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Research and Extension

Annual Forages

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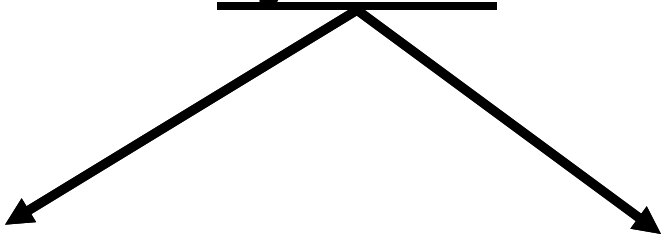
Knowledge for Life

Outline

- Systems
- Precautions
- Species Selection
- Concepts
- Integrating Forages into Various Crop Rotations
- Resources Available

Systems

Systems



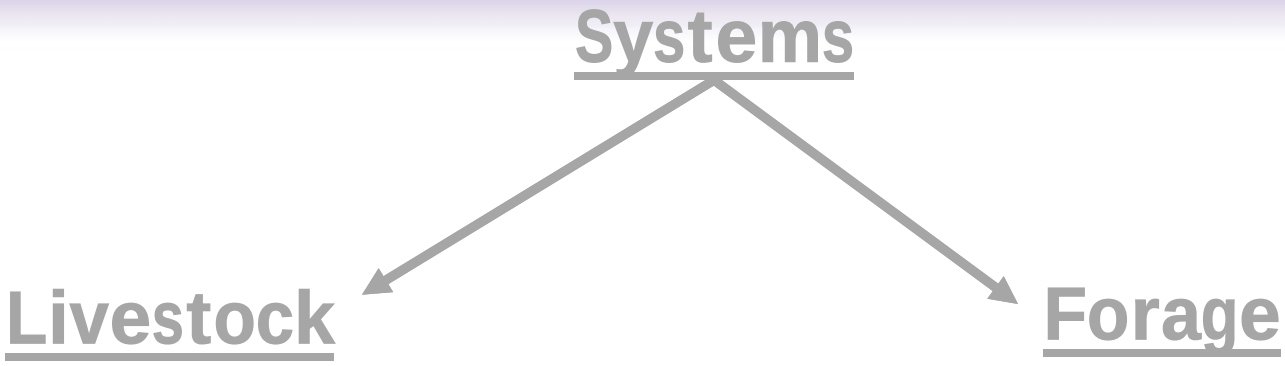
Livestock

- Cow/Calf
- Stocker/Yearling

Forage

- Native Range
- Annual Forage
  - Baled
  - *Graze*
  - Swath/Graze
  - Bale/Graze

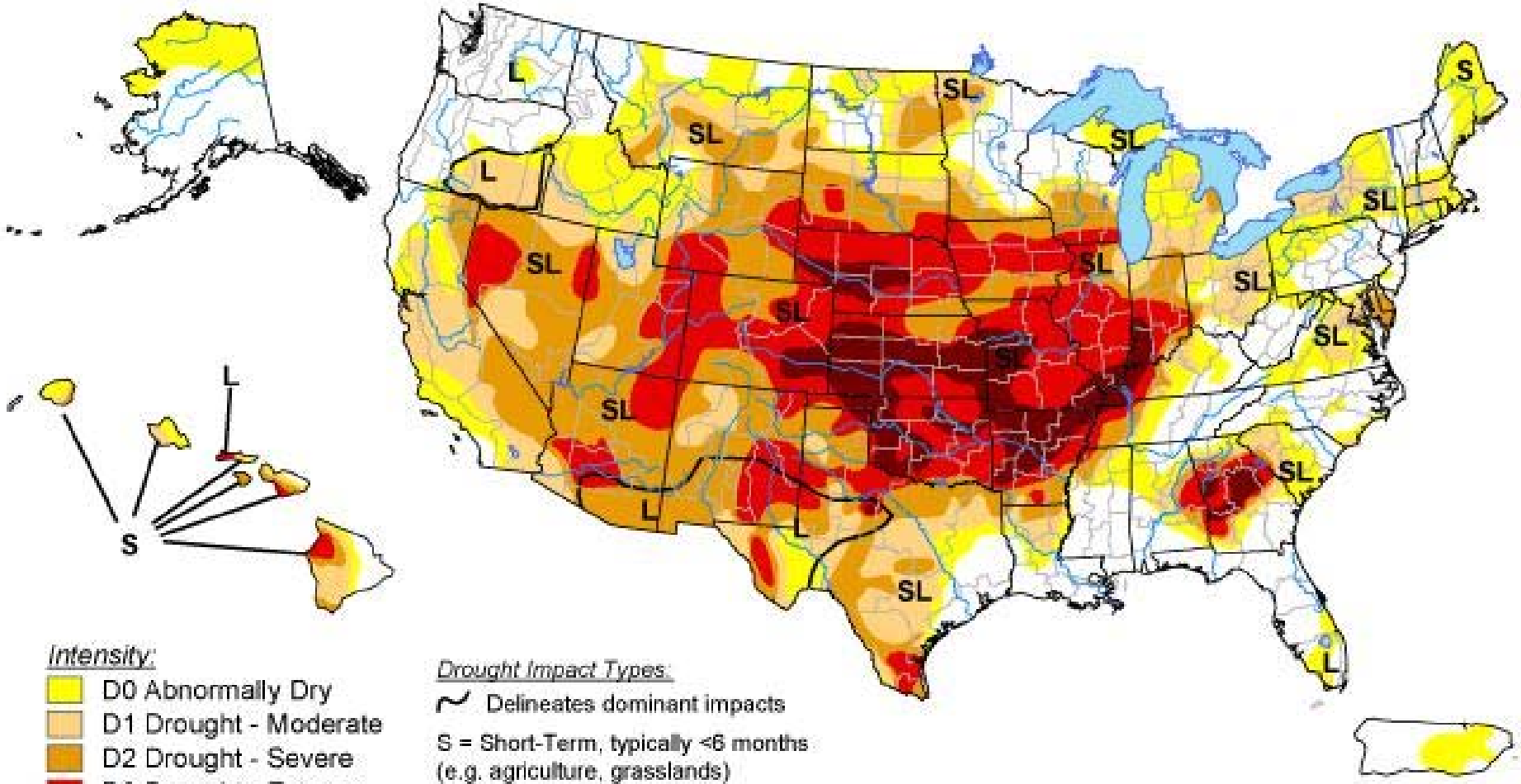
Systems



- **Every producer's operation is a bit unique:**
  - **Resources (land, labor, skills, capital, fence and water infrastructure, etc.)**
    - **Baled**
    - *Graze*
    - **Swath/Graze**

U.S. Drought Monitor

August 14, 2012
Valid 7 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
~ Delineates dominant impacts

S = Short-Term, typically <6 months (e.g. agriculture, grasslands)

L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, August 16, 2012

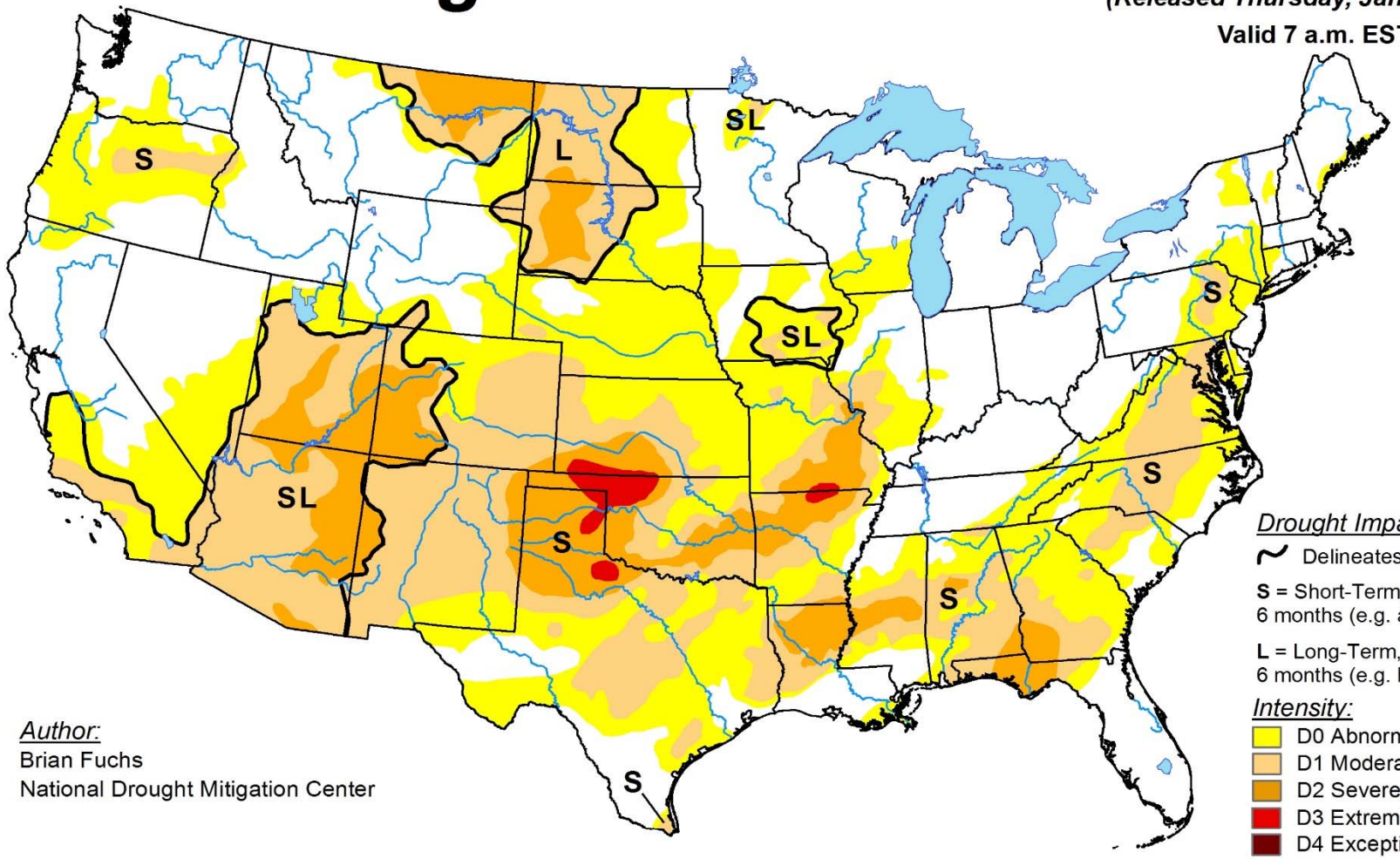
Author: Michael Brewer/Liz Love-Brotak, NOAA/NESDIS/NCDC

U.S. Drought Monitor

January 16, 2018

(Released Thursday, Jan. 18, 2018)

Valid 7 a.m. EST



Author:
Brian Fuchs
National Drought Mitigation Center

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

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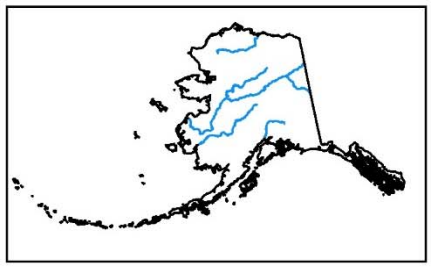
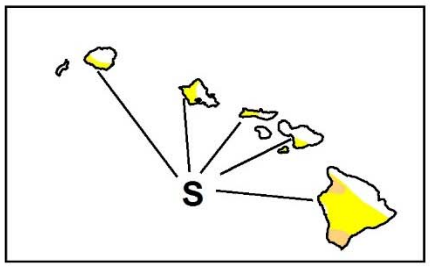
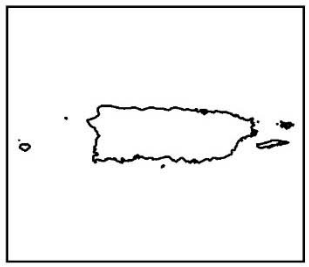




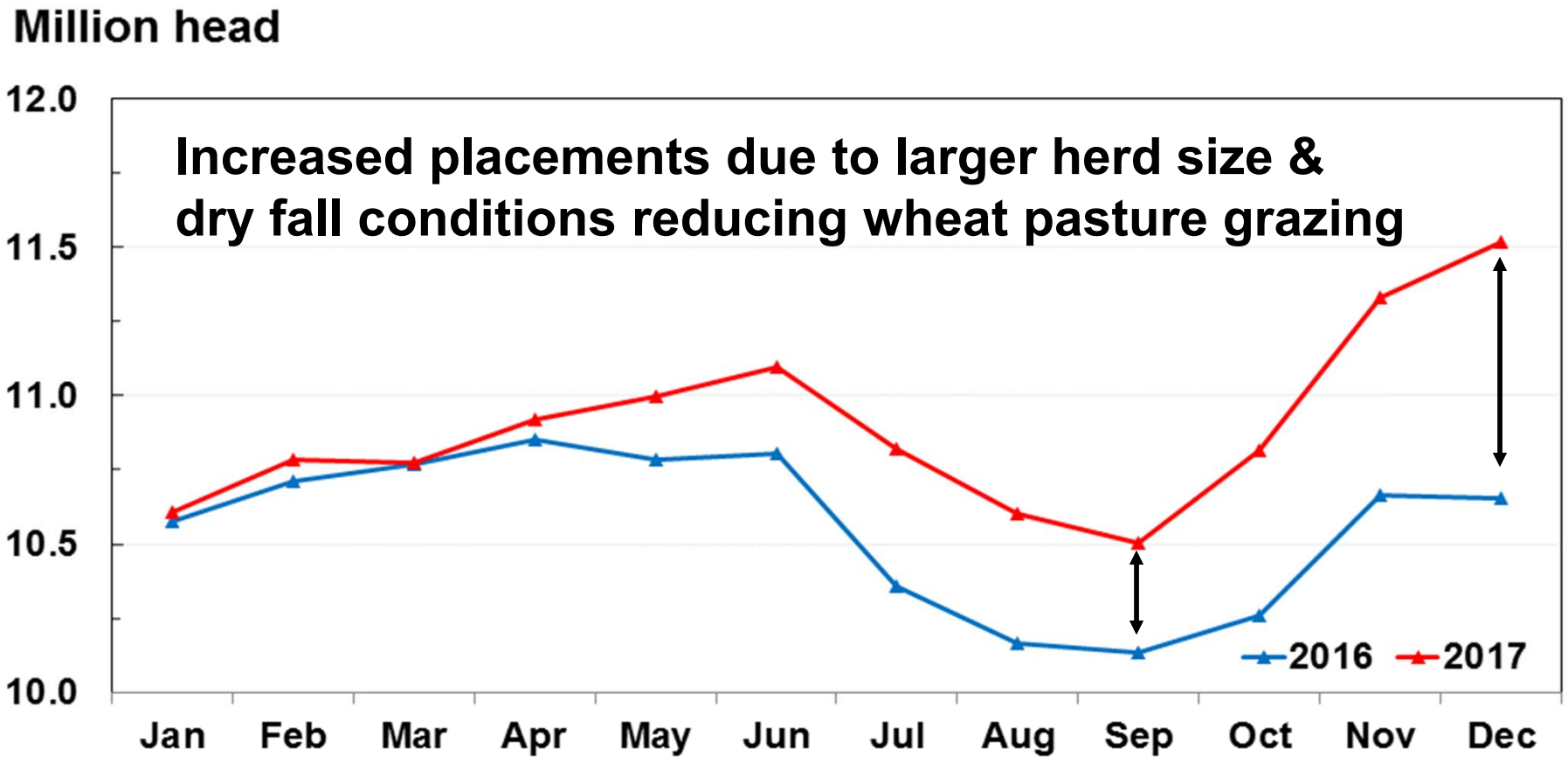


USDA NDMC

http://droughtmonitor.unl.edu/

- **Wheat stocking density: effected rate of gain: 1.5 to 3 lbs/day**

United States Cattle on Feed
1,000 + Capacity Feedlots



USDA-NASS
12-22-2017

Annual Forage Systems

Bale/Silage Forage

Advantages

- Controlled Feeding
- Ration Formulation
- Controlled Traffic
- Storage
- Drought Insurance

Disadvantages

- Machinery Costs
- Feed Delivery Costs
- Nitrates in Bale
- Nutrient Removal

Annual Forage Systems

Grazed Forage

Advantages

- Less Machinery and Feeding Costs
- Less Nutrient Removal
- Extend Grazing Season
- Manage High Nitrate Forage
- Drought Rescue Crop

Disadvantages

- Unpredictable Weather
- Unpredictable Yield
- Uneven Nutrient (Manure) Deposition and Volatization
- Selective Grazing
- Trampling/Cover Loss
  - 60% for Mature Forage
  - 40% for Grain Residue and Immature Forage
- Move Electric Fence every 1-3 days
  - Increase utilization
  - Reduce selective grazing

Annual Forage Systems

Swath-Grazed Forage

Advantages

- Same as grazing but includes cost of swathing
- Easier to move electric fence
- Lock in Forage Quality
- Forage regrowth

Disadvantages

- Same issues as grazing
- Mold/Rot/Rejection
- Best suited for cold, dry climate

Annual Forage Systems

Bale-Graze

Advantages

- Reduce feeding expense
- Easiest to move electric fence
- Control amount of forage fed fed/preserved
- Strategically place bales for residue/manure placement
- Can improve soil quality over time

Disadvantages

- Equipment expense
- A lot of forage not consumed/“wasted”
- Too much concentrated residue

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Summer Annual Forages

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Sorghum Types:

- **Grain Sorghum:**
  - **Selected for grain production**
  - **Developed to be shorter to resist lodging**
  - **Stalks underutilized for grazing**
  - **Failed crop can be good rescue feed crop**

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Sorghum Types:

- **Forage Sorghum:**
  - **Older ‘work horses’ were open pollinated: ‘Rox Orange’ or ‘Sumac’ vs newer Hybrid: ‘Sweet King’ or ‘Canex’**
  - **Older varieties drought tolerant and lower seed cost, but less disease/insect resistance, more variable, and slower emergence than hybrids**
  - **Plant when soil temp is 60°F or warmer, seed up to 2” deep**
  - **Taller, more leaf area, and mature later than grain sorghum**
  - **High biomass: best in a one-cut system for silage or hay**
  - **Grain production for silage & crop insurance**
  - **Less regrowth, coarser stems, but better palatability (sweeter stems) than sudan or sorg/sudan**
  - **Prussic acid risk higher than sorg/sudan or sudan**

Sorghum Types:

- **Sudangrass:**
  - **Less common in the marketplace**
  - **Good regrowth, fine stemmed, looks like a “grass”**
  - **Good quality for grazing- cut early**
  - **Lower quality and palatability silage**
  - **Low grain yield**
  - **Less prussic acid risk than sorghum**

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Sorghum Types:

- **Sorghum/Sudan (Two-way cross):**
  - **Typically has 'Grazer' in the name**
  - **Forage sorghum (female) x sudangrass (male parent)**
  - **Good all around purpose for hay or graze**
  - **Better vigor, iron chlorosis tolerance, regrowth, tillering, and drought tolerance than forage sorghum**
  - **Grazing may be initiated when the plants are 18-24" tall**
  - **Less sweet and palatable than forage sorghum**
  - **Palatability reportedly drops more than forage sorghum at heading**

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Millet Types:

- **Pearl Millet:**
  - **Smaller seed size (75,000-90,000 seed/lb)**
  - **Seeding depth shallower (0.5-1.5”)**
  - **Plant when soil temp is 65°F or warmer**
  - **Very leafy, good regrowth, can be grazed**
  - **Regrowth less than sorghum/sudan, leave 8” stalk**
  - **Yield less than sorghum but high quality (50% or more leaf)**
  - **Some PS varieties**
  - **Good tolerance to high pH soils**
  - **Good drought tolerance**
  - **Can be fed to horses**
  - **May not be a host to sugar-cane aphid (SCA)**
  - **Does not have prussic acid, higher potential for nitrate**

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Millet Types:

- **German (Foxtail) Millet:**
  - **Fine stemmed, very leafy, good palatability for hay**
  - **Not suitable for grazing-roots are easily dislodged**
  - **Short season crop (rescue crop)-60 days**
  - **Yield potential less than Pearl Millet**
  - **Seed heads unpalatable-cut early**
  - **Does not have prussic acid, higher potential for nitrate**
  - **May not be a host to SCA**
  - **Can be fed as fine textured hay to weaning calves**

Crabgrass:

- **Crabgrass:**
  - **Annual but managed as a perennial if allowed to make seed**
  - **Can be a weed in subsequent crops**
  - **Seed does not meter well-fertilizer carrier**
  - **Can be incorporated by hoof action into grazed wheat or seeded 0.5” deep**
  - **Plant 5-6 lbs/acre**
  - **Germinates at soil temps of 60°F**
  - **1st year stands can be variable**
  - **Can interseed with other annuals-improve first year yield**
  - **Good forage quality and regrowth**
  - **Can be grazed after ~4 wks**

Teff:

- **Teff:**
  - **Small seeded annual, seed 0.25” deep, soil temp 65°F**
  - **Seed 8-10 lbs/acre**
  - **Multiple cuttings with irrigation**
  - **Leafy, high quality forage**
  - **Good for horses or weaning calves**
  - **Cut prior to heading for best regrowth**
  - **First cutting after ~45 days, and every 30 days thereafter**
  - **Use caution when grazing for dislodging roots**
  - **Can accumulate nitrates but less risk than sorghums or millet**
  - **May not be a host to SCA**

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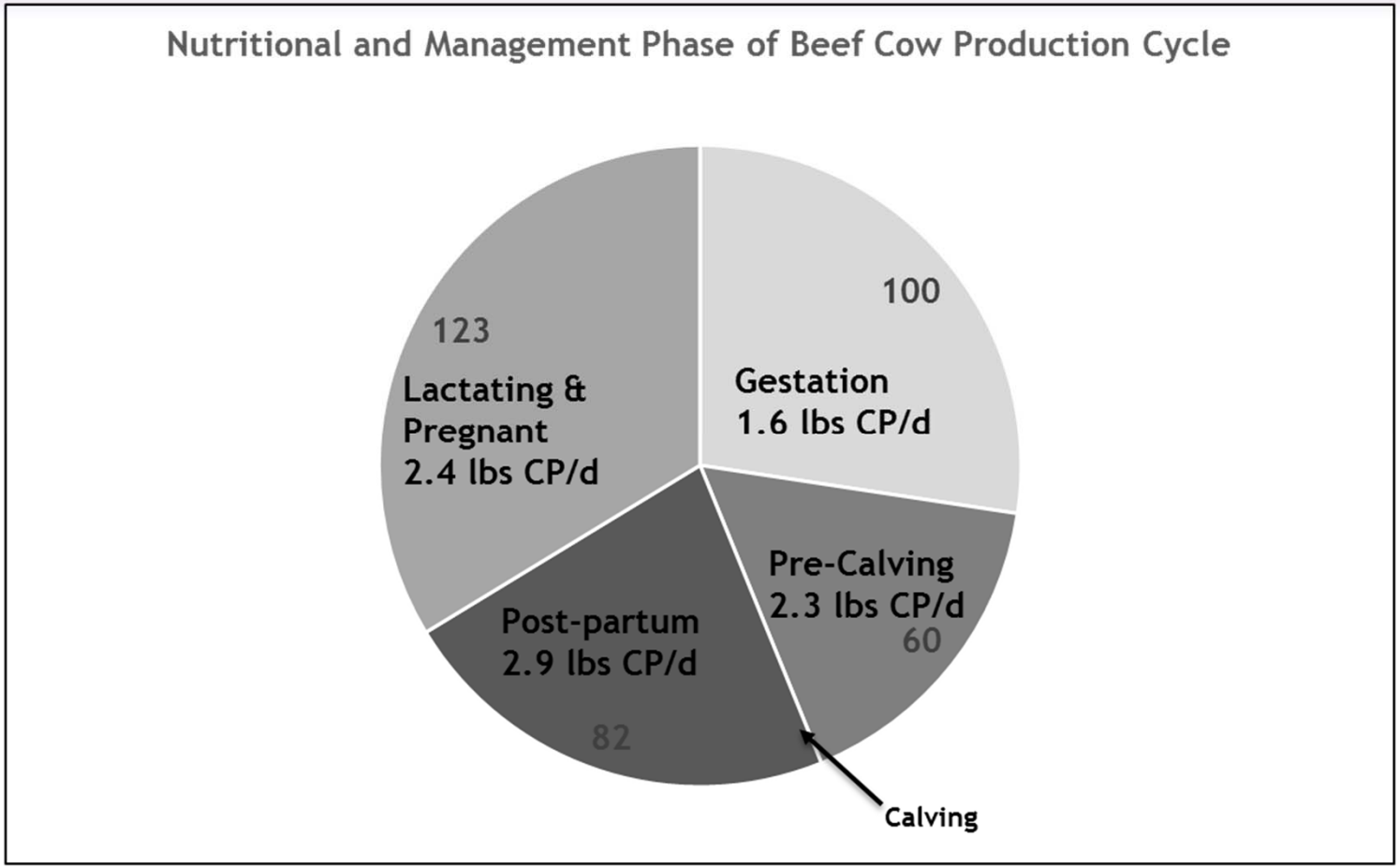
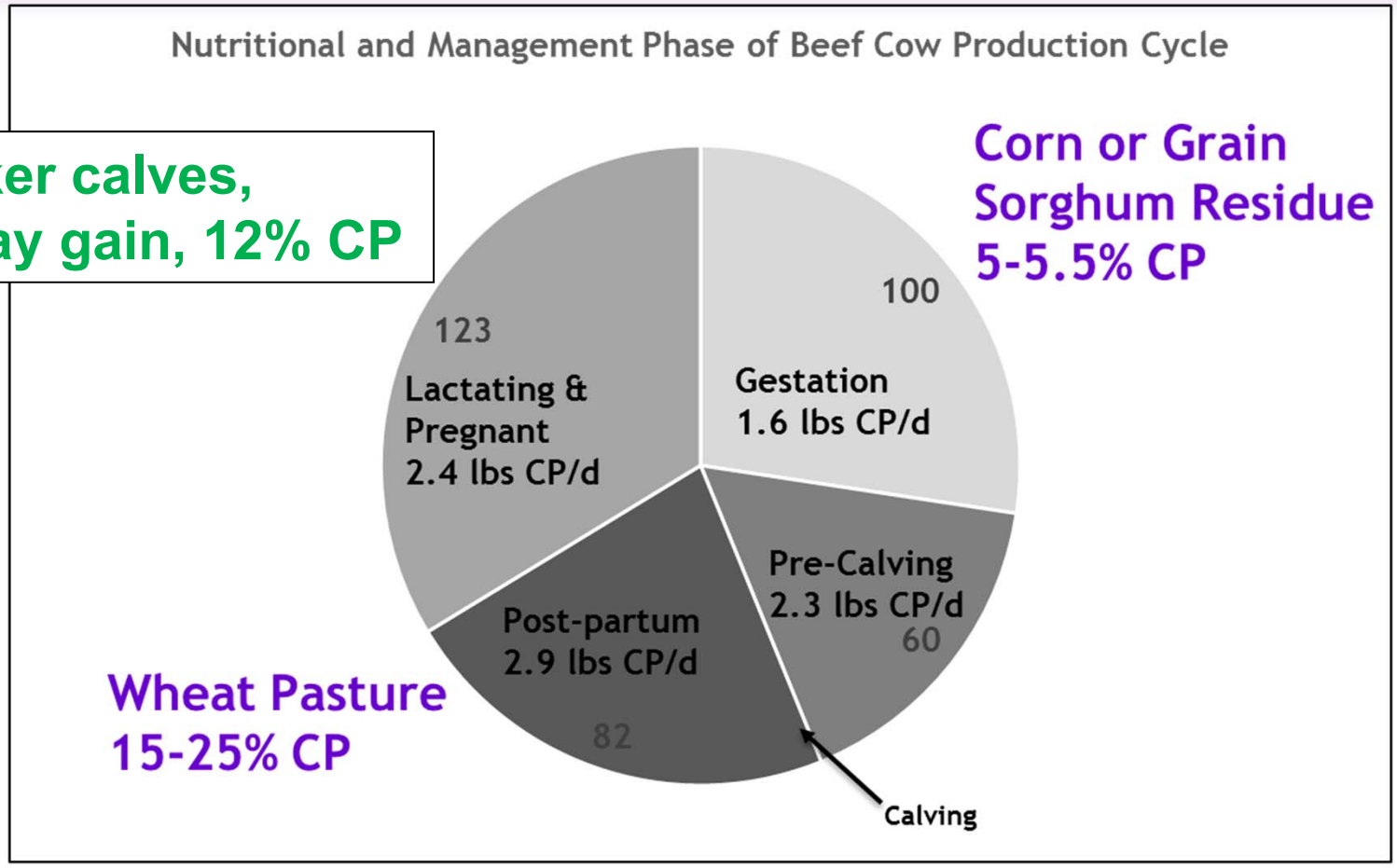
Production Cycle and Nutrient Demand



- **Determine nutrient requirement, forage needs, and opportunities**
  - **Weaned calves, yearlings, 1st calf heifers, thin cows, ?**

Production Cycle and Nutrient Demand



- **Determine nutrient requirement, forage needs, and opportunities**
  - **Weaned calves, yearlings, 1st calf heifers, thin cows, ?**

Species Selection

- **Spring:**
  - Oat, Triticale, Pea
    - Yield range: 1500-4000 lbs DM acre^{-1}
- **Summer:**
  - Annual: Forage sorghum, Sorghum-Sudan, Sudan, Pearl Millet, Cowpea, Sunhemp, Forage Brassica, Teff
    - Yield range: 4000-8000 lbs DM acre^{-1}
  - Perennial (high rainfall): Bermuda grass, Crabgrass
    - Yield range: 4000-14000 lbs DM acre^{-1}
- **Fall/Winter:**
  - Oat, Triticale, Rye, Wheat, Vetch
    - Yield range: 3000-6000 lbs DM acre^{-1}
- **Midwest Cover Crop Decision Tool:**
  - http://mccc.msu.edu/covercroptool/covercroptool.php

Midwest Cover Crops Council - Cover Crop Decision Tool
Kansas: All Counties Average County Seeding Dates

NEW UPDATE!
HOVER OVER COVER CROP, CLICK TO REVIEW THE INFORMATION SHEET.

Location Information | Cash Crop Information | Soil Information | Attribute Information

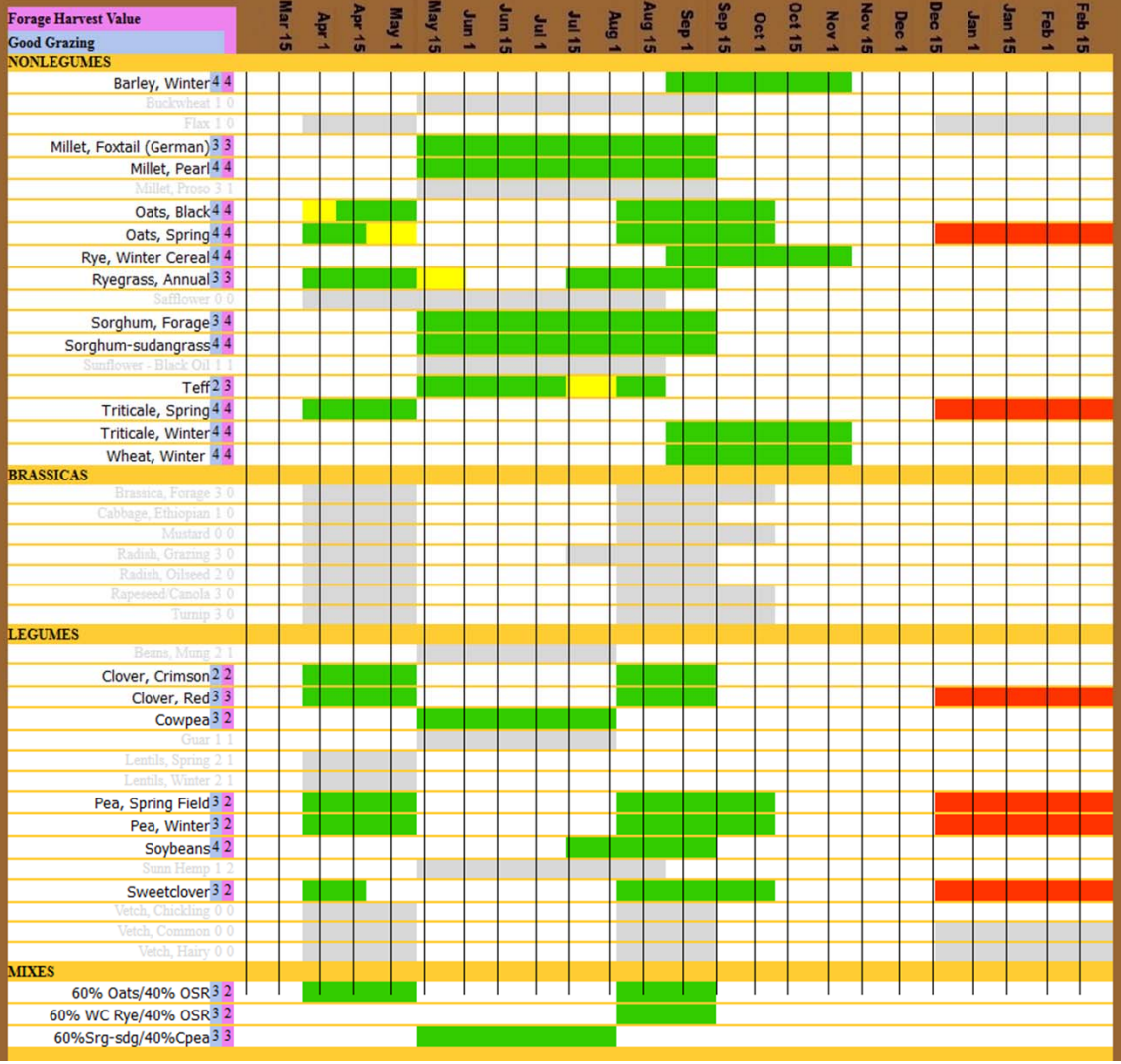
Location Information Kansas | All Counties Average

Cash Crop None or Prevented Planting **Plant Date:** **Harvest Date:**

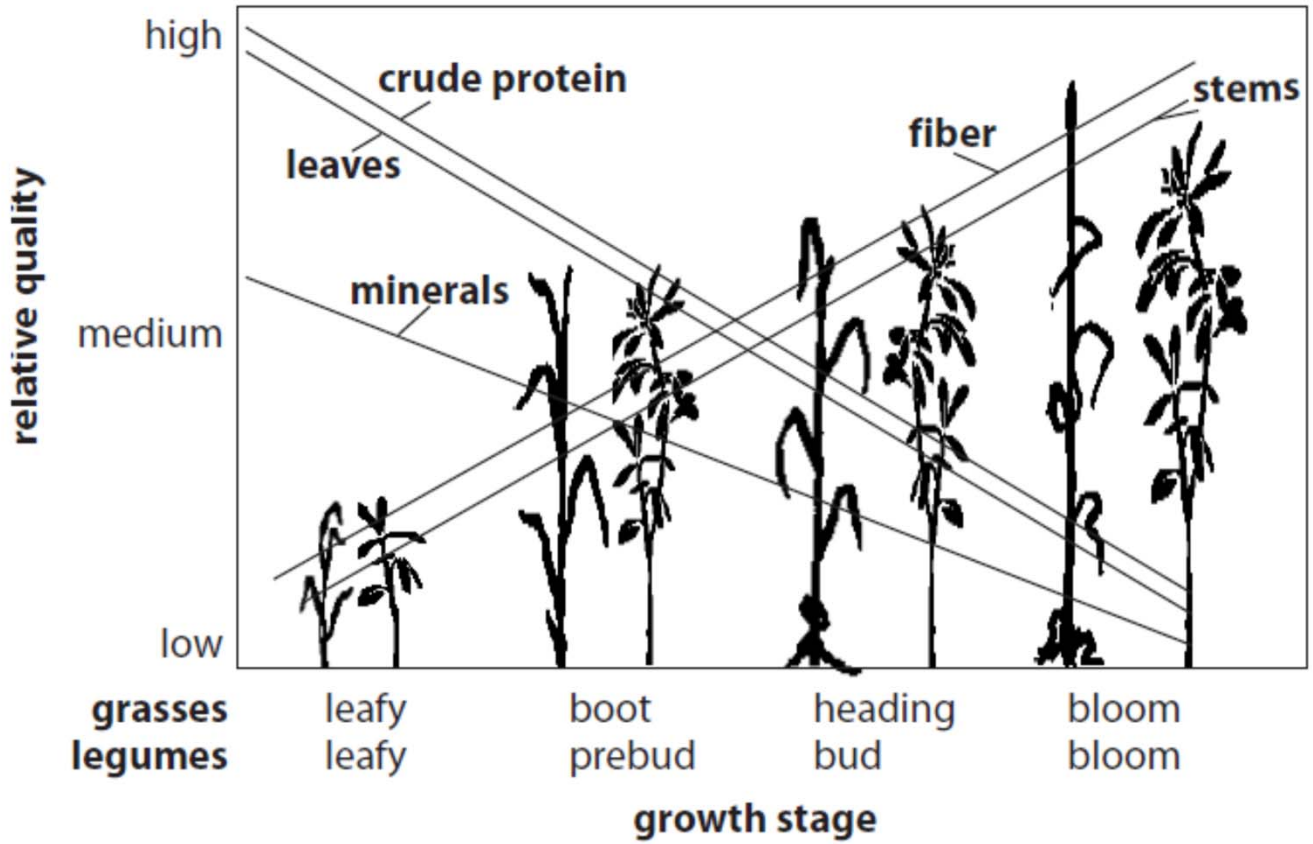
Drainage Information Moderately Well Drained **Flooding** No

Goal #1 Good Grazing **Goal #2** Forage Harvest Value **Goal #3** Select an attribute

Attribute Ratings: 0-Poor, 1-Fair	Reliable Establishment	Freeze Risk to Establishment	Frost Seeding
2-Good, 3-Very Good, 4-Excellent	Cash Crop Growing Period: Requires Aerial Seeding or Interseeding of Cover Crop		



Forage Quality



Source: *Adapted from Blaser, R., R.C. Hammes, Jr., J.P. Fontenot, H.T. Bryant, C.E. Polan, D.D. Wolf, F.S. McClaugherty, R.G. Klein, and J.S. Moore. 1986. Forage–animal management systems. Virginia Polytechnic Institute, Bulletin 86-7.*

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Management Concepts

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Management Concepts

Soil test for N, P, K and S

Implement weed management

Manage forage/cover crop as a “cash” crop to maximize production and profit

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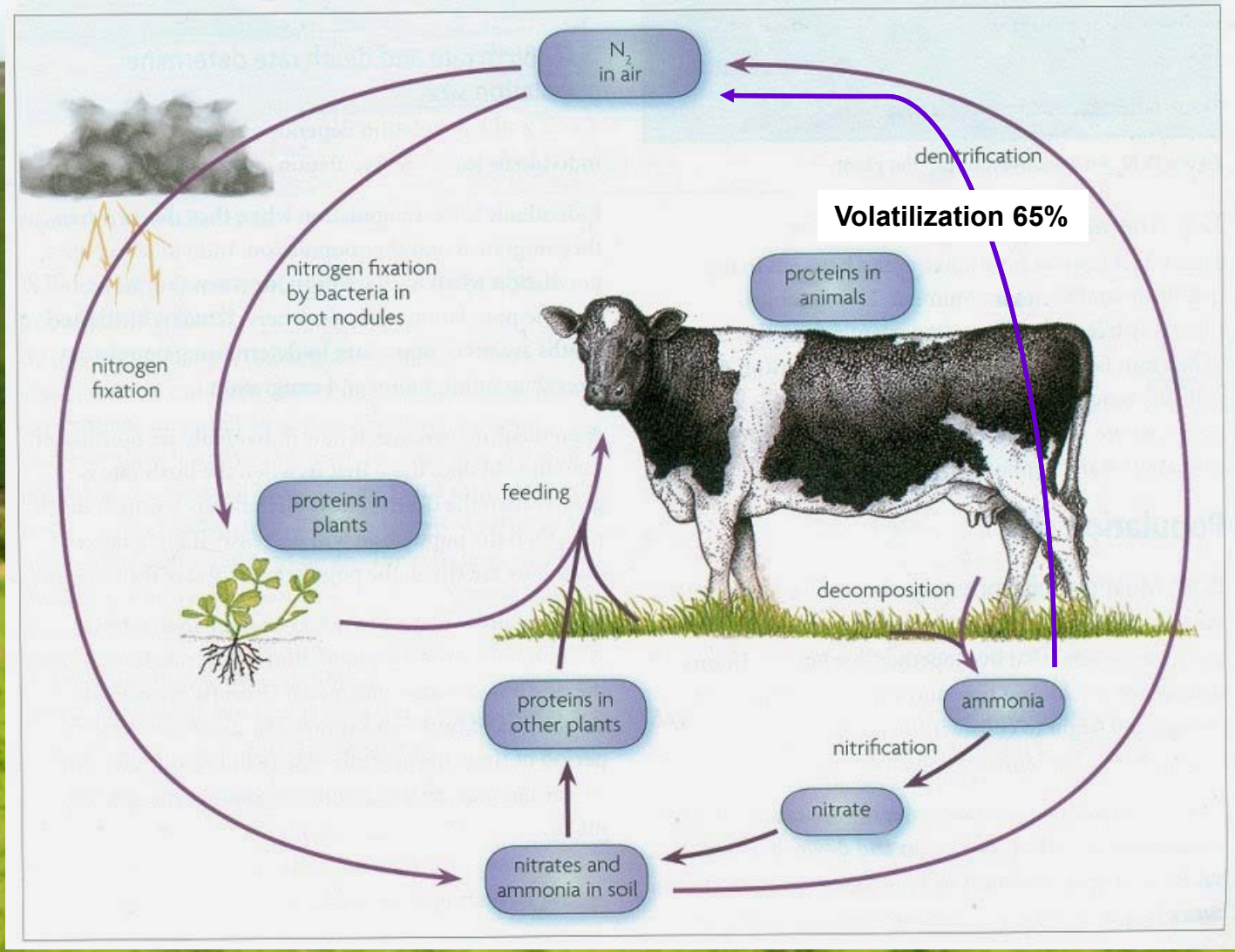
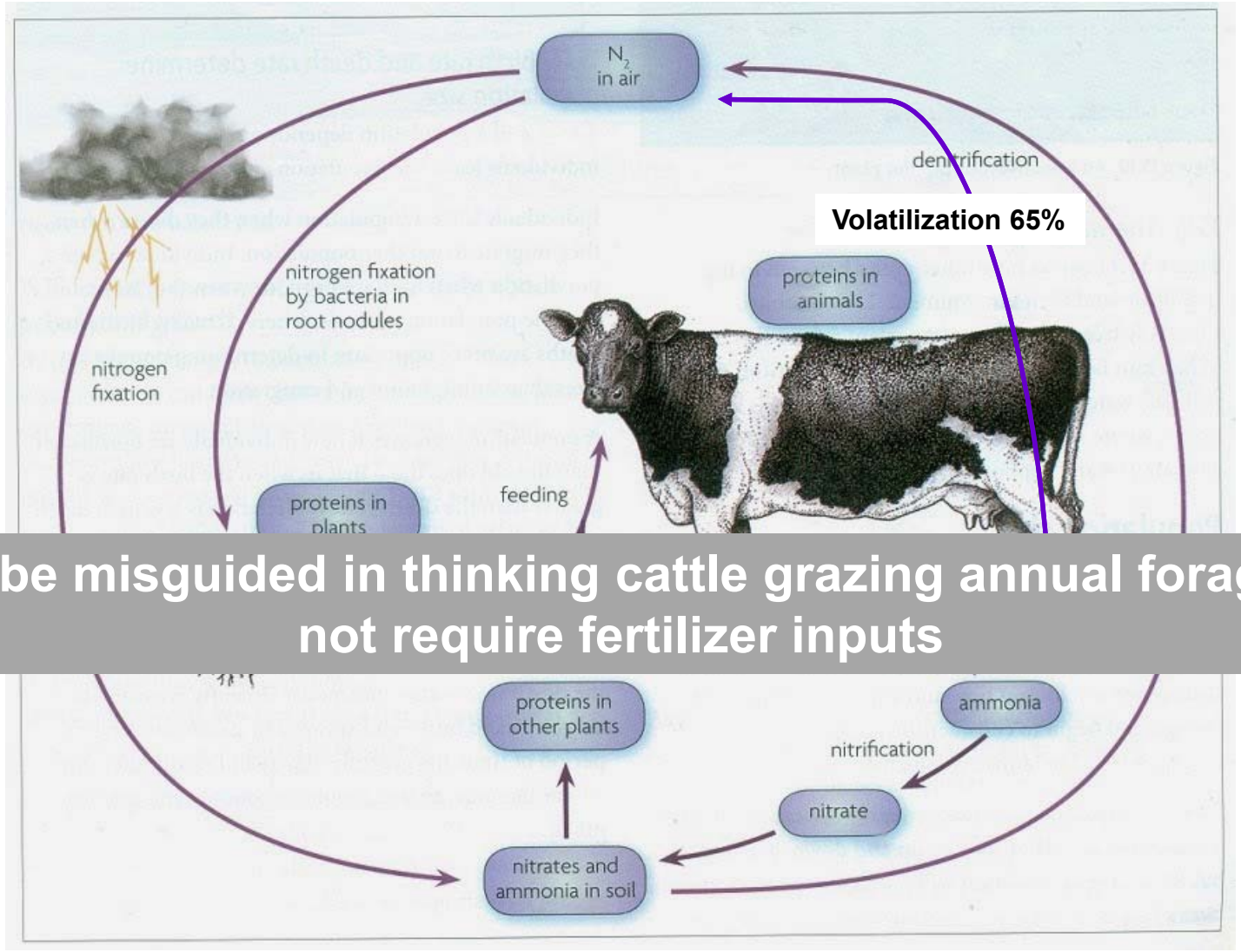
Management Concepts



Management Concepts



Do not be misguided in thinking cattle grazing annual forages will not require fertilizer inputs

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Managing Stubble Height

Corn stalks with standing strips

All taken 2/24/15

Forage sorghum cut 6” tall in 2014, no regrowth

Grain sorghum residue from 2013

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2015 Forage Sorghum Harvest

Ideal situation:

1. **Good forage crop**
2. **Left adequate residue to prevent soil erosion, capture precipitation, and reduce soil water evaporation**

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Residue Reduces Soil Erosion

- **Must be careful to leave enough residue when haying or grazing**
  - **Very easy to take too much**
  - **Important for soil erosion and precipitation storage**

Knowledge for Life

Weather Challenges

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Weather Challenges

Knowledge for Life

Soil Compaction

- **Grazing no-till wheat and grain sorghum residue reduced grain yields over time due in part to soil compaction near Bushland, TX (Baumhardt et al. 2011, AJ)**
- **Grazing no-till corn stalks increased crop yields over time and did not affect soil compaction in NE (Drewnoski and Blacno, 2015).**
- **?**

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Biomass after grazing

Grazed from 5/19/15 to 5/22/15

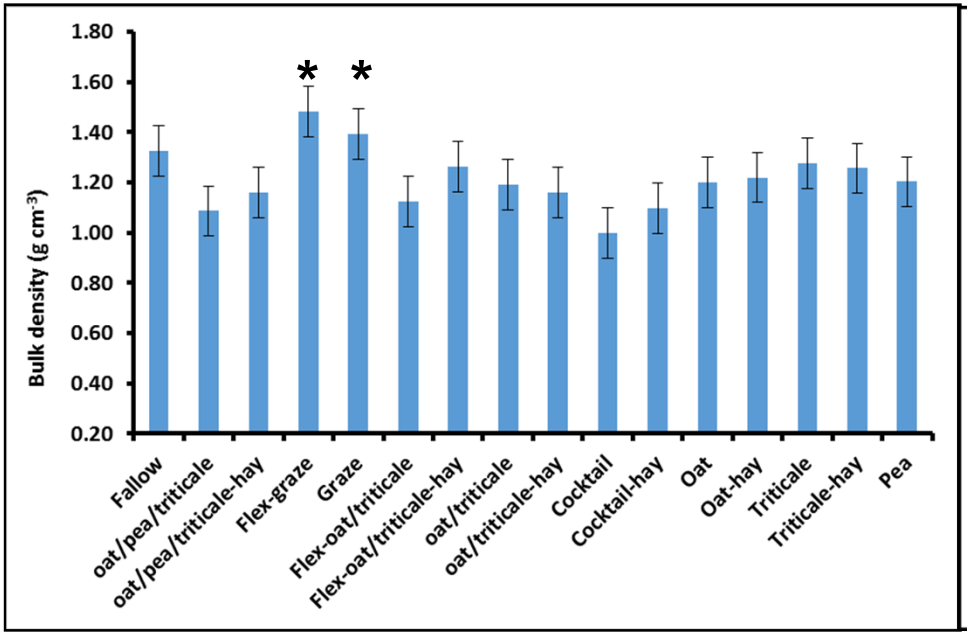
Grazed from 6/14/16 to 6/21/16

A. Obour and J. Holman, Hays, KS

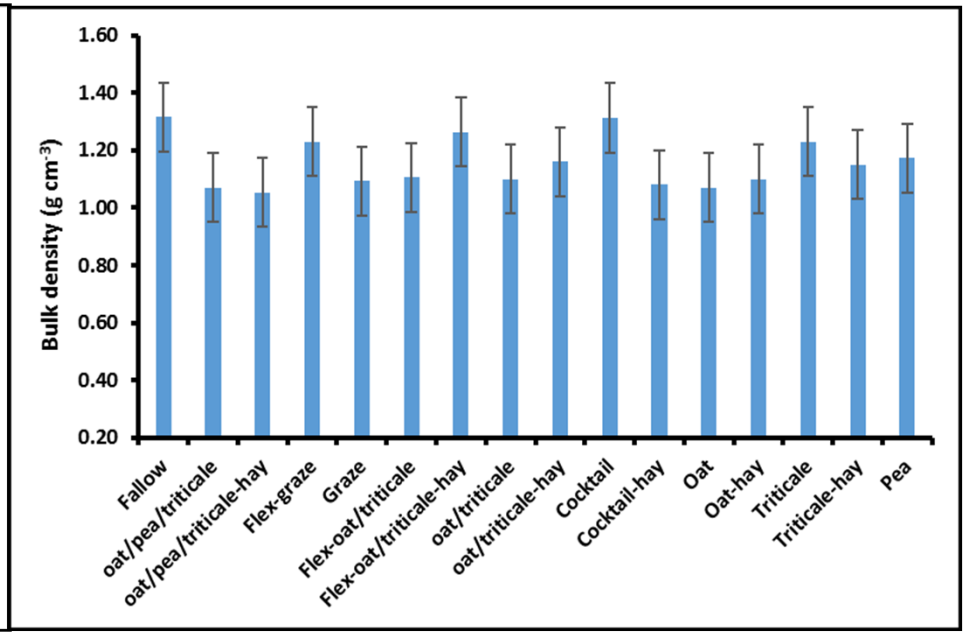
Knowledge for Life

Soil bulk density at wheat planting

0-2” depth in 2015



0-2” depth in 2016



- **Grazing increased compaction 0-2” when soil grazed wet**
- **No compaction measured deeper than 2”**

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Soil Compaction

- Compaction is less on frozen, dry soils
- Wet/dry and freeze/thaw helps break-up compaction near the soil surface
- Shallow tillage can correct livestock compaction
- Avoid grazing when soils are wet

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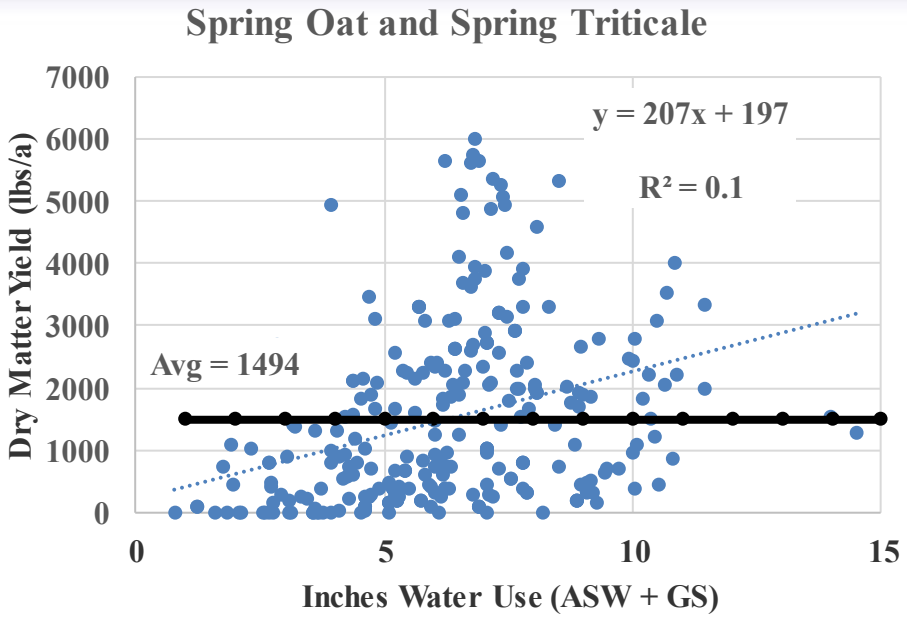
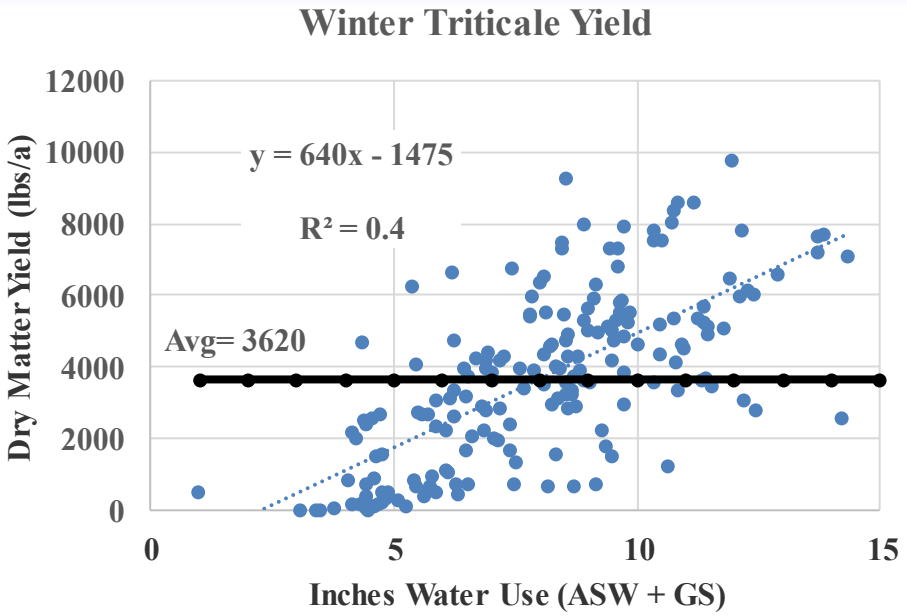
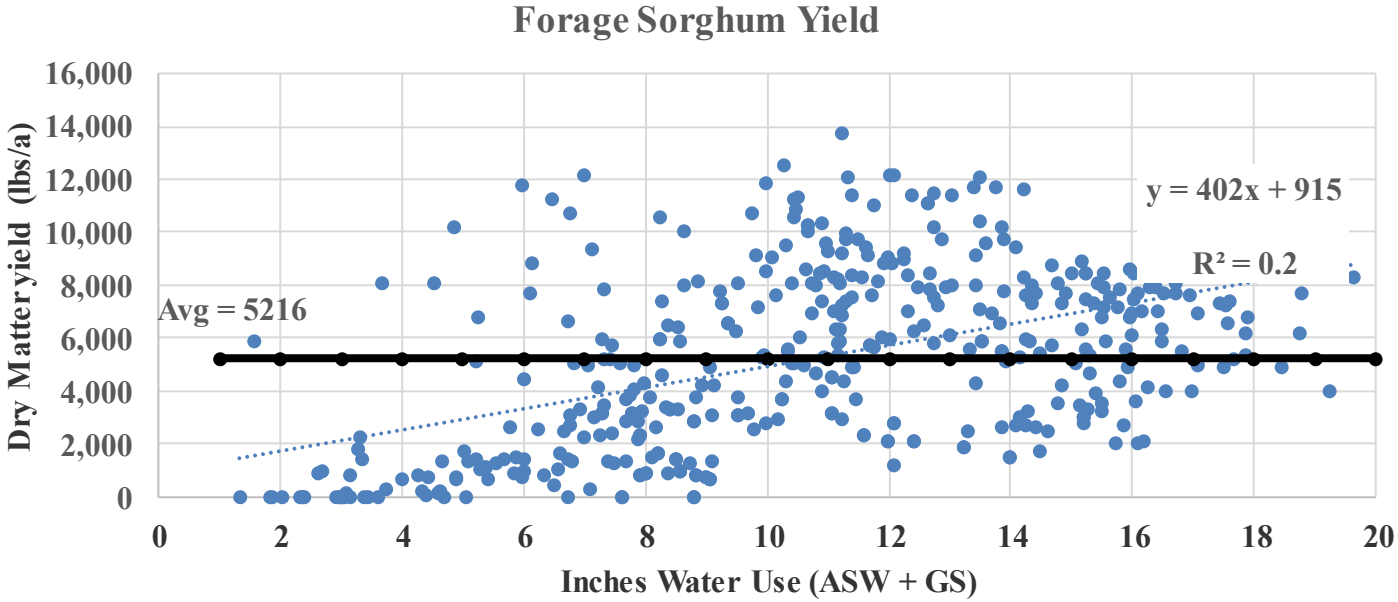
Estimating Forage Yield-ASW & GS







Knowledge for Life

Estimating Available Forage

Estimate available forage?

Establish stocking rates?

Stocking Rates

- **Forage Yield: Average yield estimate (adjust based on planting conditions and seasonal outlook)**
- **Determine Utilization: 90% baled, 40-50% with grazing**
- **Animal class and intake: 2.5-3% of body weight**
- **Determine grazing days or number of animals needed:**

$$f(x) = \frac{\text{Acres} * \text{Forage Yield} * \text{Utilization Rate}}{\text{Animal Wt} * \text{Intake} * (\text{Number of Head or Grazing Days})}$$

Stocking Rates

Need to have a Plan B

- Too wet, too dry, too few head or too many head
- Works best to supplement native range nearby
  - Move them to range if too wet, run out of feed, make better utilization of higher quality forage
- Consider baled forage/silage as part of the plan
  - Store excess forage for those years it is not in excess

Considerations

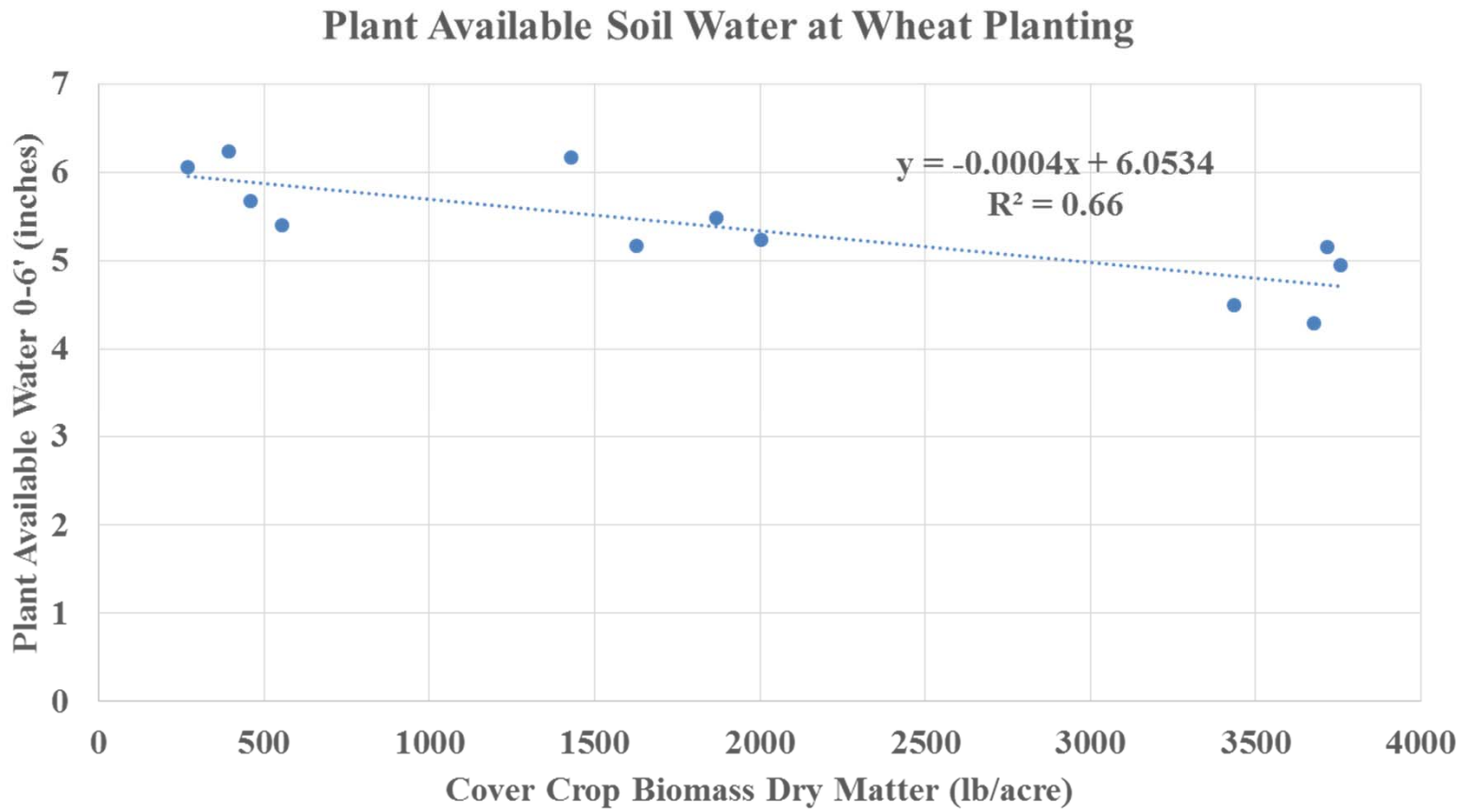
- **Many Opportunities and Advantages to Grazing but consider some things to be aware of:**
  - **Resource availability (land, capital, labor, fencing, water, etc.)**
  - **Basis risk: http://www.beefbasis.com/**
  - **Cattle sickness, death loss (stockers)**
  - **Variable/unpredictable weather (feast or famine)**
    - **Western KS: we know precipitation will be variable**
      - **Need to have a mitigation plan in place**
    - **Eastern KS/Irrigation: forage production more predictable**
      - **Watering cattle may be a concern**

Management Concepts

- **Cover crops are grown for agroecosystem benefits <u>but</u> not technically harvested**
- **Forage crops are grown for "feed" that is either hayed or grazed**
- **Statements like:** *"Hay or Graze my Cover Crop"*
- **We can manage forage crops for residue cover**
- **We can grow cover/forage crops in place of fallow to increase crop residue and improve soil health over time**

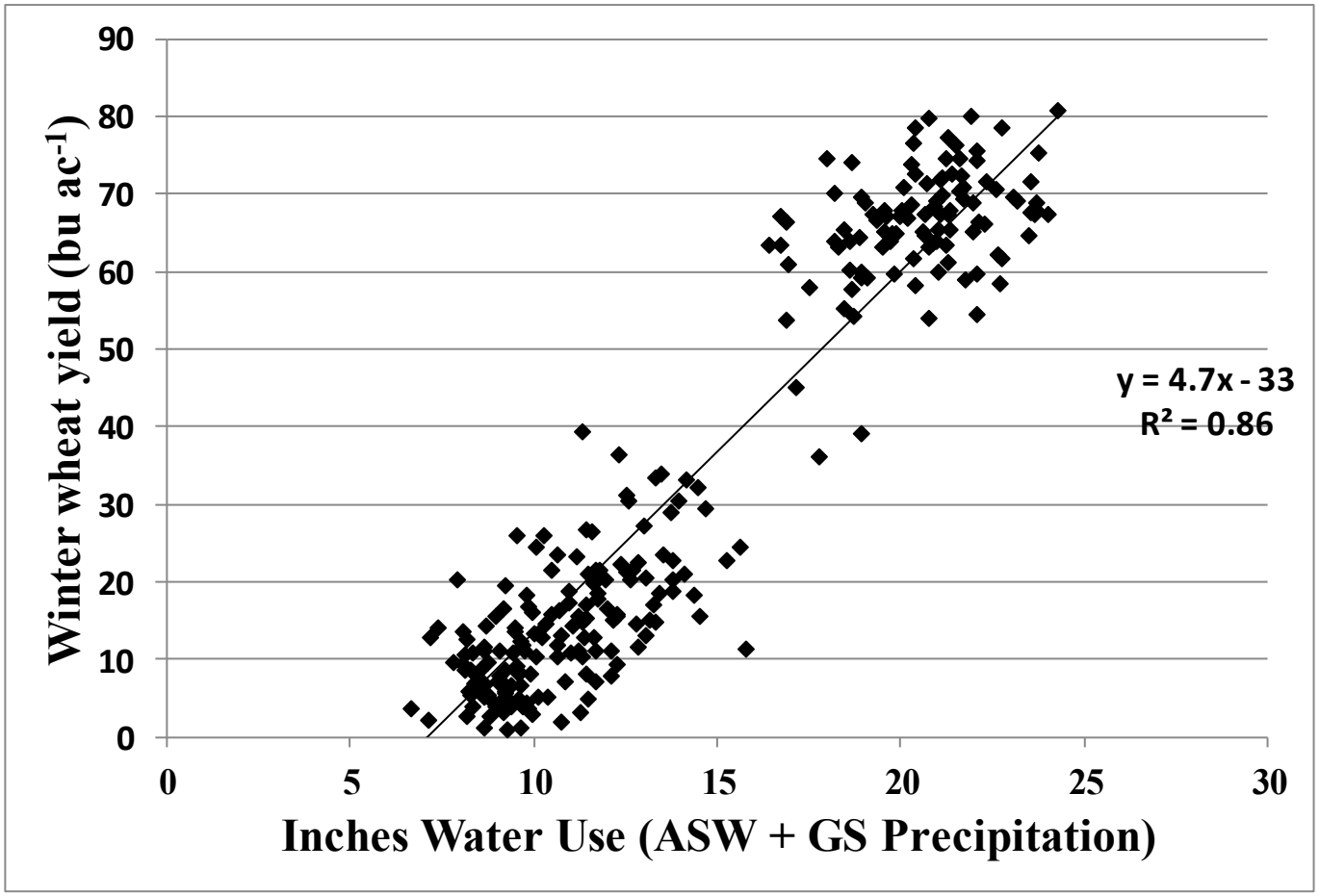
Management Concepts

- **Cover/Forage crops USE water**
  - **The more biomass grown the more water used**



Water Makes Grain

- **Winter wheat: 4.7 bu ac^{-1} inch^{-1}**



Wheat-Fallow
(Forage, Cover Crop, Grain, or Fallow)

Economic Net Returns: W-F

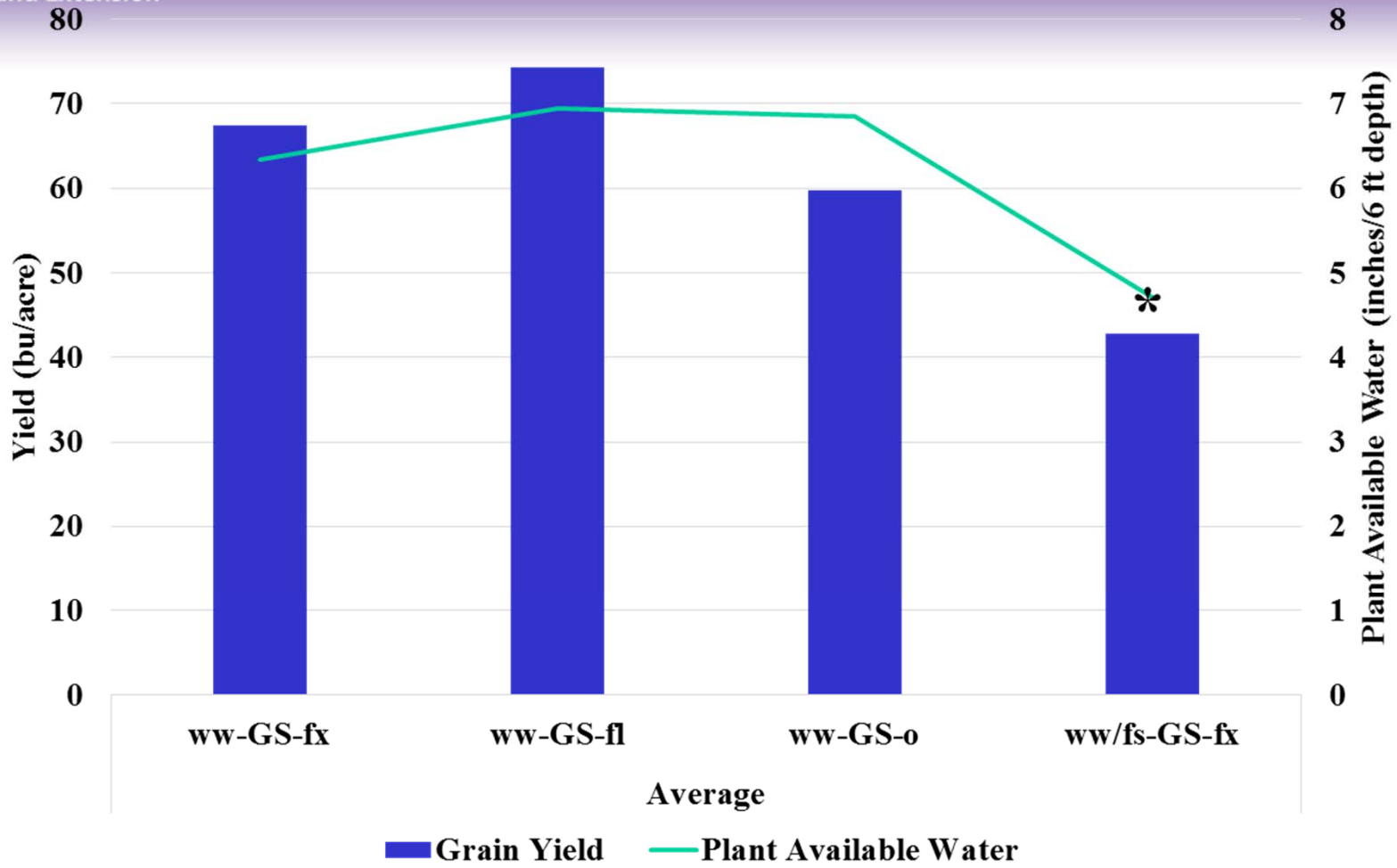
	Spring Species						Winter Species							
	Fallow	Lentil	Lentil/ Triticale	Pea	Pea/ Triticale	Pea (grain)	Triticale	Hairy Vetch	Hairy Vetch/ Triticale	Lentil	Lentil/ Triticale	Pea	Pea/ Triticale	Triticale	Cont. WW
	Net Return ($ acre-1)														
Cover Crop	-	-82	-104	-113	-113	-	-99	-137	-130	-84	-105	-112	-122	-110	-
Forage	-	-83	-62	-77	-57	-	-48	-140	-10	-92	4	-109	-1	7	-
Other	-55	-	-	-	-	-114	-	-	-	-	-	-	-	-	-71
LSD 0.05								21							

- Fallow costs ~$55/A
- Returns include variable costs and wheat yield
- Incentive for forages:
  - Profit ↓, when spring triticale reduced wheat yield >14 bu/acre
  - Fallow most profitable in dry years
- Flex-fallow to reduce losses and take advantage of wet years?

Knowledge for Life

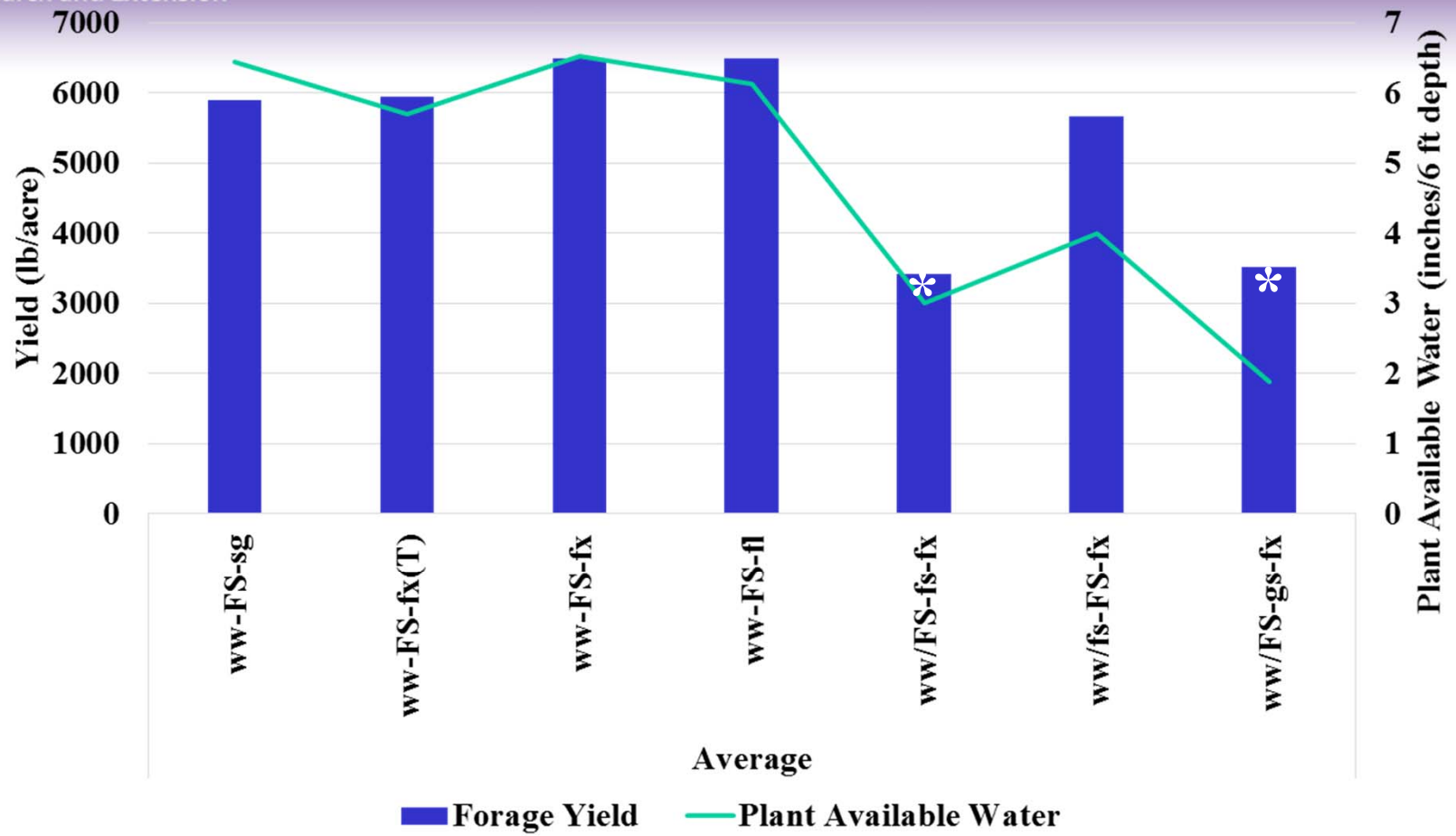
Wheat/(Forage or Fallow)-Sorghum(Grain or Forage)-Fallow(Forage or Flex or Fallow)

Grain Sorghum (W-GS-F): 2014-2017



- **Forage sorghum (FS) grown after wheat reduced second year grain sorghum (GS) yield**

Forage Sorghum (W-FS-F): 2014-2017



- **Forage sorghum (FS) grown after wheat did not affect second year FS yield**
- **FS double-cropped after wheat yielded about 50% of full season**
- **Opportunity to crop more intensively with forages**

Summary

Replacing Fallow with a cover/forage crop:

- Cover crops under all conditions were never profitable
- Forages can be profitable if:
  - Seed cost is minimized
  - Select crop with high forage yield
  - Wheat yields weren't reduced by >7% (sensitivity analysis)
- Cover crop mixes (up to 6 species) did not reduce water use or improve crop performance compared to single species
- Need to match cropping intensity to environment
- Wheat yield <50 bu/a expect some yield and profit reduction if forage grown in place of fallow
- It is only sustainable if it is profitable

NRCS-CIG On-Farm Cover Crop Grazing

- **Cooperative On-Farm Project with KSU, CSU, and NRCS**
- **Producers graze and leave standing replicated plots**
- **Project started in 2016**
- **2016 spring covers in W-S-F**
- **2017 spring and double-crop cover after wheat in W-S-F**
- **Measure soil moisture and crop yield from grazed and ungrazed plots**

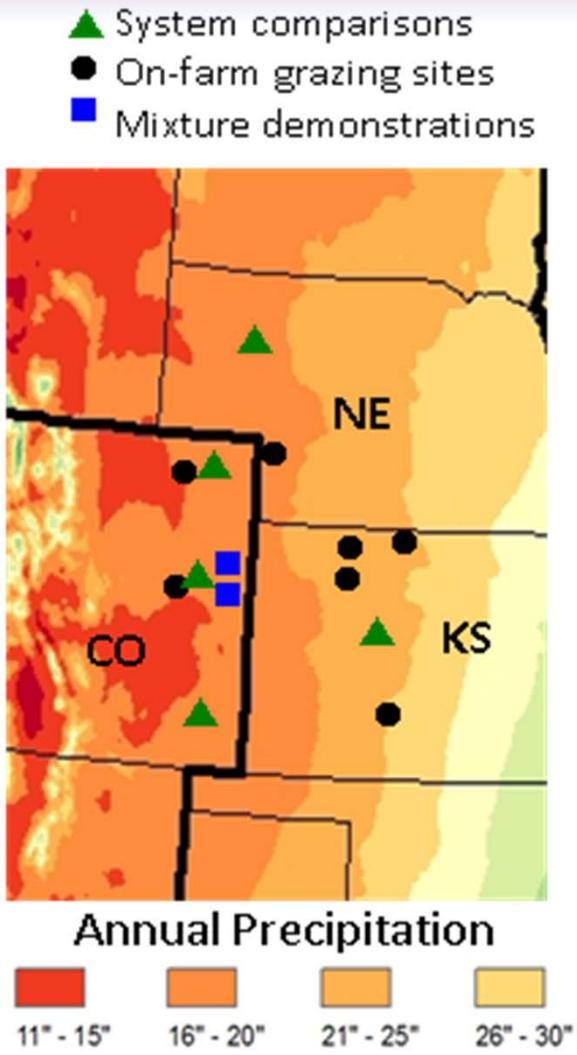


Figure 1. Map of demonstration and on-farm research sites.

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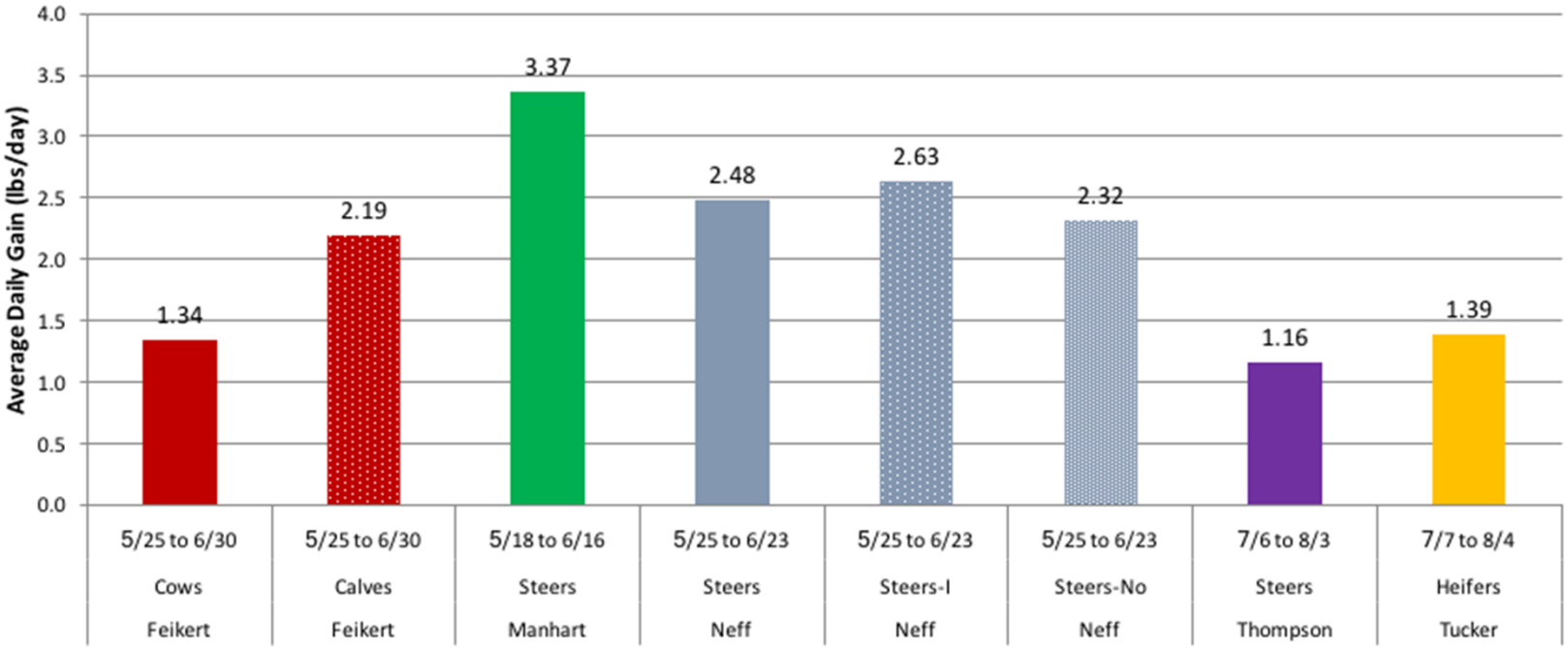
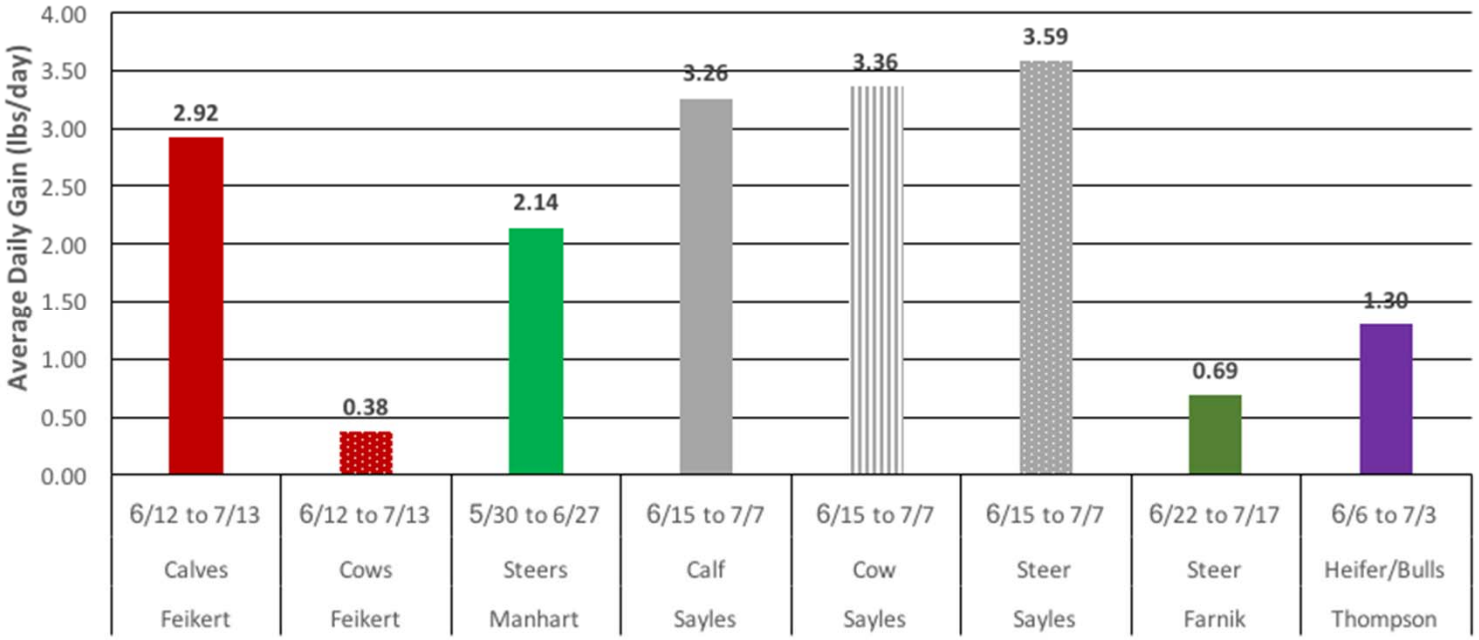
Producer Cooperator Cattle Gains



Improved Cow BCS .3 to .4



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Determining Profitable Annual Forage Rotations

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Forage Rotation Research:

- **Forage rotations with winter triticale (T), forage sorghum (S), and spring oat (O)**

    1. **S-S (no-till)**
    2. **T-S-O (no-till)**
    3. **T/S-S-O (no-till)**
    4. **T/S-S-O (min-till)**
    5. **T/S-S-S-O (no-till)**
    6. **T/S-S-S-O (min-till)**

- **Garden City, KS (19 in annual precipitation)**

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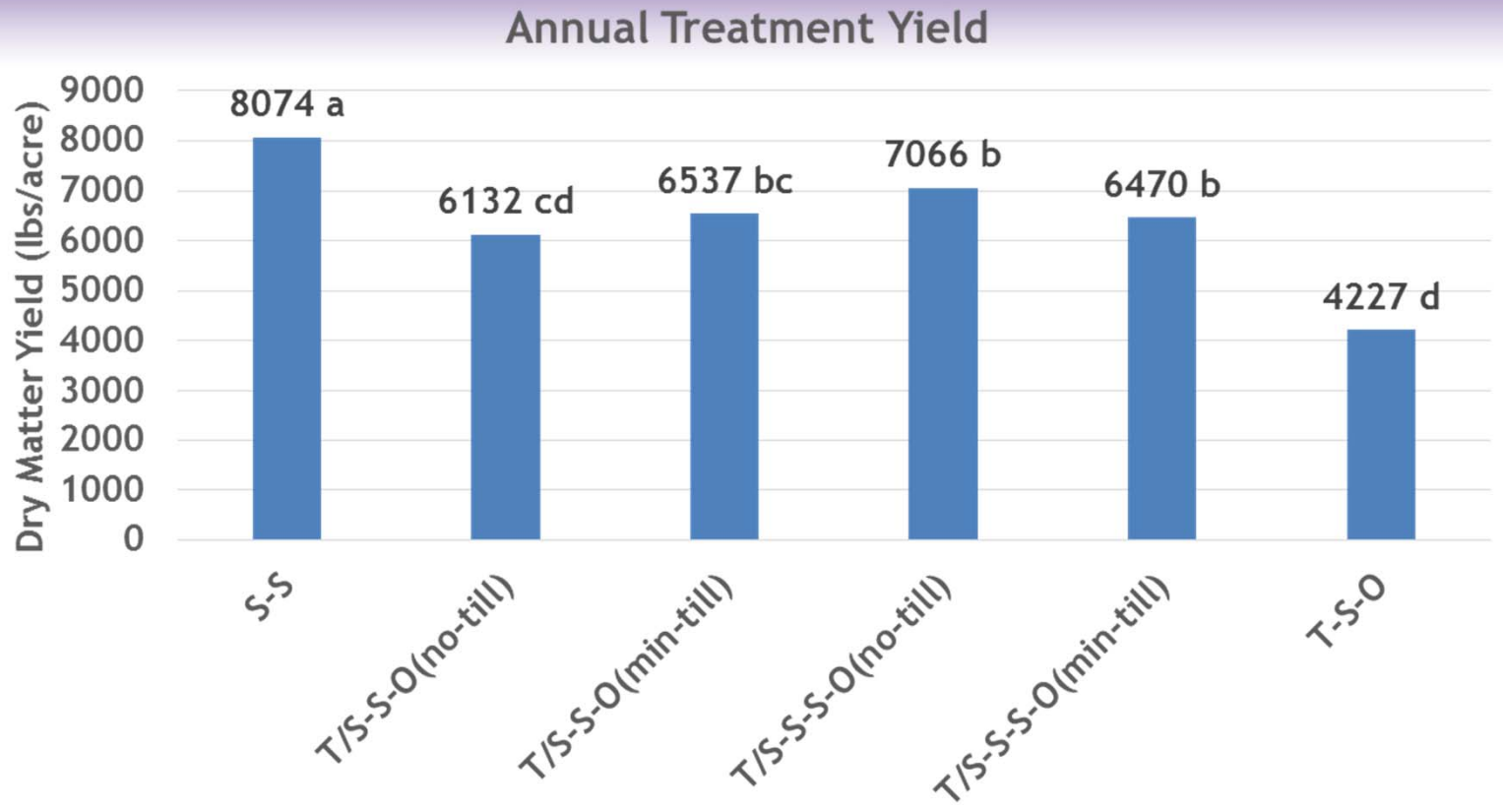
Treatment Yield (2015-2017)



- **Annual yield due to rotations are different lengths**
- **Tillage increased triticale yield after oat**
  - **No-till works best with high residue, oat stubble poor residue**
- **Consider forage quality and other available feed sources**

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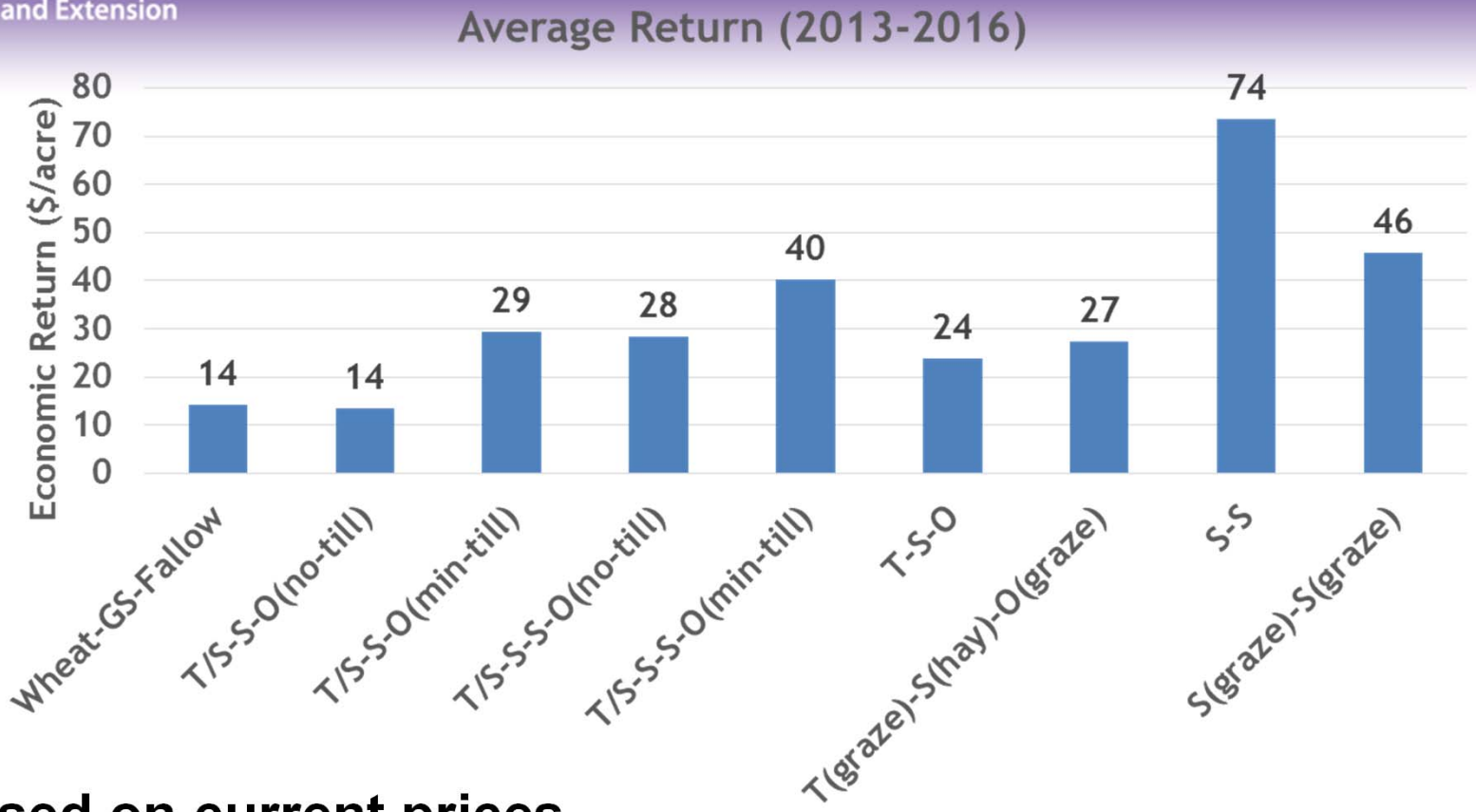
Economic Return



- **Based on current prices**
- **Estimated trampling loss at 60% in S & 50% in O or T**
- **More beneficial to graze oat or triticale than sorghum**
- **Too much hay production, may have difficulty selling or using**
- **Does not account for costs to feed forage (delivery, fence, or hay loss in feeding)**

Resources

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FORAGE CROPS

GRAZING MANAGEMENT: TOXIC PLANTS MF3244

A SHORTAGE OF GOOD-QUALITY PASTURE CAN BE A LIMITING FACTOR FOR A CATTLE OPERATION.

Annual forage crops grown in place of fallow can provide high-quality forage during key production periods and may help reduce soil erosion, suppress weeds, and increase soil nutrient profiles. Traditionally grown for agronomic or soil benefits but not harvested, cover crops are being considered for grazing, haying, or planting as annual forages. They are appealing because of the potential for additional revenue from improved cattle performance combined with the benefits of soil stabilization. Those contemplating this decision should know that plants that work well as cover crops may not be suitable for forage or grazing. In fact, some species can be toxic or fatal to livestock. This publication describes popular cover crops and the dangers they present for grazing livestock.

METABOLIC DISORDERS

BLOAT

Frothy bloat refers to a condition that occurs when a ruminant consumes feeds that produce thick, foamy gas that the animal cannot pass by belching. Froth builds in the rumen and causes noticeable discom-

GLUCOSINOLATES

Glucosinolates are natural compounds that plants a bitter, "hot" taste. Found in the leaves certain plants, they are highly concentrated in When consumed by livestock, glucosinolates ir with thyroid function, cause liver and kidney le and reduce mineral uptake. For livestock, the n serious issue is inhibited iodine uptake which c reduce production of the hormone thyroxine a in goiters.

GRASS TETANY

Also known as grass staggers or wheat pas poisoning, grass tetany is a metabolic disorder acterized by low magnesium levels in the bloo tetany mainly affects older lactating cows graz lent, immature grass. It can result in uncoordin (staggers), convulsion, coma, and death. To pre grass tetany, supplement magnesium by offeri mineral or high-magnesium feeds when grass i Graze high-risk pastures with steers, heifers, ar cows that are less susceptible to this disorder.

NITRATE TOXICITY

Ruminants are vulnerable to nitrate toxicit occurs when plant nitrate is converted to nitrit the rumen. From there, nitrite is absorbed into

Knowledge for Life

Summer Annual Forages: Selection and Production Characteristics

K-STATE Research and Extension

FORAGE FACTS MF2871

Management

Introduction

Summer annual forages are warm-season grasses that tolerate hot, dry weather and are adapted to most areas of Kansas. Although most species should not be planted until the soil temperature reaches 70 degrees to 75 degrees Fahrenheit, some can be used by 4 to 6 weeks after planting. Summer annual forages include forage sorghums, sudangrass, sorghum-sudangrass hybrids, hybrid pearl millet, and foxtail millet (a.k.a. Italian, German, Hungarian, or Japanese Millet). Selecting a type of summer annual should be based on the needs and location of the individual livestock program because they have different growth characteristics that influence how they are used. The following table summarizes characteristics of the most commonly used summer annual forages used in Kansas.

Forage Sorghum	Sudangrass	Sorghum-sudangrass Hybrids	Hybrid Pearl Millet	Foxtail Millet
		Strengths		
yield, better quality with brown midrib (BMR) hybrids, may have better yield with photo-period sensitive (PS) hybrids	rapid regrowth (leave 6 to 8-inch stubble), small stems, extensive tillering,	yield, regrowth, better quality with brown midrib (BMR) hybrids	rapid regrowth, quality, greenbug resistant, extremely low potential for prussic acid toxicity, drought resistant, high leaf to stem ratio	short growing season/late planting, no prussic acid toxicity, drought resistant, can plant in August for emergency forage
		Weaknesses		
limited regrowth, no grain yield with PS hybrids, BMR trait may result in more lodging with delayed harvest, potential for nitrate and prussic acid toxicity, susceptibility to chinch bugs	yield, potential for nitrate and prussic acid toxicity, poor leaf retention after heading	potential for nitrate and prussic acid toxicity, susceptibility to chinch bugs, poor leaf retention after heading	sensitive to overgrazing (maintain 8-inch stubble), potential for nitrate toxicity, susceptibility to chinch bugs	quality, palatability, yield, shallow rooted, uproots easily when grazed, awns can injure livestock (sore mouth)
		Uses		
silage, hay – harvest at mid to late dough, increase seeding rate for hay	grazing, hay – harvest before heading to maximize quality	grazing, hay – harvest before heading to maximize quality	grazing, hay – harvest before heading to maximize quality, cut whenever growth	grazing, hay – always harvest before heading to maximize quality and to avoid

Resources

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DUAL-PURPOSE WHEAT MANAGEMENT FOR FORAGE AND GRAIN PRODUCTION MF3375

DUAL-PURPOSE WHEAT AS A FORAGE SYSTEM

The unique climate characteristics of the southern Great Plains allow producers to use wheat as a forage and grain crop (dual-purpose), potentially increasing overall profitability compared to grain-only or forage-only systems. Dual-purpose wheat is currently working well on about 8 million acres in southern Kansas, Oklahoma, and Texas.

The fall and winter temperatures in this region generally allow for significant wheat growth before winter and for relatively few snow-covered days that limit grazing. As a result, winter wheat in this region has the potential to be grazed for 120 to 150 days.

Wheat pasture is a valuable source of high-quality forage when most other forage sources are low in quantity and quality (late fall, winter, and early spring). To minimize grazing effects on grain yield, certain adjustments in management practices must be considered.

CULTURAL PRACTICES

Compared to grain-only management practices, when implementing a dual-purpose wheat system, adjustments are required in planting date, seeding rate, variety selection, and soil fertility. These adjustments help maximize fall forage production while minimizing grain yield losses.

SEEDING RATE

PLANTING DATE

Earlier planting dates increase wheat fall forage yield potential. Research in north-central Oklahoma has shown that planting 2 weeks earlier, in early September rather than late September, can increase fall forage dry-matter production as much as 1,000 pounds per acre when wheat was sown at 120 pounds per acre (Figure 1a).

Earlier planting dates may result in suboptimal conditions for grain yield (Figure 1b). Therefore, producers should consider the tradeoff between maximizing forage yield while minimizing grain yield losses when selecting the best planting date. Generally, a good compromise for producing both good forage and grain yields would be to plant 2 to 4 weeks earlier than the optimal planting date for grain yield. This increases the chances of maximizing wheat enterprise profitability in a dual-purpose system.

It is best not to plant any earlier than that unless the wheat is to be produced only for grazing, or "grazeout." For grain yields, the risks from early planting include an increased potential for wheat curl mite, aphid, and Hessian fly infestations, leading to an increased risk of fall infections by wheat streak mosaic virus (WSMV) and barley yellow dwarf virus (BYDV). These pathogens can not only lead to a significant decrease in grain yield, but also reduce forage production.

Another disadvantage of early planting is that dry and hot soil conditions frequently prevail in late August and early September and may require "dusting-in" the seed. If

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Nontraditional Forages as Emergency or Supplemental Feedstuffs

K-STATE Research and Extension

FORAGE FACTS MF2872

Management

Introduction

Despite the best plans, shortages of forage commonly occur some time during the year in Kansas. Drought, hail, early freeze, crop failure, harvest delays, and unusually cold and wet winters can cause forage shortages. In response, producers may choose to buy the extra forage needed or sell livestock. But in many cases, it may be more economical to use nontraditional forages. The following table summarizes several options for obtaining forage from nontraditional sources or in emergency situations generated by an unexpected shortage of forage. In times of drought stress and when harvesting weeds as emergency forage, always test the crop for nitrate levels. High nitrate levels are toxic, and death loss can be high without proper feeding of forages high in nitrate.

Forage Source	Uses	Quality/ Livestock Performance	Management Tips
		Crops	
Annual Legumes (winter: hairy vetch, Austrian winter pea; spring: spring pea, lentil; summer: cow pea, sunn hemp)	graze, hay, or ensile	good quality forage with crude protein up to 21 percent and TDN up to 57 percent if harvested by early bloom	Usually planted as cover crops. Can be planted in mixtures with cereals to improve yield and quality of cereal forage. Recently-developed sunn hemp varieties should have no toxic alkaloids and can produce significant biomass in a short time. Cut sunn hemp for hay rather than graze to avoid potential toxicity problems. Seed pods require longer to dry than stems and might delay curing slightly longer than plant material without seed pods.
Brassicas (canola, kale, rape, turnip, radish, turnip x Chinese cabbage crosses)	graze or hay	good quality forage with high digestibility, protein and energy content; low fiber content – provide additional roughage; when cut at early bloom, rape can have 24 percent crude protein and 75 percent TDN	Fast-growing, cool-season species with relatively high water requirement. Seed at 3 to 8 pounds per acre from mid- March through May for summer grazing, or June through August for fall and winter grazing. Begin grazing in about 45 to 60 days. When planted immediately after wheat harvest on irrigated ground, brassicas can make excellent forage for livestock during the summer.
Soybean	graze, hay, or ensile	good quality forage, comparable to alfalfa or clover hay	Pasture as soon as plants are 12 to 18 inches tall; remove livestock once most of the leaves have been eaten to allow regrowth for additional grazing in about a month. Cut for hay before pods are 1 inch long. Mix 1 ton of chopped soybeans with 2 to 4 tons of corn or sorghum forage to

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Prussic Acid Poisoning

FORAGE FACTS MF3040

Prussic acid is also known as hydrocyanic acid or hydrogen cyanide (HCN). Ingesting plants that have produced excess cyanide causes prussic acid poisoning. Sorghums, sudangrass, sorghum–sudangrass crosses, and closely related species are most commonly associated with prussic acid poisoning. Most sorghums and sudangrasses contain a prussic acid precursor (dhurrin) in their epidermal cells. Dhurrin in itself is not toxic. The mesophyll cells located below the epidermis contain an enzyme that under certain conditions converts dhurrin to prussic acid (HCN). It is the prussic acid that is toxic to livestock.

Grain sorghum generally has higher concentrations of dhurrin than forage sorghums or sudangrass. Under normal growing conditions, the dhurrin concentration is low enough that animals can detoxify it before it causes toxicity. Dhurrin concentrations are highest in young plants, new regrowth, and following rapid regrowth after a period of stunted growth, such as rapid growth of drought-stressed plants following a rain, or regrowth following a frost or freeze. Under these conditions dhurrin concentrations can be high enough to poison livestock.

Appropriate management of these forages combined with sample analysis can minimize poisoning risks and allow safe use of these forages. Delaying grazing until minimum plant heights are achieved or until injured or stressed plants have had adequate time to recover or by proper ensiling or conditioning and drying hay can reduce prussic acid concentrations.

Why Prussic Acid is Toxic

Once the prussic acid precursors are eaten, the rumen is an excellent medium for formation of

Table 1. *Level of prussic acid in and potential effect on animals.*

ppm HCN	Effect o
0–500	Generall toxicity.
500–1,000	Potential the only
1,000 and above	Dangero will caus

Prussic acid acts rapidly within minutes. Symptoms increased pulse rate and res tion and foaming at the mo lining of the mouth, difficu convulsions, and collapse. D paralysis follows shortly.

The clinical signs of pr similar to nitrate toxicity, b poisoning have bright red b whereas animals poisoned v chocolate-colored blood. Th is often detected in animals

Because it occurs quickl observed too late for effectiv of a veterinarian, and if ther diagnosis, the animal can be sodium nitrate and sodium t releases the cyanide from th sodium thiosulfate to form excreted. Animals still alive onset of visible signs usually

Prussic Acid Concentra

Plant Species, Crop st

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Nitrate Toxicity

FORAGE FACTS MF3029

The potential for high nitrate concentrations in crops such as corn, sorghum, canola, cereal grains, and some grasses occurs after exposure to drought, hail, frost, cloudy weather, or soil fertility imbalance. Nitrates accumulate in the lower portion of these plants when stresses reduce crop yields to less than those expected, based on the supplied nitrogen fertility level. Feeding harvested forages or grazing plants that are high in nitrates can be toxic to livestock because the metabolism products from nitrates interfere with the ability of blood to carry oxygen, causing asphyxiation.

Why Nitrates Are Toxic

Nitrate toxicity is a misnomer because nitrite (NO_2), not nitrate (NO_3), is poisonous to animals. After a plant is eaten, rumen bacteria rapidly reduce nitrates in the forage to nitrites. Normally, the nitrites are converted to ammonia and used by rumen microorganisms as a nitrogen source. But, if nitrite intake is faster than its breakdown to ammonia, nitrites will begin to accumulate in the rumen. Nitrite is rapidly absorbed into the blood system where it converts hemoglobin to methemoglobin. Red blood cells containing methemoglobin cannot transport oxygen, and the animal dies from asphyxiation.

Animals under physiological stress (sick, hungry, lactating, or pregnant) are more susceptible to nitrate toxicity than healthy animals. Toxicity is related to the total amount of forage consumed and how quickly it is eaten, but, generally, if forages contain more than 6,000 ppm nitrate, they should be considered potentially toxic (Table 1).

Symptoms of nitrate toxicity may appear within a few hours after eating or not for several days. Signs of toxicity include reduced appetite, weight loss, diarrhea, and runny eyes. However, these are nonspecific symptoms of numerous disorders and are not a reliable diagnosis of nitrate poisoning. Lower nitrate levels can cause abortion without any other noticeable symptoms.

Acute toxicity usually is not apparent until methemoglobin approaches lethal concentrations. Symptoms include cyanosis (bluish color of mucus membranes), labored breathing, muscular tremors, and eventual collapse. Coma and death usually follow within two to three hours. Postmortem confirmation of nitrate toxicity is chocolate-colored blood; however, the color will change to dark red within a few hours after death.

A veterinarian should perform the diagnosis and treatment of nitrate toxicity. In acute cases where time is limited, an antidote of methylene blue can be injected to convert the methemoglobin back to hemoglobin.

Forage suspected to contain high nitrate levels should be tested by a laboratory before feeding to livestock. Unfortunately, different laboratories may report nitrate level as nitrate (NO_3), nitrate-nitrogen (NO_3-N), or potassium nitrate (KNO_3). Potassium nitrate, nitrate nitrogen, or percent nitrate can be converted to ppm nitrate using the conversion factors in Table 2.

Resources

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Winter and Summer Forages

2016 Summer Annual Forages

2015 Summer Annual Forages

2015 Winter Annual Forages

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- **Garden City, Hays, and Scandia**

K-STATE
Research and Extension

Funding Provided By: The Ogallala Aquifer Program, USDA-ARS, Industry Partners, NRCS & KS Agricultural Exp Station

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