Tips for Improving Forage Establishment Success

Establishing a forage stand is a long-term investment which begins at least one year in advance. Several factors play important roles in achieving success in establishing the stand. These factors will be discussed on the following pages.

Preparing the Field

Previous year crop selection

The decision to plant a particular field to forage must be made more than a year ahead. The crop you select for the year prior to converting to forage can have an impact on establishment success. Previous crops often determine the weed spectrum and fertility levels into which the forage crop will be seeded.

A herbicide-tolerant crop grown the previous year is an excellent choice for cleaning up a field because it allows aggressive weed control measures.

Legumes should be planted into soils free of herbicide residues. Herbicide residues such as chloropyid (Lontrel™, Curtail™) and in some cases, 2, 4-D will reduce seedling survival and the plant stand of all legume forages. This may have an impact on your choice of previous-year crops. Review *Re-cropping Restrictions* on the herbicide labels or in the Manitoba Agriculture, Food and Rural Initiatives *Guide to Crop Protection*.

Weed Control

Since the choices of in-crop herbicides for use on forages are limited, reduce the perennial and annual weed densities in the field prior to seeding your forage. In addition to crop choices and associated weed control strategies mentioned above, other methods of weed control should be considered. Pre-harvest application of glyphosate on the previous crop will help. If you prefer to avoid the use of herbicides to controlling weeds during the previous year, the crop can be harvested pre-maturely as green feed to help reduce weed densities. Harvesting pre-maturely is also recommended when using cover crops for establishing forages.

Pre-seeding and pre-emergence applications of glyphosate in the year of seeding are also excellent ways to reduce weed densities without harming the yield potential of a forage crop.

Seedbed Preparation

Forage seeds are smaller than most other crops, so seedbed conditions are critical. An ideal seedbed should be smooth, firm, moist and relatively free of weeds. If necessary, drainage should also be improved prior to seeding.

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Selecting the Forage

The species and variety of forage to plant should be chosen depending upon the intended use and the environmental conditions into which it will be seeded. Choose the species first, then the variety. Species are the broader categories of crops. For example, alfalfa, smooth bromegrass and timothy are species. Within each species, a number of varieties are available, each with its own characteristics. Currently, Manitoba producers have access to approximately nine species of legumes, 18 tame grasses and at least nine native grasses. Consult the Manitoba Agriculture, Food and Rural Initiatives *Forage Adaptation Guide* for help in making your species selection decision.

The Right Species

Environmental factors must be considered when choosing a forage species. Dry soils are best suited to either deep-rooted species such as alfalfa that can reach deep moisture sources, or species with higher water use efficiency such as crested wheat grass and smooth bromegrass. Conversely, wet soils are best suited to either shallow rooted species, red clover for example, or those with poorer water use efficiency, or species that tolerate wet conditions, such as timothy and reed canary grass.

Crested wheat grass

Timothy

Also consider the length of time you wish to have the stand in production, as some species are more persistent than others. Consider how the forage will be harvested whether for hay or pasture, or both. The frequency of harvest is also a consideration.

Pure stands (single species) are best suited to a single use and environment, whereas mixtures provide harvesting options and an ability to provide some growth in a range of environments. Grass-legume mixtures can reduce bloat hazard, increase grazing season length, make more efficient use of water, sunlight and nutrients, and improve the nitrogen fertility of the soil. Sod-forming species are beneficial for reducing soil exposure, but at the expense of re-growth. Conversely, the quick re-growth of bunch grasses can produce higher yields in multiple harvest systems.

In pastures, mixtures are often short-lived if grazing is not managed. Uncontrolled grazing favours the dominance of less palatable and more aggressive species. To avoid problems with species dominance in uncontrolled grazing situations, determine the dominant growth period for each species and plan your species selection and paddock use accordingly.

For special purpose seedings, such as wildlife plantings, saline areas and land reclamation, up to three or four grasses and legumes may be required in the mixture. For these areas, native species provide an excellent option for marginal areas with low input. Warm season native species also provide excellent mid-season growth during periods when some tame species have reduced growth rates.

Environmental Factors to Consider When Selecting Forage

- Frequent drought or flooding
- Poor soil drainage
- High salinity
- Low or high pH
- Extreme winter soil temperatures
- Pest infestations
- Soil fertility

The Right Variety

Longevity and yield of a forage stand begins with choosing a variety adapted to the intended use and field conditions. Select high quality seed that is suitable for the environment, maintains a high level of germination and is free of weeds. Certified seed is recommended as it provides legal guarantees for these standards, whereas common seed does not. However, if common seed is the only option, purchase it from a reputable dealer and ask for the germination test results and the weed seed types and counts.

Since seed cost represents only 13.5 per cent of the total establishment costs, seed quality should not be compromised. An additional seed cost of $2 per pound for reduced weed seed content and increased germination is easily justified by an additional 500 pounds per acre of dry matter yield.

Alfalfa Autotoxicity

Alfalfa is unique in the forage world because it produces a toxin (medicarpin) that allows the plant to manage its own stand densities. Since the toxin only reduces plant vigor on alfalfa, it only presents a problem when re-seeding alfalfa into an existing alfalfa stand, or one that has experienced stand loss due to flooding or winterkill. Wait at least 12 months before seeding alfalfa back into alfalfa residue. Seeding earlier than the 12-month interval will often reduce stand density, but most importantly, will result in reduced plant vigor and lower yields. In a Wisconsin study, seeding alfalfa into soil that had a previous stand terminated within two weeks reduced yield by 80 per cent, seeding within four weeks reduced yield by 55 per cent, and seeding in spring after fall termination reduced yield by 40 per cent.

Factors affecting the level of alfalfa autotoxicity in the soil

Age of stand	Soil toxin levels require two years of alfalfa growth to build up. Therefore, fields in production for only two years can be reseeded with relative safety
Soil type	Effects are most severe in the initial year on sandy soils, but the toxin is water soluble and can leach out of the rooting zone with sufficient moisture. Effects are most prolonged on clay soils, a function of poor drainage and soil type.
Plant density	Higher stand densities have higher concentrations of the toxin in the soil.
Residue	Fields with more top growth residue will require more time for safe seeding. Therefore, remove all residues during harvest if you plan on re-seeding.
Tillage practice	Tilling the stand as soon as possible following harvest can also reduce autotoxic effects.

Seeding

When to Seed

Spring seeding is ideal for germination and establishment because of the cool, moist conditions. However, excessively wet spring conditions, or weed control timing issues often limit this seeding period. Fortunately, there are other options for forages.

Summer seeding is only recommended for those species that are known to establish easily with spring seeding, and if fall moisture conditions are expected to be favourable. Summer seeding should be timed late enough to avoid hot mid-summer temperatures that stress young seedlings, but early enough for the plant to develop a crown before freeze-up. The crown is a small swollen area on the stem near the soil surface. Because of the different stem structures, it is easier to find crowns on legumes than grasses. With a crown, the seedling is more likely to survive winter if conditions are reasonable. Alfalfa requires six weeks and most grasses three to four weeks to develop a crown.

Dormant seeding is the practice of seeding the crop with the intention of it remaining ungerminated until optimum temperatures exist. The options are to plant either late in the fall, allowing the seed to lay dormant over the winter and germinate early in the spring, or to broadcast and harrow immediately prior to snow melt. These options can be successful when spring seeding options are limited. The concerns are pre-mature seed germination, making the seedling vulnerable to loss from fall or spring frosts, and seed loss to rodent feeding. Seeding rates should be increased by at least 25 to 30 per cent to accommodate seed and seedling mortality. Fall dormant seeding systems work best with direct seeding into stubble.

Seeding Method

Seeding methods for forages vary depending on equipment and time available and environmental conditions. Ideal seeding depth depends on the soil type and moisture conditions. Course-textured soils require deeper seeding to access available moisture (Table 1).

Table 1: Soil Texture vs. Optimum Seeding Depth

Soil Texture	Optimum Depth (inches)
Clay	1/4" – 3/4"
Loam	1/2" – 1"
Sand	3/4" – 1 1/2"

Optimum seeding depth ranges between one-half to three-quarters of an inch (1.25 to 1.90 centimetres), and is best when some seed can be seen on the soil surface. Seeding deeper can significantly reduce emergence for most forage species (Table 2).

Table 2: Rate of Seedling Emergence vs. Seeding Depth

	Seeding Depth			
	1/2"	1 1/2"	2"	3"
Timothy	89%	39%	12%	0%
Smooth Bromegrass	95%	45%	24%	10%
Alfalfa	64%	26%	14%	0%

Although broadcasting seed on the soil surface and harrowing it in is cheaper than placing the seed directly into the soil, it becomes more difficult if seeding equipment is not capable of managing chaffy seed or if two different densities of seed are involved. Light, chaffy seed will not spread as far as heavier seed resulting in missed areas, and it may also bridge in the seeder. Mixing fertilizer and inert material such as cracked grain or a cover crop seed with the forage seed may improve seed flow. However, if using fertilizer in the seed mix, seeding must occur immediately after blending because the salt content of most fertilizers can increase seed mortality. Be sure to check for seed settling in the seed box during seeding.

Harrowing seedbeds before seeding is recommended to firm up mellow soils and improve seeding depth control. Set the aggressiveness of the harrow tines based on how deep the seed will be placed; more aggressive harrowing will create firmer seedbeds. Harrowing after seeding is also an effective tool to cover seed and improve seed-to-soil contact.

Seeding Rate

Seeding rates should be determined based on a combination of the end use, moisture conditions, predicted survival rate of the seedlings, and most importantly, on the number of seeds per square foot rather than a per cent by weight.

Table 3 illustrates two seeding scenarios with a similar number of seeds per square foot with different percentages of each species based on two different end uses. Use the optimum plant populations in Table 4 to determine your correct seeding rate. You may also need to adjust your seeding rate according to environment and seedling survival.

For example, to determine the seeding rated needed to achieve the optimum alfalfa seedling density of 40 seeds/ft^2, use the following calculation:

(40 seeds/ft^2 x 43,560 ft^2/ac = 1,742,400 seeds/ac) ÷ 220,000 seeds/lb ÷ 90% survival rate = 8.8 lbs/ac

Table 3: Comparison of seeds per square foot seeding rates on a pasture vs. hay mixture

	PASTURE MIX	HAY MIX
	Lbs/ac (seeds/ft^2)	Lbs/ac (seeds/ft^2)
Legume		
Alfalfa	1 (4.5)	6 – 8 (30.3 – 40.4)
Trefoil	1 (4.5)	0
Grass		
Meadow Brome	5 (9.1)	4 (7.3)
Tall fescue	3 (15.6)	0
Timothy	2 (56.5)	2 (56.5)
Total	**12 (90.2)**	**12 – 14 (94.1 – 104.1)**

Table 4: Desired plant population and average number of seeds per pound for some popular Manitoban forage species

CROP	DESIRED PLANT POPULATION	AVERAGE-SEED WEIGHT
Legumes	**(SEEDS/FT^2)**	**(SEED/LB)**
Birdsfoot trefoil	60	1,000,000
White clover	80	800,000
Alsike clover	80	700,000
Red clover	40	275,000
Sweet clover	40	260,000
Alfalfa	40	220,000
Grasses		
Timothy	100	1,230,000
Orchardgrass	80	650,000
Meadow Fescue	40	577,000
Reed Canarygrass	80	530,000
Tall Fescue	40	227,000
Slender Wheatgrass	30	160,000
Smooth Bromegrass	30	137,000
Meadow Bromegrass	30	80,000

Fertility

Like any crop, forages require adequate nutrient levels to establish successfully. Soil testing your field for nutrient requirements before seeding your forage crop is a very valuable management tool. All nutrients should be applied according to recommended soil test rates.

Research has shown that banding fertilizer can double plant size within 30 days when compared to broadcasting the fertilizer. But, excessive fertilizer levels, or fertilizer placed too close to the seed, can damage the seed, especially with the smaller-seeded forages. While optimum results are achieved when fertilizers are banded one or two inches (2.5 to five centimetres) from the seed, this level of accuracy may not be possible with some machinery.

Phosphorus is especially important for establishing plants as it improves root development. Adding as little as 30 pounds/acre (33 kilograms/hectare) of phosphorus has shown to quadruple plant size within one week of emergence under ideal conditions. The best response to phosphorus is obtained when it is banded one inch (2.5 centimetres) directly below the seed. Good response is also obtained when the phosphorus is placed one inch (2.5 centimetres) below and one inch (2.5 centimetres) to the side of the seed. Placing the phosphorus further from the seed, or broadcasting and incorporating it into the soil, reduces its effectiveness to the new seedling.

Potassium improves the ability of a young seedling to survive over the winter. Applying potassium is especially important on sandy soils.

Sulfur and nitrogen are more important for increasing yield and protein so can be spared until the following spring, provided existing soil levels at seeding time are moderate. However, if planting a cover crop with the forage, nitrogen and sulfur should be applied to optimum levels for the cover crop. For sulfur, use sulphate forms rather than elemental (natural) forms to improve availability to the plant.

Nitrogen is not important for legumes as they produce their own, provided they are properly inoculated.

Inoculants

Legume seed should be inoculated immediately prior to planting to encourage early and increased development of nodules on the root, which in turn makes nitrogen available to the plant. Enhanced nitrogen availability gets the plant off to good start and increases yield.

Inoculants are bacteria, and as living organisms, they have an expiry date. Inoculants and seed treated with inoculants must be stored in a cool, dry place to maintain the viability of the treatment. Treated seed should be seeded within 24 hours. If you are inoculating your own seed, only treat the amount of seed that you can plant in one day.

Inoculants are host-specific, so not all inoculants work on all legumes. For example, inoculants for clover or trefoil will not work on alfalfa. Normally, this is not an issue when purchasing seed from a seed company as they will often pre-inoculate the seed before packaging it. This type of inoculant may also have a longer shelf life, depending on the polymer coating the seed company may have used.

It is important to check for the level of nodulation (the success of inoculation) and the rate of nitrogen fixation. Approximately one month after emergence, carefully remove a few random plants from the soil and check for the number of nodules on roots. The number of nodules and the rate of nitrogen fixation peaks just before bloom. There should be clusters of nodules growing around the crown area, and each nodule should be pink to red in colour on the inside. Creamy white indicates the nodule is immature, and pale green indicates the nodule is not healthy.

Companion Crops

Companion crops, nurse crops or cover crops are not essential for good forage establishment, but can be beneficial if properly managed. The emphasis should be on providing a good environment for establishing forage crops, and not on producing a "bumper" companion crop. Companion crops can aid in suppressing weeds, maintaining soil moisture at the soil surface and providing slower-growing seedlings with protection from excessive heat and frost during establishment.

However, the competition that companion crops provide can reduce yields in the seeding and subsequent years. In a three-year study comparing alfalfa sown alone versus with an oat cover crop, the alfalfa seeded with a cover crop did not yield as well as the alfalfa seeded alone; however, the three-year total for dry matter yield was highest in the alfalfa/oat combination because of the added dry matter from the oat green feed crop. Species such as Russian wild rye grass, birdsfoot trefoil and sainfoin are poor competitors and should be sown on weed-free soil without a companion crop. In contrast, alfalfa, sweet clover, alsike clover, timothy, wheat grasses and brome grasses are reasonably competitive and under normal conditions can be sown with a companion crop.

Forage stands seeded without cover crops can yield up to three cuts in the seeding year. However increased exposure to wind, soil crusting, soil drying, weed competition and extreme temperatures as a result of less soil cover may reduce stand densities. However, it is key to select a cover crop that will minimize competition. Most small grains such as wheat, oats, barley, fall rye, winter wheat, millet and flax are acceptable cover crops. These crops can be harvested early as greenfeed. Canola is less desirable because of its aggressive ability to stool thus providing excessive shading, and because it is less desirable as a greenfeed. In all cases, establishment success can be further improved by direct seeding into standing stubble; the stubble will provide some protection from the elements.

Companion Crop Management Factors

- Use the least competitive crop in your rotation. An example order of crop competitiveness from least to most is:
  - Flax
  - Millet
  - Oats
  - Canola
  - Wheat
  - Barley
- Reduce seeding rate of companion crop to 30 to 50 per cent of normal.
- Seed forage at right angles to the companion crop to reduce in-row competition.
- Harvest cereal grain companion crops at heading to soft dough stage for green feed.
- Do not leave swath in the field for more than 24 hours.
- Leave high stubble to trap snow and improve winter survival.

For more information on establishing forage crops, contact your local Manitoba Agriculture, Food and Rural Initiative GO office or visit us on line at manitoba.ca/agriculture/production

The following agencies worked collaboratively and provided funding support for this publication:

- **Manitoba Agriculture, Food and Rural Initiatives**
- **Agriculture and Agri-Food Canada**
- **Manitoba Forage Council**

Partial funding for this publication was provided by the Greencover Canada Program, a five-year, $110-million Government of Canada initiative to help producers improve grassland-management practices, protect water quality, reduce greenhouse gas emissions, and enhance biodiversity. For more information please visit http://www.agr.gc.ca/env/greencover-verdir or phone 1 866 844-5620.

March 2006

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