishment year will be predominantly annuals.

Annual weeds can be controlled in the establishment year by using herbicides or mowing when weeds elongate, but prior to seed set. This method of cutting reduces competition and seed production of the weeds. Care should be taken to avoid mowing too low as this damages forage seedlings.

Chemical weed control options are often limited in established forage stands, especially when a mixture of legumes and grasses are seeded, or when controlling grassy or broadleaf weeds in like forage crops. Management of forage stands to maintain a healthy, competitive stand goes a long way in reducing weed problems in established forage stands. Proper cutting

schedules, good snow management, good fertility management, adequate rest periods after grazing or cutting and appropriate stocking rates will all contribute to a healthy, weed-free forage stand.

Perennial weeds in forages are more difficult to control. Quackgrass is very difficult to successfully control in-crop using herbicides. However, maintaining a vigorous forage crop will limit its spread in the field. Canada thistle can be controlled in most grasses by using herbicides. However, a healthy forage crop can reduce Canada thistle through competition.

Refer to Saskatchewan Ministry of Agriculture *Guide to Crop Protection* for recommendations on herbicides. Refer to product label for directions and restrictions before using any herbicide.

Inoculation of Legumes

Inoculation is the addition of effective *rhizobium* bacteria to legume seed prior to planting. After germination, the bacteria form nodules on the roots and begin taking nitrogen (N) gas from the soil air. The bacteria convert the gas to ammonium and give it to the plant. Well nodulated forage legumes can grow without the need for nitrogen fertilizer.

Many Saskatchewan soils lack the specific *rhizobia* needed for rapid growth and high yields of forage legumes. Inoculation sticks thousands of nitrogen-fixing bacteria to each seed just before planting. The cost of inoculant is low and the potential yield benefits are substantial. Each legume or group of legumes requires a unique species of *rhizobium* to form nodules and fix nitrogen. Commercial inoculants are prepared for specific legumes. Be sure to obtain the right one for the crop being seeded.

Methods of Inoculation

Inoculants may be available as peat powder, liquid, granules, or pre-inoculated seed. Inoculant is a dry powder that is mixed with the seed just prior to planting. In order to be effective, it must be glued to the seed, so a sticker solution is used to bind the two together. Sticking agents like diluted sugar water, molasses, soda pop, etc., are used, but research has shown that a solution of ordinary powdered skim milk is very effective. If calf milk replacer is used, use a formulation without antibiotics.

Precise amounts of sticker are not crucial. Just mix the skim milk according to package directions (do not use hot water). Dribble, or spray the milk onto the seed, wetting it thoroughly, and let the excess milk drain off. Turning the seed during this operation will ensure complete wetting.

Add inoculant to the wetted seed. Follow manufacturer's instructions for proper amounts. If seed is to be broadcast, or if seeding conditions are not ideal, increase the amount. Many growers routinely double the recommended rate of inoculant. Stir the seed and inoculant thoroughly, then proceed with seeding as quickly as possible. Small batches of wetted seed can be inoculated manually by mixing seed and inoculant in a large container or on a polyethylene sheet. For larger amounts of seed, cement mixers or ice augers can be used for mixing.

Pre-inoculated Seed

Pre-inoculated seed of major forage legumes is commercially available. Seed should be stored appropriately to ensure viability of inoculant.

Guide to successful inoculation

- Inoculate seed with the correct *rhizobium*.
- Use a sticking agent.
- Store inoculant in a cool dry place until use.
- Do not expose inoculants to direct sunlight.
- Inoculate seed just before seeding.
- Do not mix fertilizer with inoculated seed.
- Sow inoculated seed into a moist seedbed.
- Use more inoculant under adverse conditions.

Using Annual Crops for Forage

Using annual crops for forage is a common practice in Saskatchewan. Crops such as barley, oats, triticale, peas, rye, corn, and many other crops are commonly grown and used as greenfeed, silage, pasture, or swath grazing in a livestock production system (Table 4, 5 and 6). Some producers have used annuals such as sorghum-sudangrass and millet.

Annual crops are productive and flexible, allowing them to be used effectively to deal with feed shortages. However, adequate levels of nutrients in the soil, particularly nitrogen in the case of cereals, are required in order to obtain maximum profitability from annual forages. If crops are stressed prior to or during use, nitrate levels in the crop should be monitored. Nitrates can poison livestock if present in high concentrations (0.5 per cent or greater).

Pasture

Annuals can be used for pasture, and fit well into complementary grazing systems. The choice of crop depends on when the additional pasture is required: fall rye sown in late August to early September will provide early grazing the next spring. Oats, barley (smooth awned varieties), wheat, spring rye or triticale, sown in the spring, is ready for pasture about seven weeks after planting. Spring-seeded fall rye or winter wheat will not set seed, and will yield abundant leaf growth for mid- and late-season grazing. High stocking rates are required on annual forages to reduce trampling losses and prevent cereals from heading and losing quality. Rotational grazing is useful to achieve the required grazing intensity and allow for plant recovery following grazing. Expected grazing productivity of annual pasture ranges from 25-150 grazing days per acre depending on the soil zone.

Greenfeed

Annuals can be used for greenfeed production. Timing of cutting has a large impact on subsequent feed quality. Considering the required feed quality prior to harvest will allow the operator to cut the crop at the appropriate time to maximize the value of the greenfeed crop. Generally, fibre content increases and protein and energy decrease as annual cereal forages go from boot to hard dough stage. The decline of protein and energy levels is slower in barley than in oats, triticale, and rye.

Generally, annual forages produce the highest yields and protein when harvested in the dough stage. The relative performance of annual species varies with soil zone. For instance, in the Dark Brown and Brown soil zones, barley usually has greater yield than oats. However, in the Black and particularly Grey soil zones, oats usually has greater yields than barley.

Table 4

Protein, total digestible nutrients (TDN) and fibre (acid detergent fibre (ADF), neutral detergent fibre (NDF) content of cereal greenfeed.

Crop	Protein (%)	TDN	ADF	NDF
barley	11.2	58.4	37.3	58.1
oats	10.8	57.0	37.6	60.9
rye	8.7	53.8	42.3	66.3
wheat	10.6	55.7	37.6	63.1

Swath Grazing

Swath grazing has developed into a popular technique to extend the grazing season. Swath grazing involves cutting an annual or perennial crop late in the season and allowing the crop to remain in swath. Cattle graze the swaths in late fall or winter.

Annual cereals are commonly used for swath grazing. Swath grazed crops are usually planted later than other annual cereals, so that they are ready to be cut in September. When swath grazing, stock densities must be kept high with the use of electric fencing to reduce trampling losses and wastage.

Figure 2
Soil Zones of Saskatchewan

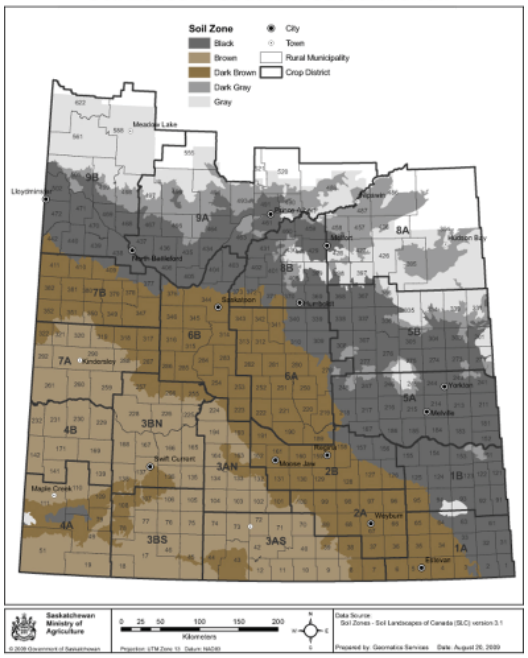


Table 5
Dry matter yield of annual crops as greenfeed, Black soil zone

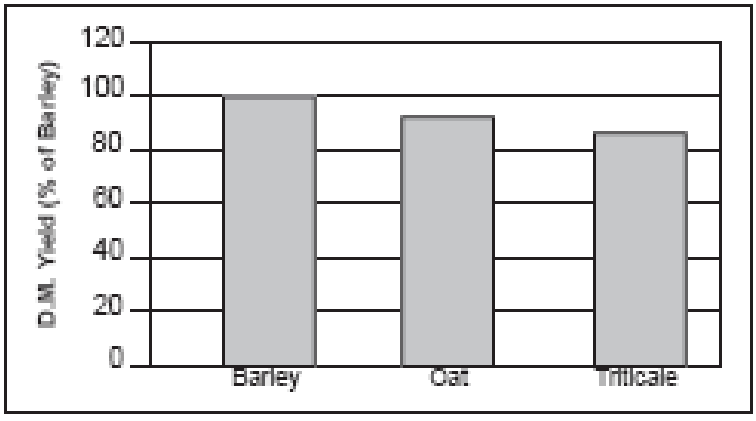
Crop	Yield (kg/ha)
barley	5,000 - 7,500
fababeans	2,500 - 4,500
Italian ryegrass	4,600 - 4,900
oats	5,600 - 9,800
peas	5,600
Proso millet	3,100 - 5,600
canola	3,000 - 4,200
sorgum-sudangrass	3,200 - 5,300
spring rye	5,900 - 6,100
sunflowers	1,200 - 2,900
triticale	5,600
wheat	2,600 - 6,800

Agriculture and Agri-Food Canada Data, Melfort

Silage

Cereals, corn, peas and other field crops are commonly used as silage. Barley is the dominant silage crop in Saskatchewan due to its high yield and good quality. All annual silage crops have different quality characteristics that influence the composition of the end product. Operators should determine the desired quality of silage, then select the crop that will provide the desired quality and acceptable yield. Crops can be grown in mixtures for silage to enhance silage quality or provide additional forage resources. Peas are included with cereals to increase protein content, and triticale is sometimes included with other cereals to provide late-summer grazing after the silage crop is removed.

Figure 3
Dry matter yields of annual cereals grown for forage expressed as a per cent of barley yield - average of 15 site-years of data from northwest Saskatchewan, 1992-96.



Corn for Forage

Corn has very high yield potential when moisture, nutrients and heat are not limiting. In Saskatchewan, corn is used as a silage crop, although using corn for fall and winter grazing is becoming more common. Early maturing corn varieties can be grown successfully for forage nine years
out of 10.

The average number of corn heat units (CHU) received varies across Saskatchewan. Corn growers should determine their certainty of receiving 2,200 CHUs. Obtain the Corn Heat Unit Maps for Saskatchewan (http://www.agriculture.gov.sk.ca/Corn_Heat_Units) from Saskatchewan Ministry of Agriculture (Irrigated Corn, Silage, Irrigation and Grain) to determine the average corn heat units received across the province. Corn hybrid performance is tested at Outlook and is described in the Alberta Corn Committee's Hybrid Performance Trails, www.albertacorn.com.

When growing corn for forage, higher CHU-rated (later) varieties have a significant yield advantage if the spring and summer growing conditions have above-average temperature. Field selection should favor warm, sheltered, well-drained and non-saline sites. Corn should be planted in high quality soils at 30,000 kernels per acre. Precision seeding and row crop management is the preferred method.

Corn competes poorly with weeds. In order to maximize production, excellent early weed control is required. Depending on available moisture, nitrogen application rates range from 90-170 kg/ha (80-150 lb./ac.). Corn can use 73 kg/ha (65 lb./ac.) of banded phosphorous from May through September. High organic matter and well manured cropland is great for corn nutrition. Corn field grazing is an efficient method of nutrient cycling.

Due to the greater input costs associated with growing corn, new growers must be aware of the agronomic requirements of the crop, and start with a modest acreage. The Manitoba Corn Growers Association's *Corn Production Guide* is the best prairie corn reference available.

Annual Ryegrass for Pasture in Saskatchewan

Annual ryegrass is grown in many areas of the world as a forage and seed crop. In recent years, this species has been grown in Saskatchewan as summer and late-season pasture, and as a seed crop.

Annual ryegrass is adapted to the Black and Grey soil zones of Saskatchewan. There are two types of annual ryegrass. Italian ryegrass is a biennial that usually does not develop seed heads until the crop has been vernalized; and Westerwolds ryegrass is a taller, stemmier type which will develop seed heads in the year of seeding.

As both types have limited winter hardiness under Saskatchewan growing conditions, they will not successfully overwinter and are considered annual crops. Adequate moisture and soil fertility are required to achieve maximum productivity of this species. The cultivars Maris Ledger (Italian type) and Aubade (Westerwolds type) have been successfully grown in Saskatchewan. Annual ryegrass can be used for hay, silage or pasture, but the Westerwolds type is better suited to haying due to its tall growth. Annual ryegrass production peaks in late-July and early-August, with growth continuing late into the fall. This growth pattern, in addition to the high quality forage produced (crude protein levels in excess of 20 per cent in fall regrowth), makes grazing into winter possible.

Annual ryegrass is best seeded in mid-May at a depth of 1.5 to 3 cm (0.6-1.2 in.), depending on soil moisture conditions. Stands should be fertilized at the same level as a cereal crop to realize full production potential. Recommended seeding rate is 11.2-13.4 kg/ha (10 to 12 lb./ac.). Annual ryegrass can also be underseeded to cereals and used for greenfeed, silage or grain, to provide late season grazing after harvest.

Fertilizing Forages

Forages require nitrogen (N), phosphorus (P), potassium (K), sulphur (S) and micronutrients. Most Saskatchewan soils are low in nitrogen and phosphorus, many are low in sulphur, and some are low in potassium and may be low in one or more micronutrients. Properly inoculated alfalfa will not require nitrogen fertilizer.

Soil testing is the best way to assess soil nutrient levels. Crop inspecting and tissue testing allow for fine-tuning fertilizer application and problem diagnosis. Some soil testing labs will do an economics report on fertilizer application, for a nominal fee, which analyzes the benefit versus the cost of applying fertilizer.

Establishment Year

With good to excellent soil moisture, only 7 kg (15 lb.) P_2O_5 can safely be placed with forage seed, using equipment with a 15 to 17 cm (6 to 7 in.) row spacing and 2.5 cm (1 in.) spread. All other fertilizer should be banded away from the seed (side banded or deep banded) or broadcast and incorporated. Banding often results in greater nitrogen, phosphorus and potassium fertilizer use efficiency.

Established Forages

Nitrogen and sulphate-sulphur are mobile nutrients (are carried into the soil by rainfall) and thus can be top dressed annually after establishment of the forage, though significant losses of nitrogen can occur if rainfall is not received within one to two days of application of top-dressed urea (46-0-0).

Spraying liquid nitrogen (28-0-0) is not recommended on established forages. Dribble banding liquid nitrogen is considered more effective.

Placing nitrogen in the soil using a spoke-wheel applicator or disc bander can avoid the potential problem of nitrogen loss through ammonia volatilization. Banding with knives, however, has been shown to be a poor alternative. It was less effective than disc banding for fall application, and less effective than top dressing for spring application.

Grasses for hay or pasture should be fertilized with nitrogen in late fall or early spring. When a high rate of nitrogen will be applied (greater than 100 lb. actual nitrogen per acre), split application will result in higher forage protein content, and sometimes higher yield.

Table 6

Approximate nutrient removal per tonne/ton of air-dried forage				
Nutrient	Amount removed: kg/tonne (lb./ton)			
Nitrogen (N)	45	50	31.5	35
Phosphate (P_2O_5)	9	10	9	10
Potassium K_2O)	45	50	45	50
Calcium (Ca)	27	30	6.3	7
Magnesium (Mg)	4.5	5	4.5	5
Sulphur (S)	4.5	5	4.5	5
Iron (Fe)	0.27	0.3	0.27	0.3
Manganese (Mn)	0.09	0.1	0.09	0.1
Boron (B)	0.072	0.08	0.072	0.08
Zinc (Zn)	0.045	0.05	0.045	0.05
Copper (Cu)	0.009	0.01	0.009	0.01
Molybdenum (Mo)	0.0018	0.002	0.0018	0.002

***Nutrient removal is an indication of nutrient requirement, but not a recommendation for fertilizer application.**
Recommended application rates of fertilizer based on a soil test also considers fertilizer use efficiency and availability of nutrients in the soil, etc.

Nitrogen fertilization of mixed legume-grass forage stands is difficult, because nitrogen application stimulates grass production and reduces the longevity of the alfalfa. Also, the alfalfa in the stand will use some of the applied nitrogen, reducing the amount of nitrogen it fixes from the air, increasing the cost of supplying the stand with nitrogen.

The yield response of mixed forage stands to nitrogen application depends on the percentage of legume in the stand, soil nitrogen level, soil type and forage species. Generally, mixed stands that are more than half alfalfa respond little to nitrogen fertilizer application. Yield responses are greatest on stands with a low percentage of alfalfa and low soil nitrogen. When soil testing mixed forage stands, be sure to indicate the approximate percentage and species of legume and grass.

Phosphorus does not move readily into the soil, thus planning a fertilizer program is important for grass, legume and mixed stands. The options for phosphorus fertilizer application are:

- Band or broadcast and incorporate more than one year's supply of phosphorus prior to forage establishment.
- Band phosphorus with a disc bander, dribble band liquid phosphorus, or nest phosphorus with a spoke wheel applicator, annually.
- Top dress two to three times the amount of phosphorus required when banding, annually.

Potassium moves into the soil more quickly than phosphorus, but much less readily than nitrogen; thus application options are similar to those for phosphorus.

Seeding Forages in Saline Areas

Saline patches that appear in annually cropped fields may steadily enlarge if management practices remain the same. Converting this land to forages is much more successful if done while the affected land still supports barley crop production.

Late-fall seeding of saline areas can be desirable, since early spring snowmelt temporarily decreases soil salinity concentrations. Enhanced early spring emergence has been observed in intermediate, crested, and tall wheatgrasses following late fall seedings. Russian and Dahurian wildrye grasses, smooth and meadow bromegrasses, tall fescue, creeping foxtail, and slender wheatgrass emerge best in the warmer temperatures of mid- to-late spring.

Table 7

Perennial Forages for Saline Soils, Flooded Areas and Peat
(Based in part on test results from Canada's Salt Tolerance Testing Lab. at Swift Current)

Limited Spring Flooding (up to two weeks)

Candidate Forages	Occurrence of Visible Surface Salts (Salinity Rating[1])								Seeding rate[2]
	Almost always		Frequently		Infrequently		Rarely		
	Pasture	Hay	Pasture	Hay	Pasture	Hay	Pasture	Hay	lb./ac. (kg/ha)
Tall wheatgrass	X	X		X		X			12 (13.4)
Green wheatgrass	X	X	X	X	X	X			10 (11.2)
Russian wild ryegrass			X		X		X		8 (8.9)
Slender wheatgrass[3]				X		X	X	X	8 (8.9)
Intermediate wheatgrass				X		X		X	10 (11.2)
Crested wheatgrass			X	X	X	X	X	X	7 (7.9)
Smooth bromegrass				X		X		X	8 (8.9)
Meadow bromegrass			X		X		X		12 (13.4)
Alfalfa[4]					X	X	X	X	6-8 (6.7-8.9)
Awned wheatgrass[5]					X		X		
Northern wheatgrass[5]					X	X	X	X	7 (7.9)
Western wheatgrass[5]					X	X	X	X	10 (11.2)
Green needlegrass[5]							X		

Limited Spring Flooding (two to five weeks)

Candidate Forages	Occurrence of Visible Surface Salts (Salinity Rating[1])								Seeding rate[2]
	Almost Always		Frequently		Infrequently		Rarely		
	Pasture	Hay	Pasture	Hay	Pasture	Hay	Pasture	Hay	lb./ac. (kg/ha)
Tall wheatgrass	X	X		X		X			12 (13.4)
Green wheatgrass[6]	X	X	X	X	X	X			10 (11.2)
Slender wheatgrass				X		X		X	8 (8.9)
Intermediate wheatgrass				X		X		X	10 (11.2)
Tall fescue			X	X	X	X	X	X	8 (8.9)
Smooth bromegrass				X		X		X	8 (8.9)
Meadow bromegrass					X		X		12 (13.4)
Creeping foxtail					X	X	X	X	5 (5.6)
Western wheatgrass[5]					X		X		10 (11.2)
Orchard grass					X		X		10 (11.2)
Sweetclover						X		X	8 (8.9)
Alfalfa[4]					X	X	X	X	4-8 (4.5-8.9)
Reed canarygrass						X		X	5 (5.6)
Alsike clover						X		X	4 (4.5)
Timothy						X		X	5 (5.6)

1. **Approx. Salinity Rating by Visual Occurence**
   Rarely (0 - 2 dS/m)
   Infrequently (2 - 5 dS/m)
   Frequently (5 - 8 dS/m)
   Almost always (>8 dS/m)
2. **Required to achieve a pure stand; use as a guide for various seed mixtures.**
3. **Short-lived, but establishes rapidly.**
4. **Watch for possible bloat problems when grazed.**
5. **Reclamation species.**
6. **Less tolerant of flooding than tall wheatgrass.**

Saline sites typically exhibit a wide range of salinity levels in relatively small areas. Seed mixtures designed to attain a wide range of inherent tolerances of salinity are suggested in order to establish and maintain a productive forage stand across an entire saline site. The frequency of occurrence of visible surface salts at each site from “rarely” to “almost always” can assist in defining the upper salinity level for selecting forages. Select up to four forages per seed mix, one from each level of salinity (Table 7).

Nearby water recharge areas should be identified and seeded to alfalfa.

Land Reclamation

Land reclamation is any activity with a primary goal of re-establishing vegetation on sites that have had major disturbance. Common disturbances in Saskatchewan that require subsequent reclamation include oil and gas drilling, logging, mining, pipeline development, gravel pits and road construction.

Land reclamation activities often occur on areas that have native vegetation present. The goals of reclamation should be to return the disturbed areas to as close to original condition as possible and reduce the risk of erosion on the site during and after reclamation activities are complete. Some factors to consider when reclaiming land include:

- Minimize disturbance on the site to reduce the amount of reclamation required.
- Use good topsoil conservation techniques.
- Select species with characteristics that are suitable for the area where they will be established. Salinity tolerance, drought tolerance, and competitive ability are all factors to consider. Some effort should be made to select species that were present on the site prior to disturbance. This will ensure the appearance and grazing value of the reclaimed area will be similar to the surrounding area.
- Some introduced species are invasive, and will spread into surrounding areas by seed production or by spreading rootstocks. Avoid use of long-lived, aggressive species when reclaiming areas in or adjacent to sensitive areas.
- Use certified seed, or obtain the weed seed content of the seed to be purchased to ensure that the seed lot is clean and that problem weeds are not present.
- Plan to use erosion control measures until the seeded area has a chance to become established.
- Refer to reclamation guides for further guidelines.

Improved Grazing Management

More Pasture for More Months

Economical production of high yielding, quality forage is a necessity for a successful livestock operation. Grazing management is one of the cornerstones of successful forage production. Since feeding costs are the single greatest expenditure in a cattle operation, management of the grazing resource has large impacts on the financial success of the operation.

Forage plants require certain conditions to survive and produce to their potential. Managing a forage stand for livestock production is a balancing act between providing growing conditions that allow the forage species to maintain its vigour and providing a satisfactory level of forage for the grazing animal. The manager controls grazing by regulating the season, intensity and frequency of grazing on a pasture. Species of forage and past use history will influence how the pasture will react to management.

The season of use should take into account the particular species being grazed. Each forage species has growth characteristics that make it conducive to grazing during certain times of the year. For example, crested wheatgrass is well-suited to spring grazing, while native range is best suited to summer or fall grazing. If necessary, forage species can be grazed outside their optimal grazing period. However, the subsequent rest period must be longer to avoid decline in the health of the forage stand. The rest period must occur when growing conditions allow for growth and recovery of the pasture. Growth periods of common forage species in Saskatchewan are shown in Figure 5.

Intensity refers to the amount of vegetation removed in a grazing season. Most tame forage species can have up to 70 per cent of the above ground vegetation removed, while native range should have lower levels of use, in the range of 50 per cent. Forage can have higher levels of use imposed on them, but again, the subsequent rest period needs to be longer to account for the additional stress put on the plant. In the case of native range, early season grazing or high levels of use will require rest periods of one and a half years or more to allow for adequate recovery.

Frequency of grazing, or the rest period between grazing events, is an important consideration when grazing forages. Factors such as the species of forage, growing conditions, rainfall, intensity and timing of grazing will all influence the rest period required on a pasture.

Stocking Rates

The stocking rate is the number of animals grazing an area of land for a given period of time. Setting a stocking rate involves balancing forage removal with forage production, and should accurately reflect the production capacity of the pasture. Stocking rates are affected by the species of forage, age of the stand, soil zone and texture, fertility levels and growing conditions.

Animal Distribution

Animal distribution is the degree of use by livestock of all areas of a pasture. It is desirable to have even distribution across all areas of the pasture. Uniform animal distribution reduces selective grazing—this occurs when livestock over-graze the most palatable plants and under-graze the rest. Uniform animal distribution also reduces waste of forage. Areas located far away from water sources or areas difficult to access by livestock will not be used, while areas more accessible are overused and will decline. Animal distribution can be improved by increasing the number of livestock in a pasture and reducing the amount of time they are in it. Pasture size can also be reduced while maintaining herd size. Both of these techniques more effectively increase stock density.

Other methods to improve animal distribution include locating salt in under-utilized areas of the pasture and burning or fertilizing under-utilized areas to increase their palatability and attractiveness to livestock. Developing new water sources or limiting access to existing ones is an effective way to change use patterns of livestock.

Balancing Forage Supply and Demand

Feed costs are a major expense in any livestock operation. The longer livestock can remain on pasture and harvest their own forage, the lower the cost of feeding. This indicates that most producers should attempt to develop a supply of adequate quality grazing starting as early in the spring as economically possible and as late as possible in the season.

Developing a forage budget will help identify periods in the grazing season when there may be a deficiency. As these deficient periods are identified, grazing resources can be developed to address the deficiency. For instance, if early-spring grazing is lacking, marginal farmland can be seeded to crested wheatgrass. If late-season grazing is required, altai or Russian wildrye grass can be seeded. To calculate a forage budget, it is useful to use the Animal Unit Month [(AUM) (Table 8)] as a way of determining forage use and planning grazing strategies.

One AUM is defined as one-450 kg (1,000 lb.) cow (with calf at foot) grazing for one month. Thus, a quarter section that is rated at 48 AUM can carry eight cows for six months.

Alternately, the same pasture can carry 12 cows for four months or any other combination equal to 48 AUM. To calculate AUM, see the chart on the right for the conversion rates.

Table 8
Animal Unit Equivalents

One – 450 kg cow (with calf)	1.0 AUM
One – yearling steer or heifer	0.65 –0.75 AUM
One – bull	1.5 AUM
One – horse	1.5 AUM
Five – ewes (with or without lambs)	1.0 AUM

Note: AUM value is adjusted upwards for larger cow. For example, a 540 kg (1,200 lb.) cow would be 1.2 AUM. Calves account for significant forage removal by mid-to-late season; this is particularly true in early calves.

Grazing Systems

A grazing system can be described as a conscious effort to influence the time, space, duration and intensity of grazing events on an area of land to suit management goals. Successful grazing systems integrate a number of tools and resources to achieve well-defined goals. A common goal in many grazing systems is to have high livestock performance at acceptable costs and risks, while improving or at least maintaining pasture productivity.

Planning is the First Step

There are many types of grazing systems with varying levels of complexity. However, before any one grazing system is selected, planning must occur to determine which grazing system is most suitable to the production unit (Figure 4). Every unit is different, and a generalized grazing system should be custom tailored to the features and resources present on each farm or ranch.

Figure 4

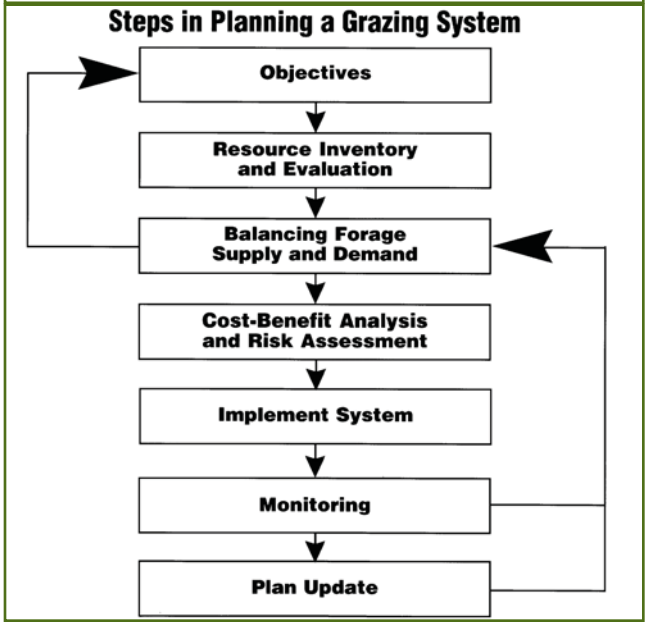
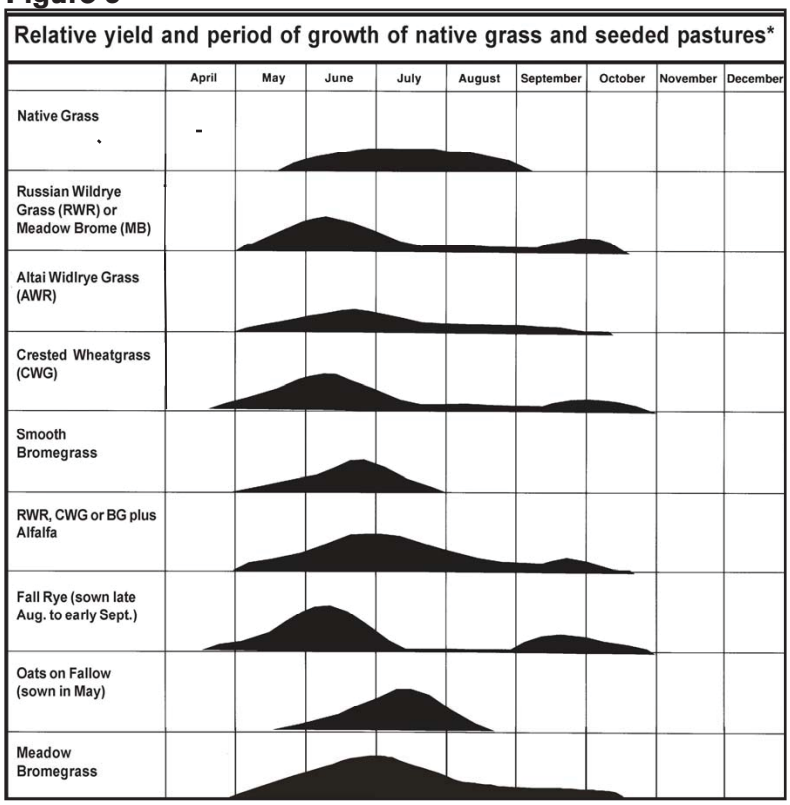


Figure 5

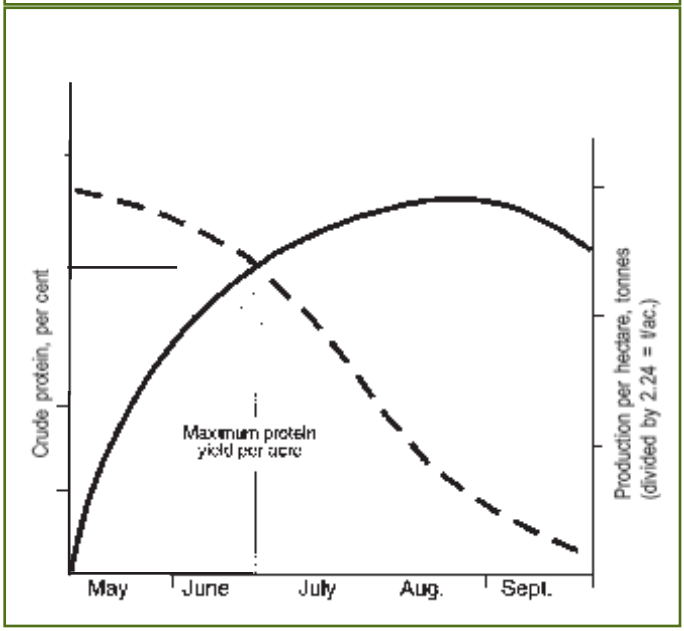


***These curves are averages for Saskatchewan. Growth patterns may differ, according to weather and soil zones.**

Haying – Cutting for Maximum Quantity and Quality

A major goal of haying is to maximize tonnage of harvested forage. Forage quality is also a very important component of successful haying. Striving for high tonnages of hay while also trying to maximize protein and nutrient harvest is a good practice. Determining when to harvest in order to maximize both dry matter yield and nutrients can be done if the relationship between dry matter accumulation and protein content dynamics in the crop are understood.

Figure 6
Relationship between forage yield and forage quality. From *Cultivation and Management of Cultivated Forages,* Walton, 1983.



Generally, dry matter accumulates during the growing season and peaks late in the season. Conversely, forage quality is very high early in the season and declines as the season progresses. The goal is to determine at which point in time these two lines intersect. This point will determine when the best compromise between yield of dry matter and nutrients will occur.

In Saskatchewan, this point usually occurs in the third week of June, but this date may vary depending on the species of forage and the growing conditions. In the case of alfalfa, the point at which 10 per cent of the flowers on the plant are blooming is the best time to cut for maximum quality and yield (Figure 6). In the case of most grasses it is best to cut after the boot stage, but before heading.

Bloat

Bloat is a potentially lethal expansion of the stomach in ruminant animals, which can occur after they have eaten large quantities of legume forage. During digestion, legumes can create a stable foam in the rumen that blocks the normal escape of gas. Distention of the stomach creates breathing difficulties that can be lethal. Fear of bloat causes many producers to avoid the use of forage legumes. However, most of the specific situations that cause bloat can be avoided.

Reduce bloat risk by:

- Do not turn livestock directly on to a lush, vigorously growing legume field. Ensure the animals are fed prior to turnout and avoid turning out in the morning, when dew increases plant moisture content.
- Seed pastures to a mixture of grasses (e.g. meadow bromegrass) and legumes, to reduce legume intake.
- Where appropriate, feed bloat control products containing poloxalene or Rumensin.
- Consider use of non-bloating legumes (sainfoin, cicer milkvetch) or low-growing types (certain clovers).

Certain breeds and strains of livestock seem to be prone to bloat. Bloated animals can be saved if prompt action is taken, in consultation with a veterinarian.

Nitrate Poisoning

Plants take up nitrogen as ammonium or nitrate. Under favourable growing conditions, plants quickly convert nitrate to non-toxic compounds. However, poor growing conditions (drought, hail, or frost) can cause nitrate to accumulate in plant tissues. Frosted green oats can cause nitrate poisoning. Barley, wheat, corn, flax sorghum and other forages, and some weeds, such as lamb's quarters, kochia and Russian thistle, can also be poisonous. Nitrates are quickly used up if growing conditions improve and the plant resumes growth.

When livestock consume forage containing nitrate, their ability to absorb oxygen is reduced. Symptoms of mild nitrate poisoning included restlessness, frequent urination and watery eyes. Acute poisoning causes extreme weakness, blue coloration of eyes and mouth, shortness of breath, and finally death. Nitrate poisoning can be treated by prompt injection of aqueous methylene blue by a veterinarian.

Nitrate poisoning can be avoided by taking the following precautions:

- Feed animals prior to turning them out on lush or stressed annual pasture, cereal aftermath, or swath grazing.
- Check the herd frequently during initial period and consider supplementary feeding.
- Have stored hay, especially frozen cereal forage, analyzed by a laboratory. It is a good management practice to have all forages analyzed.
- Feed containing 0.5 per cent or more nitrate is considered dangerous. The hazard can be reduced by mixing high nitrate feed with other fodder low in nitrates.

Forage diagnostic services are available through:

Central Testing Labs Ltd.
Unit 9 – 851 Lagimodiere Blvd.
Winnipeg, Manitoba R2J 3K4
Phone: 204 – 237 – 9128
Toll free: 1-877-955-7861 (BC/AB/SK)
E-mail: info@ctl.mb.ca
Website: www.ctl.mb.ca