



Agriculture and
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Forage Establishment

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125 YEARS of AGRICULTURAL RESEARCH
ANS de RECHERCHE en AGRICULTURE

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S'enraciner dans la science • Innover pour l'avenir*

Canada

Goal of Forage Production

- Increase productivity from the forage stand
- Increase the quality of the forage produced
- Increase the profitability of the farming operation



Forage Establishment

The first step to a productive/profitable forage stand is strong seedling establishment



What are the factors to consider?

- Choose the correct species
- Choose the correct cultivar
- Ensure the seed is of good quality
- Prepare the seedbed
- Use good seeding technique: seeding rate, date and depth
- Post-seeding management



Choosing the Forage Species

- Pasture/grazing
- Harvested feed
- Rotational crop
- Longevity/persistence versus high productivity in the shorter term
- Restrictions: Soil conditions or any other environmental factors
- Seasonal productivity (species with contrasting growth patterns can complement each other and help produce forage throughout the growing season; they can be sown together or in different fields)
- Maturity and quality



Fact Sheets for Atlantic Canada

- <https://www.perennia.ca/wp-content/uploads/2018/04/pasture-mixtures-for-atlantic-canada.pdf>
- <https://www.perennia.ca/wp-content/uploads/2018/04/2018-forage-guide-to-cultivar-selection-for-ns.pdf>



Rankings of Common Atlantic Forage Species [highest (3) to lowest (1)]

Species	Persistence	Poor Drainage	Grazing Tolerance	Low Fertility	Species Compatibility
<i>Bromegrass, Meadow</i>	3	2	3	2	3
<i>Bromegrass, Smooth</i>	3	1	2	1	3
<i>Fescue, Meadow</i>	3	3	3	1	2
<i>Fescue, Red</i>	3	3	3	3	3
<i>Fescue, Tall</i>	3	3	3	2	2
<i>Kentucky Bluegrass</i>	3	1	3	2	3
<i>Orchardgrass</i>	2	3	3	1	1
<i>Reed Canarygrass</i>	3	3	2	2	2
<i>Ryegrass, Perennial</i>	1	1	3	1	2
<i>Timothy</i>	3	3	2	2	3
<i>Alfalfa</i>	2	1	2	1	2
<i>Alsike Clover</i>	2	3	2	3	1
<i>Birdsfoot Trefoil</i>	2	3	3	2	3
<i>Red Clover</i>	2	2	2	2	2
<i>White Clover</i>	2	1	3	1	3



Simple and Complex Mixtures

	2005	2007	2008
	Total DMY (kg/ha)	Total DMY (kg/ha)	Total DMY (kg/ha)
T-Mf-Wc	3544	7467	5456
T-Bg-Wc	3484	7369	7564
T-Rca-Wc →	4017	7591	5757
Mf-Bg-Wc →	3888	6231	7218
Mf-Rca-Wc →	4506	5524	6133
Bg-Rca-Wc	3952	5166	6848
T-Mf-Bg-Wc →	4009	7930	7115
T-Mf-Rca-Wc →	4456	7744	6766
T-Bg-Rca-Wc →	3728	8471	6751
Mf-Bg-Rca-Wc →	3676	6347	7187
T-Mf-Bg-Rca-Wc →	3811	8658	7896



Timothy/Meadow Fescue/Alfalfa



Seed Quality

- Seed certification – Certificate of Analysis
 - Gives you a measure of the quality characteristics of the forage seed
 - Germination rate
 - Percent of pure seed
 - PLS: Pure live seed



Pure Live Seed

- If the pure live seed is not given on your seed certificate you can simply calculate:
 - $\%PLS = (\% \text{ germination} \times \% \text{ pure seed}) / 100$
 - Example: Alfalfa has 95% germination and 90% pure seed.
 - $\%PLS = (95 \times 90) / 100 = 85.5\%$

This means if you have 100kg of alfalfa seed, 85.5 kg of it is pure live alfalfa seed and would be expected to germinate.



Factors affecting seed quality

- Seed needs to be stored cool and dry.
- Failure to do so will reduce seed quality
- This affects viability of the seed



Germination

- If using seed from a previous season ideally you should repeat the germination test

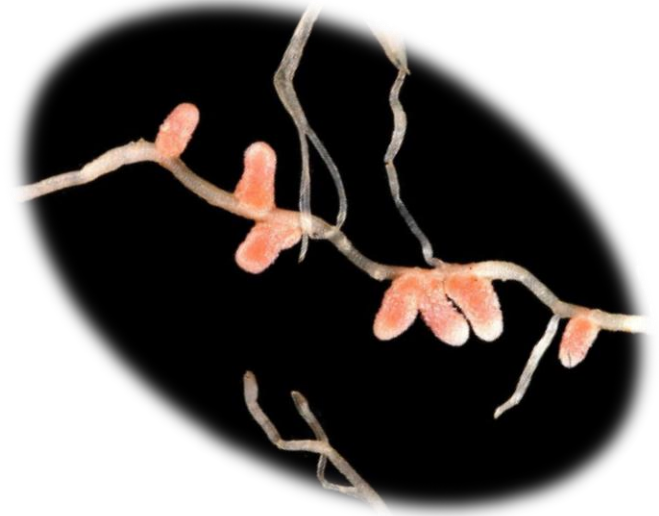


Seed Inoculation

- Forage legumes can fix nitrogen
- Need the aid of a group of bacteria known collectively as rhizobia
- Unique rhizobial species are required for each legume species although some rhizobia can work on more than one legume species.
 - Alfalfa ▶ *Sinorhizobium meliloti*
 - Birdsfoot trefoil ▶ *Rhizobium/Mesorhizobium loti*
 - Red clover ▶ *Rhizobium leguminosarum* bv. *trifolii*



Nodulation



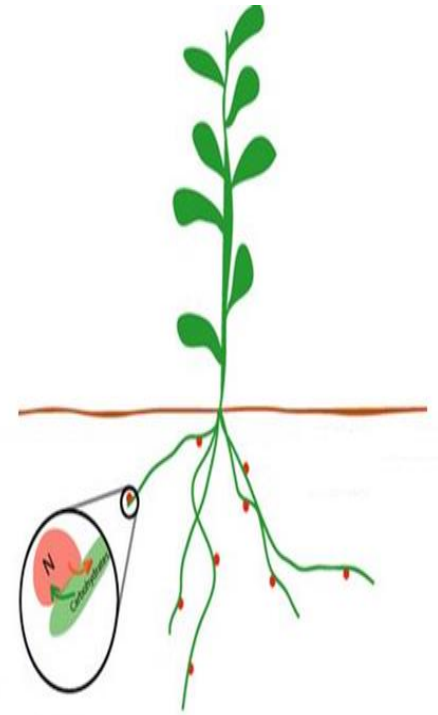
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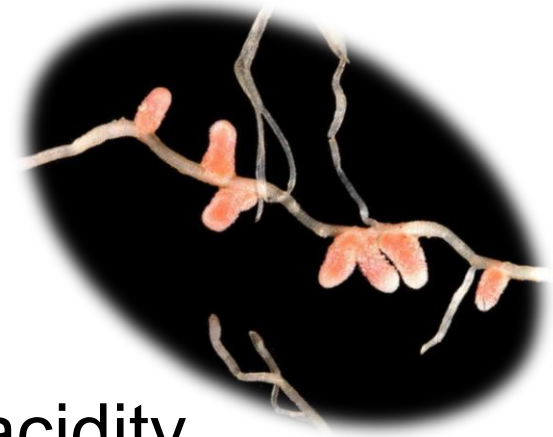


Seed inoculation

- There are native rhizobia in the soil and also rhizobia in the soil from previous cropping where rhizobial inoculant was used.
- However, the formation of nodules is faster and the rate of N fixation is generally better when inoculum is applied close to the seed



Nodulation



- Rhizobia are living bacteria
 - Drought, heat, desiccation, soil acidity ...
 - Both in the soil and on the seed before planting
- Rhizobia should be in close contact with the seed
 - Pre-inoculated seed
 - Or inoculate the day of seeding



Inoculants come in different forms

- Pre-inoculated seed
- Peat based powder
- Self sticking powder
- Granular placed in the soil near the seed
- Liquids



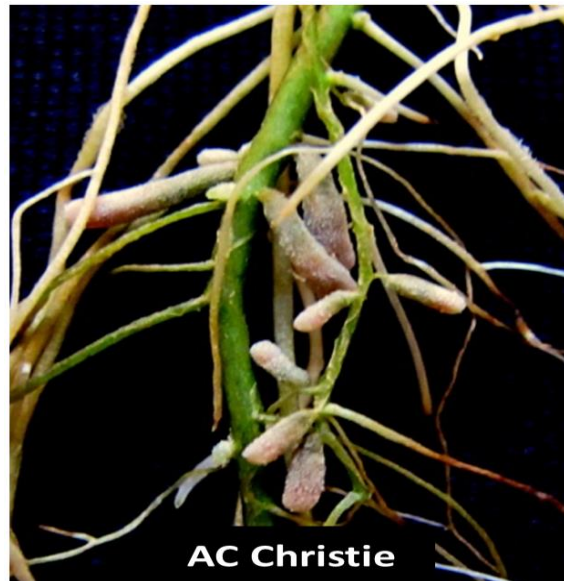


Applying self sticking
powdered inoculant

Photo credit: Saskatchewan Agriculture and Food



Red Clover Nodules



Seedbed Preparation

- Two approaches to seeding a forage crop:
 - Conventional tilling and direct seeding
 - Reduced or no-till such as frost seeding or sod seeding



Seedbed Preparation

- The goal of conventional tillage is to produce a fine, firm, level and well-packed seedbed.
 - Enhance control over seeding depth
 - Ensure good seed to soil contact



Rule of thumb: Footprint should sink no deeper than 9 mm (3/8 inch)

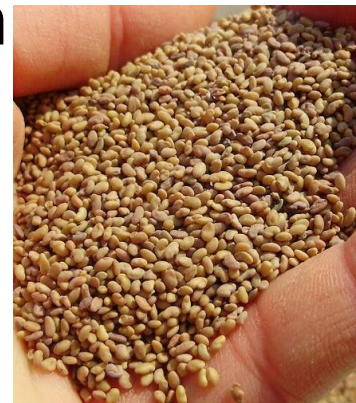


Photo credit: *Alfalfa Management Guide*; Undersander *et al.*, 2011. American Society of Agronomy



Tilling

- Recommended tilling:
 - Primary tillage (moldboard plow or chisel) to loosen the soil and break-up/turn over any vegetation/weeds
 - Disking to break up large soil clods, level and continue to control weeds
 - Light cultivation as needed to level
 - Pack



Seeding

Many different types of seeders and drills are used to sow forages but the most important elements are seeding depth and seed/soil contact (packing).

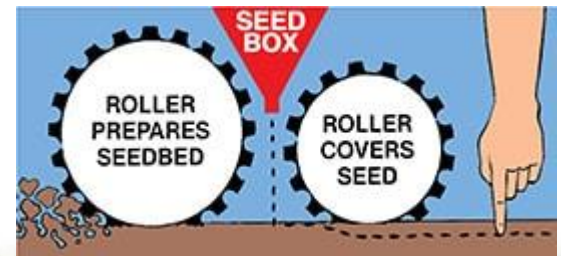
- Grain Drills
 - You should see a few seeds on the soil surface
 - Press wheel should be used to pack soil or use a packer pulled behind

Band fertilizer



Seeding

- Packer Seeders
 - Brillion type seeder
 - Large and small seed boxes
 - Two rollers (first levels and firms, second covers the seed)
 - Very good at controlling seed depth
 - Cannot band fertilize
 - Not good for very hard or sandy soils



Seeding

- Broadcast seeders

- Fast
- No control on seeding depth
- Packing is needed



- No-Till Drills

- Control amount of surface plant residue and its distribution before seeding



- Checking seed placement (depth) is critical (evenness of the field)
- Packing wheels need to be accurately closing the drill



Seeding Rates

- The seeding rate is an important factor in determining the forage stand density
- It is measured as:
 - The weight of seed/area (kg/ha)
 - The volume of seed/area (bu/ac)
 - The number of seeds/area (seeds/m²)
- It should be based on the PLS
 - Pure Live Seed



Pure Live Seed

- Pure Live Seed is the percent of the seed that is expected to be viable (germinate and produce a seedling).
- It is a product of the germination rate and seed purity (percentage of the weight of the seed bag that is just seed of the desired species – no debris, weed seed... other contaminants)
- Seed lots can differ in these values



Using the PLS value

- Example:
- Germination rate of 90%
- Purity rate of 95%
- $PLS = 90\% \times 95\% = 85.5\%$
- Recommended seeding rate for alfalfa is 15 kg/ha then your actual seeding rate is $15 \text{ kg/ha} / .855 = 17.5 \text{ kg/ha}$



Recommended Seeding Rates

- Vary with the location: See you local forage specialist
- Generally account for adverse seeding conditions so you don't have to correct for that
- Increasing the seeding rate will not compensate for poor field preparation
- Vary with the seeding method:
 - For example with broadcast seeding it is generally recommended to increase the seeding rate by as much as 30%



Seeding Depth

- Rule of Thumb: Seeding depth for most forages should be between
 - 6 – 12 mm (0.25 - 0.5 in.) on clay and loam soils
 - 12 – 18 mm (0.5 – 0.75 in.) on sandy soils
- Emergence declines if seed is too deep (> 20 mm or 0.75 in.)
- Plant deeper if moisture is a concern.



Equipment Calibration

- Important for both seeding rate and seeding depth.
- Exceeding the recommended seeding rate has not been shown to substantially increase yields while under sowing can.
- Planting too deep or failing to provide good contact between the seed and soil will decrease successful seedling establishment.
- Measure seeding depth after packing.



Seeding Date

- The most reliable time to seed forages in Eastern Canada is early spring
 - Late April to mid-May ideal but can seed 'til mid-June
- The two most important climatic factors are temperature and soil moisture
- Plant as early as you can prepare a good seedbed
- Early germination and growth helps to compete with weeds



Seeding Date

- Germination can occur at temperatures as low as 5°C
- Alfalfa tolerates the lower temperatures at germination better than birdsfoot trefoil, red and white clover
- Cool-season grasses also very tolerant of low temperatures



Seeding Date

- Summer seeding can present a challenge if moisture is limiting
- Fall seeding is not recommended for forage legumes in this region because of heaving
- Grasses can be seeded in the fall but need 6 weeks of root and shoot growth. Tillering is a good indication the plants will survive the winter.



Seedling Establishment

- How can you measure the success of your seeding?
- Determine the number of seedlings per unit area:
 - Alfalfa ~ 25 plants/ft² for the seeding year
 - For most forage legumes approximately 100-200 plants/m²
 - For grasses it is difficult to count individual plants but you can look for uniform ground coverage (gaps) and you need to consider the grass species



Birdsfoot trefoil cv Bruce



Seeding Costs

<u>Materials</u>	\$/ac
herbicide (glyphosate 1.5 l/ac)	10
fertilizer	35
lime (2 tonnes/acre)	72
seed	47
herbicide (weed control)	0
<u>Operations</u>	\$/ac
Ploughing (5 furrow)	50
disc harrow	35
cultivator/landleveler	18
rock picking	25
lime spread	8
fertilizer spread	8.5
seeder	30
mow weeds	18
	~200

Credit: Bill Thomas



No Till Seeding

- Reduce erosion
- Reduce cost of seeding
- Replace lost legumes in a sward
- Two methods:
 - Sod seeding
 - Frost seeding



Sod Seeding



Frost Seeding





Field of Tall Fescue in Spring 2019



Nappan Experimental Farm



Frost seeding into Tall Fescue





Birdsfoot trefoil
frost seeded into
tall fescue



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- Agriculture and Agri-Food Canada
- Beef Cattle Research Council (a division of the Canadian Cattlemen's Association)





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Thank you!

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