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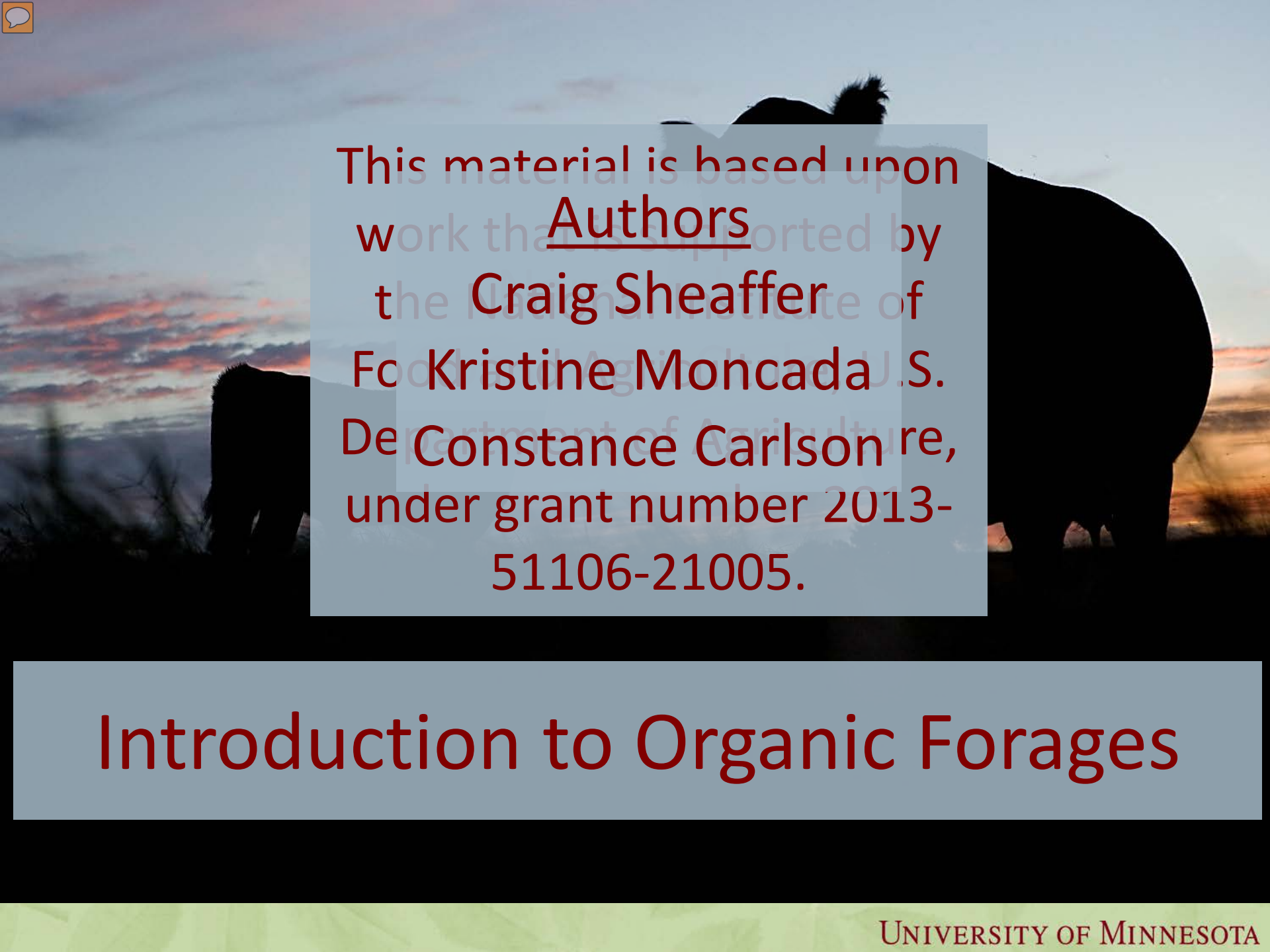

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Introduction to Organic Forages

Forages

- Grasses and legumes used for livestock feed
- Harvested by grazing livestock, or mechanically as hay or silage

Introduction to Forages

I. Organic Forage Systems
II. Forage Grasses
III. Forage Legumes
IV. Grass-Legume Mixtures

Forages in Organic Systems

- Nutrients and fiber for livestock diets
- Cover the soil and reduce soil erosion
- Weed suppression
- Promote soil health by adding carbon
- Legume forages require no N fertilization
- Add N to the soil

Introduction to Forages

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Forage Grasses

A. Grass morphology

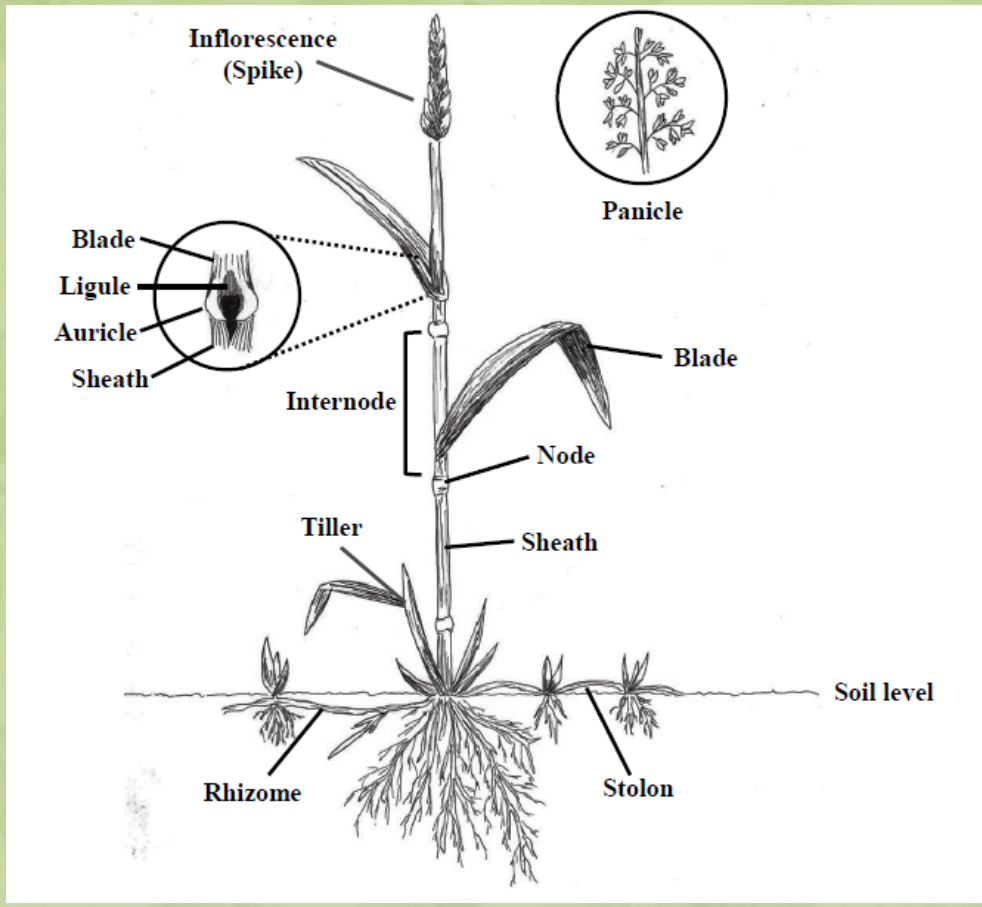
B. Cool and warm season grasses

C. Annual and perennial grasses

D. Perennial grass profiles

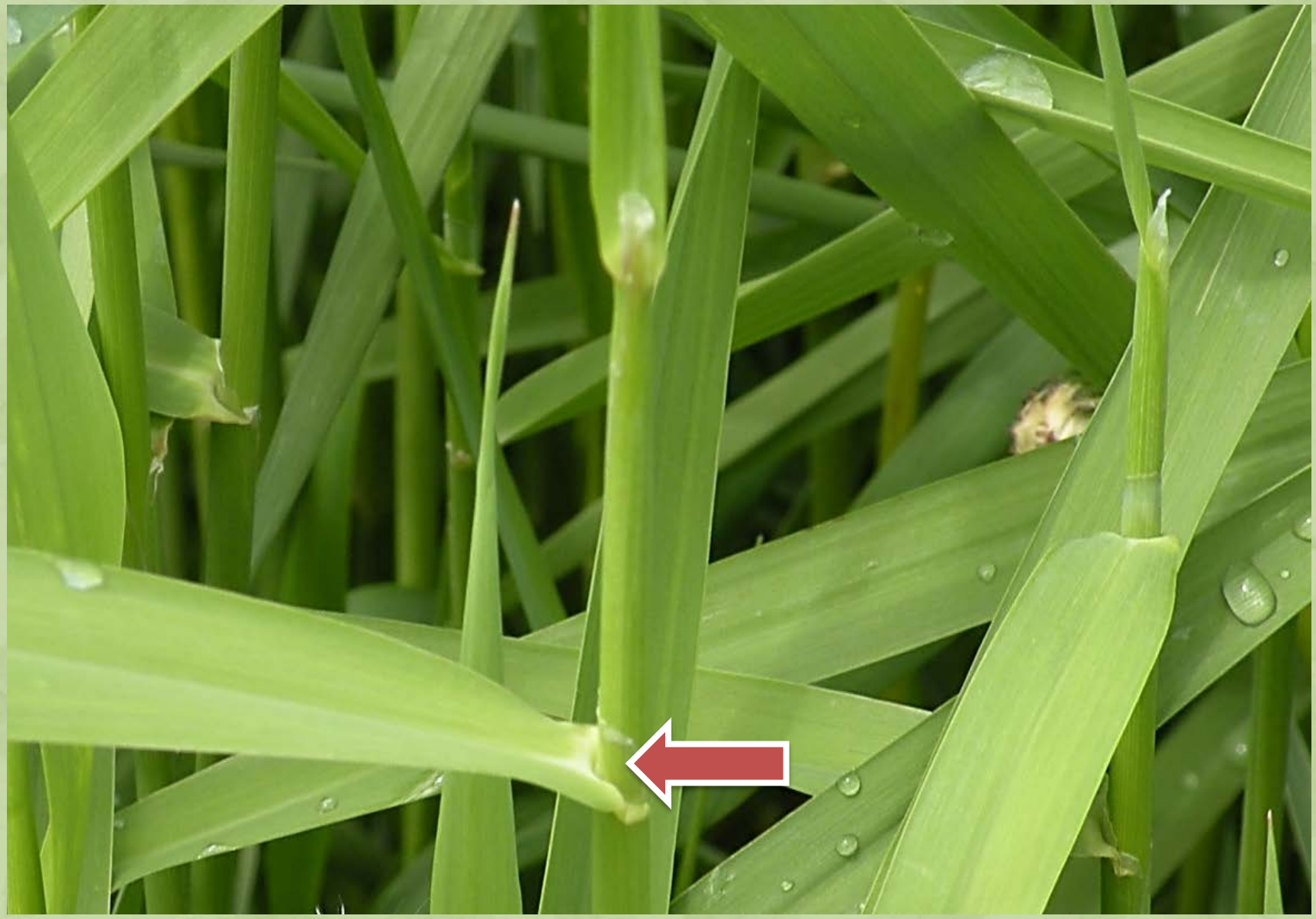
Grass Morphology

- Upright stems during flowering
- Leaves attached to stems
- Non-showy flowers
- Fibrous root system
- Some spread by underground stems



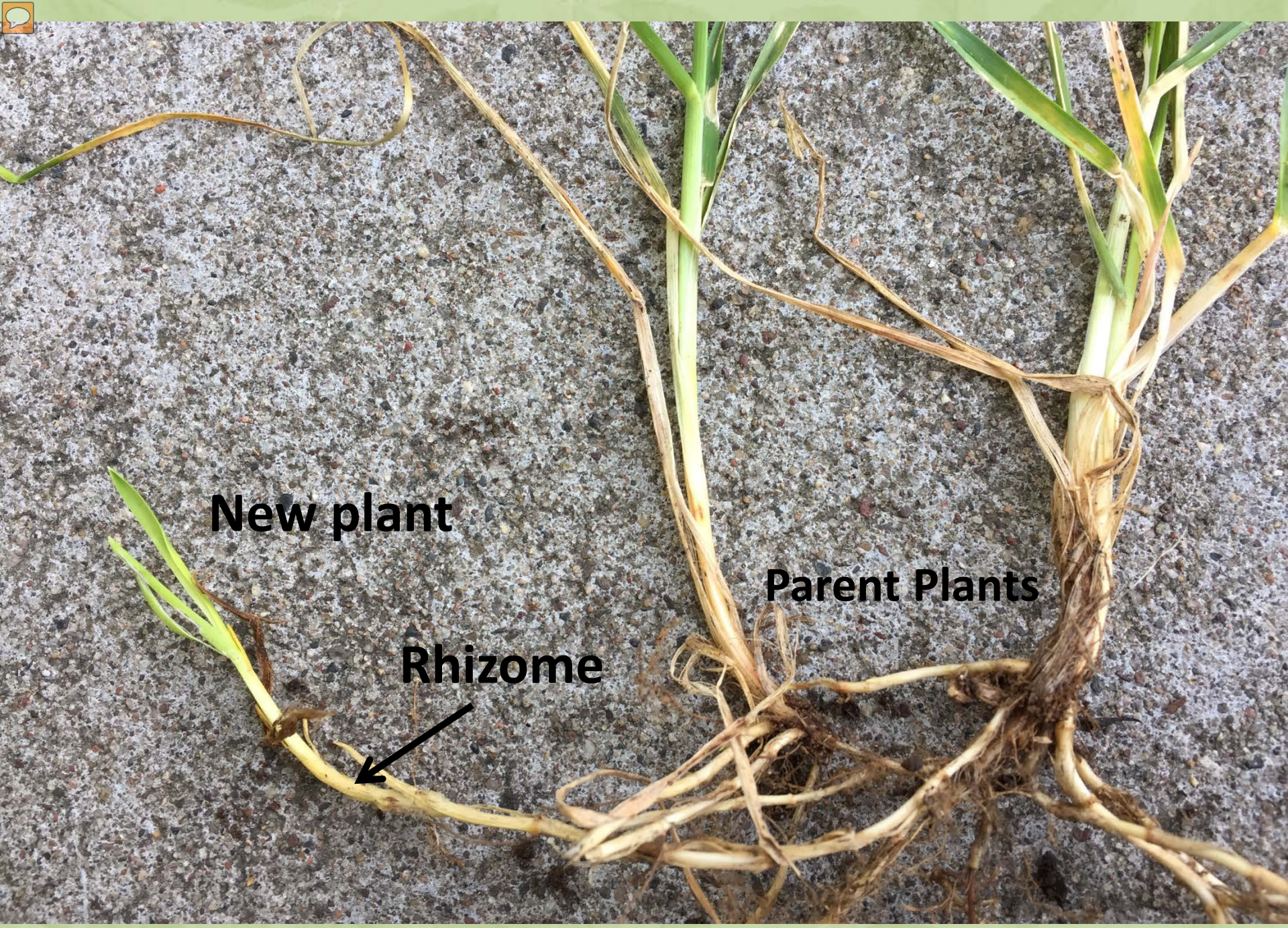

Reed Canarygrass


Timothy



Grass Root Systems

- Fibrous root system
- Root system stabilizes soil and adds carbon.


New plant
Parent Plants
Rhizome

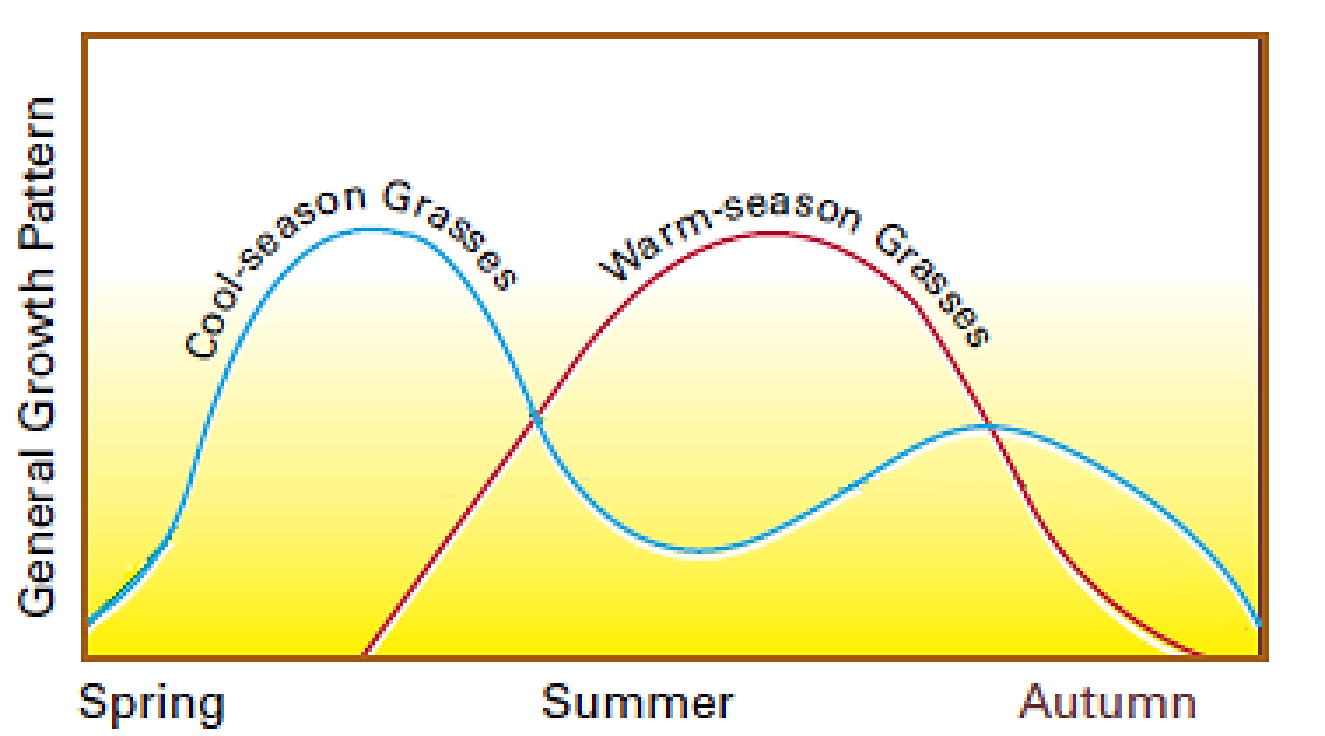
Orchardgrass and Kentucky Bluegrass

Forage Grasses

A. Grass morphology
B. Cool and warm season grasses
C. Annual and perennial grasses
D. Perennial grass profiles

Cool and Warm Season Grasses

- Cool season grasses: best growth in spring and fall
- Warm season grasses: best growth in summer



Cool Season Grass Pasture in Spring and Summer

Forage Grasses

A. Grass morphology
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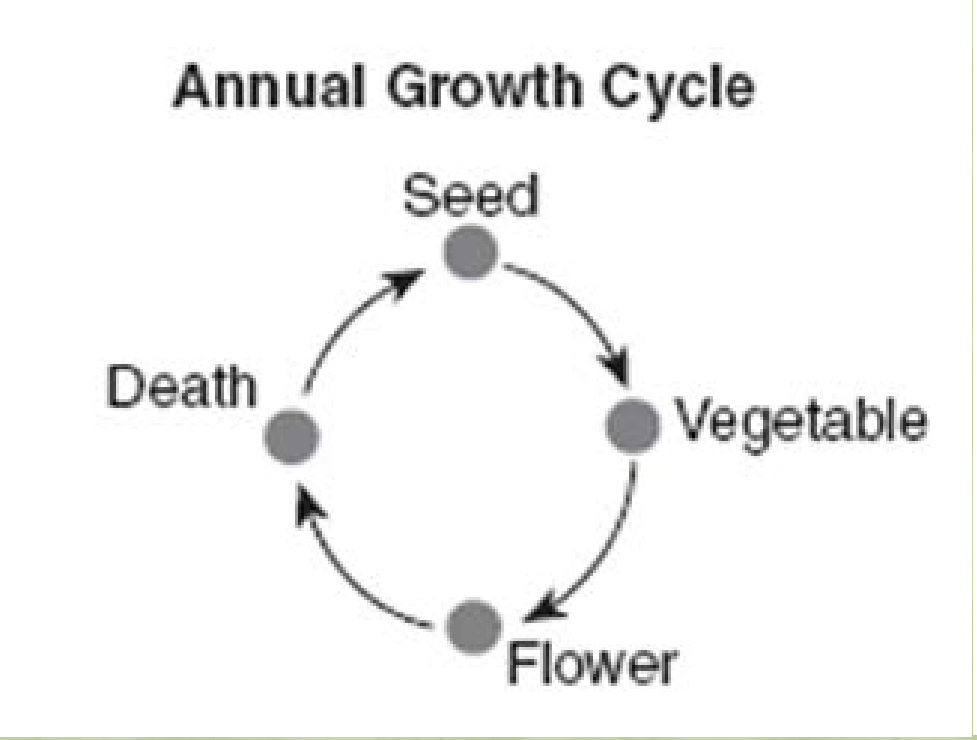
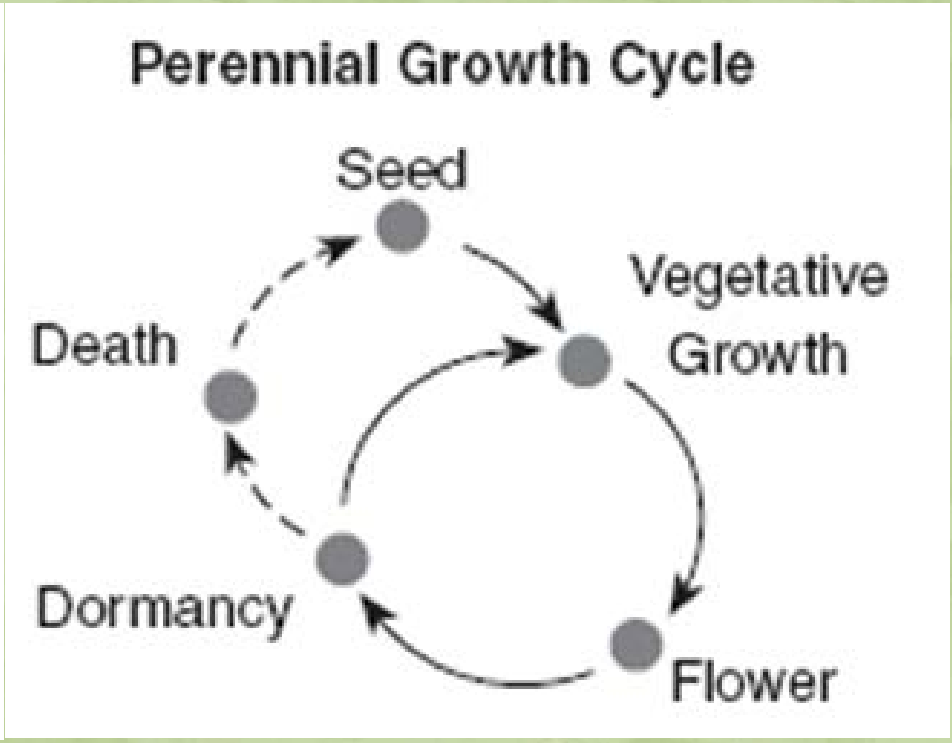
Annual vs. Perennial Grasses





Annual Grasses

- Cool season
  - Small grains: spring seeded wheat,oats, barley
  - Annual and Italian ryegrass
- Warm season
  - Sudangrass
  - Teff
  - Millets
  - Corn

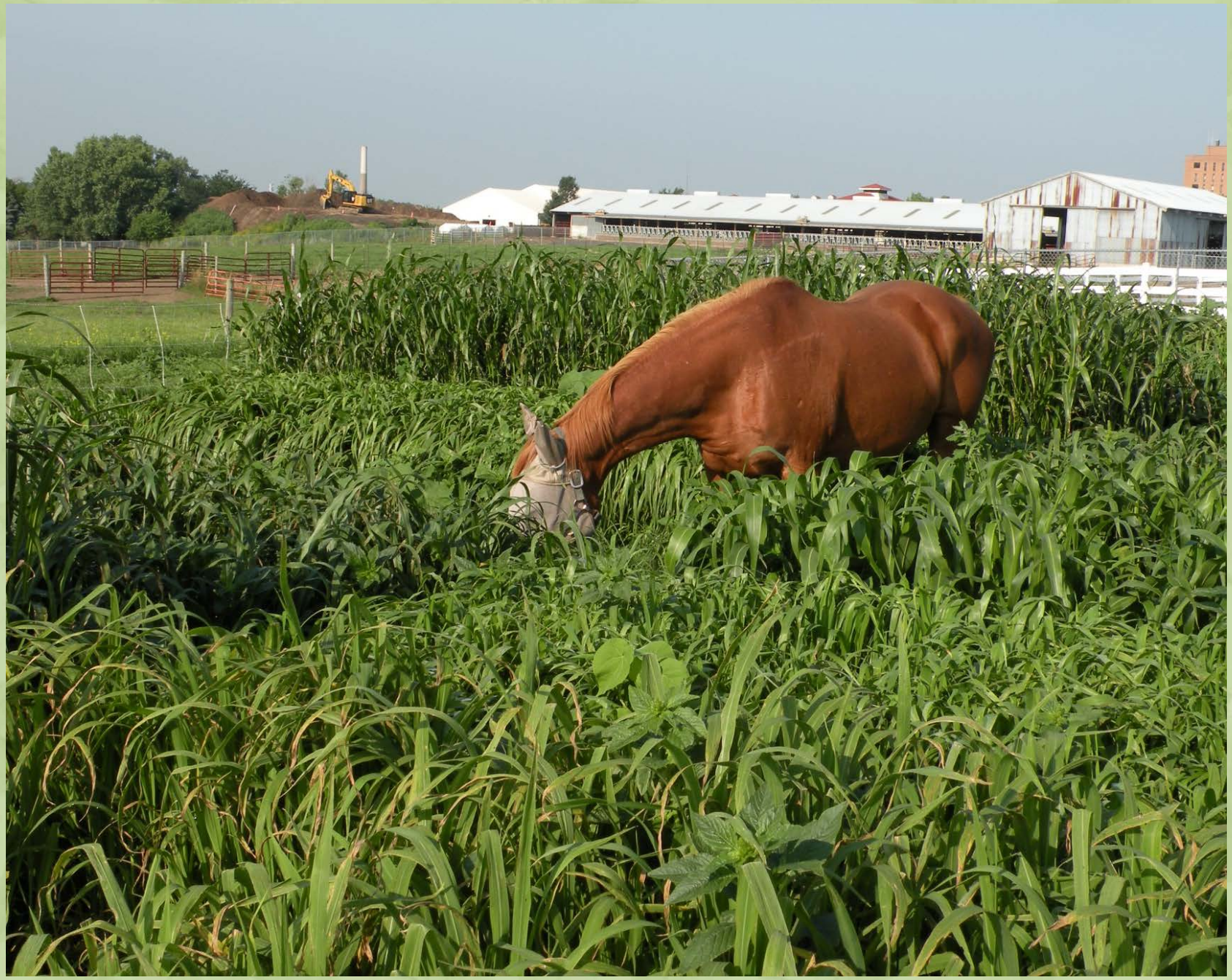

Spring Oats
Annual Ryegrass

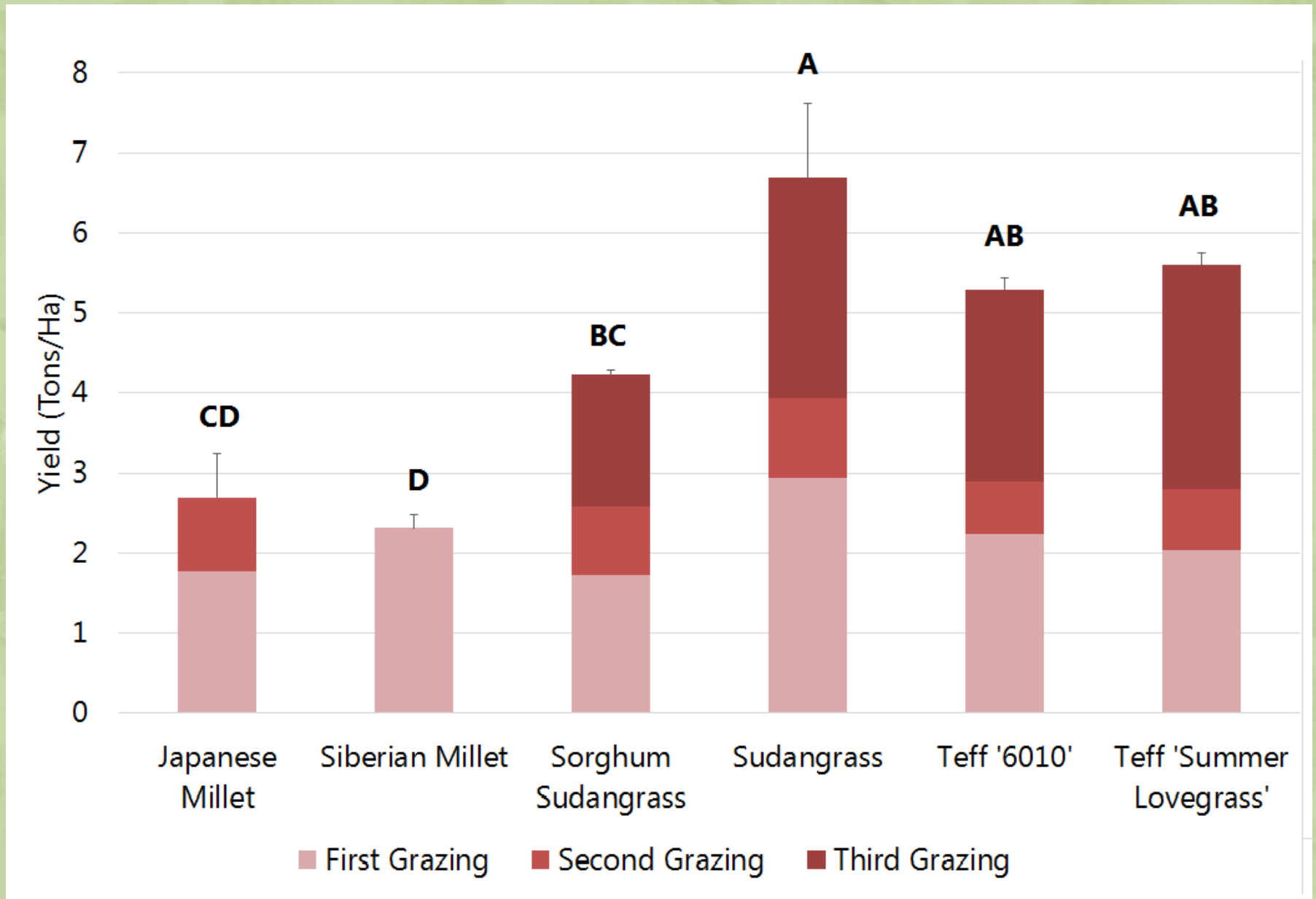
Yields of Cool Season Annual Forages Planted in Spring and Fall

Species	Spring	Fall
	Yield (Tons/Acre)	
Annual Ryegrass	1.9	1.9
Spring Oat	1.7	1.6
Spring Barley	1.4	1.4
Spring Wheat	1.4	1.4
Winter Wheat	1.4	1.5
Winter Barley		2.2
Spring Oat		1.9
Winter Rye		1.5

Amanda Grev, University of Minnesota


Sudangrass
Teff





Michelle L. DeBoer, University of Minnesota

Forage Grasses

A. Grass morphology
B. Cool and warm season grasses
C. Annual and perennial grasses
D. Perennial grass profiles

Perennial Grass Profiles

Most traditional

- Kentucky bluegrass
- Smooth bromegrass
- Timothy
- Orchardgrass
- Tall fescue
- Reed canarygrass

Grasses (*Poaceae* Family)

Newest

- Meadow Fescue
- Festulolium
- Perennial Ryegrass
- Meadow Bromegrass

Grass Adaptation to Climate Stress

Grass	Drought Tolerance	Flooding Tolerance	Winter hardiness
Festulolium	P	P	P
Kentucky bluegrass	F	G	VG
Meadow bromegrass	P	P	G
Meadow fescue	VG	G	F
Orchardgrass	F	F	F
Perennial ryegrass	P	P	P
Reed canarygrass	VG	VG	VG
Smooth bromegrass	VG	P	VG
Tall fescue	VG	F	F
Timothy	P	F	G

Grass Grazing Tolerance and Hay Yields

Grass	Grazing Tolerance	Hay Yields (ton/acre)
Festulolium	G	5.3 (3.5-6.1)
Kentucky bluegrass	VG	--
Meadow bromegrass	F	4.5 (3.0-5.0)
Meadow fescue	VG	5.0 (3.8-5.7)
Orchardgrass	VG	6.4 (4.6-8.0)
Perennial ryegrass	G	4.7 (3.8-7.4)
Reed canarygrass	G	6.6 (6.3-6.9)
Smooth bromegrass	F	5.9 (4.4-7.7)
Tall fescue	VG	6.6 (5.5-7.9)
Timothy	F	5.3 (3.8-6.7)

Yield data source: University of Wisconsin and University of Minnesota

Reed Canarygrass

Yield Potential

Perennial Grass Profiles

- Kentucky bluegrass
- Orchardgrass
- Perennial ryegrass

Kentucky Bluegrass

- Forms sod; rhizomes; shallow root system
- 8-12 in tall
- Spring flowering; regrowth vegetative
- Use: grazing
- Found in old pastures
- Common lawn grass

Orchardgrass

- Bunch grass; forms clumps
- 3-4 feet tall
- Spring flowering; regrowth leafy
- Use: grazing or hays
- Winter hardiness issue


Orchardgrass

Orchardgrass Winter Injury

Perennial Ryegrass

- Bunch grass
- 2-3 feet tall
- Spring flowering; regrowth leafy
- Use: hay or grazing
- High quality forage
- Winter hardiness issue


Perennial ryegrass

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Forage Legumes

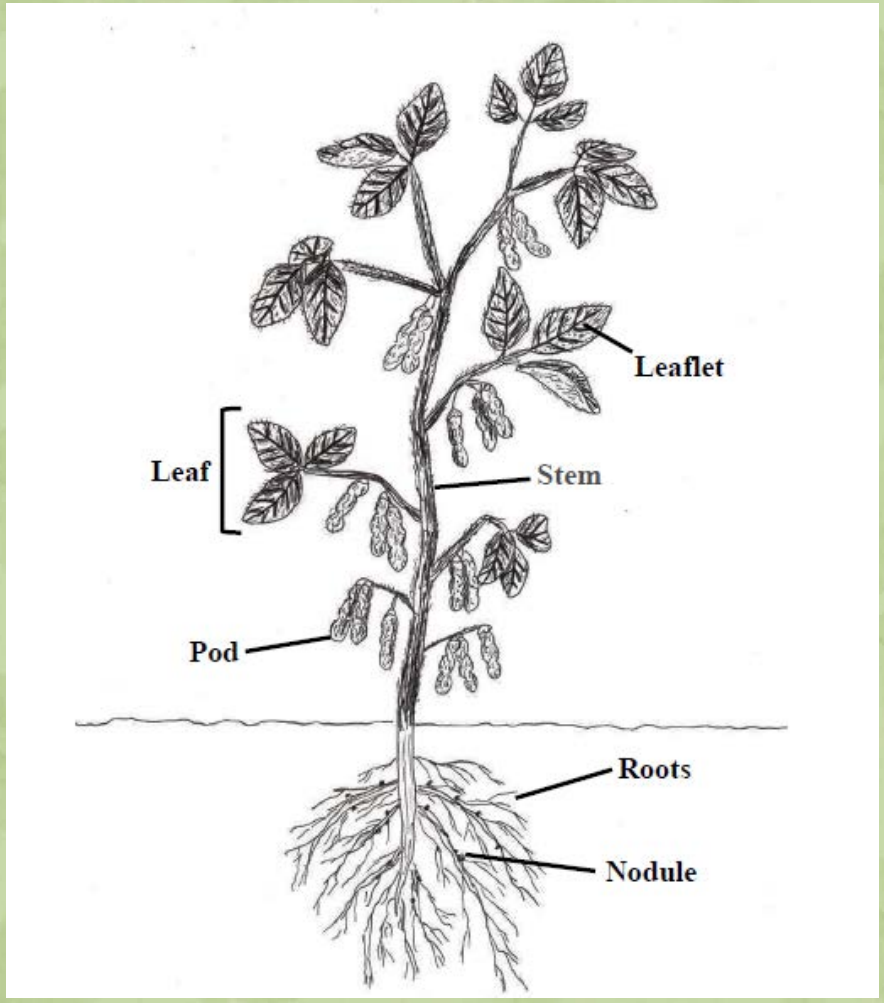
A. Legume morphology

B. Annual and perennial legumes

C. Legume profiles

Legumes

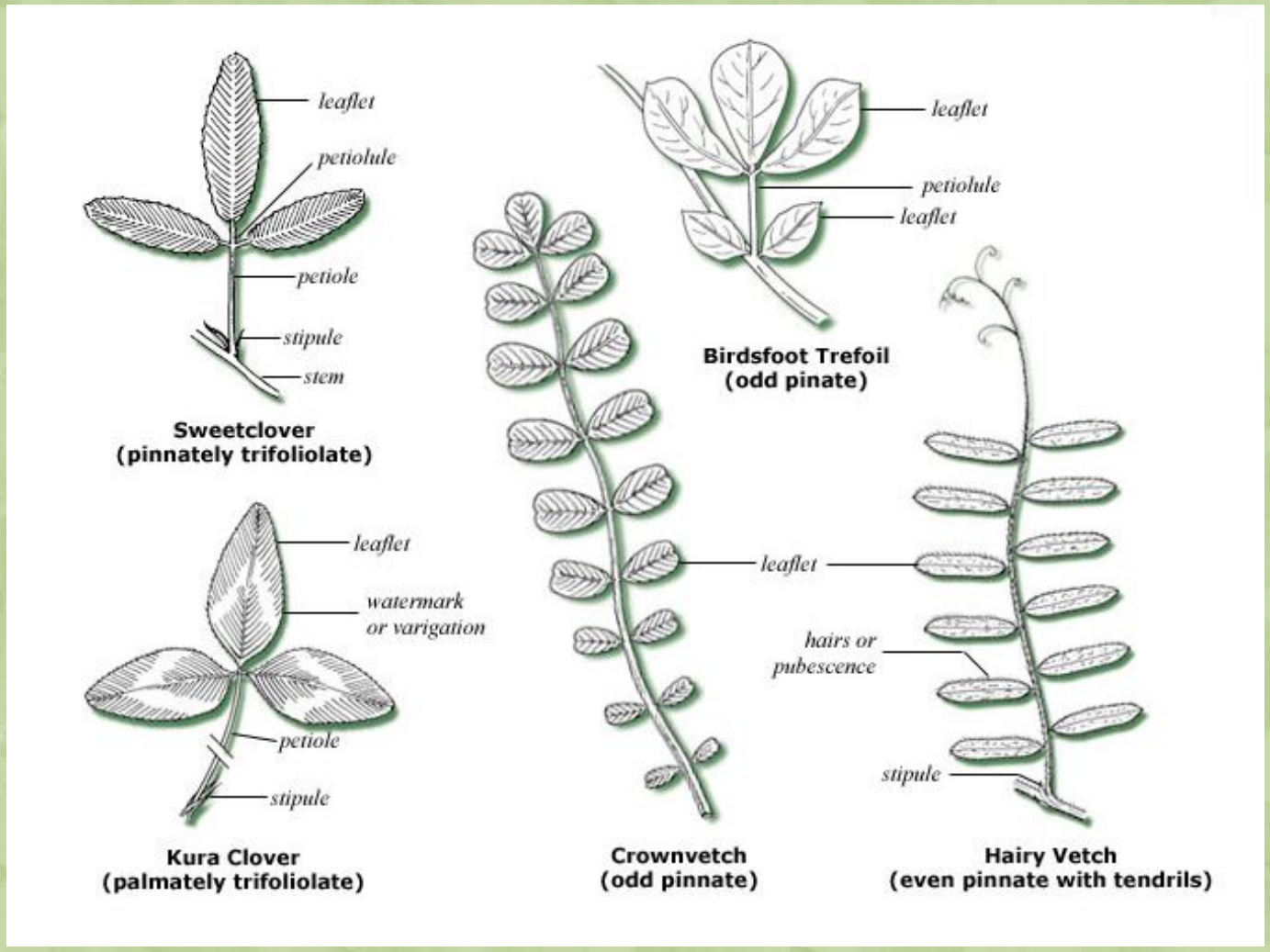
- Seeds borne in pods
- Showy flowers
- Compound leaves
- Tap root
- Biological N fixation
- Seed and foliage rich in protein



Showy Flowers and Seed in Pods

Flowers of Other Legumes

Compound Leaf Arrangements



Legume Plants

- Tap root system
- Branching crown

Nitrogen Fixation

- Legumes conduct biological nitrogen fixation
- Nodules are sites of biological nitrogen fixation

Stolons and Rhizomes

Forage Legumes

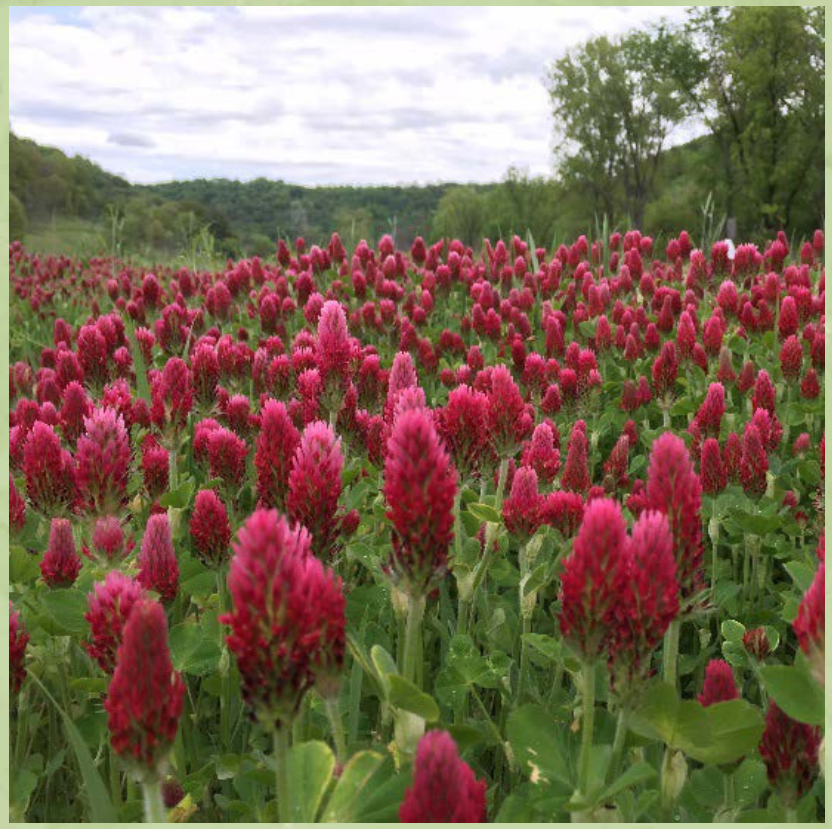
A. Legume morphology

B. Annual and perennial legumes

C. Legume profiles

Annual Legumes

Crimson clover



Berseem clover

Sweet Clover – A Biennial Legume

Perennial Legumes

Forage Legumes

A. Legume morphology
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Perennial Legume Profiles

- Alfalfa
- Alsike clover
- Birdsfoot trefoil
- Cicer milkvetch
- Crownvetch
- Kura clover
- Red clover
- White clover

Characteristics of Legumes for the Upper Midwest

Table 12-1. Characteristics of various legumes for the Upper Midwest

	TOLERANCE TO:						
LEGUME	Heat/ drought	Wet	Winter injury	Cutting/ grazing	Soil acidity	Low fertility	Seedling vigor
Alfalfa	E	P	G	F	P	P	G
Alsike clover	P	E	P	P	G	F	G
Birdsfoot trefoil	F	E	F	G	G	F	P
Cicer milkvetch	G	F	E	F	F	F	P
Crownvetch	G	P	F	P	G	F	P
Kura clover	F	G	E	E	F	G	P
Red clover	F	F	F	F	G	G	E
Sweetclover	E	P	E	P	P	F	G
White clover	P	G	F	E	G	G	G
Berseem clover	P	E	P	G	P	G	E

E = excellent, G = good, F = fair, P = poor

Legume Grazing Tolerance and Hay Yields

Legume	Grazing Tolerance	Hay Yields (ton/acre)
Alfalfa	G	12.7
Alsike clover	P	--
Birdsfoot trefoil	F	4.5 (3.0-5.0)
Cicer milkvetch	VG	5.0 (3.8-5.7)
Crownvetch	G	6.4 (4.6-8.0)
Kura clover	VG	4.7 (3.8-7.4)
Red clover	F	8.3
White clover	VG	2.5

Source: University of Minnesota

Yearly Forage Yields after Three Harvests per Year

	Forage Yield (tons/acre)		
Legume	**1987**	**1988**	**1989**
Alfalfa	6.1	4.8	2.6
White clover	2.2	0.3	--
Alsike clover	3.1	--	--
Red clover	5.8	2.4	1.1
Crownvetch	3.3	2.0	0.9
Cicer milkvetch	3.9	2.4	1.5
Birdsfoot trefoil	5.3	3.1	1.5

Perennial Legume Profiles

- Alfalfa
- Red clover
- White clover
- Kura clover

Alfalfa

- Crown former
- 2-3 feet tall
- Multiple flowering cycles
- Stands last 3-4 years
- Hay or grazing

Alfalfa Hay


Not winter hardy
Winter hardy

Red Clover

- Crown former
- 2-3 feet tall
- 2-3 flowering cycles
- Stands last, 2-3 years
- Hay or grazing

Winter Injury – Red Clover

White Clover

- Spreader (stolons)
- 6-8 inch tall
- Stands last 1-2 years; persists through reseeding
- Tolerant to grazing

Kura Clover

- Spreader (rhizomes)
- 8-12 inches tall
- Stands last 10+ years
- Tolerant to grazing
- Very poor seedling vigor

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Grass-legume Mixtures

Grass-legume Mixtures: Advantages vs Pure Stands

- Greater soil, water, and solar resource use
- Resistance to weed invasion
- Tolerance to stand loss and winter injury
- Legumes can supply N to grasses
- Potential for legume bloat reduced
- Legume hay can dry faster

Mixture Guidelines

- Select species adapted to your soils, climate, and management
- Keep the mixtures simple; limit to complementary species
- Start with the best adapted legume and grass, THEN add complementary legumes, grasses or forbs

Example Mixtures for Haymaking

- 3-4 cuts per growing season: Alfalfa (10 lb) with orchardgrass (4 lb), tall fescue (6 lb), perennial ryegrass (6 lb) or meadow fescue (6 lb)
- 2-3 cuts per growing season: Alfalfa (10) or red clover (8 lb) with orchardgrass (4 lb) or smooth bromegrass (8 lb)

Amending the Mixtures

- To diversify the legume component add:
  - About 2 lb of red clover or alsike clover to alfalfa-grass mixtures
  - About 2 lb of alsike or white clover to red clover-grass mixtures
- To diversify the grass component:
  - Include about 2 lb of orchardgrass, tall fescue, or perennial ryegrass to alfalfa-grass mixtures.
  - Include 2 lb each of timothy, orchardgrass, or perennial ryegrass to red clover-grass mixtures.

Example Mixture for Pasture

- Legume
  - White clover (3 lb)
  - Birdsfoot trefoil (3 lb) or alfalfa (8 lb)
- Grass
  - Orchardgrass (4 lb)
  - Meadow fescue (5 lb)
  - Kentucky bluegrass (3 lb)

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