

Seeding and Invasives

- **Reclamation** – starting from nothing – typical in a mine or gravel pit.
- **Rehabilitation** – have some plants growing but want to improve or restore a specific plant community. Typically this involves seeding or planting.
- **Restoration** usually refers to restoring a function. Uses seeding but often other methods. *Ex. Planting trees along the edge of an oxbow dominated by grass. The trees will provide shade that will then facilitate natural establishment of more trees and shrubs over time naturally and shade out grassy species.*



Assess Site to Determine Need for Seeding after invasive plant control:

Consider site conditions and potential natural recovery before you ever treat invasive plants since this may influence how you treat it.

- Is the plant community likely to recover on its own?
- If you plan to seed choose your herbicide carefully.



Overview

- Set Objectives - What do you want it to look like after?
- Are there limitations on plant height or palatability?
- Native vs non-native?
- Source of seed and potential contamination.
- How to get seed on the ground?
- What to expect post seeding/planting.
- Are land management changes needed?
- Monitoring – when and how?



Set Objectives for a site - what do you want it to look like after, why are you doing it? (aesthetic values, want more forage, or just want no invasives).

Are there limitations by the land manager on plant height, or palatability? (often the case along roadsides).

Species selection for seeding/ planting– native vs non native or combination of; forbs vs grasses vs shrubs?

Source of seed – source can be important and also how clean it is.

How to successfully seed considering site conditions –understanding or your best guess at your site limiting factors for growth which will influence timing, applications methods, etc.

What to expect post seeding/planting – how long it will take to grow – takes years so be realistic in your expectation of how long it takes to recover.

Are there land management changes that need to happen at the location to facilitate the desirable species growth (ex. Remove livestock to 2 years, or mow higher, or don't mow until late summer to allow natural species to seed)

Monitoring – when and how

Set Objectives

- Set realistic objectives that are specific and measurable in the timeframe of the project.
- Consider site limitations for species.



Set realistic objectives – could be 50 % cover of desirable in following season or 80% cover by second season.

Are you achieving objectives? Plan to use adaptive management principles. If it is not working – change your approach.

Native vs non-native?

- Native slower to establish and costly- genetics of source.
- Non-native (typically agronomic) establish easier and cost less.
- Consider native shrubs and trees if site is appropriate.
- Potential contamination of seed with noxious weeds.



Native versus non-native. Agronomic grass species cost less and establish better. Native grass species are slower to establish, cost more, but may not be available depending on the fire rehab being done in the US. New research on seeding post fire is finding little difference in plant community on seeded and non-seeded burned sites after 10 years. Native shrub and trees species are best adapted for a site but some are easier to propagate and more likely to survive in the long term than other species.

There is no such thing as weed free seed. There is a risk anytime you seed of introducing a new species. This can be limited by checking the seed analysis results. Different grades of seed have different tolerances for weeds. By checking seed analysis you at least know what you are likely introducing.

Seed sealing number (lot number) _____ Crop certificate number _____ Crop Kind and Variety _____ Seed testing certificate number _____

Brett Young Report of Seed Analysis

This certifies that a sample of Canadian Red Fescue - Boreal designated as 1357-9-000037 CC # 08-8055624-401 and was tested at: 10-3772

was retained from: Brett Young and was tested at: Brett Young
 Box 100 Box 100
 Pymont, AB Pymont, Alberta T0A 3A2
 T881 3A2 Tel: 780-765-5009 Fax: 780-765-5960

with the following results:

WEEK SEEDS: No. PER 25	GRAMS	OTHER WEED SEEDS	OTHER CROPS SEEDS
Prohibited Noxious	0.0	None Found	0.0
Primary Noxious	0.0		
Total Primary	0.0		
Secondary Noxious	0.0		
Total Secondary	0.0		
Total Prohibited and Secondary	0.0		
Pure Seed	99.9%	Pure Seed	99.9%
Other Crop Seeds	0.0%	Multiple Seed Units	0.0%
Other Crop Seeds	0.0%	Included in Pure Seed	0.0%
Test Matter	1.1%	Incl. Test Seeds	0.0%
Germination	99.9%		

Germination - percent of seeds that grow
 Hard Seeds (only relevant to legume seeds) - seeds still included in germination
 Pure Living Seed - seed that is pure and viable

Pure Seed = crop seed only
 Inert Matter = stems, seed husks, dirt, etc.

TZ - Tebrazolium test (only applicable to cereals) - determines percent viable seed

Signed and stamped by accredited seed analyst.
 Place and Date of analysis:

This certifies that the sample of seed submitted from the lot designated above has been analysed according to Methods & Procedures of Seed Testing, C.F.I.A. C.F.I.A. Accredited Laboratory 1117

18-Msg-11

Accredited Analyst: Chantal Gauthier

Responsibility for any seed sold under this Certificate with respect to purity or any other specification rests solely with the seller.

Keep your seed tags after seeding in case you find a contaminant.

EXAMPLE 1: Gas pipe line reclamation



EXAMPLE 1:

Southern Crossing Project – Gas line installation. Installed fall 2000 to summer 2001 and main planting done in 2001. Some aerial seeding on rough terrain, some conventional equipment seeding on suitable slopes. Mix of drought resistant grasses seeded by plane and main species to grow was Intermediate wheatgrass. Used different mixes where requested so on some stretches of trans Canada trail low growing fescue mix used. In agriculture land then hay mixes used.



Picture of gasoline- virtual monoculture of Intermediate wheatgrass in 2018 in hot dry areas. Grows 3 ft tall so has created massive fire hazard and livestock and wildlife avoid grazing it. Virtually no native species growing.

Similar monocultures have been recorded after planting of hard fescue, smooth brome, and crested wheatgrass.

The stretches of gas line along the Trans Canada Trail where Sheep's fescue seeded established well – low growing grass (no fire risk). Would have been a better choice in many locations. Consider mature plant height and fire hazard before planting.

East of Grand Forks is dominated by Intermediate wheatgrass. It got so thick they had to mow the grass just to allow passage by bikes.

EXAMPLE 2: Roadside seeding 20 years later.

All seeded grass died.
Cottonwood and rabbit
brush starting



Road cut slopes with exposed mineral soil was broadcast seeded right after construction with agronomic grasses. Some grass established but declined over time.

Picture: Cobble areas steep south aspect – all seeded grass died and slowly cottonwood and rabbitbrush are establishing except

Soil
raveling
down slope



where soil sloughing off top where now native bunchgrass is growing.

Cooler east
aspect -
Annual
cheatgrass
and forbs
dominate



Picture: East aspect gravelly mineral soil is a mix of primarily annual cheatgrass and a few annual forbs. Diffuse knapweed keeps coming up. Annual grasses are not as good as perennial grasses.

Soil
sloughed
and now
bluebunch
wheatgrass



Picture: Areas where soil sloughed onto slope with native species flourishing. Some diffuse knapweed by biocontrol insects suppressing its growth.

Site is so hot and dry that no agronomics persisted which is good in the long-term. Site too hot for clover but a nitrogen fixer would have sped up the process of establishing grass on mineral soils. Biocontrol has controlled the diffuse knapweed and hound's tongue. Dalmatian toadflax was spot sprayed.



To seed or not to seed?

After the Rock Creek Fire there was debate of whether to seed or not seed. Decision was made to only seed areas where soil horizons were significantly disturbed by equipment. In the past a seed mix had been used on crown land that contained very long persistence species and once seeded the native species were not able to establish in seeded areas. Native species perform the best in the climate so the eventual goal for crown land is to allow the native species to return to areas disturbed by resource management activities. But in the short-term some areas need competition to prevent rapid invasive plant spread. With this in mind a series of new mixes were designed by range staff, ecosystem staff and BISS using low to moderate persistence species mostly agronomic with one native. Four mixes including a dry palatable, dry less palatable, wetter palatable and wetter non-palatable mixes were created. Dry refers to PP and IDF zones. Wetter mixes were intended for ICH and ESSF zones. Range officer now requires all seeding on crown land to use these mixes unless specific other mixes are reviewed and approved by the Range Officer. The team worked with a local supplier to bring in stock of the new seed mixes. This has also provided an opportunity to get the seed retailer educated about reviewing seed analysis results for contaminants.

Mostly the dry and wetter palatable are being used on crown land by forest companies seeding roadsides and landings.

Dry non-palatable is being used along highways roadsides and pits and by some private landowners and woodlot owners who want to discourage livestock use.

After two years of using the mixes it is time to assess seeded sites to see how well the mix is establishing on a range of sites. Last year was too droughty for monitoring.

Main local seed retailer now has the seed analysis on hand for all the mixes that may go on crown land and he sends them to me. He called this spring to ask about potential contaminant since Wild Oats was present in the Slender wheatgrass lot and the seed mixer was not sure if this would be acceptable or not. The seed distributor is now making sure the seed mixes sent to the retailer meet our standards and are free of BC listed noxious weeds. This summer one lot of slender wheatgrass was refused and an adjustment to the mix made to add a different species to the mix that had a clean seed analysis.

Seeding of Rangelands Burned by Wildfires **Boundary Region, BC**

Use of non-native seed

There is concern about the introduction of non-native plant species through seeding of domestic forage species. Consider site sensitivity, invasiveness of the seeded species, and persistence of the seeded species and availability of native species when making your decisions. Short-lived, non-invasive domestic species will have the least long-term impact on a site while persistent invasive species will have the greatest.

There does not appear to be any native species available that can achieve a weed resistance in the short-term needed to control the establishment of invasive weeds. Furthermore, British Columbia cultivars of native grass species can be difficult or costly to obtain.

Annual grasses are an option as long as they can maintain sufficient cover in successive years to resist weeds. In very dry conditions, annual grasses may not set seed and therefore may not maintain the needed cover. Reseeding would then be needed.

Hard Fescue is persistent but not invasive on very dry sites and appears to be one of the options available.

Copies available. Documented through process for development of the mixes.

Mostly the dry and wetter palatable are being used on crown land by forest companies seeding roadsides and landings.

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After two years of using the mixes it is time to assess seeded sites to see how well the mix is establishing on a range of sites. Last year was too droughty for monitoring.

Main local seed retailer calls to ask about potential contaminants to see if they are Ok in the mix or not as he brings in new shipments of the mix. The seed distributor is now making sure the seed mixes sent to the retailer meet our standards and are free of BC listed noxious weeds. This summer one lot of slender wheatgrass was refused and an adjustment to the mix made to add a different species to the mix that had a clean seed analysis.

How to apply seed?

To get seed to grow you need moisture, warm soil, and soil seed contact.

How to seed in order of effectiveness:

- Hydro seeding
- Zero till drill seeding
- Conventional tractor seeding
- Broadcast seeding by hand (Variations using livestock feeding to trample in seed is improves effectiveness as does hand raking).

Timing for broadcast seeding:

- Immediately after disturbance when the soil is soft and powdery allowing the seed to sink into the soil;
- Dormant fall seeding before or into less than 1 inch of snow;
- Early spring dormant seeding after the main winter snow melts and just before the last snowfall – Less than 1 inch of snow.
- Early spring seeding- as early as possible.

EXAMPLE 4:
Big White
realignment
Project –
seeding and
offset
planting



Picture of banks - hard smooth compacted slopes. Fall hydroseeding very poor establishment. Compaction is the biggest issue and not much can be done unless equipment is used to soften slope. Broadcast seeded site anyway just in case the weather conditions allow more grass to establish.

Hard
compacted
growing
surface



Most shrubs
and trees
died after
original
planting



Shrubs and trees planted along the creek mostly died the first season.



Planting 2018

Shrub planting by wildlife underpass – a few areas were topped with soil to enable planting. Soil was not deep enough, compaction layer below, and extreme dry conditions in year after planting resulted in most shrubs not surviving. (Picture of site) A few saskatoon survived. Replanted site in spring 2018– had to use cat bar to dig holes and loosen ground below shrubs. Applied mulch around plants to retain as much moisture as possible. Watered site a few times over the summer using a plastic cube tank and buckets. Good shrub survival through first season. Takes 2 seasons for potted plants to establish root systems so if they make next year then we can call it a success.



EXAMPLE 5: Midway area former rail grade now Kettle Valley Rail Trail –Before treatment

2008 – dense weeds – Dalmatian toadflax, Diffuse knapweed, Baby’s breath. Hoary alyssum just starting. Not much else growing. Received specific trails treatment funds. Spot sprayed the former railway right of way with tordon 22k. Herbicide treatment alone would have been pointless since no desirable plant community expected to be released as the weeds control. Even though we knew that tordon 22k (Milestone and Clearview do this also) may inhibit grass germination during the season of application we still went ahead and seeded it since it was a spot treatment, so some areas were not treated. If it has been broadcast sprayed over the whole area, then we would have delayed seeding to the next season.

Grass dominates now



The contractor broadcast seeded in the fall with a standard drought resistant grass mix – added sand dropseed (*Sporobolus cryptandrus*). As expected not a great seed take. We had planned to seed a second time, so broadcast seeded again the following fall with same mix. Better establishment but still not great. A few years later there was a nice stand of mainly sand dropseed with small amount of crested wheatgrass (*Agropyron cristatum*) on the right of way. Some gaps but at least grass growing. Main issue on site was soil contamination, compaction, hot dry conditions, and rapid drainage. Sand dropseed seems to grow well on hot sandy rapidly drained sites so that was why we added it to the mix. We continued with some spot treating annually to control the hoary alyssum which seems to continue to pop up in new spots every year due likely to people using the trail spreading the seed. Biocontrol insects on Dalmatian toadflax were not working as well as hoped, partially because the site was annually mowed to reduce fire risk and keep it looking neat. Mowing prevents the insects from completing their life cycle. Mowing can also prevent seeding of desirable species and can spread invasive plant seed. Unfortunately, the village would not completely stop mowing the grade but at least are doing a narrower strip either side of the rail trail only now. So carefully if you want to mow the site or not after treating invasive plants.

In 2018 the main grass on the rail grade continues to be sand dropseed and crested wheatgrass which is providing competition for the weeds and because of its growth form does not create fuel loading. Considering the low annual rainfall on the site widely spaced bunchgrass is expected since there is not enough annual moisture to support a dense stand of grass. Crew still spot treating a few hoary alyssum plants, dalmatian toadflax and sulphur cinquefoil each year.

Exploit weakness of Invasive Plants



Shade intolerance

Plant shrubs and trees
Ex. Hoary alyssum



Nutrient levels – do a soil test

Change soil Ph, increase Phosphorus, or add organic matter.
Ex. Oxeye daisy, Equisetum



Longevity

Deplete seed bank using repeated glyphosate treatments before seeding *Ex. longspine sandbur*

MONITORING

Very rarely does monitoring of plant community happen.

Even visual surveys 1, 2 and 5 years post seeding are helpful.

Then an assessment - is it too sparse and needs more seed? Or it is coming and needs more time?

Plan for up to 5 years of monitoring if you can find a funder who will commit.

Very rarely does monitoring of plant community happen, it is usually just are invasives present or not as a measure of success or failure. Even visual surveys 1, 2 and 5 years post seeding are helpful. It does not need to be complicated monitoring – just some notes – date, planted species that did establish and estimated % cover by species and overall % cover. Then an assessment of is it too sparse and needs more seed? Or it is coming and needs more time? You can do plots to monitor the establishment, but unlikely project resources will be available beyond year 1. Plan for 5 years of monitoring if you can find a funder who will commit. Sometimes you find success initially then failure.

EXAMPLE 6: Gas pipe line replacement project



Seeded all non-crop areas with a mix of native and low persistence agronomics. Good mix, drought adapted, looked great for the first few months (June 2017). It should have worked. But last summer's drought – 90 days without rain – killed the drought adapted perennial grass in some areas. Not all areas, just some. Most obvious reason was topsoil not deep enough – only a couple inches then mineral soil (gravel and cobble). There was debate about whether there was also a compacted layer below the topsoil at some locations. Need rough and loose. Top soil settles 1/3 after it is spread. Recommended final minimum soil depth is 4-5 inches, so need to apply 6-8 inches of topsoil to create a suitable growing surface in droughty climates.

To achieve success:

- **Minimise footprint** where possible.
- **Salvage topsoil** and use it to restore after the project. Top 8-12 inches of soil is active and lots of native seed. Below that usually won't grow.
 - Scrape off the top 6 inches and then another 8-12 inches and put back in reverse order.
 - If you store topsoil for more than a year the inner soil will not grow. Either store in shallow piles or mix soil before spreading.



Minimise footprint where possible.

Salvage topsoil and use it to restore after the project. Top 8-12 inches of soil is active and will grow. Below that will not grow. Scrape the top 6-8 inches and put on a tarp. Scrape the next layer down and put on a different tarp. Do not mix up the layers. Then after excavation complete then return the soil in the reverse order. Topsoil may be very shallow in forested ecosystems. In these situations use salvaged litter layer or wood mulch or decaying log material to cap the mineral soil. That is how nature does it.

If the soil was excavated from deeper, you can help to stimulate the soil by mixing in wood mulch (hog from a mill that has bark and wood is great) that will decompose and get fungal activity started. Often used on mine sites. The decomposing wood inoculates fungus and bacteria into the soil that will enable mycelial web to form which is essential for movement of nutrients to plants. Commercial inoculants are species specific and likely not appropriate mix of species for native plant restoration. Inoculants Work well in nurseries for ornamentals. Some experiments being done with compost tea as inoculant but likely provide only short-term results. Image Source: https://twitter.com/jenn_lamoureux/status/776132893168906240.



To achieve success:

- **Select adapted grass species** that meet your end goal. Lower growing species might be better for use along trails.
- **Include forbs where possible** - It is not all about grass. Pollinators need food too so consider forbs (broadleaf plants) where possible.
 - Fireweed will grow on burned soil when nothing else will and it flowers at a time when pollinators have few other options.
 - Lupins, yarrow, spirea and other species are available and establish well.

Select adapted grass species that meet your end goal. Lower growing species might be better for use along trails.

Include forbs where possible - It is not all about grass. Pollinators need food too so consider forbs (broadleaf plants) where possible. Fireweed will grow on burned soil when nothing else will and it flowers at a time when pollinators have few other options. Watch nature and then mimic the natural processes wherever possible. Fireweed seed is not commercially available so collect your own in the fall. There are late flowering natives – look around and use what is available.

Use nitrogen fixing species on exposed mineral soil – clovers are amazing to kick start growth on exposed mineral soil. They will decline once the available nutrients levels increase so work well when combined with species that are slow to establish. But they attract bears and other wildlife so are not appropriate everywhere.

Or reduce nitrogen levels if site is too nutrient rich by mixing in sawdust which will bind up carbon and nutrients at least temporarily. Weeds love nutrients. Most native plant communities grow on nutrient poor soils. Be careful with use of fertiliser as it could just increase your invasive plant problem.

Table 5.1 Species summary ratings (species filters).

Precipitation and Objectives Filter					SPECIES FILTERS		
Agronomic Grasses	Min ppt (mm)	Max ppt (mm)	Drought Tolerance	Flooding Tolerance	Control Erosion	Suppress Inv Plants	Enhance Forage
Canada bluegrass	300	1100	H		H		M
Kentucky bluegrass	350	1100	M	M	H	M	M
Hybrid brome grass	300	600	H	M	M	H	H
Meadow brome grass	350	600	H	L	M	L	H
Smooth brome grass	350	600	H	H	H	H	H
Chewings fescue	400	600	H	M	M	H	L
Creeping red fescue	400	600	M	M	H	L	M
Hard/sheep fescue	300	760	M-H	L	H	H	L
Tall fescue	400	600	M	M	M	M	H
Orchardgrass	400		M	M	L	M	M
Italian ryegrass ^a	400	600	L	H	H	H	H
Perennial ryegrass ^a	400	600	L	H	H	H	H
Red top	450		M	M	H		L
Timothy	400	600	L	H	M	L	M
Crested wheatgrass	200	450	H	L	M	H	M
Intermediate/Pubescent wheatgrass	330	1120	M	L	H	M	H
Tall wheatgrass	300	550	H	M	M		M

Source: British Columbia Rangeland Seeding Manual

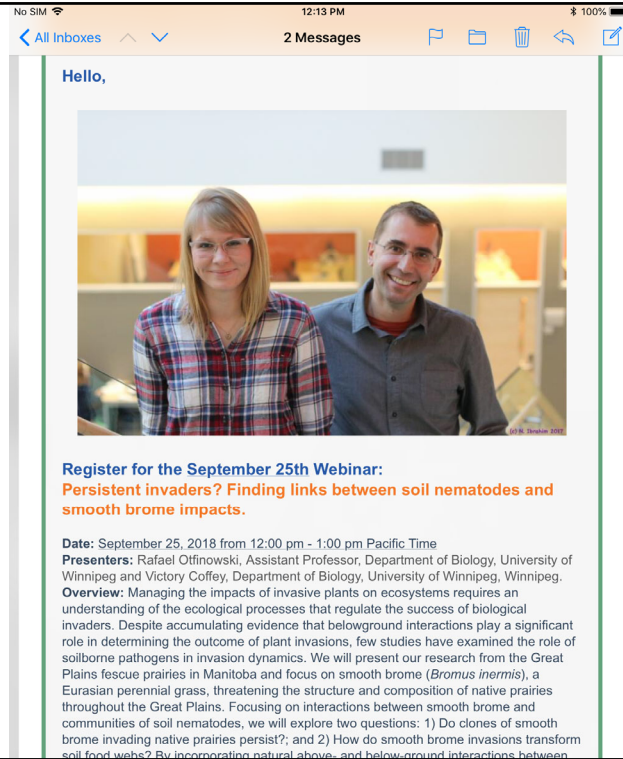
Agronomic Grasses	Ease of Estab	Winter Hard	Persist	Comp	Long	Graz Recov	Texture	Acidity	Salinity
Canada bluegrass	M	M	M	M	M	L	A	M	
Kentucky bluegrass	M	H	H	H	H	H	A	H	L
Hybrid brome grass	H	H		H	H	H	A	M	M
Meadow brome grass	M	H		M	H	H	A	M	M
Smooth brome grass	M	H	H	H	H	L	A	M	H
Chewings fescue	H	M	H	H	H	M	MC	H	M
Creeping red fescue	H	H	M	M	H	H	A	H	M
Hard/sheep fescue	M	M	H	H	H	M	FM	L	
Tall fescue	M	M	L	M	M	H	FM	H	H
Orchard grass	H	L	M	M	M	H	FM	H	L
Italian ryegrass	H	L	L	H	L	H	A	H	M
Perennial ryegrass	H	L	L	H	L	H	FM	H	L
Red top	M		H		H	L	F	H	L
Timothy	M	H	M	M	H	L	A	H	L
Crested wheatgrass	M	H	H	M	H	M	A	M	H
Intermediate/Pubescent wheatgrass ^b	H	H	M	M	M	L	FM	M	M
Tall wheatgrass ^b	L	M	M	L	H	M	FM	L	H
Dahurian wildrye	H	M	L	M	L	H	A	M	H
Russian wildrye ^b	L	H		H	H	M	FM	M	H

Source: British Columbia Rangeland Seeding Manual

Persistence is important

Species to avoid in
natural areas in my
view:

- Smooth brome
- Kentucky bluegrass
- Crested wheatgrass
- Hard fescue
- Sheep fescue (avoid
in grasslands)
- Reed canary grass
- Intermediate
wheatgrass



To achieve success:

- **Use nitrogen fixing species on exposed mineral soil** – clovers are amazing to kick start growth on exposed mineral soil.
- **Or reduce nitrogen levels if site is too nutrient rich** - mixing in sawdust will bind up carbon and nutrients at least temporarily. Weeds love nutrients.



Nitrogen fixes include sanfoin, alfalfa, bird's foot trefoil. Check out the rangeland seeding manual for more details on persistence.

<http://balconygardenweb.com/planting-white-clover-how-to-grow-white-clover/>

Agronomic Legumes	Min ppt (mm)	Max ppt (mm)	Drought Tolerance	Flooding Tolerance	Control Erosion	Suppress Inv Plants	Enhance Forage
Alfalfa	300	600	H	M	M	L	H
Birdsfoot trefoil	400	600	M	H	L	L	M
Alsike clover	400	600	L	M	M	M	M
Red clover	400	600	M	M	M	M	H
White clover	400	600	L	M	M	M	M
Sainfoin	300	600	M	L	M	L	H
Cicer milkvetch	350	600	M	L	H	L	H
Common vetch	310	1630	L	L	H	H	H
Hairy vetch	450	1650	H	M	H	H	H

Suitability ratings short-term unless combined with longer-lived species.

Legend

Abbreviations in Headings	Suitability & Adaptation Ratings	Seeding Objectives
Precipitation	L = Low	Control Erosion = Erosion Control
Min = Minimum	M = Moderate	Suppress Inv Plants = Invasive Plant Suppression
Max = Maximum	H = High	Enhance Forage = Forage Enhancement
ppt = Precipitation		

Source: British Columbia Rangeland Seeding Manual

Agronomic Legumes	Ease of Estab	Winter Hard	Persist	Comp	Long	Graz Recov	Texture	Acidity	Salinity
Alfalfa	H	M	M	M	H	M	A	L	M
Birdsfoot trefoil	L	L	M	L	M	M	FM	H	H
Alsike clover	H	H	M	M	L	H	F	H	L
Red clover	H	M	L	H	L	M	A	H	L
White clover	H	L	M	M	L	H	FM	H	L
Sainfoin	M	H	L	L	M	L	A	L	L
Cicer milkvetch	M	H	M	M	H	H	A	L	L
Common vetch	M	L	H	M	L	M	A	M	
Hairy vetch	H	H	L	H	L		C	L	L

^aTolerance for alkaline soils with pH up to 9.0; source: U.S. Department of Agriculture NRCS. 2011. The PLANTS Database, National Plant Data Team, Greensboro, N.C. <http://plants.usda.gov/java> [Accessed June 13, 2011].

Legend

Abbreviations in Headings Adaptation & Soils Ease of Estab = Ease of Establishment Winter Hard = Winter Hardiness Persist = persistence Comp = Competitiveness Long = Longevity Graz Recov = Recovery after use Texture = Soil Texture Acidity = Acidity Tolerance Salinity = Salinity Tolerance	Suitability & Adaptation Ratings L = Low M = Moderate H = High	Soil Texture Ratings A = All Textures C = Coarse textured MC = Medium to Coarse textured M = Medium textured FM = Fine to Medium textured F = Fine textured
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British Columbia Rangeland

Source: British Columbia Rangeland Seeding Manual

To achieve success:

- **If site is irrigated make sure to deeply water** the site to encourage deep root systems. The plants will be more likely to survive drought.



Graphic Source: <https://www.sagegrouseinitiative.com/roots/>

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To achieve success:

- **Understand your site conditions** and limitations.
- **Plan out the project from start to finish** before you even start.
- **Monitor and adapt** where needed if something fails. In restoration or rehabilitation it often takes several attempts to get successful establishment particularly with natives.
- **Anticipate losses.** It takes years to re-vegetate a site so wherever possible reduce the need for rehabilitation or restoration by minimising the footprint of all projects.

Restoration is expensive so be a smart land manager and protect and enhance the functioning plant communities you have wherever possible.

Resources and Publications

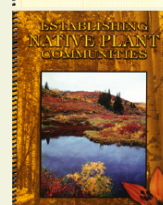
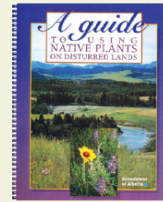
Resources:

- Local Restoration ecologists (ecosystem function)
- Local Agrologist (rangeland seeding or crops)
- Soil Scientist
- Native Plant Nursery staff often have experience or may do restoration planting.
- BC Chapter of Society for Ecological Restoration.

Useful Publications

- **British Columbia Rangeland Seeding Manual.** Dobb, A., S. Burton. 2013. B.C. Min. Agri., Sust. Agri. Mgmt. Br., Abbotsford, B.C. (Available as a free digital download or purchase hard copies from Queens Printer).
- **Shrub-Steppe and Grassland Restoration Manual for the Columbia River Basin.** Benson, J. E., R.T. Tveten, M. G. Asher and P.W. Dunwiddie. 2011. (Available as a free digital download)
- **Propagation of Pacific Northwest Native Plants.** Robin Rose, C. Chaachulski, D. Haase. 1998. Oregon State University Press. (available as hard copy from Oregon State University or other book sellers).
- **Montana Native Plants for Pollinator-Friendly Plantings** (Available as a free digital download)

Information sources for restoration



<https://www.agric.gov.ab.ca/app08/showpublications?type=NP>

Roadside blueweed patch pre-treatment



Park – mechanical treatment 1 and 2 years post construction



Native
plant
community
response





Before treatment and After Treatment

Leafy spurge roadside treatment

