AGRICULTURAL CLIMATE SOLUTIONS

Considerations for Restoration

Transboundary Grasslands Partnership Workshop
Mike Schellenberg PhD PAg CPRM
Living Lab – Central Prairies

SOUTH of the DIVIDE Conservation Action Program Inc.

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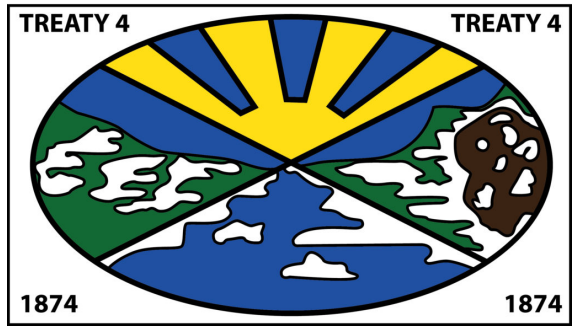
Acknowledgement

On Treaty 4 lands, territory of nehiyawak, Anihsinepek, Dakota, Lakota, and Nakoda, and the homeland of the Metis/Michif Nation.

Supporters (I)

Supporters (II)



Canada

Outline

- What is restoration
- Why consider restoration
- Native or introduced species
- Seeding basics
- Plant species differences
- Summary

Restoration

- The act of restoring something to a satisfactory state
- State of being restored to its former good condition

(Advanced English Dictionary 3.0)

- Note: does not indicate exactly the same but satisfactory or former good condition

Why Consider Restoration?

- Non-productive cropland
- High percentage undesirable vegetation
- Habitat creation
- Improve environmental status
  - Recent Western producer article states 19% increase in C emissions due to conversion of perennial cover to annual crops

Future climate change

- Climate change is occurring
  - Spring is occurring earlier, minimum temperatures are increasing and more cloudy days without precipitation (Cutforth 2000, Cutforth et al. 1999)

- Aridity (annual precip/potential evapo) projected to increase (Sauchyn et al 2002)
  - 1961 to 1990 climate better described as dry subhumid

- Pastoral systems are sensitive to climate change if rainfall affected (Gregory et al 1999)
- Depending on rate of change adapted vegetation may not be able to move North at appropriate pace (Gayton 2003)
- Evidence exists that 80% of species examined already show shift in distribution ranges (Root et al 2003)

From Impacts to Adaptation: Canada in a changing climate

(Sauchyn and Kulshreshtha(2010))

- Increases in water scarcity represent the most serious climate risk
- Recent trends and future projections include lower summer streamflows, falling lake levels, retreating glaciers and increasing soil- and surface-water deficits….

The Effects of Climate Change on U.S. Ecosystems

(8 Jan. 2010 Sask. Forage Newsletter)

- USDA expects climate changes to stress food production including the forage content of pastures and effects on winter and summer livestock production
- Longer growing season but increased temperature and in some areas combined with decreased water availability
- Declining quality which will reduce the land's ability to supply adequate and nutritious livestock feed.

Fire

- Mixed grass prairie in S. Saskatchewan largely resistant and resilient to effects of disturbance by fire (Kroeger 2022) (MSc)
- Dominant boreal species, due to deep, short-interval burning… not regenerating replaced by shrub thickets and grassland (Brackley and Lundy.2023. Can. Geographic 143 (6))

Seeding basics

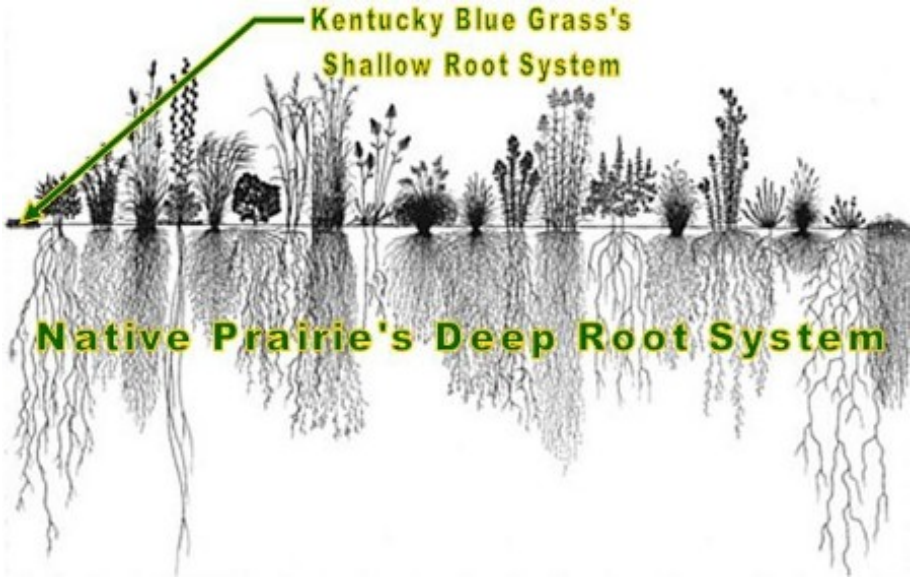
- Clean field or appropriate safe zone for seedling emergence and growth
- Weed free seed source
- Seed source adapted to environmental conditions
- Appropriate seed equipment
- Firm seed bed as most require shallow seeding depth
- Moisture

Seed Source

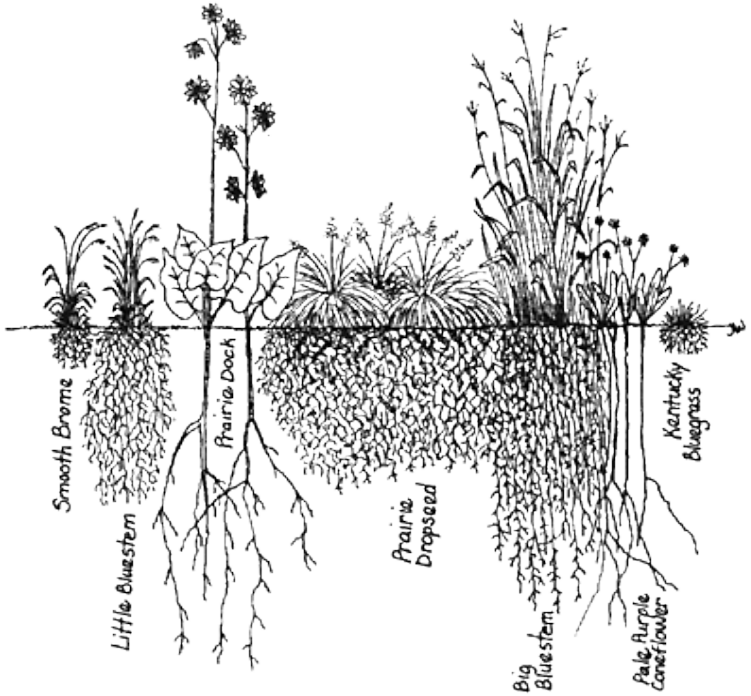
Available germplasm	Source	Adapted to Can Pr Conditons
Local	Wild harvest	yes
Open Range	Montana	yes
Avalanche	Colorado	no
Hatch	New Mexico	limited

Native vs Introduced

Native	Introduced
Seed availability a problem	Often readily available
May have unique seeding requirements	Typically fewer issues for seeding
Adapted to climate extremes	Survival sacrificed for production
Additional nutritional value	Nutritional value season dependent or sacrificed for biomass
Locally adapted	Bred for wide range
Usually seeded as multi-species mix	Seeded as monoculture or binary mix
Forage/habitat	Forage



www.coolstream.org



www.roots-for-wild.org

-Restoration of late successional grassland diversity leads to accelerating carbon storage rates… 70% greater than monocultures (Yang et al 2019)

- C sequestration enhanced through grazing management, sowing favorable species…. (Ghosh Mahanta 2014)

Microbe Diversity

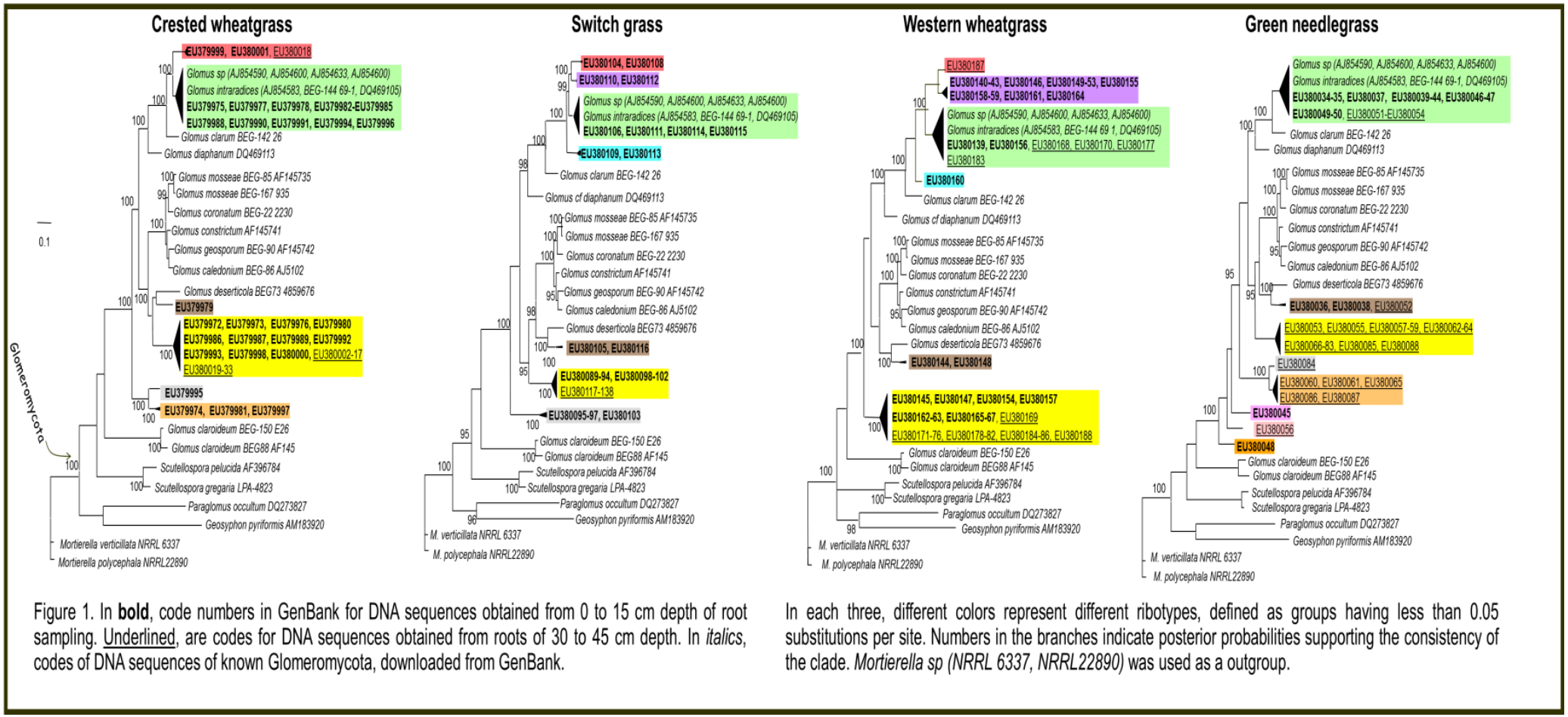


Figure 1. In **bold**, code numbers in GenBank for DNA sequences obtained from 0 to 15 cm depth of root sampling. Underlined, are codes for DNA sequences obtained from roots of 30 to 45 cm depth. In *italics*, codes of DNA sequences of known Glomeromycota, downloaded from GenBank.

In each three, different colors represent different ribotypes, defined as groups having less than 0.05 substitutions per site. Numbers in the branches indicate posterior probabilities supporting the consistency of the clade. *Mortierella sp (NRRL 6337, NRRL22890)* was used as a outgroup.

Seed

Species Differences

Hard Seed Coat

- Most legumes
- Stipas

◆Means of preventing germination until correct conditions

Time of seeding

Species	Spring Seeded	Fall Seeded
WWG	5.4	2.8
SWG	13.8	9.5
AWG*	2.8	7.2
GNG	1.8	18.6
CWR*	0.0	0.3

% 0.25 m

Western wheatgrass vs Needle and thread

- Wide variety of sites best on moist, saline and heavy soils

- Wide range of soils except heavy soils; drought tolerant

Growth Form

- Caespitose grasses (Stipa species) exhibit a greater drought tolerance. but the

Rhizomatous grasses such as western a northern wheatgrass had as stronger compensation of productivity after defoliation under wet conditions.

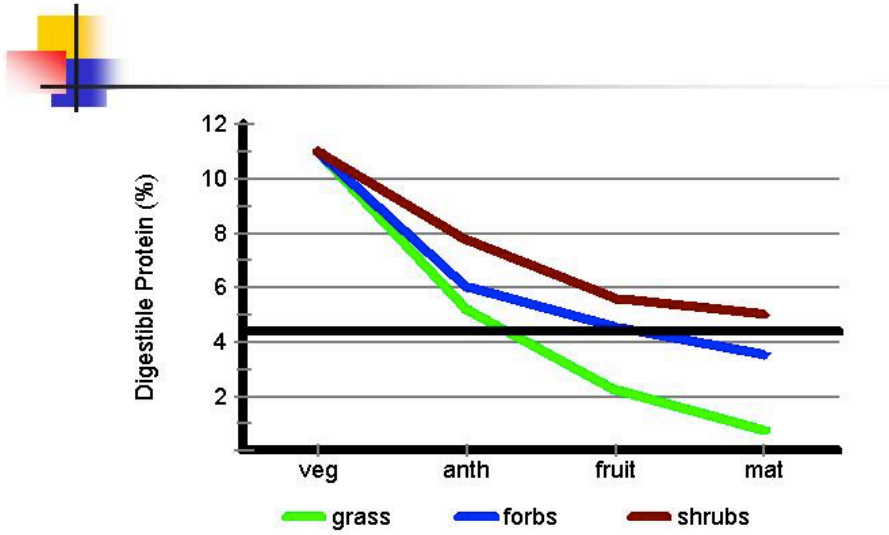
Deep Roots




- Little Bluestem
- Russian wildrye
- Shrubs (winterfat, antelope bitterbrush, saltbush, leadplant)
- Legumes – alfalfa (AC Yellowhead)

Shallow roots

Nutritional Quality



Cook 1972

Legumes

- Fix nitrogen
- Alfalfa has been know to increase forage production by 100% (Leyshon 1978; Kreuger and Vigil 1979) with accompanying increase in livestock production (Hervey 1960; Kreuger and Vigil 1979)
- Good source of protein
- Most available native legumes: Purple and white prairie clovers, American vetch

	Texture					pH		
Species	Crse	Mod Crse	Med.	Mod. Fine	Fine	Acidic	Neutral	Basic
Cicer	1	2	3	2	1	1	3	2
Trefoil	0	2	3	3	2	2	3	1
Alfalfa (fal.)	1	2	3	2	1	1	3	1
Alfalfa	1	2	3	2	0	1	3	2
White Sweet clvr	1	2	3	3	1	1	3	2
Am. vetch	1	2	3	3	2	1	3	2
					Granite Seed Company Catalog (2009)			

Summary

- Need to know what your end goal is
- Follow proper seeding protocol
- Know your species

Questions (Photo by Ruiyang Zhang 2017)