SUCCESSFUL FORAGE CROP ESTABLISHMENT

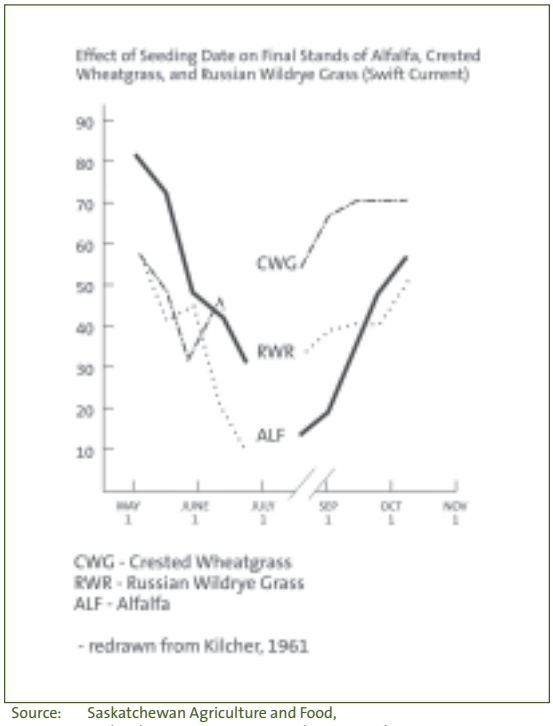
Careful planning and attention to detail are necessary to ensure successful forage stand establishment. Factors to consider include species and cultivar selection, timing of seeding, seeding equipment, weed and insect management, seedbed preparation, seed quality, seeding rates, and fertility.

Species and Cultivar Selection

Successful forage production depends on selection of species and cultivars that are adapted to site conditions and the intended end use of the forage. Consult the Saskatchewan Agriculture and Food website (www.agr.gov.sk.ca) or the Saskatchewan Forage Council's *Dryland Forage Species Adaptation CD* to obtain current information regarding species and cultivar adaptation and performance.

Seeding Date

Moisture deficiency is a major cause of forage seeding failures. Planting when available moisture is present, when the probability of rainfall is greatest, and when air temperatures are moderate will increase the probability of successful establishment. The impact of varied seeding dates on establishment success is illustrated below.



Source: Saskatchewan Agriculture and Food, Saskatchewan Forage Crop Production Guide.

When dormant seeding in the fall, plant when soil temperatures are below 2° Celsius (October 15 or later) to prevent initiation of germination. Legumes and grasses require soil temperatures of 5° and 8° Celsius, respectively, for germination to occur. Legume seeding rates should be increased by 20% when fall seeding, to offset seed mortality occurring over winter. Some native species, such as green needlegrass, show increased emergence from fall seeding, as cold conditions assist in breaking seed dormancy (vernalization).

TO CALCULATE SOIL TEMPERATURE:

- place a thermometer at seeding depth (1" (2.5cm) maximum for forages)
- obtain temperature readings early in the morning and in the early evening; average the two temperatures to get a daily soil temperature
- take readings at several locations in the field, especially in rolling topography

Seedbed Preparation

The seedbed should be firm and weed-free prior to seeding. The resulting close seed-to-soil contact allows accurate seed placement by the seeder and results in even and rapid germination. Clean stubble makes an ideal seedbed by providing a firm seedbed while reducing evaporation at the soil surface. Walking across a seedbed that is sufficiently firm will leave only a faint foot imprint.

Herbicide Residues

Herbicide residues can impair or prevent the establishment of forage crops by inhibiting germination, sprouting, and root and stem formation. Herbicide residue breakdown in the soil is slowed by very dry or very wet conditions, cool soil conditions, high or low soil pH, and low

soil organic matter levels. Consult the *Guide to Crop Protection* (www.agr.gov.sk.ca) for recropping restrictions to assist in planning of pre-establishment weed control or to identify potential residue problems from previously applied herbicides.

Weed Control

Weeds compete for moisture, nutrients and light and can jeopardize forage establishment. Perennial weeds, in particular, should be controlled prior to planting as they are often difficult and expensive to control in-crop, especially when a mix of grasses and legumes is seeded. A pre-seeding application of a non-selective herbicide, such as glyphosate, is recommended to eliminate weeds without disturbing the seedbed. Consult the *Guide to Crop Protection* for recommended herbicides and rates.

Insects

Insects such as alfalfa weevils, thrips, sweet clover weevils, and grasshoppers can be pests on newly established forage crops. Grasshoppers pose the greatest threat and can create enough damage to cause establishment failure. Infestation levels can be predicted based on the prior year's insect densities and weather patterns. When establishing a new field, Saskatchewan Agriculture and Food's annual *Grasshopper Infestation Map* should be consulted to determine risk. Economic thresholds are guidelines that indicate when chemical control of grasshoppers is economically viable. Early and frequent scouting for grasshoppers is crucial for successful control. Consult the *Guide to Crop Protection* for information on insecticides. When using insecticides, note any feeding restrictions and field re-entry guidelines.

Cover Crops

Forages are often seeded with an annual crop (referred to as a cover crop or a nurse crop).

Advantages of cover crops:

- provide income in the year of forage establishment
- protect forage seedlings from wind and heat and reduce soil crusting and erosion

Disadvantages of cover crops:

- increased risk of forage establishment failure, particularly during drought
- potential limitations for in-crop chemical weed control
- potential reduction in yield of the forage crop

Negative effects of cover crops can be mitigated by seeding cover crops at reduced rates (1/3 to 1/2 grain production seeding rate), harvesting the cover crop early for feed, keeping stubble heights high when harvesting and avoiding competitive cover crops, such as barley. Cover crops can be cross-seeded to the forage to reduce competition. When seeding the cover crop with a forage in one pass, seed at a depth appropriate for the forage. Do not seed a cover crop when seeding forage species that are difficult to establish (such as the wildryes and native species), if moisture is limiting, or in the Brown soil zone.

Photo credit: Saskatchewan Agriculture and Food, Trevor Lennox

Clean stubble field suitable for seeding forages

Seed Quality

Most forage stands are in production for several years. Purchasing quality seed represents a sound investment and provides benefits throughout the life of the stand. The use of certified seed will allow for the selection of a cultivar with appropriate hardiness and disease resistance, as well as documented germination and purity. Using seed of a top yielding variety will increase the

CERTIFICATE OF ANALYSIS

This certifies that a sample designated as _____
Lot # _____
CROP CERTIFICATE NUMBER

was tested with the following results:

SAMPLE

M & P
Remarks:

SENIOR MEMBER OF

Date: _____ Analyst _____
C.S.I. Accredited

Certificate of Analysis

performance potential of a new field. The *Canada Seeds Act* regulates the sale of agricultural seed in Canada. Refer to the Saskatchewan Agriculture and Food publication, *Purchasing Quality Forage Seed,* to obtain the quality requirements for commercial grades of forage seed. When purchasing any type of forage seed, insist on obtaining a copy of the *Certificate of Analysis* from the seed dealer to determine germination, purity and weed seed content BEFORE purchasing the seed. Seed should be stored in a cool, dry space and have its germination re-tested if it is seeded a year or longer after purchase.

Inoculation

Legume seed should be inoculated prior to seeding to ensure effective nodulation and resulting nitrogen fixation. Inoculants are available in various forms, including peat-based powder, self sticking powder, granular (placed directly in the soil), liquid and pre-inoculated seed.

Photo credit: Saskatchewan Agriculture and Food

Applying self sticking powdered inoculant

TIPS TO ENSURE EFFECTIVE NITROGEN FIXATION:

- Rhizobia are species specific; make sure to use the correct rhizobia species for the crop being planted
- Store pre-inoculated (coated) seed in a cool, dark, dry location and use as soon as possible to maximize inoculant viability
- Once legume seed is inoculated USE IMMEDIATELY - inoculated seed can be stored in a cool, dark place for up to 2 days, but rhizobia mortality begins when the inoculant is applied to the seed. Reinoculate seed stored for longer than 2 days
- If inoculated seed has been mixed with phosphate fertilizer for use as a carrier, seed immediately, as the phosphate will reduce viability of the inoculant
- Do not use inoculant beyond its expiry date
- Check for successful inoculation by cutting open nodes on legume roots - a red or pinkish colour indicates nitrogen fixation is occurring

Scarification

Some legumes, such as sweet clover and cicer milkvetch, have hard, impervious seed coats. Scarification abrades the seed coat, allowing water to more effectively penetrate the seed, thereby enhancing germination. Sweet clover and cicer milkvetch should always be scarified prior to seeding.

In the first month after seeding, 36% of cicer milkvetch seedlings emerged from a planting of scarified seed, whereas only 7% emerged from a planting using unscarified seed.

Source: Agriculture Canada. 1975

Fertility

A soil test should be completed to determine a fertility baseline on any field prior to seeding. The greatest limiting nutrient for grass production is usually nitrogen (N). Legumes have high demand for phosphorous (P) and sulphur (S) and occasionally, micronutrients. Applying sufficient P prior to seeding legumes will prevent application difficulties and a delayed plant response to fertilizers, as phosphorous is relatively immobile in the soil. With good-to-excellent soil moisture, only 15 lbs (16.7 kg/ha) of phosphate (P_2O_5) can safely be placed with forage seed, using equipment with a six to seven-inch (15-17.5 cm) row spacing and one-inch (2.5 cm) spread. Phosphate fertilizer (i.e., 11-51-0) can be used as a carrier for seed when seeding, provided recommended application rates are adhered to. All other fertilizer should be banded away from the seed or broadcast and incorporated to avoid damage to the seed. Banding results in

greater nitrogen, phosphorous and potassium fertilizer-use efficiency. Fertilizer can be banded after emergence using coulter banding.

Seeding Rates

Generally, plant populations and consequently, seeding rates, should increase with increasing soil quality and available moisture. Target Pure Live Seed (PLS) densities are:

- 18-20 seeds/ft² (15-16 seeds/m²), PLS in the Brown soil zone
- 20-25 seeds/ft² (16-20 seeds/m²), PLS in the Dark Brown soil zone
- 25-30 seeds/ft² (20-24 seeds/m²), PLS in the Black/ Grey-Wooded soil zone
- 30-40 seeds/ft² (24 - 32 seeds/m²), PLS under irrigation.

Recommended row spacings in forage production stands are 12 to 14 inches (30-35 cm) and 6 inches (15 cm) under high moisture environments and irrigated fields. Seed should be placed at a depth of 1/4 to 1/2 inch (0.68 to 1.25 cm). A small amount of seed visible at the soil surface indicates that the correct seeding depth is being achieved.

Seeding rate in pounds per acre (kg/ha) is calculated by multiplying the target seed density by 43,560 square feet in an acre (1000 m²/ha) and dividing the total by the number of seeds in a pound (kg) of the species being seeded (see table).

For example, to calculate a seeding rate for an alfalfa field in the Dark Brown soil zone, assuming seed with 79% germination and 98% purity, determine the Pure Live Seed (PLS):

PLS = Germination % x Purity %
= (0.79 x 0.98)
= 0.77

Assumptions:
- Target seed density in the Dark Brown soil zone is 22 seeds/ft² (18 seeds/m²)
- 43,560 square feet in an acre (1000 m² in a hectare)
- 200,000 alfalfa seeds in a pound (440,000 in a kilogram)

Therefore the seeding rate would be:

$$\text{Seeding rate (lbs/ac)} = \frac{\text{seeds/ft}^2 \times \text{ft}^2\text{/acre} / \text{PLS}}{\text{seeds/lb}}$$

$$= \frac{22 \text{ seeds/ft}^2 \times 43{,}560 \text{ ft}^2\text{/acre} / 0.77}{200{,}000 \text{ seeds/lb}}$$

= 4.79 lbs/acre / 0.77

= 6.2 lbs/ac

Comparative seed size of forage species

Species	Approx. No. of Seeds/kg	Approx. No. of Seeds/lb.
LEGUMES		
Alfalfa	440,000	200,000
Sweet clover	572,000	260,000
Alsike clover	1,540,000	700,000
Red clover	605,000	275,000
White clover	1,760,000	800,000
Birdsfoot trefoil	825,000	375,000
Sainfoin	66,000	30,000
Cicer milkvetch	286,000	130,000
GRASSES		
Russian wildrye (diploid)	385,000	175,000
Russian wildrye (tetraploid)	220,000	100,000
Altai wildrye	112,000	51,000
Crested wheatgrass (diploid)	485,000	220,000
Crested wheatgrass (tetraploid)	385,000	175,000
Dahurian wildrye grass	175,000	80,000
Northern wheatgrass	341,000	155,000
Western wheatgrass	242,000	110,000
Needle-and-thread	253,000	115,000
Green needlegrass	370,000	180,000
Little bluestem	573,000	260,000
Canada wildrye	254,000	115,000
Intermediate wheatgrass	194,000	88,000
Pubescent wheatgrass	220,000	100,000
Slender wheatgrass	352,000	160,000
Streambank wheatgrass	344,000	156,000
Tall wheatgrass	174,000	79,0900
Kentucky bluegrass	4,800,000	2,182,000
Smooth bromegrass	300,000	136,000
Meadow bromegrass	176,000	80,000
Hybrid bromegrass	200,000	90,900
Creeping red fescue	1,353,000	615,000
Meadow fescue	506,000	230,000
Tall fescue	500,000	227,000
Meadow foxtail	1,270,000	577,000
Creeping foxtail	1,657,000	753,000
Orchardgrass	1,439,000	654,000
Timothy	2,710,000	1,232,000
Reed canarygrass	1,175,000	534,000
Italian ryegrass (Maris Ledger)	210,000	105,000
Westerwolds ryegrass	210,000	105,000
Awned wheatgrass	269,940	122,700
Purple prairie clover	644,600	293,000
Blue grama	1,709,000	775,000

Source: Saskatchewan Agriculture and Food, Saskatchewan Forage Crop Production Guide

Seeding Equipment

In order to successfully seed forages, equipment settings must control seeding depth and accurately and consistently meter small amounts of chaffy seed. Double disc press drills, hoe drills, broadcast applicators, air seeders and air drills can all be used for seeding forages. Seed bridging can be avoided by having a seed agitator in the seed box or mixing the seed with an inert carrier or fertilizer (ratio of one to three by weight using ammonium phosphate fertilizer (11-51-0)). During seeding, only put small amounts of seed in the tank at any one time in order to prevent bridging or settling.

Double disc press drills

Press drills have two discs on each opener that rotate at an angle, creating a furrow in which the seed is placed. A packer wheel follows to press the soil down on the furrow. Press drills provide precise seed placement in well prepared seedbeds and are often the preferred seeder when establishing forage seed production fields. However, discs can "hairpin" on straw laying on the soil surface due to inadequate penetration forces exerted by the opener. Depth bands can be installed on discs to achieve more consistent seeding depths.

Hoe drills

Hoe drills have a spoon opener mounted on a spring loaded shank. Many have 7 inch (17.5 cm) row spacings. Excessive crop residue can "rake" up in front of hoe drill shanks. In order to obtain wider row spacing and reduce plugging, some operators remove alternate shanks. Careful attention should be paid to the ability of the drill to adequately penetrate firm seedbeds, such as standing stubble.

Broadcast applicators

Broadcast applicators can be self-contained or mounted on tillage implements and can be used for seeding small seeded crops like forages. Broadcast seeders place the seed on the soil surface. Subsequent harrowing and/or packing are required to obtain adequate seed to soil contact. Due to the limited depth at which seed can be placed and the requirements for a firm seedbed for optimal establishment, broadcast-seeded fields are more reliant on timely rains for successful establishment that other seeding methods.

Air seeders and air drills

Air seeders/drills use a central tank, a pneumatic delivery system and openers mounted on a cultivator frame to complete the seeding operation. Air seeders/drills are large capacity machines that can seed large acreages quickly, have excellent trash clearance and, depending on the opener used, have very good seeding depth control and packing capability. Air seeders generally have packers mounted at the rear of the cultivator frame whereas air drills have packer wheels mounted on the cultivator shank. Air drills provide superior depth control and on-row packing. When using seeders with an air delivery system, fan speeds should be kept low to avoid blowing the seed out of the furrow.

Photo credit: Saskatchewan Agriculture and Food

Air drill opener with shank-mounted packer wheel

Photo credit: Saskatchewan Agriculture and Food

Air seeder opener

Establishment Year Stand Management

Weed Control

Weeds can be cut or mowed prior to seed set in the establishment year to reduce competition and future weed flushes. Cutting height should be high to avoid removing a significant portion of forage seedlings. In-crop weed control recommendations can be obtained by referring to Saskatchewan Agriculture and Food's *Guide to Crop Protection.*

Utilization

Generally, utilization of a forage stand during the year of establishment is not recommended due to the increased risk of winter kill, mechanical injury, and reduced plant vigour the following spring. If a forage stand is used in the year of establishment, avoid use prior to a killing frost and if grazed, leave at least 70% carryover.

Evaluating Stand Establishment

Plant density is the primary measurement when evaluating stand establishment. Evaluate new forage stands in the fall of the seeding year or in the spring following the seeding year. Plant densities should be determined at several points along a line crossing the entire field in order to have an accurate and comprehensive assessment of establishment. Densities of 3-5 plants/ft^2 (2-4 plants/m^2) or greater are considered necessary for optimal production. Creeping rooted species may fill in thin stands over time.

SASKATCHEWAN CROP INSURANCE CORPORATION FORAGE ESTABLISHMENT INSURANCE

Saskatchewan Crop Insurance Corporation offers forage establishment insurance to reduce risk when seeding forages. A payment is triggered if there are less than 2 plants/ft^2 over 75% of the seeded area.

To qualify, forages must be seeded between October 15 and June 20. The deadline for applying for establishment insurance is March 31 with June 25 the deadline for reporting seeded acres. The deadline to submit a forage establishment claim is June 20 of the year following seeding. Stand assessments by Saskatchewan Crop Insurance Corporation are made in the spring following seeding.

Contact Saskatchewan Crop Insurance Corporation at 1.888.935.0000 or www.saskcropinsurance.com for further information.

FOR MORE INFORMATION ON FORAGE ESTABLISHMENT CONTACT:

Saskatchewan Forage Council
1.306.966.2148 www.saskforage.ca

Agriculture and Agri-Food Canada - PFRA
Head Office (Regina) 1.306.780.5070 www.agr.gc.ca/pfra

District Offices:
Maple Creek - 1.306.662.5520
North Battleford - 1.306.446.4050
Swift Current - 1.306.778.5000
Weyburn - 1.306.848.4488
Melville - 1.306.728.5790
Rosetown - 1.306.882.4272
Watrous - 1.306.946.8720

Saskatchewan Agriculture and Food
Agriculture Knowledge Centre 1.866.457.2377
www.agr.gov.sk.ca

Regional Offices:
North Battleford - 1.306.446.7964
Prince Albert - 1.306.953.2363
Saskatoon - 1.306.933.7986
Tisdale - 1.306.878.8842
Yorkton - 1.306.786.1531
Outlook - 1.306.867.5575
Regina - 1.306.787.9773
Swift Current - 1.306.778.8218
Weyburn - 1.306.848.2857

Ducks Unlimited Canada
Regina - 1.866.252.3825
Saskatoon - 1.866.254.3825
www.ducks.ca

Native Plant Society of Saskatchewan
1.306.668.3940 www.npss.sk.ca

Saskatchewan Watershed Authority
1.306.787.8707 www.swa.ca

Satisfactory stand 4 plants/ft^2

Fair stand 2 plants/ft^2

Poor stand <1 plants/ft^2

Photo credit: Saskatchewan Agriculture and Food, Trevor Lennox

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