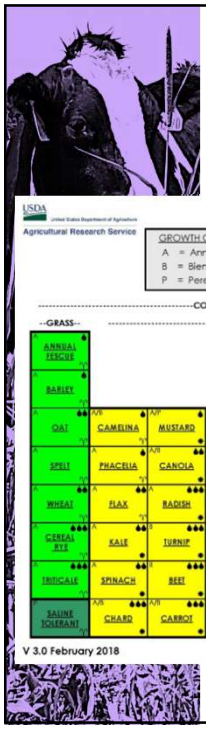
# Cover crops from a livestock perspective

Jaymelynn Farney, PhD
Associate Professor, Beef Systems Specialist
Kansas State University



## Introduction




- Incorporating cattle into cover crops quicker economic return on investment in seed (Franzluebbers et al., 2007; Drewnoski et al., 2018)
- Selecting plant species difficult with all the options
- Operations have specific goals
  - No one-size fits all plans

# Integrated Crop-Livestock Systems

- "Encourage sustainable farming and generate positive interactions between crops and livestock with environmental and economic benefits" Allen et al., 2007
- Benefits:
  - Reduce risk of raising single product
  - Increase water infiltration
  - Resist soil erosion
  - Build soil organic carbon
  - Manure from livestock increases within-farm nutrient cycling = less synthetic fertilizers

Summarized by Maughan, 2009

# Issues with cattle grazing crops

- Compaction??
- Water
- Fencing
- Toxicities

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# Why integration of cattle and covers on operations

## Cattle Performance

| Measure | Tillage[1] | Winter CC[2] | Summer CC[3] |
|---|---|---|---|
| Calf daily gain (lb/hd/d) | CT | 4.61 | **1.81*** |
| | NT | 5.00 | **2.05*** |
| Cow daily gain (lb/hd/d) | CT | 0.55 | 2.00 |
| | NT | 2.98 | 2.16 |
| Cow/calf pair daily gain (lb/hd/d) | CT | **3.17*** | 3.22 |
| | NT | **4.32*** | 3.64 |
| Calf gain (lb/a) | CT | **157*** | 206 |
| | NT | **213*** | 230 |
| Cow gain (lb/a) | CT | **38*** | 54 |
| | NT | **149*** | 77 |
| Cow/calf pair gain (lb/a) | CT | **182*** | 247 |
| | NT | **312*** | 289 |

[1] CT = conventional till and NT = no-till
[2] Summer grain (Sorghum 2002-2004) or corn (2005) and winter cover crop (Rye)
[3] Winter grain (Wheat) and summer cover crop (pearl millet)
* Indicates difference in tillage treatment

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Franzluebbers and Stuedemann, 2007. Renewable Ag and Food Systems

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# Economics - $/acre

| System | Tillage | Grazing | Total Cost | Crop Value | Calf gain value | Total crop and calf value | Net return over variable costs |
|---|---|---|---|---|---|---|---|
| Sorghum (corn) + rye | CT | Ungrazed | 159.62 | 122.13 | 0.00 | 122.13 | -37.49 |
| | | Grazed | 160.00 | 131.75 | 117.57 | 249.32 | 89.32 |
| | NT | Ungrazed | 160.59 | 153.13 | 0.00 | 153.13 | -7.46 |
| | | Grazed | 159.16 | 117.50 | 159.66 | 277.16 | 118.00 |
| Wheat + pearl millet | CT | Ungrazed | 122.96 | 100.17 | 0.00 | 100.17 | -22.79 |
| | | Grazed | 118.58 | 103.25 | 154.31 | 257.56 | 138.98 |
| | NT | Ungrazed | 129.71 | 95.50 | 0.00 | 95.50 | -34.21 |
| | | Grazed | 127.75 | 97.83 | 172.35 | 270.18 | 142.43 |
| No cost associated for fence in this analysis | | | | | | | |

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# K-State 1 yr Study

- Lyndon, KS
- Fescue versus cocktail cover crop
  - Hay, mineral, corn/distillers supplement
  - Fescue – 8 lbs/hd/d and Cocktail 5 lb/hd/d
- Wheat – cover crop – soybean
- Turn out Nov. 18 remove Feb. 10
- Shrunk body weight on an off pasture

## Raw Results

| Item | Fescue | Cover Crop |
|---|---|---|
| Heifers | | |
| No. head | 24 | 24 |
| Initial weight | 457 | 460 |
| Final weight | 602 | 626 |
| Total gain | 145 | 166 |
| Average daily gain | 1.63 | 2.00 |

## Cattle Economics

**Fescue**

- Supplement: $0.72/hd/d
- Fescue rental: $0.75/hd/d
- Hay/mineral: $19.88/hd

**Feeding cost: $140.42/hd**

- Sale wt: 602 pounds

**Sale value: $878.92**

**Covers**

- Supplement: $0.43/hd/d
- CC cost: $0.61/hd/d
- Hay/mineral: $19.88/hd

**Feeding cost: $105.16/hd**

- Sale wt: 626 pounds

**Sale value cattle: $913.96**

$35.26 lower cost in covers

$35.04 more in sale value

**$70.30/hd advantage to the covers**


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## Type and common cool season annuals

**Fall/Winter**

- Grasses
  - Rye, barley, oat, triticale, wheat, rye, ryegrass
- Broadleafs
  - Brassicas, buckwheat
- Legumes
  - Winter pea, clovers

**Summer**

- Grasses
  - Sorghums, sudans, millets, corn, teff
- Broadleafs
  - Sunflowers, buckwheat
- Legumes
  - Sunn hemp, forage soybeans

# What do we plant?

- Perennial systems diversity is the best (Gunter et al., 2012; Gadberry et al., 2015; Keyser et al., 2016)
  - Bermuda/bahiagrass pastures addition of wheat+ryegrass, wheat+ryegrass+red clover, wheat+ryegrass+white clover+crimson clover
  - Calf weaning weight greater – cow effects no difference
- Legumes in meadow or tall fescue cattle gains improved (Schaefer et al., 2014)
- In an already diverse perennial pasture – addition of 3, 5, or 8 additional plant species did not affect cattle performance (Tracy and Faulkner, 2006)

# What do we plant?

- Annual forages – few head to head between grass only and mixture
- Florida study addition of triticale into ryegrass did not improve cattle gains and was more expensive (Vendramini et al., 2016)
- Gains: Oat-ryegrass mixture = rye-ryegrass-oat mixture > rye-ryegrass mixture (Mullenix et al., 2012)
- Gains: Wheat = wheat+radish (Farney et al., unpublished)
  - *P* = 0.12 but gains are 0.50 lb/d lower with wheat+radish
  - Grain yield reduced with radish

## Average Hay Quality of 2012 Winter Forages

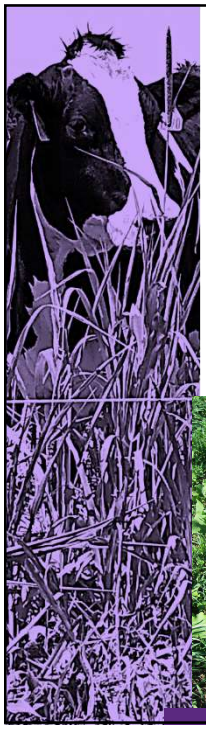
| Crop | % Crude Protein Dry Basis | % TDN Dry Basis | NO3 ppm |
|---|---|---|---|
| Brassica | 29 | 80 | 2736 |
| Cereal | 25 | 72 | 2435 |
| Brome/fescue | 21 | 57 | 817 |

## Stockpiled Forage

- Fall cereals will typically have 150 lbs/acre of dry matter forage for ever inch of top growth
  - 6" tall rye would have 900 lbs/acre usable forage
- In an open graze situation cattle will utilize ~50% of the forage
  - So only 450 lbs/acre of forage will be consumed

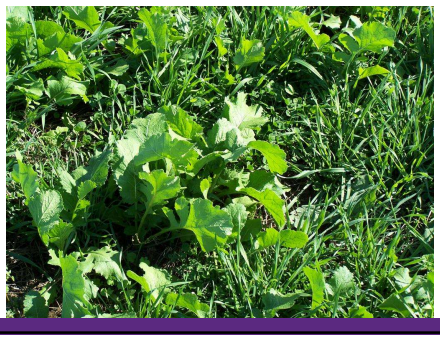
## Brassicas

- Brassicas are a highly productive and high quality forage
  - Turnips
  - Radish
  - Hybrid brassica
- Good utilization on crop fields for fall and winter grazing when fields would remain fallow otherwise
- Brassicas are >80% water, so maintaining a dry roughage in their diet is important



## Brassica

- Brassica forage quality is very high ranging from 17-22% protein
  - Turnip bulb protein content ranges from 12-15%
- Cattle will generally seek out the cereal before utilizing the turnip tops



# Brassica Quality

- Livestock devour brassica forage more rapidly following a hard freeze (28°F)
  - Digestibility increases significantly

**Forage quality measurements of canola PRE and POST freeze**

| Treatment | Protein | ADF | NDF | NEM | TDN | RFV |
|---|---|---|---|---|---|---|
| | % | % | % | (Mcal/lb) | (%) | |
| **PRE** | **26.2** | **21.8** | **24.5** | **0.84** | **73.2** | **277.3** |
| **POST** | **25.0** | **17.8** | **20.0** | **0.90** | **77.9** | **352.3** |
| LSD (0.05) | - | 1.65 | 1.5 | 0.03 | 1.9 | 23.9 |

Stamm, et. al

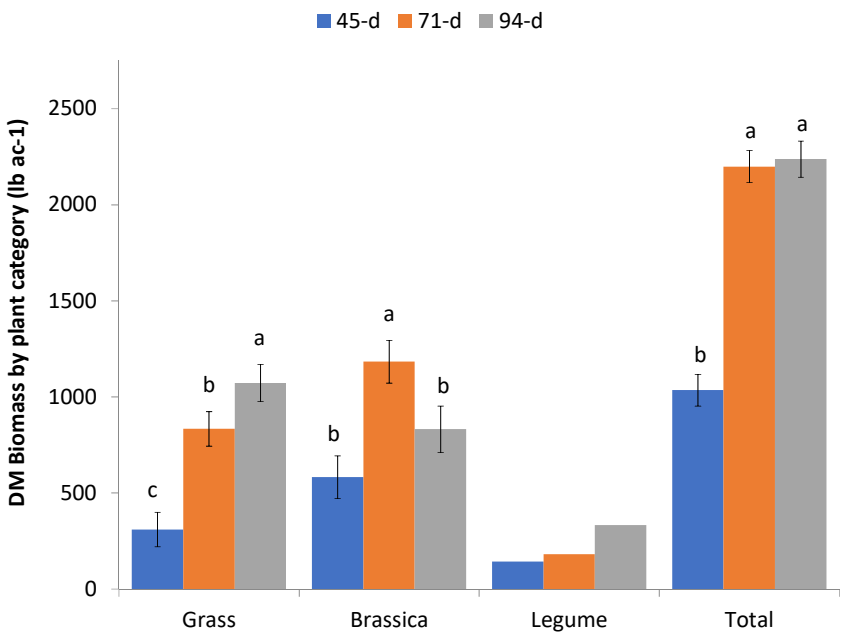
# Legumes

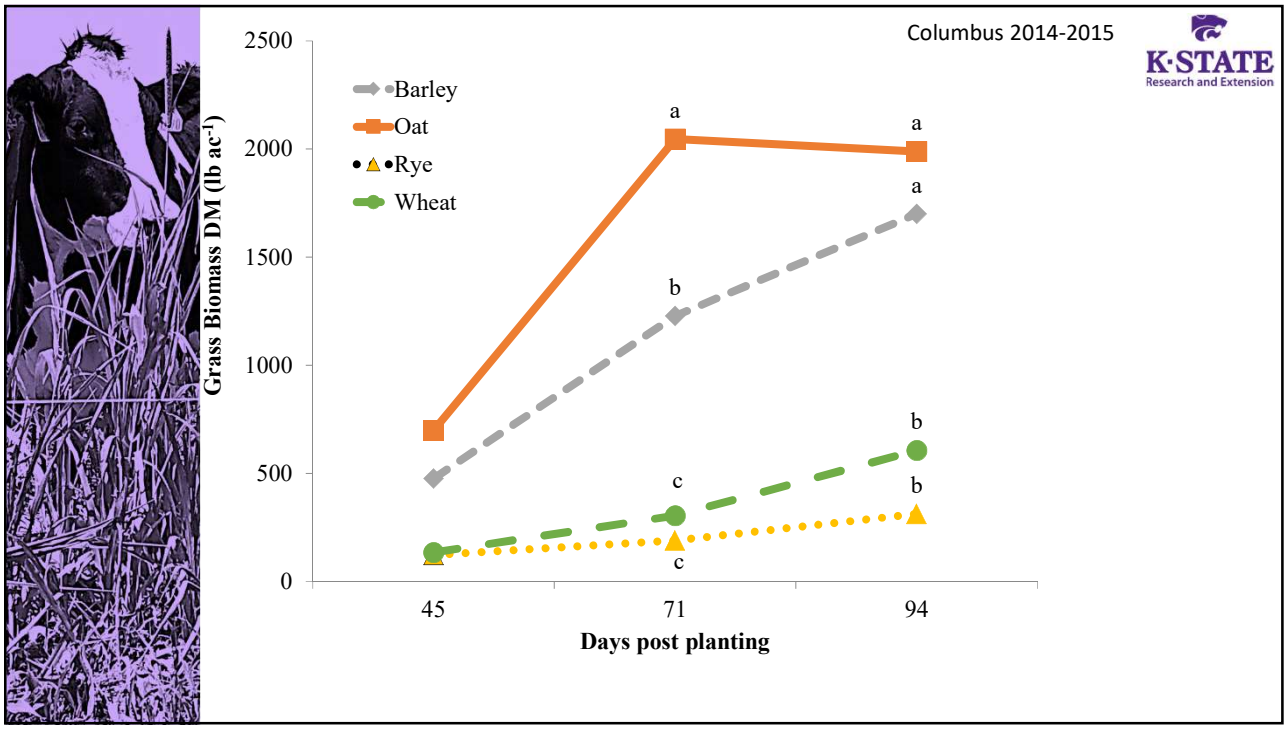
- Incorporated into mixes for N-fixation
- Winter growth of legumes very low in most of KS studies
  - Also around the country (minus hairy vetch; Coombs et al., 2017)
- Do we need legumes from a cattle diet perspective?
  - Plenty of N (CP from cereal grasses and brassicas)
    - Dairy study milk yield, fat, protein same in ryegrass or ryegrass + Berseem clover, crimson clover, and Persian clover (Veiga et al., 2016)
  - What's the difference in the amount of N contribution to the soil of plant vs cattle excretions?

# Winter legume emerged or not

- Columbus study **NO** difference in winter cover if legume emerged or did not
  - Biomass
  - Crude protein
  - TDN
  - ADF
  - NDF
  - Carbon
  - Nitrogen
  - C:N

Columbus 2014-2015




Columbus 2014-2015
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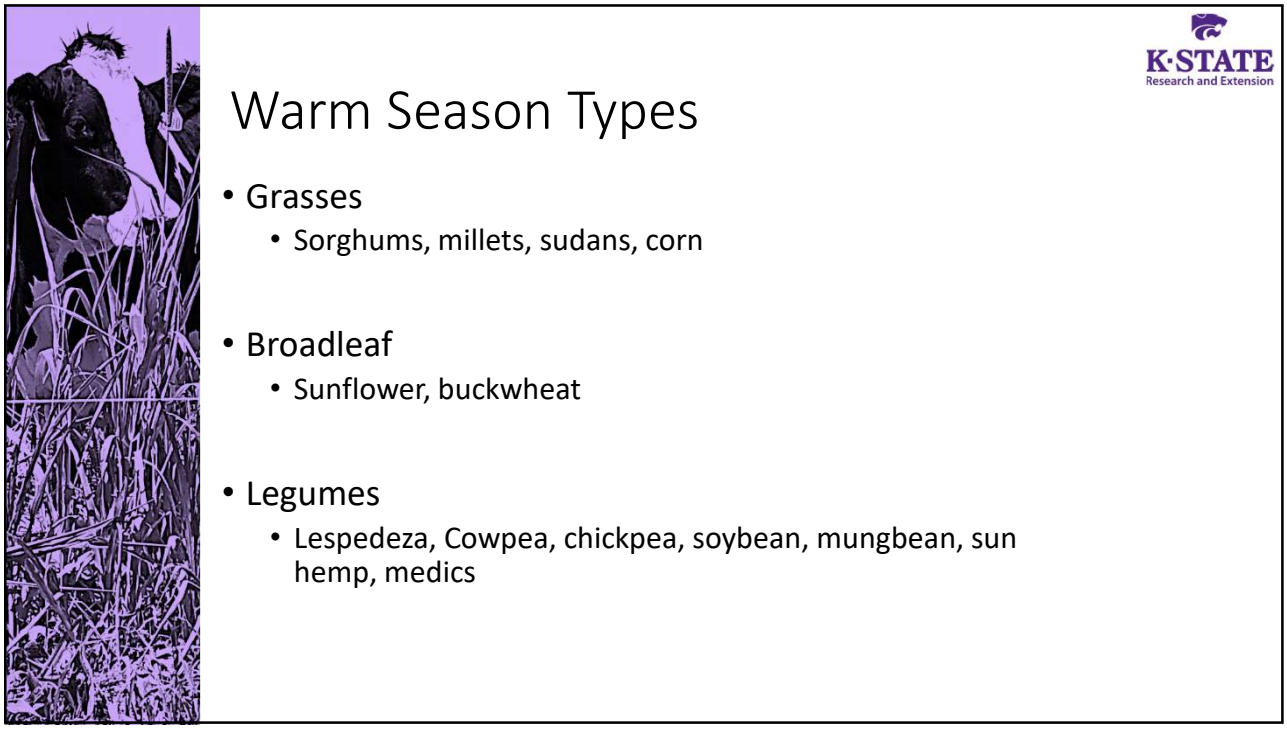
Grass Biomass DM (lb ac⁻¹)
2500
2000
1500
1000
500
0
Barley
Oat
Rye
Wheat
a
a
b
b
c
b
c
45
71
94
Days post planting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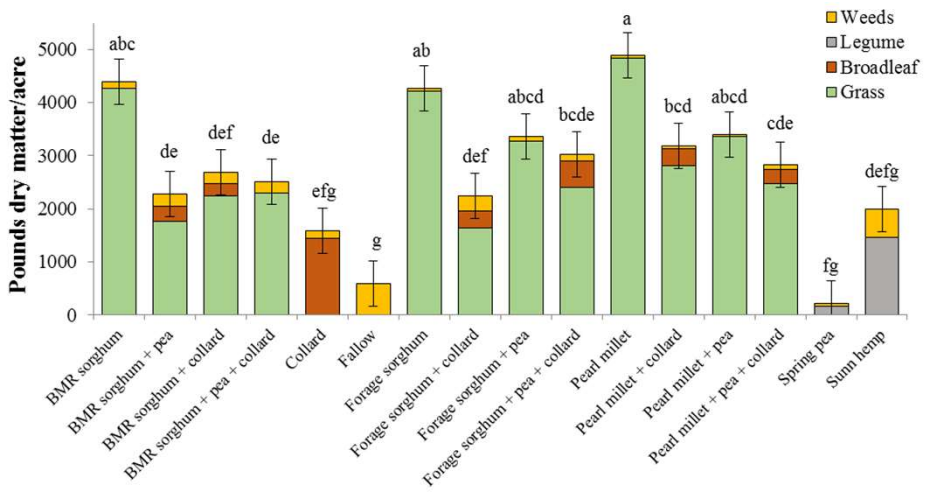
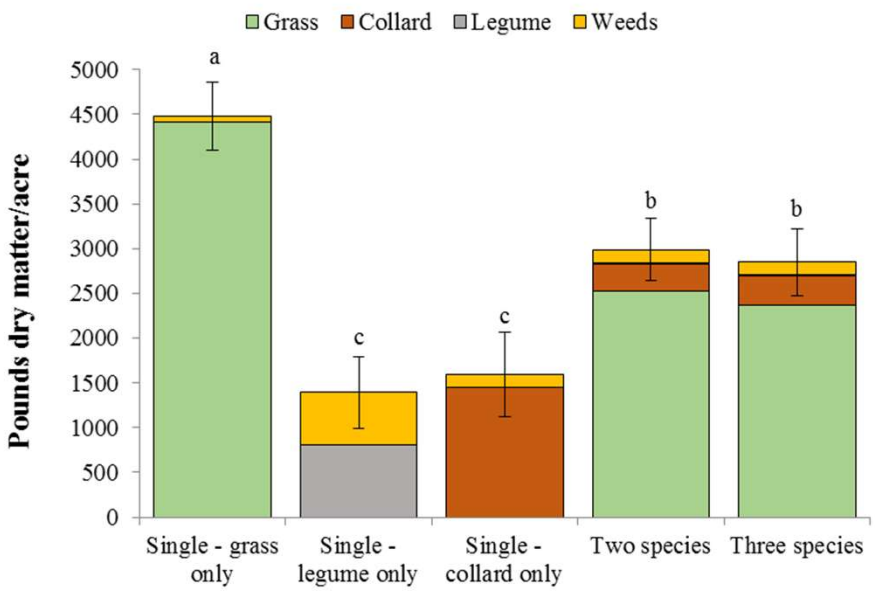
Warm Season Types
• Grasses
• Sorghums, millets, sudans, corn
• Broadleaf
• Sunflower, buckwheat
• Legumes
• Lespedeza, Cowpea, chickpea, soybean, mungbean, sun hemp, medics

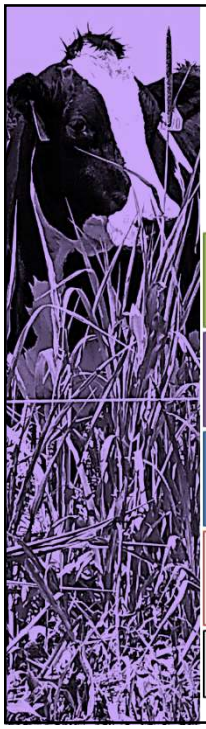
# Summer cover mixtures

| Mixture | Grass (lb/ac) | Collard (lb/ac) | Legume (lb/ac) |
|---|---|---|---|
| BMR sorghum | 20 | | |
| BRM sorghum + spring pea | 10 | | 25 |
| BMR sorghum + collard | 10 | 4 | |
| BMR sorghum + spring pea + collard | 7 | 2.7 | 17 |
| Collard | 8 | | |
| Forage sorghum | 20 | | |
| Forage sorghum + spring pea | 10 | | 25 |
| Forage sorghum + collard | 10 | 4 | |
| Forage sorghum + spring pea + collard | 7 | 2.7 | 17 |
| Pearl millet | 20 | | |
| Pearl millet + spring pea | 10 | | 25 |
| Pearl millet + collard | 10 | 4 | |
| Pearl millet + spring pea + collard | 7 | 2.7 | 17 |
| Spring forage pea | 50 | | |
| Sunn hemp | 15 | | |

# Summer cover mixtures



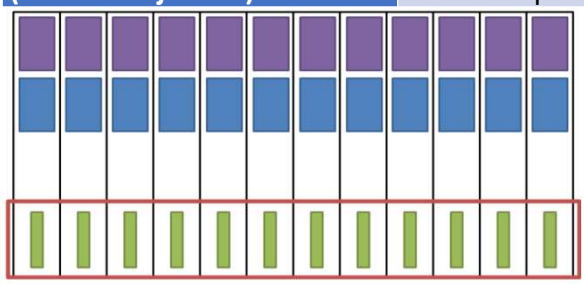


Key

- Grazing harvest sampling location
- Silage harvest sampling location
- Hay harvest sampling location
- Electric fence for grazing area
- Cover crop mixes

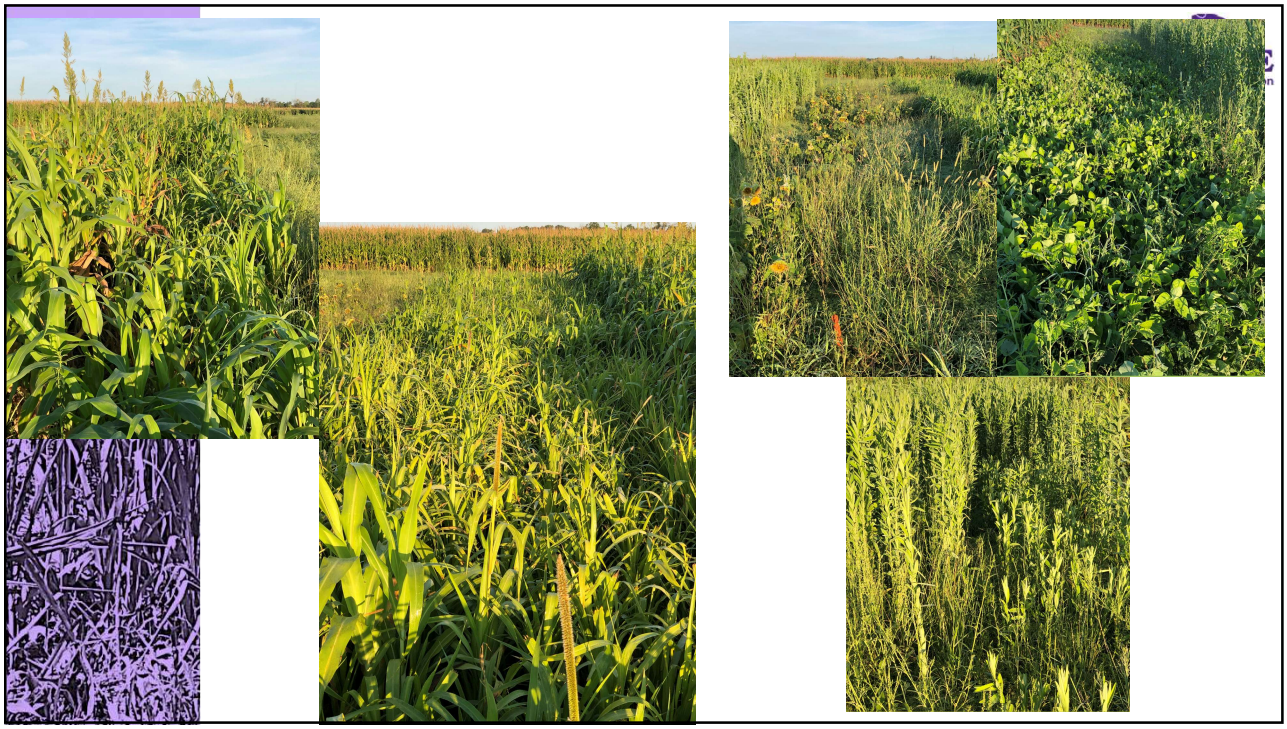
| Table 2: Summer cover crop treatments | |
|---|---|
| **Single species** | Multi-species mixtures |
| **Forage sorghum (Sorghum spp.)** | Forage sorghum – sunflower<br>Forage sorghum – sunn hemp |
| **Pearl millet (Pennisetum glaucum)** | Pearl millet – sunflower<br>Pearl millet – sunn hemp |
| **Sunflower (Helianthus annuus)** | Forage sorghum – sunflower –sunn hemp<br>Pearl millet – sunflower –sunn hemp |
| **Sunn hemp (Crotalaria juncea)** | Forage sorghum – Pearl millet – sunflower – sunn hemp |



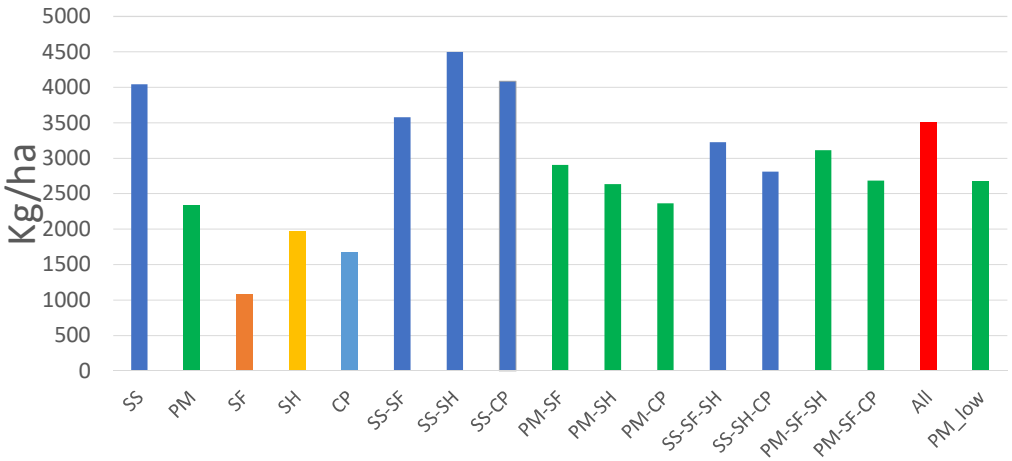
# Methods

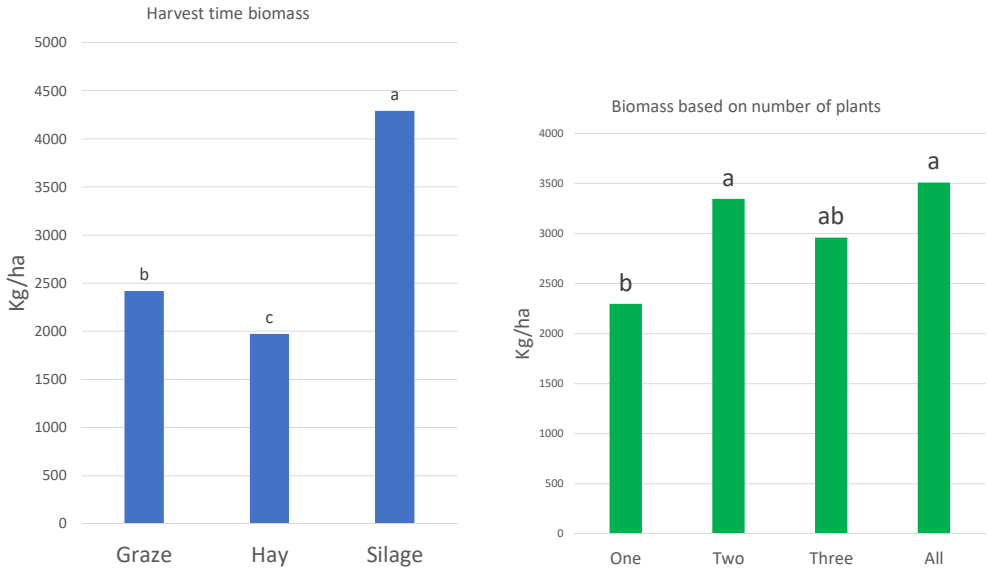
- Planted first of May
- Single species seeded at max recommended rate
- 2 species – each plant was seeded at 50% of max rate
- 3 species – each plant was seeded at 33% of max rate
- 5 species – each plant was seeded at 20% of max rate

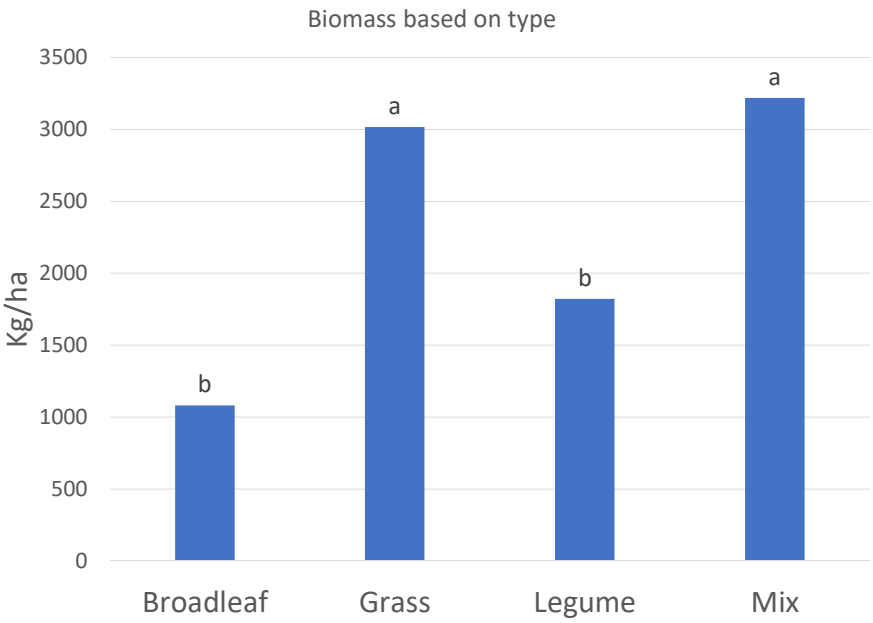
- Plant emergence data
- Graze 1st harvest 45 DAP, then every 28 days
- Hay harvested when 1st seedhead emerged
- Silage harvested when grasses were ~30% DM
- Quality (NDF, ADF, in vitro, CP, nitrates, minerals)
- Composition
- Individual plant species composition

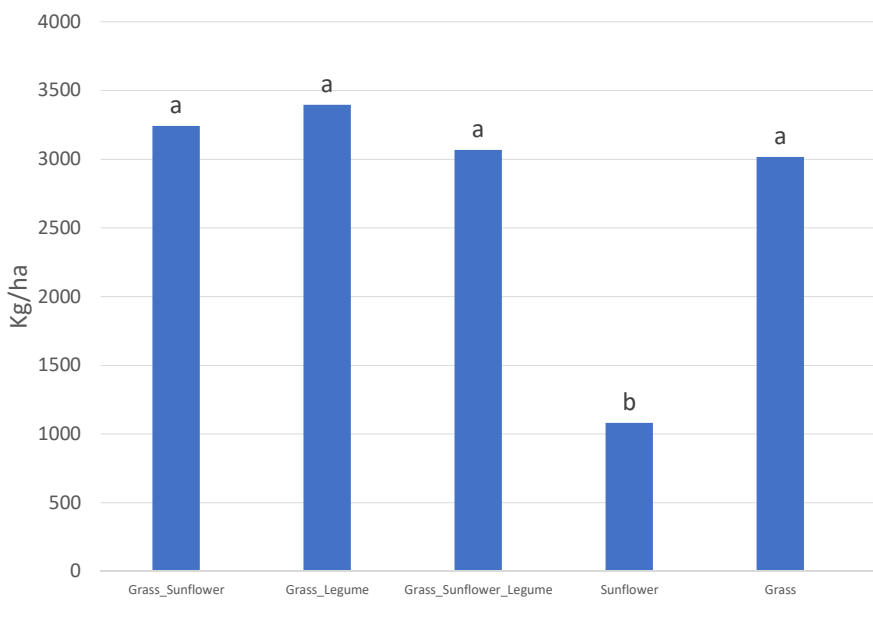


# Biomass All Treatments $P < 0.001$



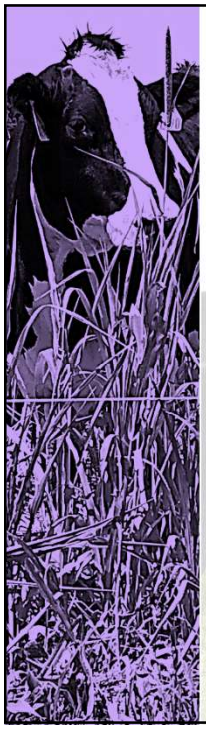




Biomass based on type
Kg/ha
3500
3000
2500
2000
1500
1000
500
0
b
a
b
a
Broadleaf
Grass
Legume
Mix


Biomass
Kg/ha
4000
3500
3000
2500
2000
1500
1000
500
0
a
a
a
b
a
b
Grass_Sunflower
Grass_Legume
Grass_Sunflower_Legume
Sunflower
Grass
Legume

## 2020 Warm Season grasses

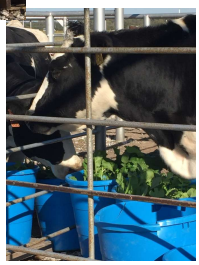
- Still analyzing quality
- Still have to analyze final cutting information
- Wheat in this plot so will have grain yield
- Included weed rings for weed suppression/emergence counts



## Cattle preference for annual forages

# Preference study – pre-freeze

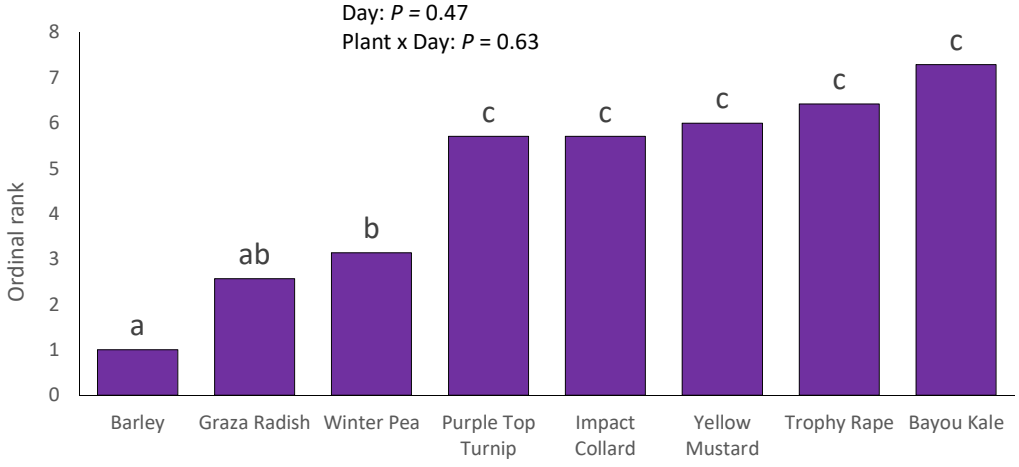
- Grew 8 plant species of fall/winter covers
  - Austrian winter pea
  - Winter barley
  - Bayou Kale
  - Trophy rape
  - Graza forage radish
  - Impact collard
  - Purple top turnip



- Offered plants for 2 consecutive days
  - Grazing occurred pre-freeze
- Recorded order consumed (1st, 2nd, 3rd….)

# Selectivity rank – pre-freeze

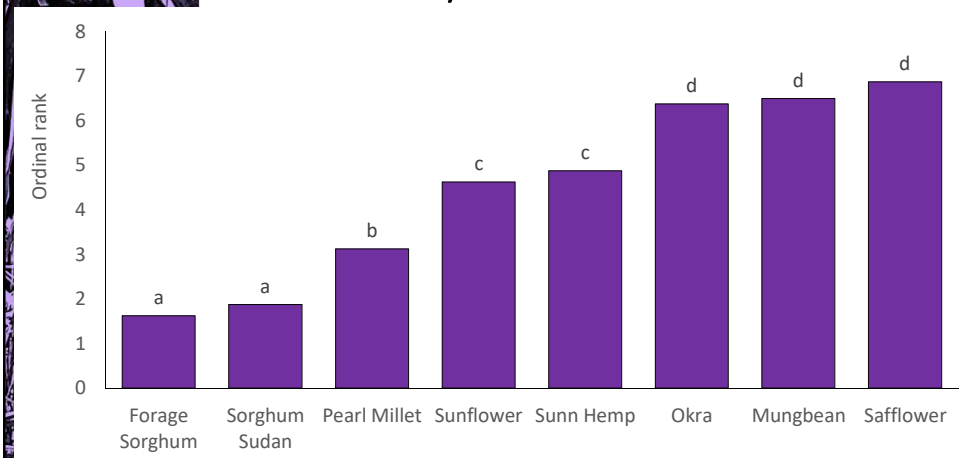
Plant type: $P < 0.001$
Day: $P = 0.47$
Plant x Day: $P = 0.63$



# Preference study – summer

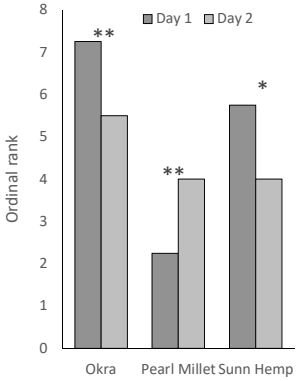
- Grew 8 plant species of fall/winter covers
  - Pearl millet
  - Mungbean
  - Okra
  - Sunflower
  - BMR forage sorghum
  - Safflower
  - Sunn hemp
  - Sorghum-sudan
- Offered plants for 2 consecutive days
- Recorded order consumed (1st, 2nd, 3rd….)

# Selectivity rank – summer annuals




[1]BMR variety Forage Sorghum
[2]SorGrow – sorghum-sudan
[3]Black Oil Sunflower

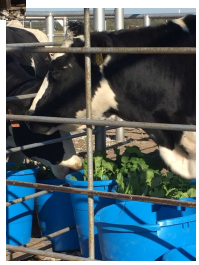
Plant type: $P < 0.001$
Day: $P = 0.93$
Plant x Day: $P = 0.04$




** $P < 0.05$
* $P < 0.10$

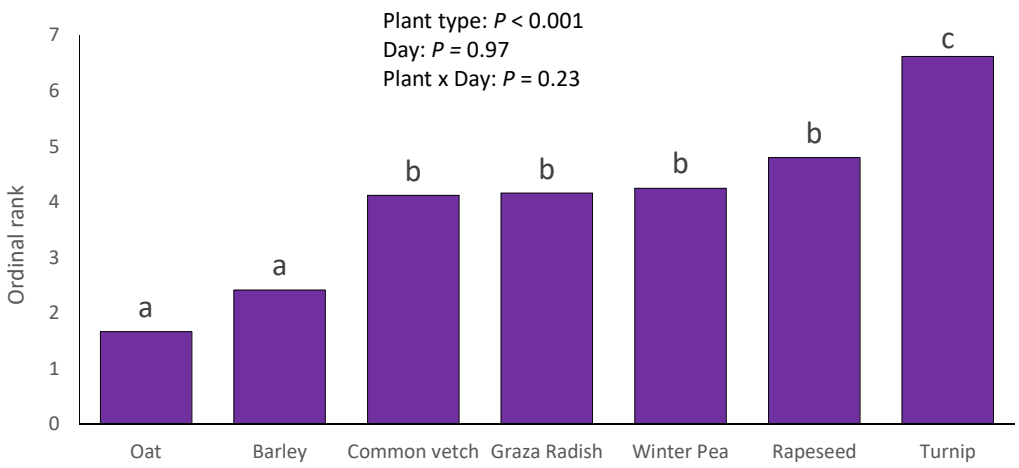
# Preference study – post-freeze

- Grew 8 plant species of fall/winter covers
  - Austrian winter pea
  - Winter barley
  - Rapeseed
  - Graza forage radish
  - Winter oat
  - Purple top turnip
  - Common vetch



- Offered plants for 2 consecutive days
  - Grazing occurred post-freeze
- Recorded order consumed (1st, 2nd, 3rd….)

# Selectivity rank – winter post-freeze



# How do we use annual forages for cattle?

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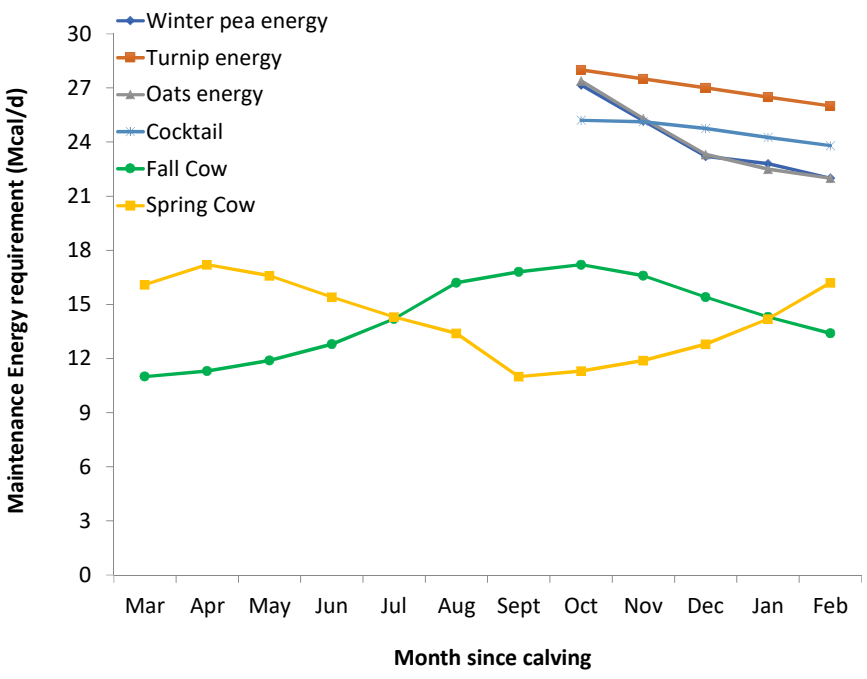
## Know purpose - Cattle

- **Are gains a priority**
  - **Might need to include supplement**
- **Is maximizing land a priority**
- **What class of animal maximizes the acreage**

# Winter Annuals and Cows

- Cow requirements, especially if dry, pregnant is much, much lower than what is offered by the winter annuals



# Winter Annuals and Cows

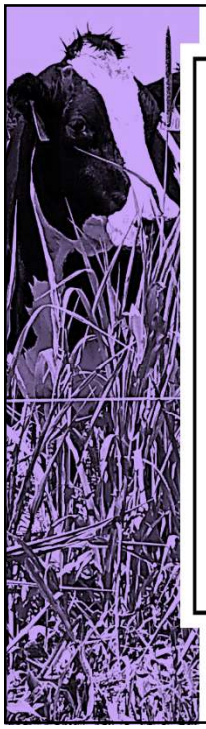
- Issues
  - Too much body condition
  - Inefficiency in production system
  - Loss of potential revenue
- Practices to manage for this:
  - Short term grazing on high quality forage
  - Combination paddock

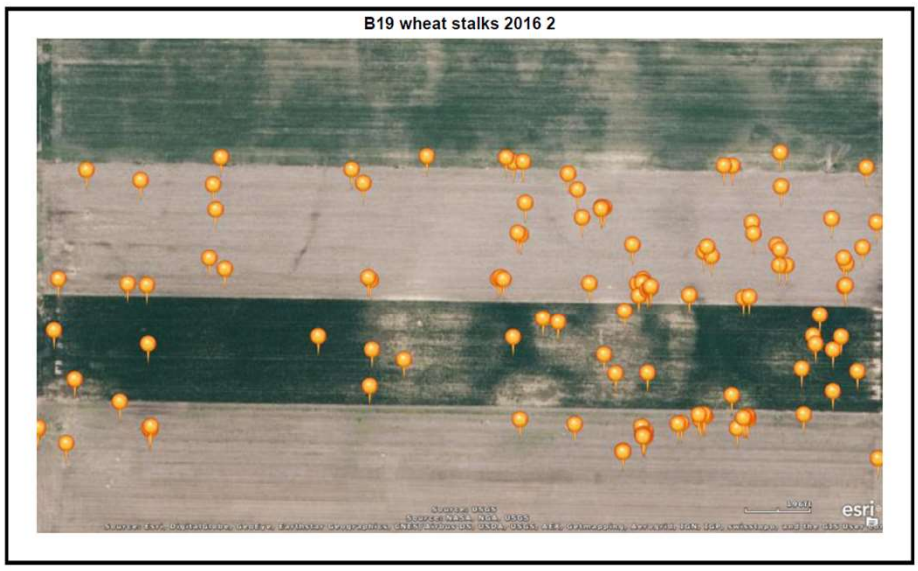
# Short term grazing

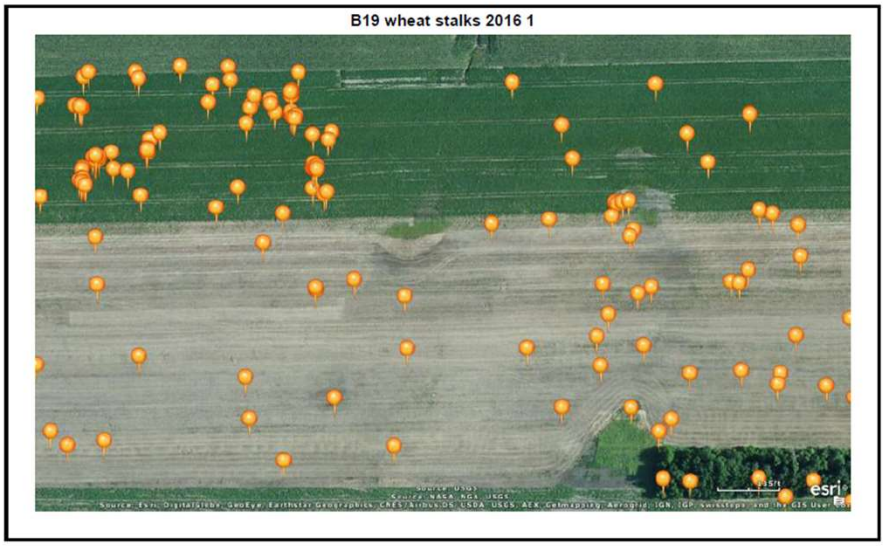
- Allow cows a couple of hours/d to graze high protein, high energy forage at least 3x/week
  - This is also know as limit grazing wheat pasture
- Oklahoma State University study
  - Allowed cows to graze wheat pasture for 4 hours 3x/week (Fall-calving herd)
  - Rest of the time cows where on native hay
  - From calving to weaning cows on this system performed exceptional

# Combination paddock

- Portion of pasture is corn/milo stalks or perennial pasture the other portion is cereal grain or brassica
  - Planting corners of circles with high quality forage
  - Fencing both types of forage
  - Flying on brassicas or cereal grains into residue??
- Cattle will consume a combination of residue and high quality forage
- Cows maintain appropriate body condition
- Removes the need for supplemental protein on residues








# How much high quality pasture need??

- Really for spring cows don't need anything other than corn stalks for 1st month of grazing
- If only want to fence once – determine was maximal acreage is needed for the highest nutrient requirement period and multiply by days (90 d)
  - Cow needs 1.14 ac of cocktail and 1.93 ac of stalks
- Fall cows for 90 d
  - Cow needs 1.51 ac of cocktail and 2.18 ac of stalks

## Weaned Calves

- Most of the time, we still are offering too much protein (much higher than requirements)
- Need another source of dry forage/feed

- Maximize gain potential want to make protein to energy ratio optimal
- Maximize gain = maximum dry matter intake

## Value of winter cover crops - stockers

- Nebraska data showed that calf gains are VERY variable with cover crop mixtures
- Over 10 studies
  - ADG ranged from 0.8 lb/d up to 2.3 lb/d
  - Same cocktail in back-to-back years
    - 2.3 lb/d one year and 1.3 lb/d next year

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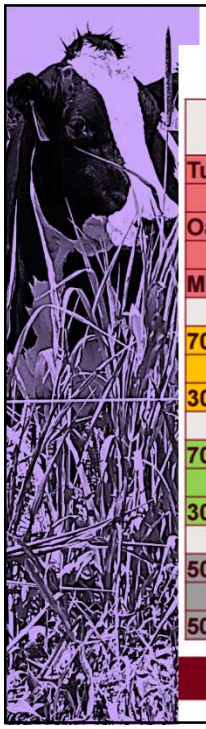
# Calf gains on cereal grains

| Cereal type | Cattle Type | Gain | Location |
|---|---|---|---|
| Oat | Heifer | 1.96 | North Dakota |
| Barley | Heifer | 1.96 | North Dakota |
| Barley | Heifer | 1.75-1.96 | South Dakota |
| Barley | Steers | 3.0 | Canada |
| Oat | Steers | 2-3.5 | Canada |
| Rye | Steers | 2.25-2.6 | Canada |
| Triticale | Steers | 1.7-2.4 | Canada |
| Wheat | Steers | 1.87 | Canada |
| Oat-Ryegrass | Steers | 3.06 | Alabama |
| Oat-Rye-Ryegrass | Steers | 2.78 | Alabama |
| Rye-Ryegrass | Steers | 2.50 | Alabama |
| Ryegrass | Calves | 1.96 | Florida |
| Ryegrass-triticale | Calves | 1.68 | Florida |



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# Grazing Weaned Calves Data - Eric Mousel

| | CP | Cost/T DM | Performance ADG | COG |
|---|---|---|---|---|
| Turnip + Radish + Rape | 18% | $46.00 | 1.37 | $0.26 |
| Oats | 20 | $57.33 | 2.55 | $0.18 |
| Millet | 14 | $26.39 | 2.57 | $0.08 |
| 70% Turnip \| 30% Oats | 18 | $47.70 | 1.56 | $0.24 |
| 30% Turnip \| 70% Oats | 18 | $53.93 | 2.23 | $0.19 |
| 70% Turnip \| 30% Millet | 16 | $40.11 | 1.78 | $0.18 |
| 30% Turnip \| 70% Millet | 15 | $32.27 | 2.36 | $0.11 |
| 50% Turnip \| 50% Oats | 18 | $51.66 | 2.26 | $0.18 |
| 50% Turnip \| 50% Millet | 16 | $36.19 | 2.31 | $0.12 |

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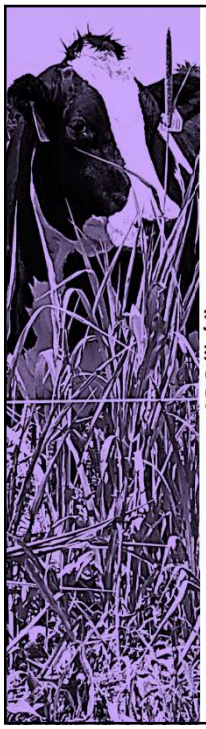


# Dual purpose wheat and compaction

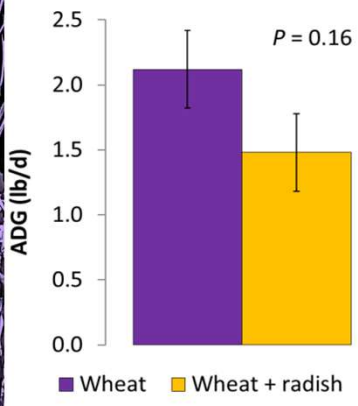



**Figure 4:** Calf average daily gain on dual-purpose wheat with or without radish (averaged over two years)
Farney and Sassenrath, unpublished

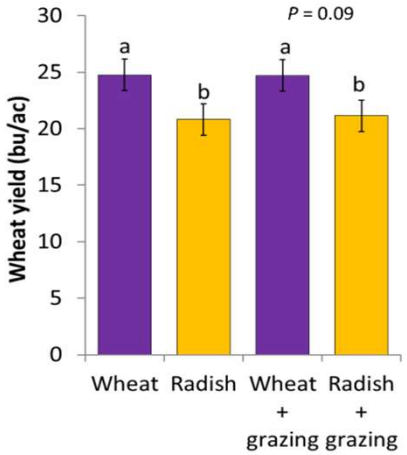
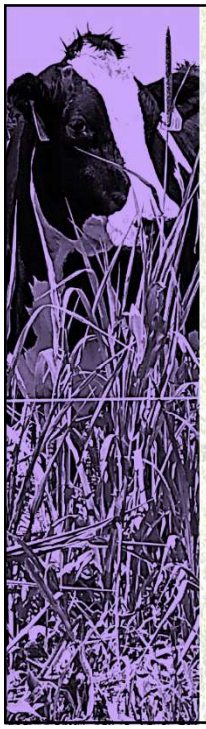


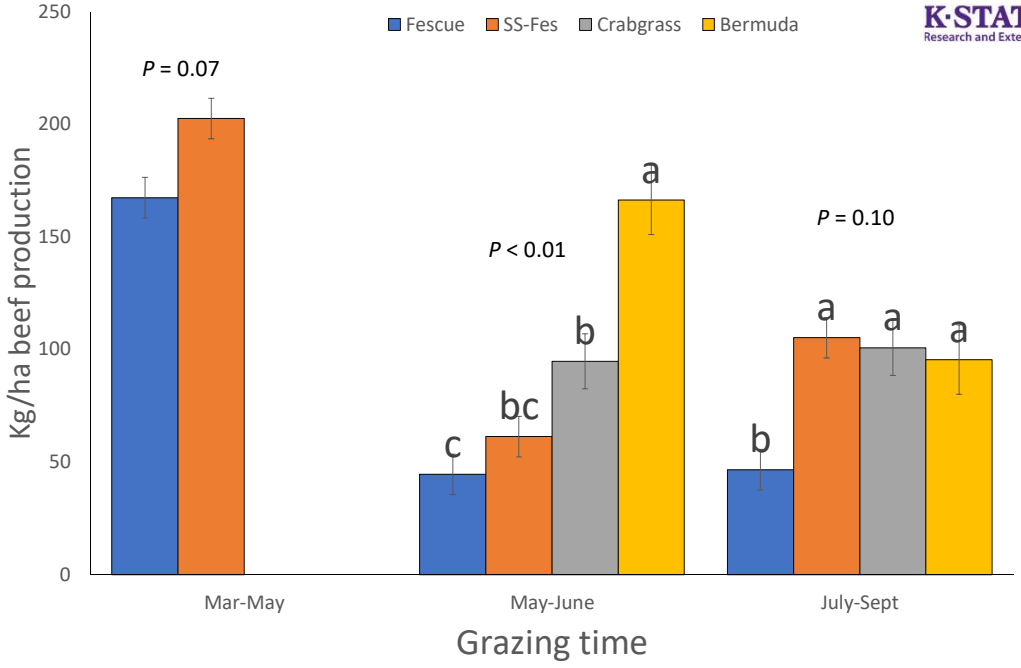

**Figure 5:** Dual-purpose wheat yield averaged over two years with or without radish and with or without grazing.. [ab] Letters with different superscripts differ $P < 0.05$.
Farney and Sassenrath, unpublished



# Grazing systems with covers

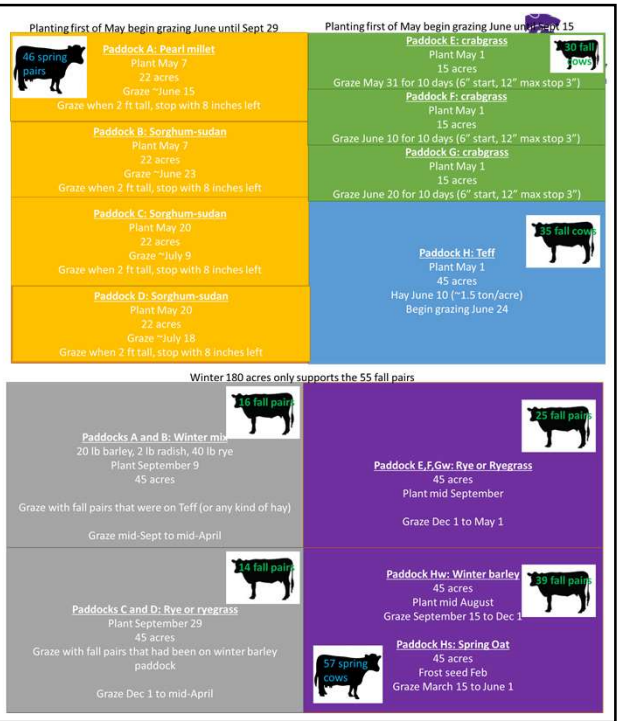
# Warm-season systems

- Year 1 of 3
- Fescue
  - 2 pastures – stocked 1 ac/hd – March to November
- Sorghum-sudan Fescue
  - 2 pastures rotationally grazed in 3 paddocks
  - Stocked 0.67 ac/hd – March to July (“mowing fescue”)
  - Drilled 25 lb/ac sorghum-sudan May 26
  - Stocked 1 ac/hd – July to November
- Crabgrass
  - 3 pastures rotationally grazed in 2 paddocks stocked 1 ac/hd
- Bermudagrass
  - 3 pastures rotationally grazed in 2 paddocks stocked at 0.8 ac/hd



# On-going project

- On-farm project converting 160 acres of cropland into a year-long annual forage grazing system
  - Summer 2020 start
    - Teff, sorghum-sudan, crabgrass
    - Supported 110 cows May – mid-September
      - 46 spring pairs and 65 fall cows
- Capture stocking rate, water runoff, and cow performance data during this transition

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GREAT PLAINS GRAZING
CATTLE, CLIMATE, CULTURE & CHANGE

- Collaborators/students:
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  - DeAnn Presley
  - Catherine Davis
  - Lyle Lomas
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jkj@ksu.edu

620-820-6125

Thanks!!

Questions