USDA United States Department of Agriculture

# Cereal-Grain Forages: Providing Nutrient Management Options and Dairy Forage

World Dairy Expo
Dairy Forage Seminar
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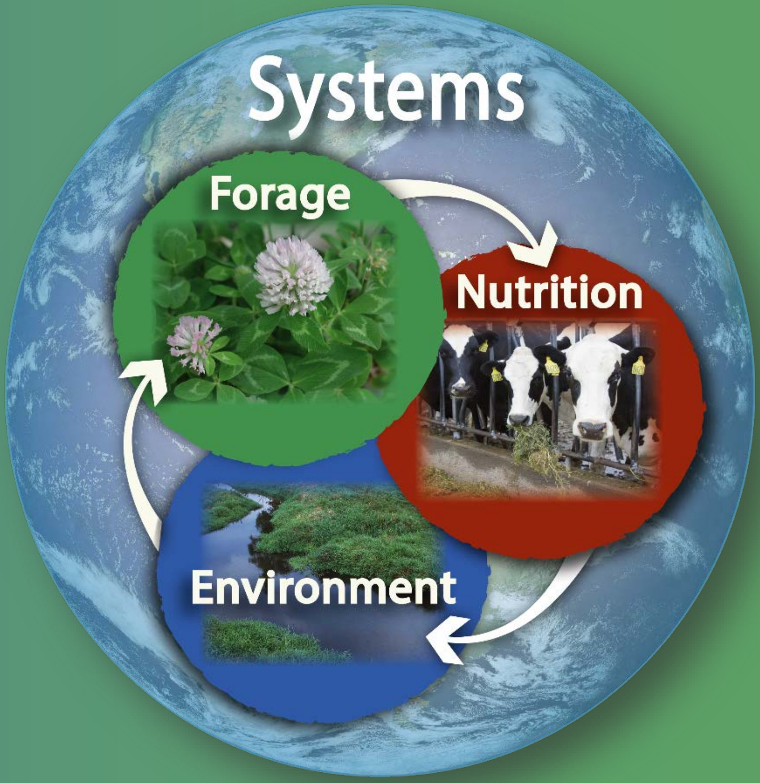


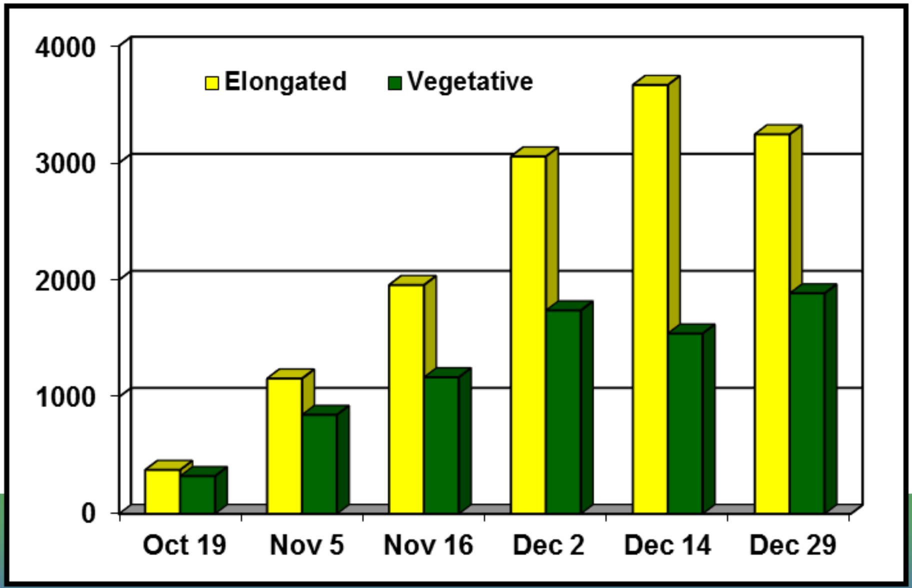
**In Oklahoma, wheat is used primarily as a dual-purpose (forage and grain) crop, but across the border in Arkansas these production practices are completely segregated.**



**Forage quality is exceptionally high, but fall/winter availability often is limiting, and becomes a serious problem if the producer is heavily invested in recently weaned stocker cattle.**

Horizon 474 (fall) Oat | Blaze (spring) Oat | AR 910 (soft red) Wheat

December 14, 2004




**What can we do to maximize fall forage yield?**

**Fall DM Yield (lbs/acre)**
**Fayetteville 2004**

*Gunsaulis et al. (2008)*

# Obvious Limitation for Fall-Grown Oat
# No Regrowth Potential

← **Blaze Spring Oat**

**(no regrowth)**

**February 15, 2005**

**Armor Prograze Wheat →**

**(regrowth)**

**February 15, 2005**

*Gunsaulis et al. (2008)*

# *Early Conclusions*

- ***In Arkansas, forages that elongate will out-yield those that remain vegetative by about a 2:1 ratio before winter.***

- ***Oat will joint and elongate during late fall, but there is very little regrowth potential from oat after jointing.***

- ***Depending on weather, growth responses can be highly variable.***

# What about Wisconsin?


?

# Management Considerations

***● Ideally, it would be desirable to double-crop oats or other cereal-grain forages after harvesting corn silage, and this is possible further south (Mid-Atlantic).***

***● Unfortunately, Wisconsin is too far north, and the growing season is too short – if you want to harvest additional fall forage.***

***● In Wisconsin, a fall crop of cereal-grain forage (oats) will need to follow a summer harvest of cereals as silage or grain.***

***● Another option is to eliminate old stands of alfalfa early (late-July or early-August), and then plant oats.***

***● Either way, an opportunity exists for summer manure distribution.***

**Prairie du Sac, WI**

**2006-2007**

***Wheat***

**Hopewell**

**Kaskaskia**

***Triticale***

**Trical 2700**

***Oat***

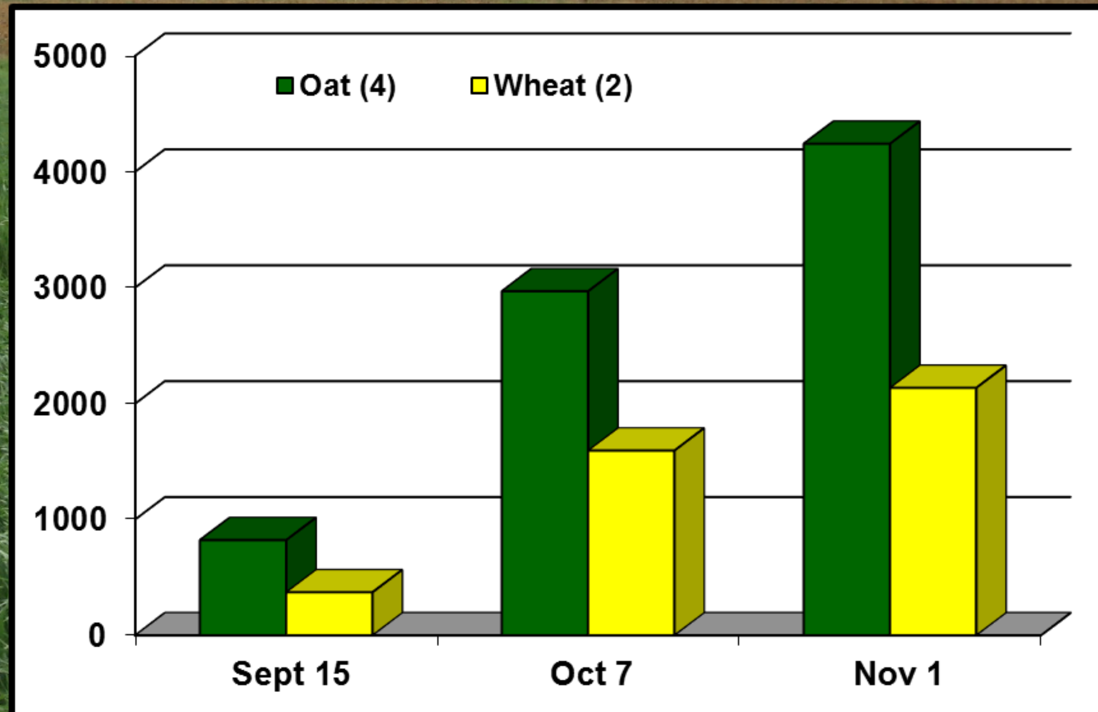
**Ogle**

**Drumlin**

**Vista**

**ForagePlus**

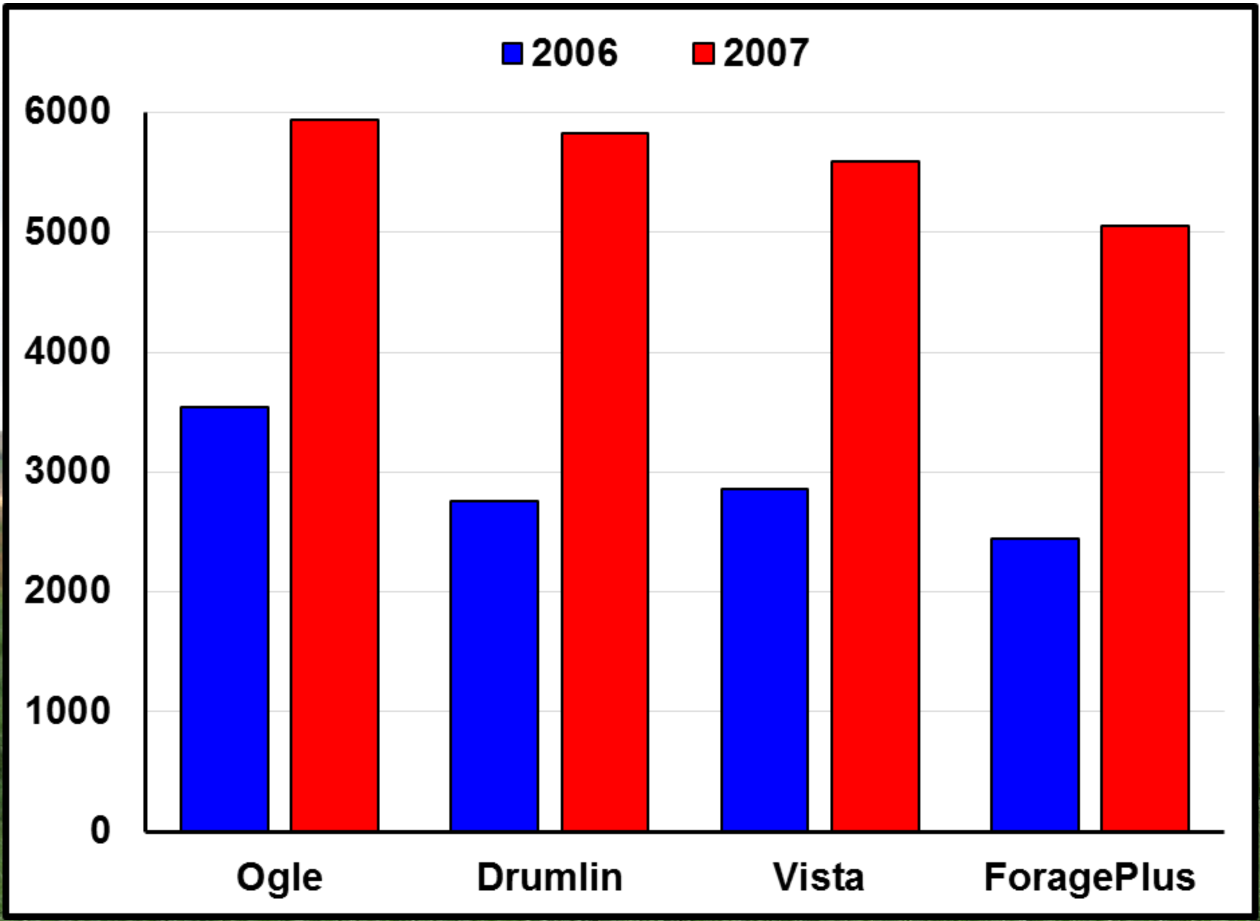
**Yield responses (lbs/acre) for elongated (oat) cultivars maintained the same 2:1 advantage over vegetative (wheat) cultivars.**




*Coblentz and Walgenbach (2010)*

# Fall Forage Yield (lbs DM/acre) on November 1 for Four Oat Cultivars

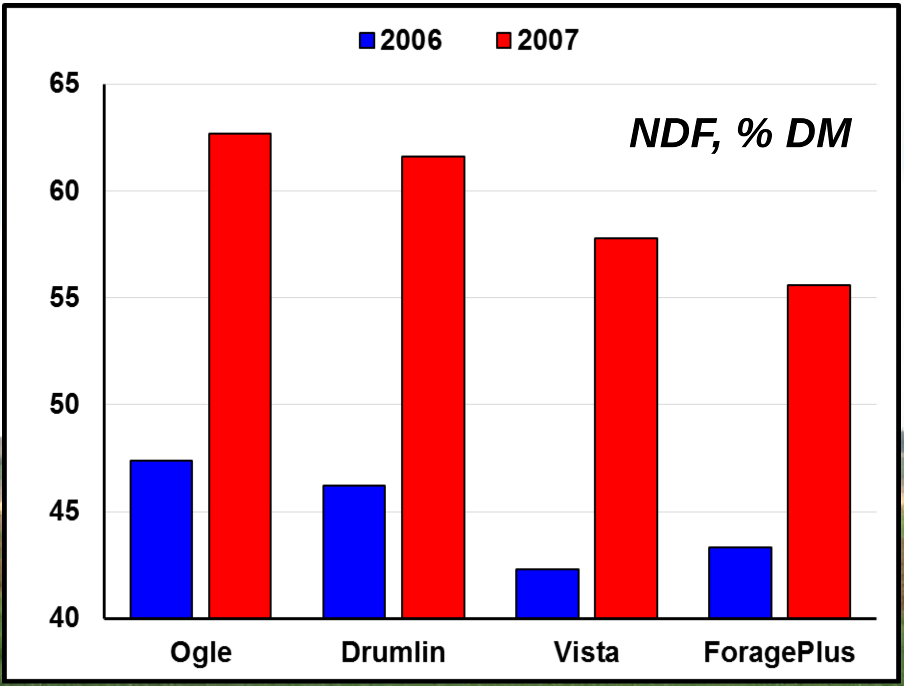
# Prairie du Sac, WI (2006-07)

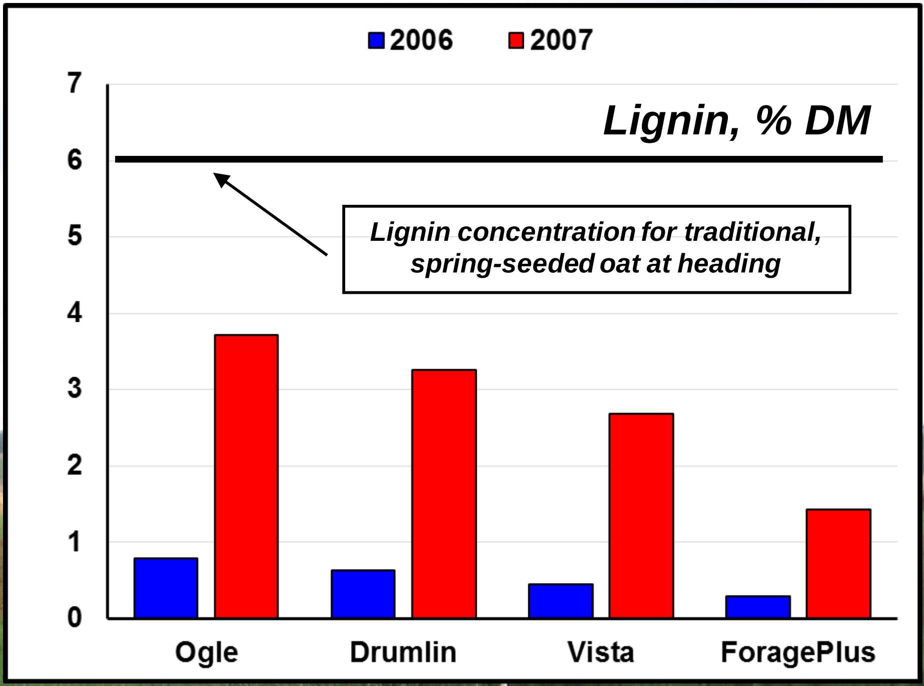


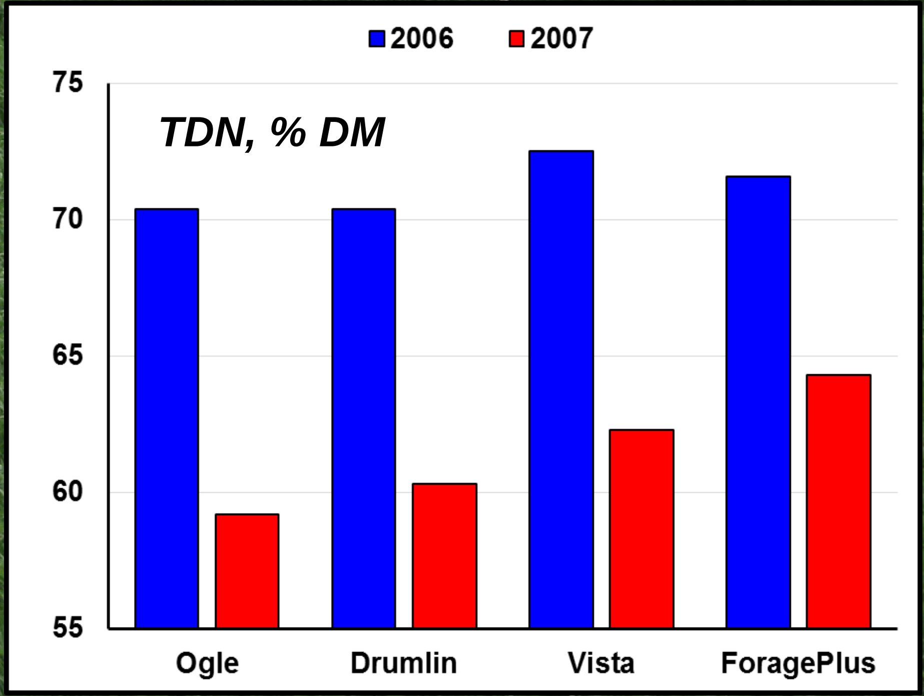

| Variety | 2006 | 2007 |
|---|---|---|
| Ogle | Elongated (3.8) | Heading |
| Drumlin | Elongated (3.3) | Early heading |
| Vista | Elongated (3.3) | Late Boot |
| ForagePlus | Elongated (2.1) | Elongated |

**Yield responses for oat cultivars were opposite those expected following traditional spring establishment across a wide range of harvest dates.**

*Coblentz and Walgenbach (2010)*

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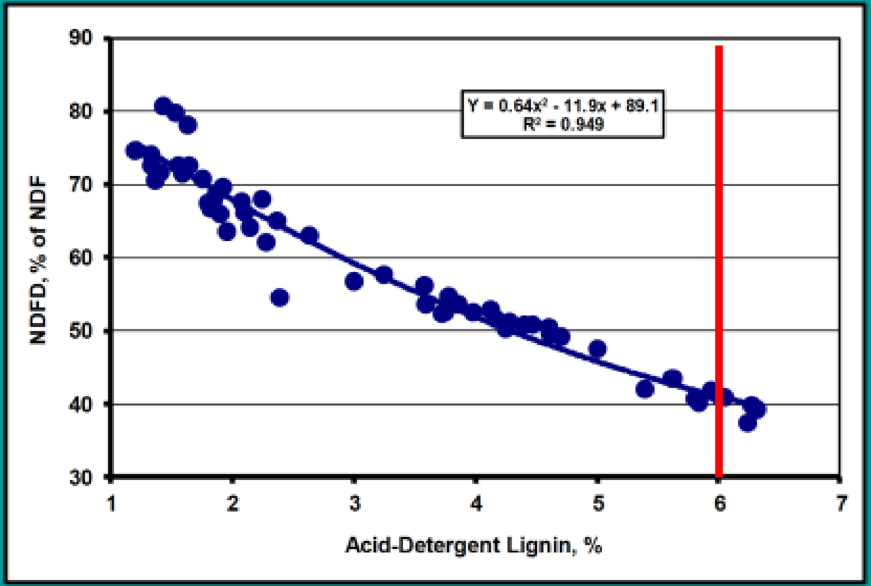
*Coblentz and Walgenbach (2010)*

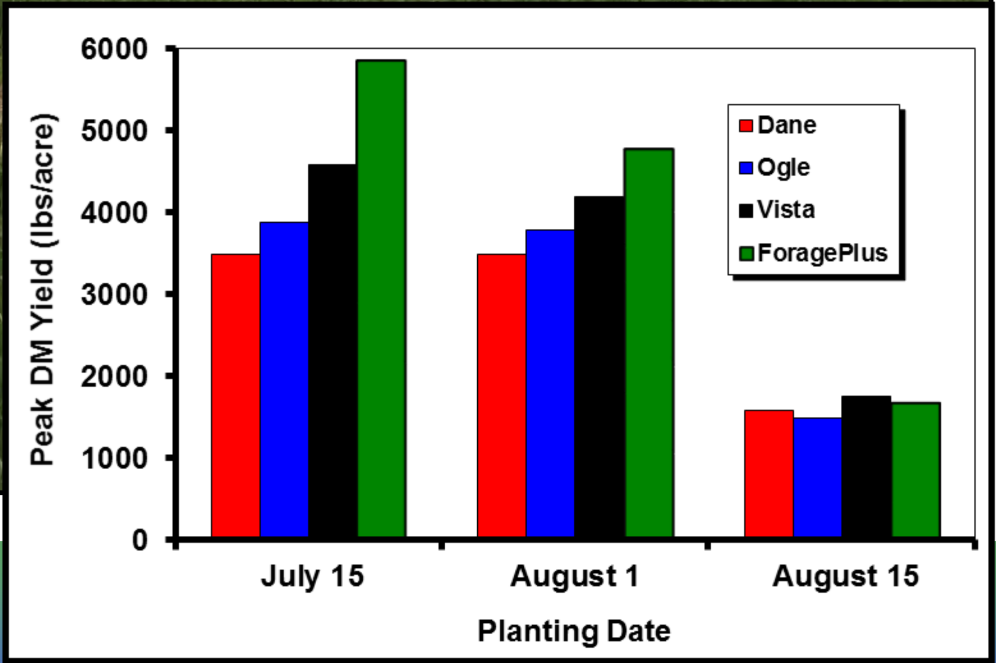
*Pictures worth a thousand words ……………….*




*Coblentz et al. (2012)*

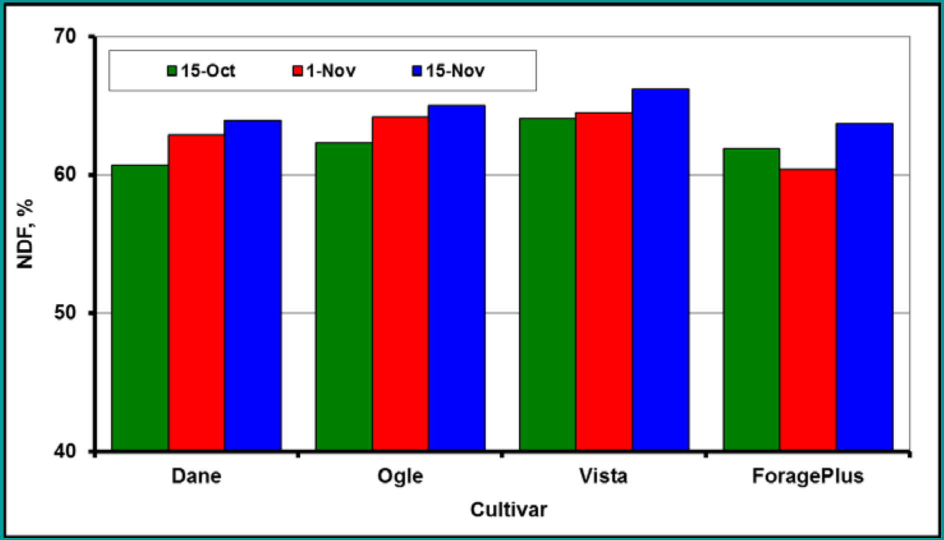
# So ….. Which Cultivar Do I Plant ? And When?

# Effects of Planting Date and Oat Cultivar on Peak Yield of Fall-Grown Oat (Marshfield, WI; 2007-2009)

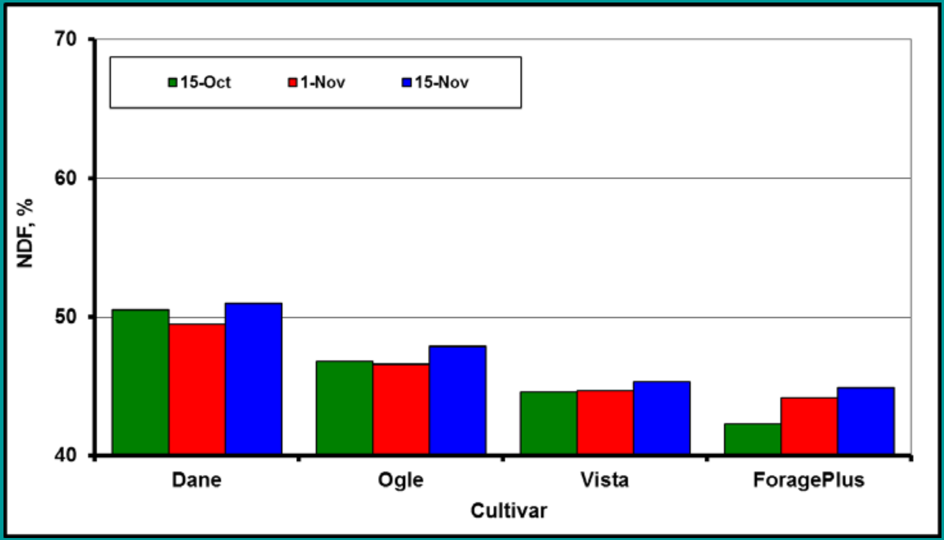




Coblentz et al. (2011)

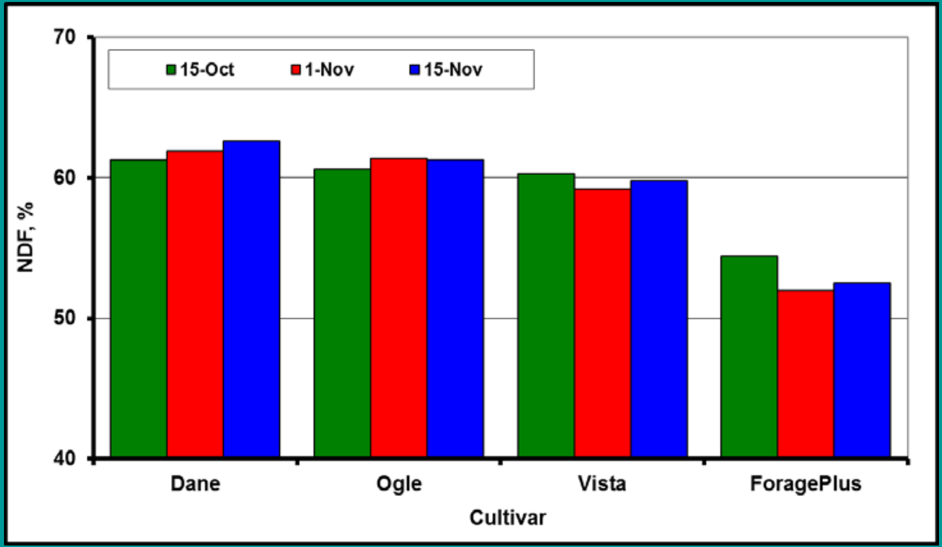
## July 15




## August 15




## August 1

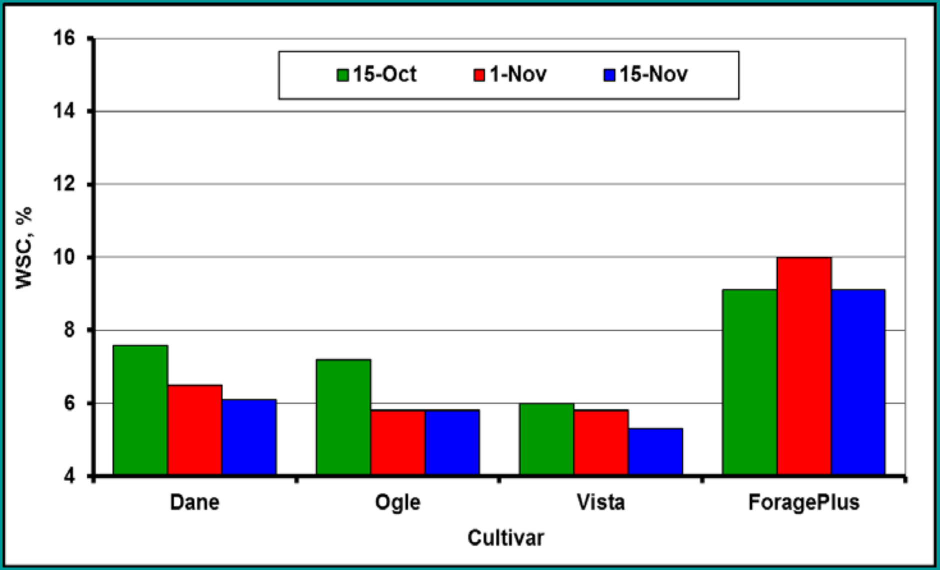



# *Effects of Cultivar and Harvest Date on Interactive Concentrations of NDF (% of DM)*

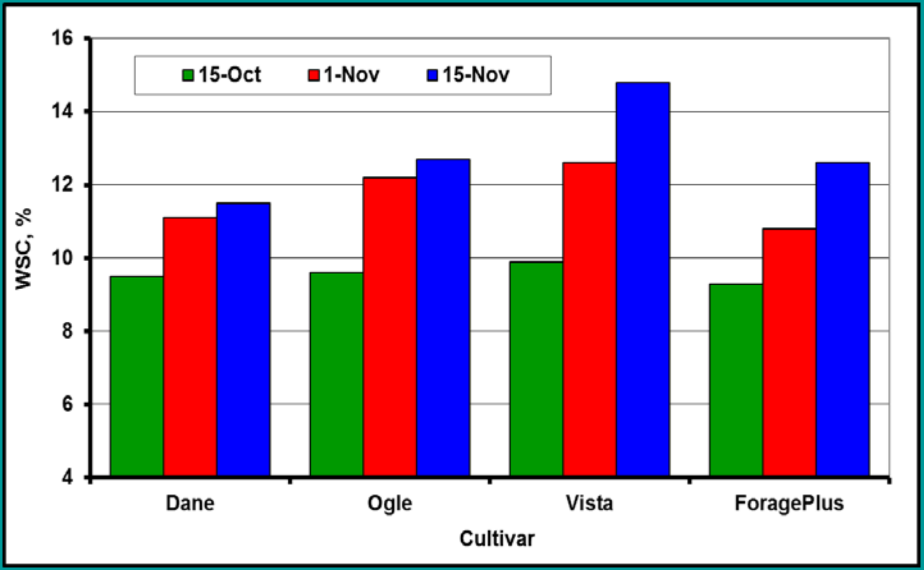
## *2007-2009*

*Coblentz et al. (2012)*

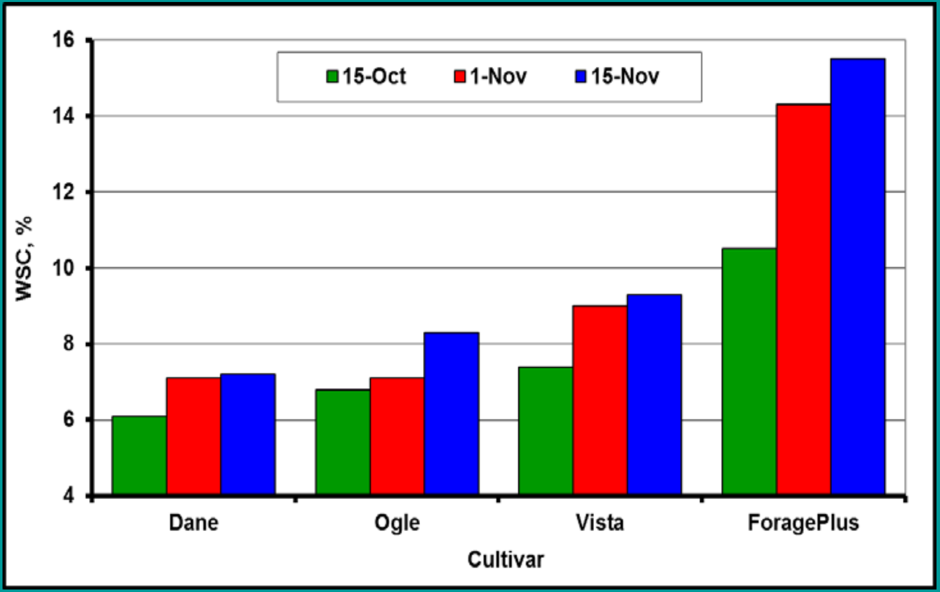
## July 15




## August 15




## August 1

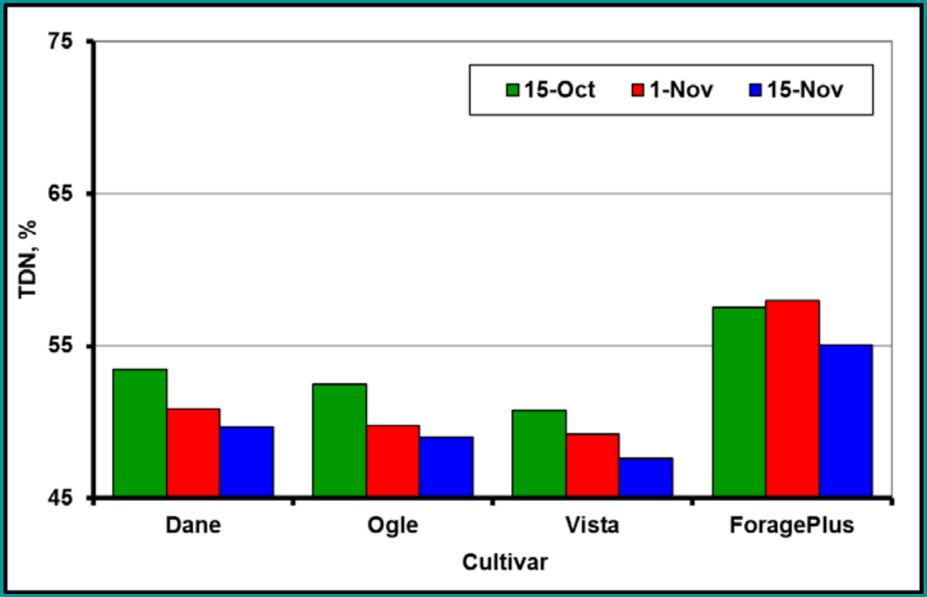



# *Effects of Cultivar and Harvest Date on Interactive Concentrations of WSC (% of DM)*

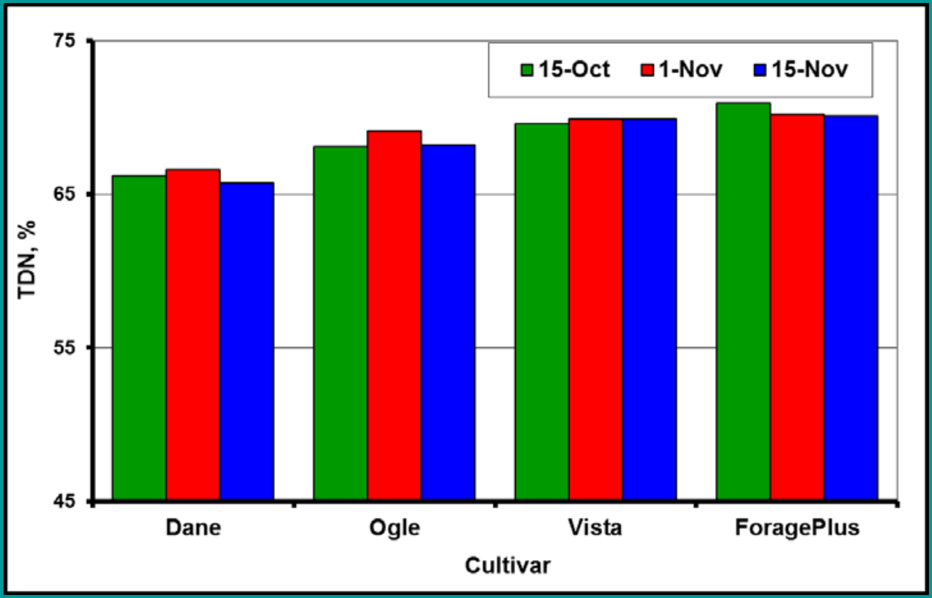
# *2007-2009*

*Coblentz et al. (2012)*

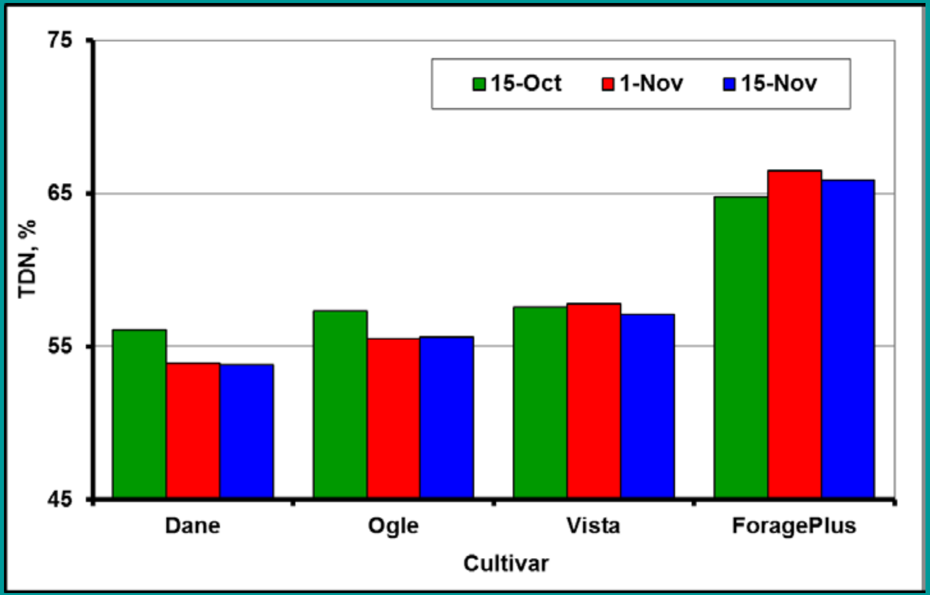
July 15




August 15




August 1



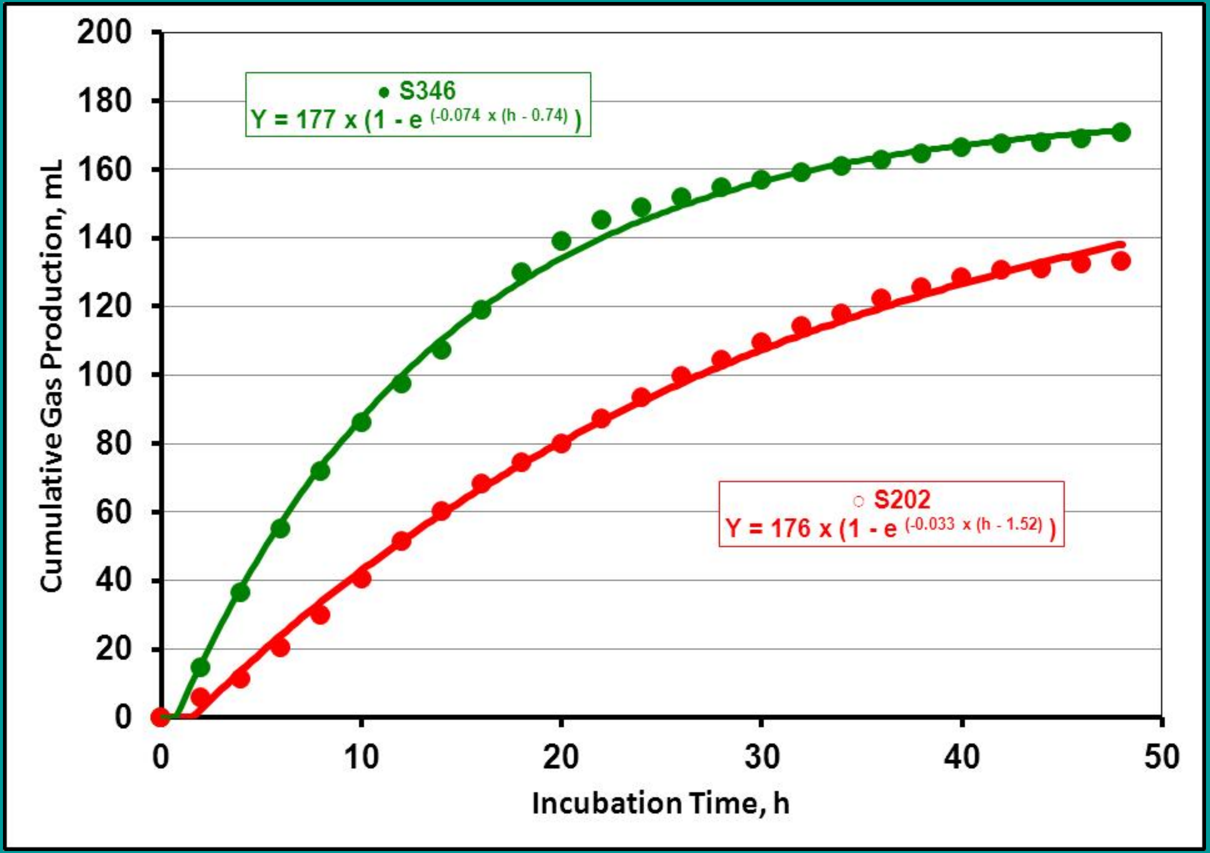

# *Effects of Cultivar and Harvest Date on Interactive Concentrations of TDN (% of DM)*

## *2007-2009*

*Coblentz et al. (2012)*

# In-Vitro Gas Production

***Further Evidence of Dilution ….***


## In Vitro Gas Production

| Item | S202 | S346 |
|---|---|---|
| Planting | 1 Aug | 1 Aug |
| Harvest | 15 Sep | 3 Nov |
| Height, in | 19 | 27 |
| Stage | Veg | Boot |
| NDF, % | 46.3 | 45.2 |
| ADF, % | 23.4 | 23.0 |
| HEMI, % | 22.9 | 22.2 |
| CELL, % | 21.8 | 21.4 |
| Lignin, % | 0.84 | 1.10 |
| Lignin/NDF | 0.018 | 0.024 |
| CP, % | 27.3 | 11.6 |
| WSC, % | 3.5 | 19.4 |
| NFC, % | 10.1 | 32.8 |
| Ash, % | 15.0 | 9.1 |
| TDN, % | 64.8 | 69.4 |

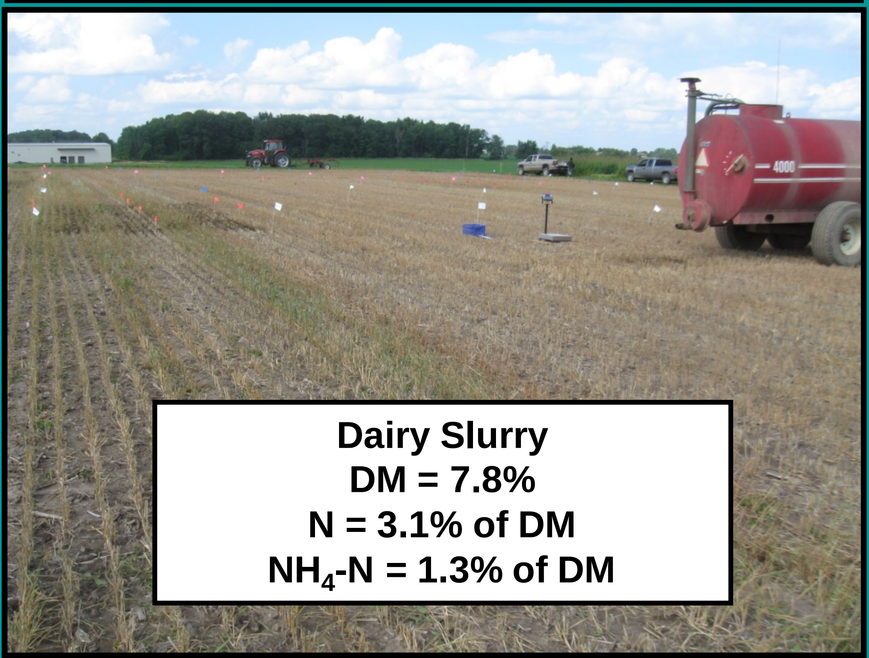
| Gas Production | S202 | S346 |
|---|---|---|
| 12 h, mL/g | 52 | 100 |
| 24 h, mL/g | 92 | 145 |
| 48 h, mL/g | 138 | 171 |
| MAX, mL/g | 176 | 177 |
| *K*, /h | 0.033 | 0.074 |
| Lag time, h | 1.52 | 0.74 |

*Coblentz et al. (2013)*

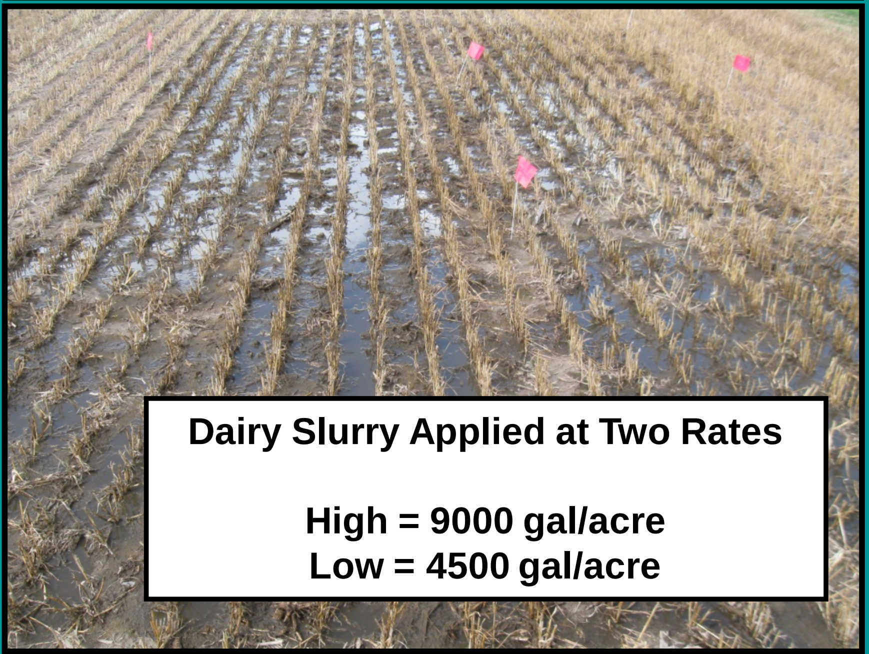

# Application of Bedded-Pack Manure (2011-2012)

***Low Rate = 10.2 tons/acre (wet)***
***High Rate = 20.0 tons/acre (wet)***
***DM = 23%***
***N = 1.9%***
***Bedding Source = Wood Shavings***
***C/N Ratio = 22***

# *Application of Dairy Slurry (2013-2014)*

**Dairy Slurry**
**DM = 7.8%**
**N = 3.1% of DM**
**$NH_4$-N = 1.3% of DM**



**Dairy Slurry Applied at Two Rates**

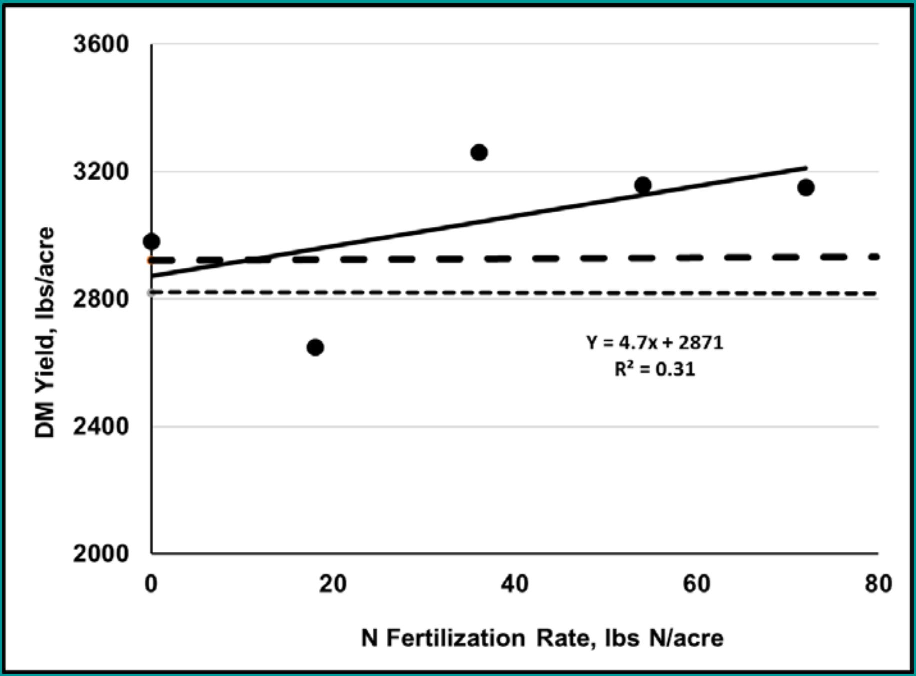
**High = 9000 gal/acre**
**Low = 4500 gal/acre**

# DM Yields of Fall-Grown Oat (2013-2016)

| Treatment | N Application Rate | Bedded Pack | Dairy Slurry |
|---|---|---|---|
| | lbs N/acre | ---------------- lbs DM/acre | -------------- |
| Control | 0 | 2982 | 1876 |
| Urea | 18 | 2650 | 2483 |
| Urea | 36 | 3261 | 2659 |
| Urea | 53 | 3160 | 3211 |
| Urea | 71 | 3152 | 3374 |
| Urea | 89 | . . . | 3535 |
| Manure | ~ 90 | 2820 | 2699 |
| Manure | ~ 180 | 2922 | 2939 |

*Coblentz et al. 2014, 2016*

# Fertilizer Equivalents from Dairy Manures, 2011-2014



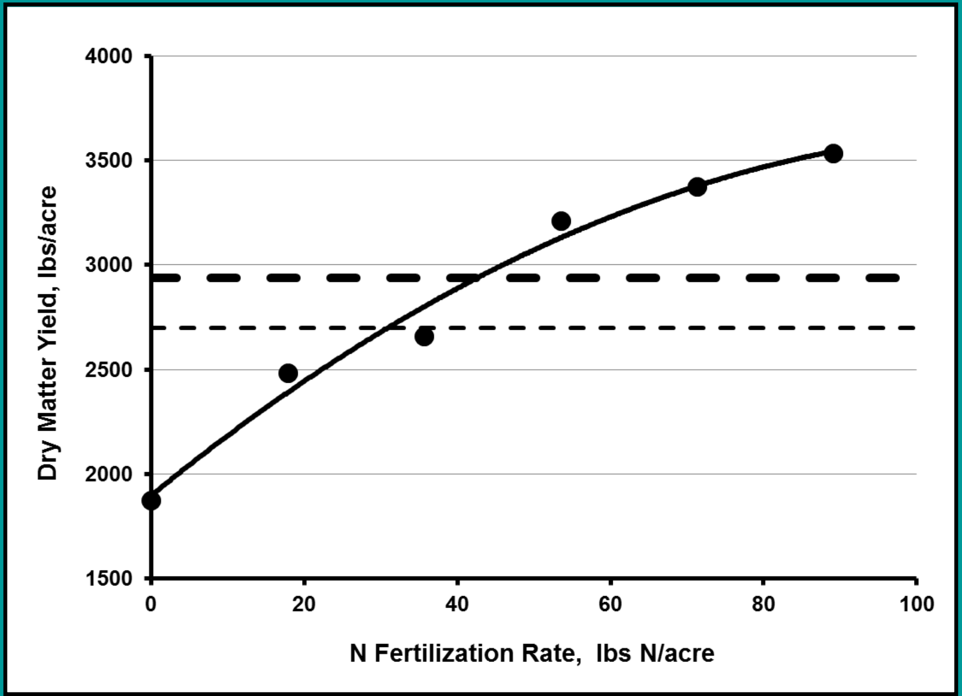


**Fertilizer Equivalents**
**Dairy Slurry**

**High Rate = 43 lbs N/acre**
**Low Rate = 31 lbs N/acre**

**Fertilizer Equivalents**
**Bedded Pack**

**High Rate = 11 lbs N/acre**
**Low Rate = -11 lbs N/acre**

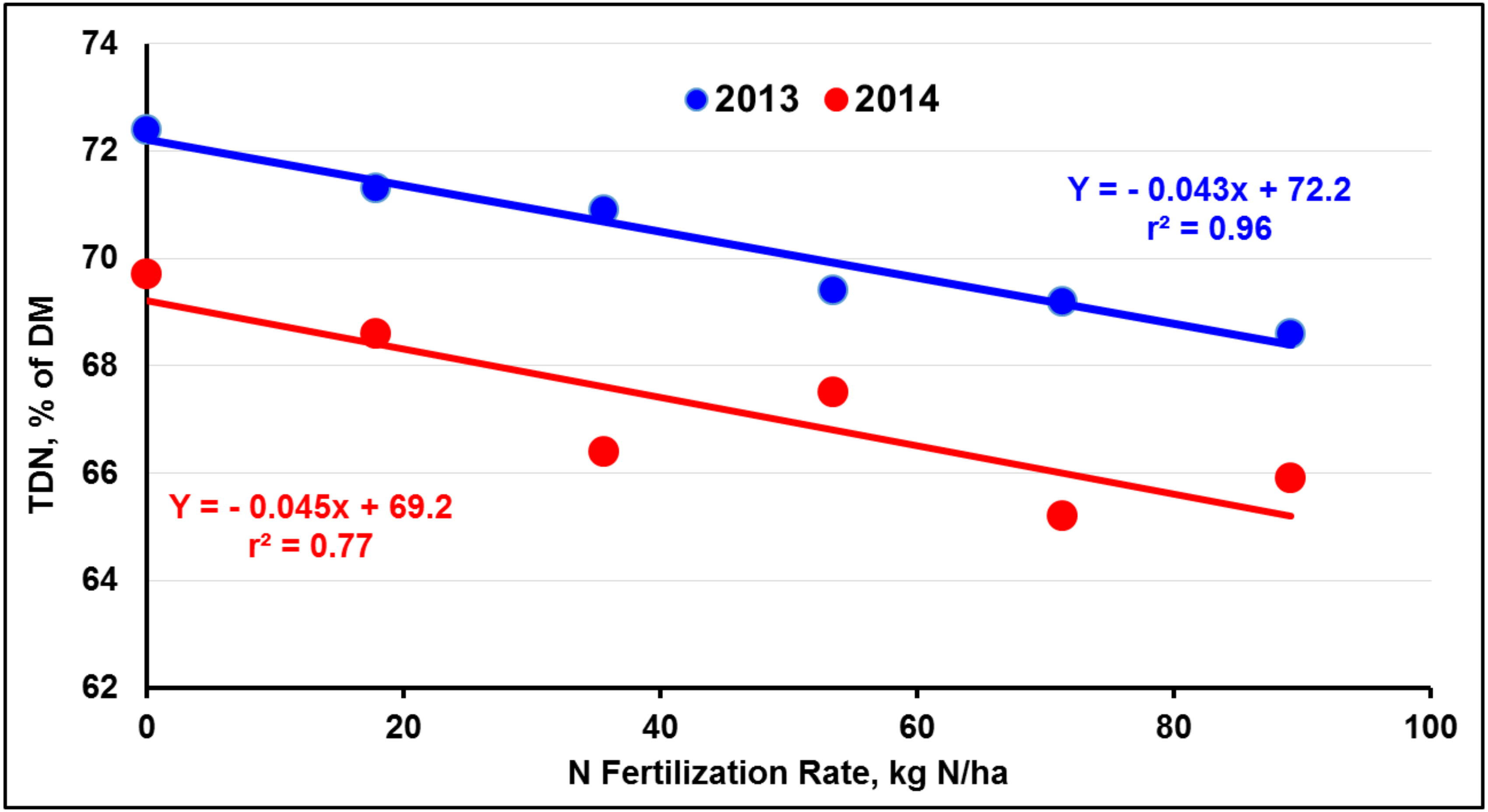



# Net Effects of Nitrogen Fertilization with Urea or Dairy Slurry on Forage Quality (2013-2014)

| Treatment | WSC | NDF | ADL | $NO_3$-N | $ivNDFD_{30}$ | $uNDFD_{240}$ |
|---|---|---|---|---|---|---|
| | ----------- % of DM | | ------------ | ppm | -------- % of NDF | -------- |
| Control, 0 | 21.2 | 41.5 | 0.70 | 1 | 71.0 | 13.6 |
| Urea, 18 | 19.6 | 43.3 | 0.90 | 12 | 70.8 | 15.1 |
| Urea, 36 | 17.1 | 45.3 | 0.99 | 34 | 69.2 | 14.6 |
| Urea, 53 | 16.0 | 45.0 | 1.07 | 224 | 69.6 | 15.0 |
| Urea, 71 | 13.5 | 47.0 | 1.09 | 343 | 69.7 | 15.7 |
| Urea, 89 | 14.4 | 46.7 | 1.11 | 426 | 69.4 | 15.6 |
| Manure, ~ 90 | 18.2 | 44.9 | 0.97 | 9 | 71.0 | 15.4 |
| Manure, ~ 180 | 16.1 | 45.9 | 1.08 | 12 | 70.1 | 14.8 |

*Coblentz et al. 2017*

# *Effects of Fertilization with Urea on Energy Estimates for Fall-Grown Oat Forages (2013-2014)*




***On average, these forages will lose about 0.5 percentage units of TDN for every 10 lbs N/acre applied as urea fertilizer.***

*Coblentz et al. 2017*

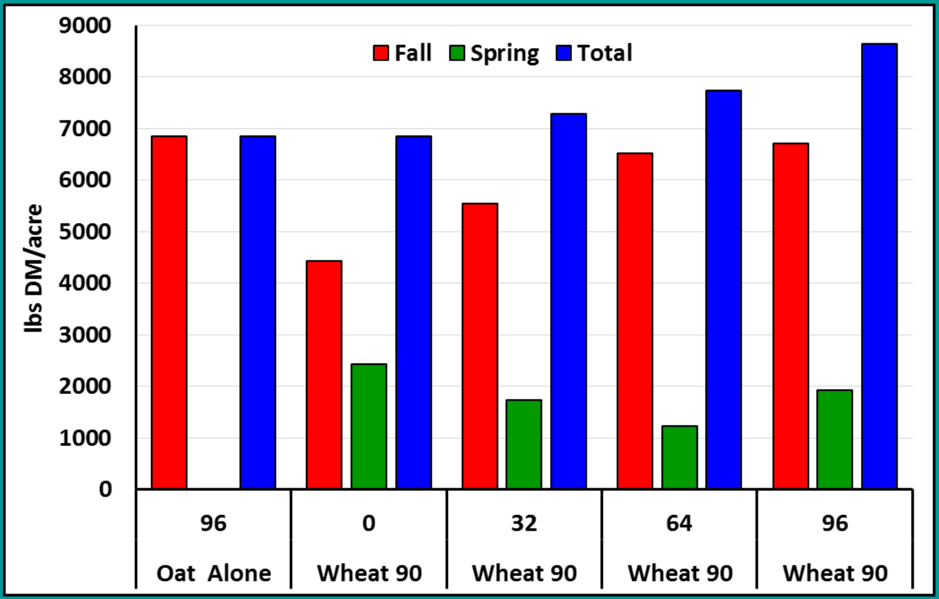
# A Brief Word About Fall-Seeded Mixtures

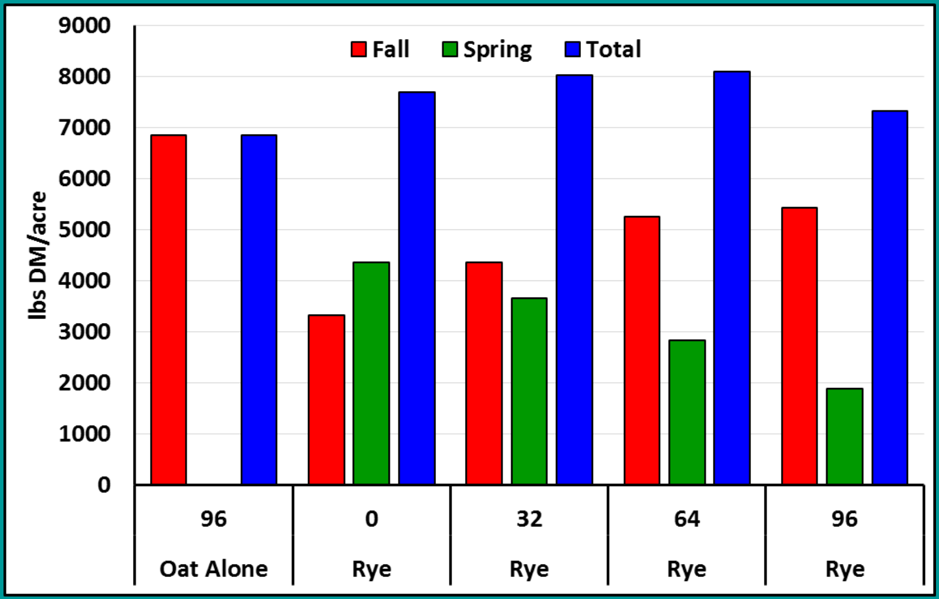
**Treatments (lbs seed/acre)**

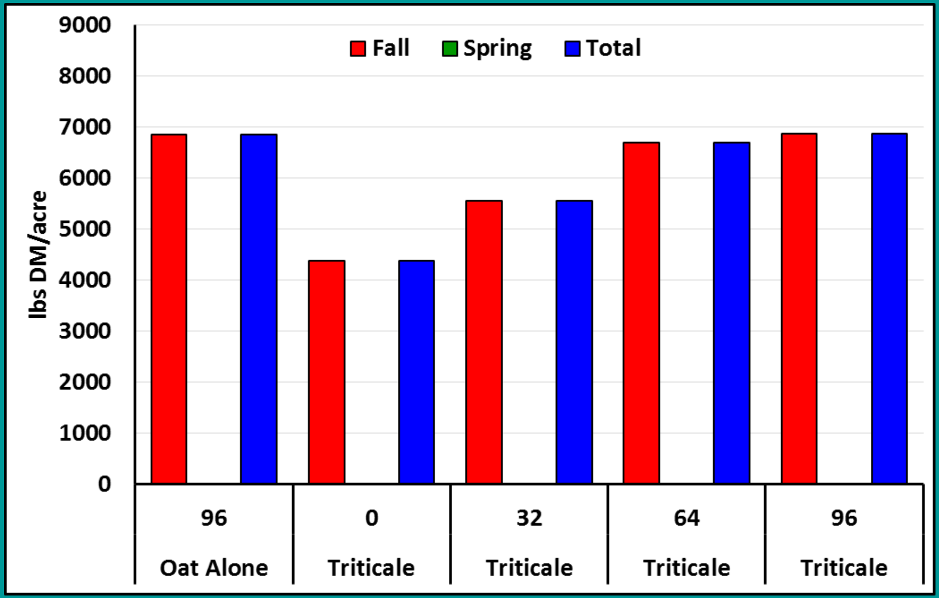
**Oat (96 lbs/acre)**
**Wheat (90)**
**Wheat (90) + Oat (32)**
**Wheat (90) + Oat (64)**
**Wheat (90) + Oat (96)**
**Rye (90)**
**Rye (90) + Oat (32)**
**Rye (90) + Oat (64)**
**Rye (90) + Oat (96)**
**Triticale (90)**
**Triticale (90) + Oat (32)**
**Triticale (90) + Oat (64)**
**Triticale (90) + Oat (96)**

*Experiment Initiated Fall 2016, Marshfield, WI*

# Fall, Spring, and Total DM Yield from Cereal-Forage Mixtures with Fall-Grown Oat



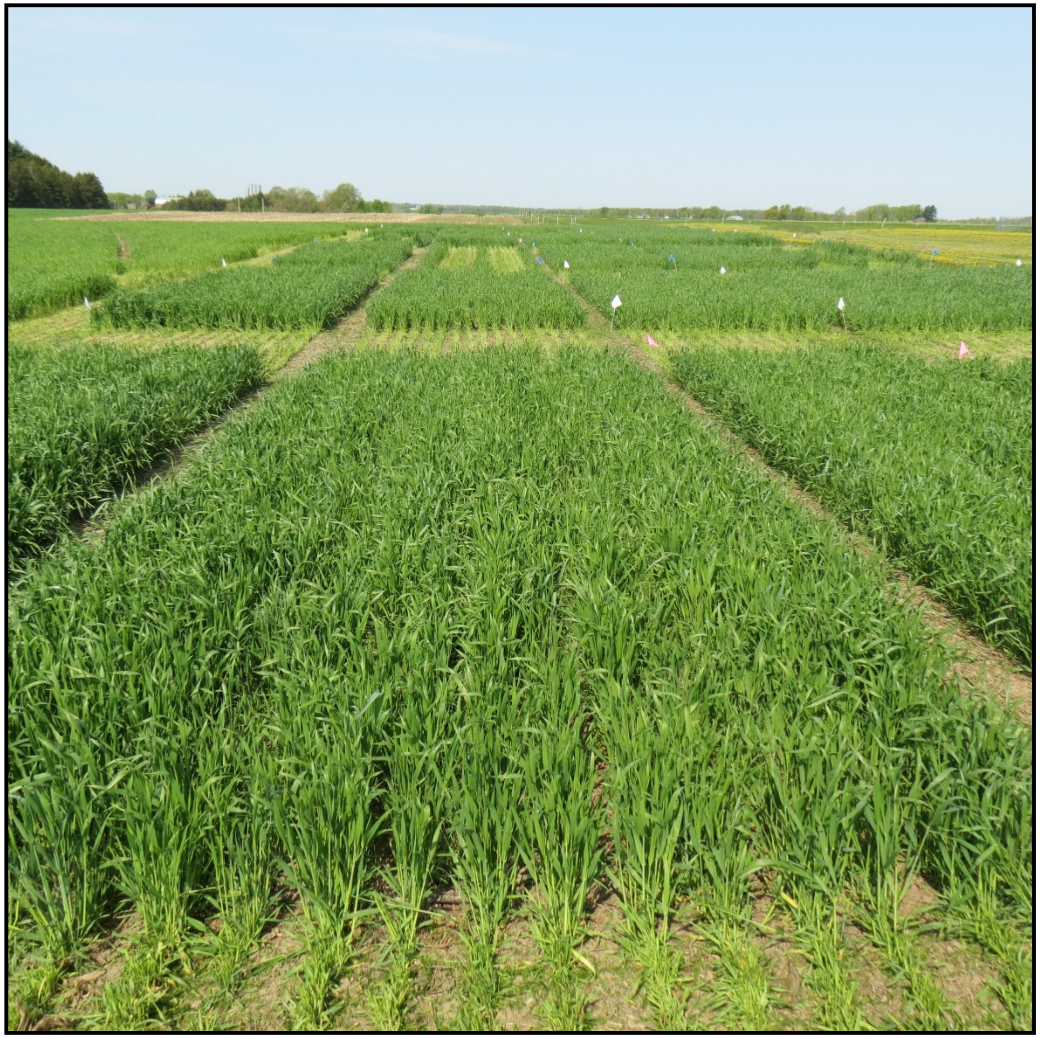



# Quality of Fall-Seeded Mixtures (% of DM)

| Species | Rate | Oat Rate | CP | NDF | WSC | TDN |
|---|---|---|---|---|---|---|
| Oat | | 96 | 13.2 | 55.7 | 8.7 | 61.5 |
| Wheat | 90 | 0 | 17.2 | 49.6 | 12.6 | 67.2 |
| | 90 | 32 | 15.9 | 50.2 | 11.3 | 65.7 |
| | 90 | 64 | 13.7 | 52.2 | 11.8 | 65.2 |
| | 90 | 96 | 14.0 | 51.5 | 12.1 | 65.8 |
| Rye | 90 | 0 | 21.0 | 49.5 | 10.1 | 67.0 |
| | 90 | 32 | 16.3 | 48.5 | 12.6 | 67.3 |
| | 90 | 64 | 15.2 | 49.2 | 13.0 | 67.2 |
| | 90 | 96 | 14.2 | 52.5 | 10.8 | 64.7 |
| Triticale | 90 | 0 | 17.3 | 50.1 | 10.7 | 65.9 |
| | 90 | 32 | 15.0 | 51.8 | 10.5 | 65.2 |
| | 90 | 64 | 14.7 | 52.3 | 10.3 | 65.2 |
| | 90 | 96 | 13.6 | 52.6 | 10.6 | 64.3 |

*Experiment Initiated Fall 2016, Marshfield, WI*

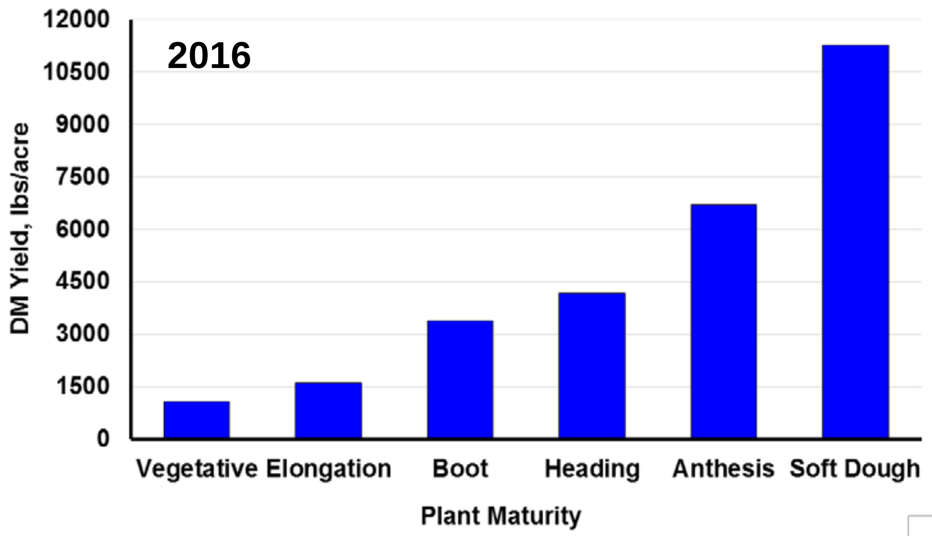
# Use of Triticale in Dairy Cropping Systems

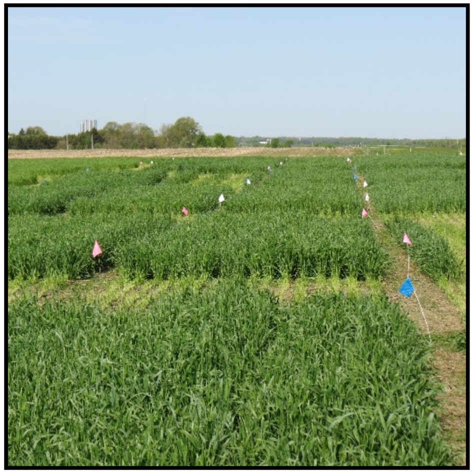


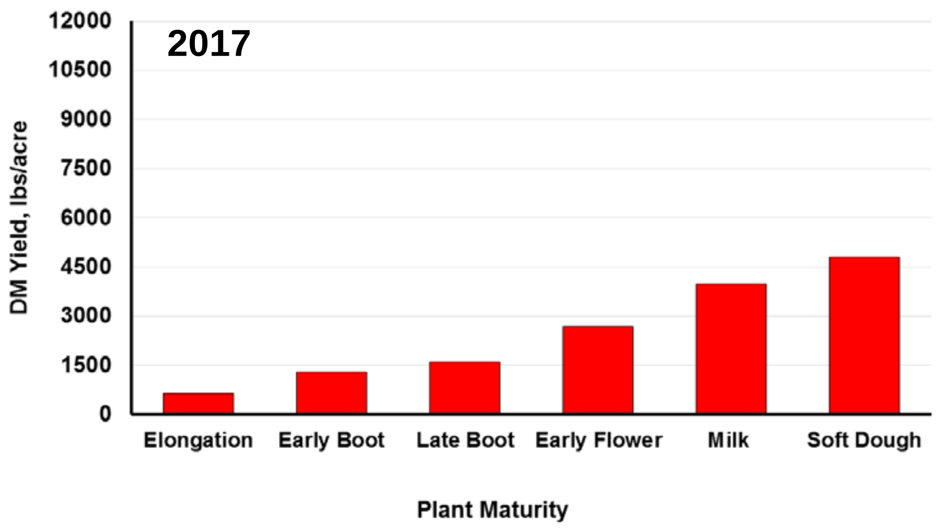
- *planted in the fall, usually after corn silage*
- *harvested in the spring as silage*
- *recent increase in popularity related (in part) to facilitation of manure distribution, and for providing winter ground cover*

*Experiment Initiated Spring 2016, Marshfield, WI*

# Use of Triticale in Dairy Cropping Systems



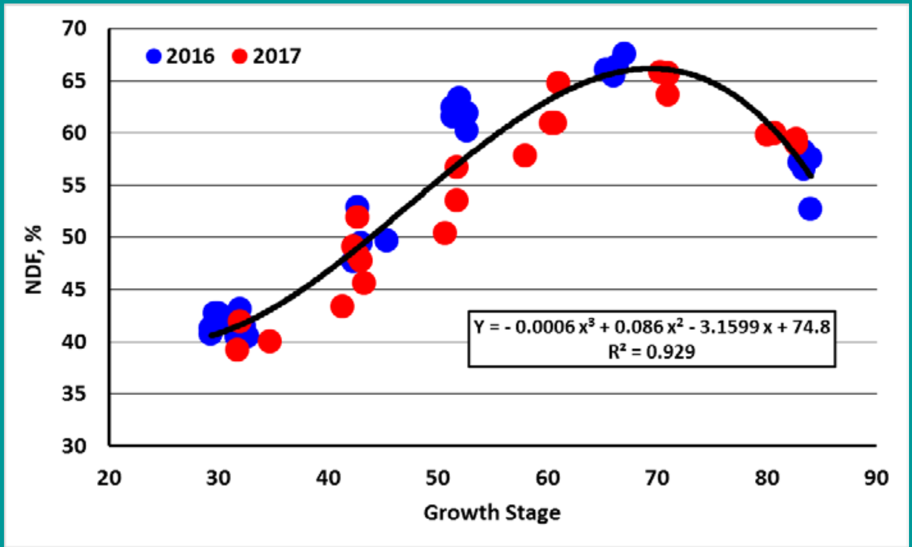



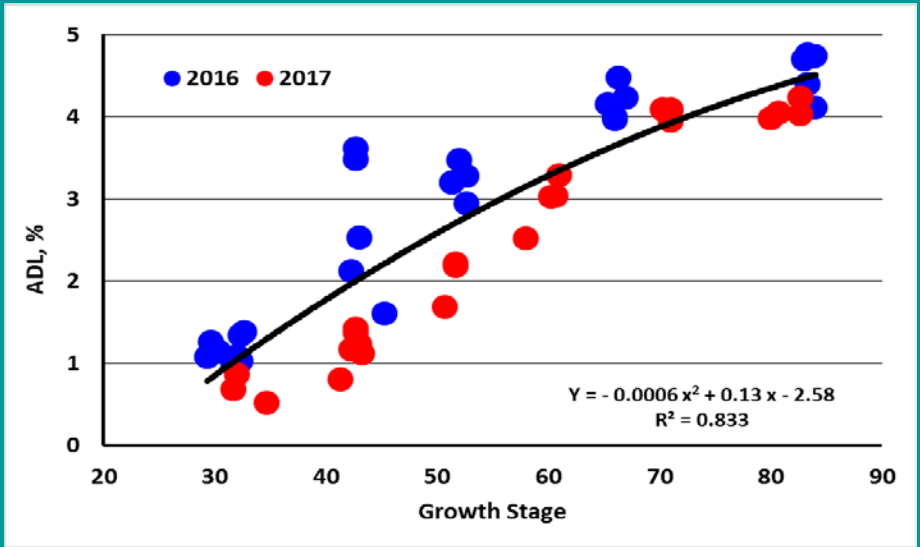


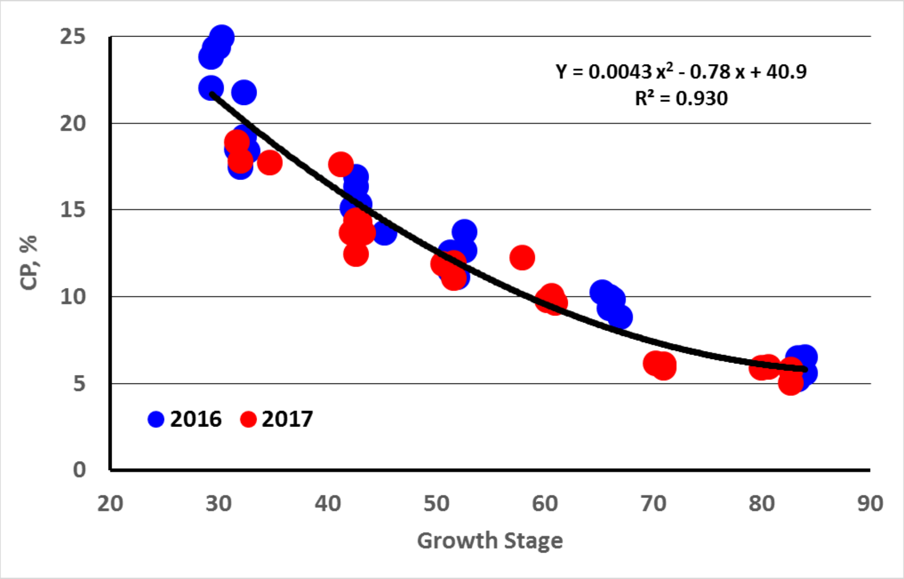

*Experiment Initiated Spring 2016, Marshfield, WI*

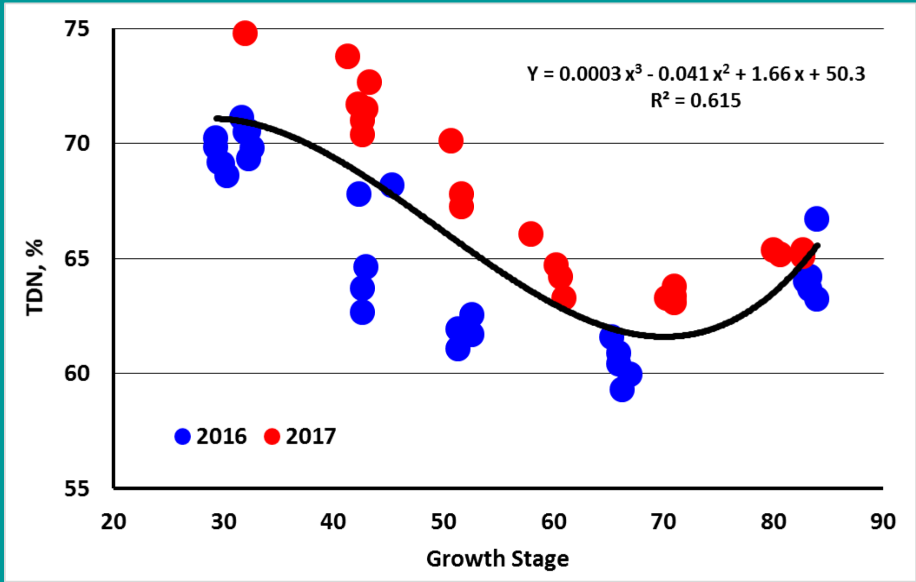
# Effects of Growth Stage on Nutritive Value of Triticale

20-29 Tillering
30-39 Elongation
40-49 Boot
50-59 Heading
60-69 Flowering
70-79 Milk
80-89 Dough
90-99 Ripe

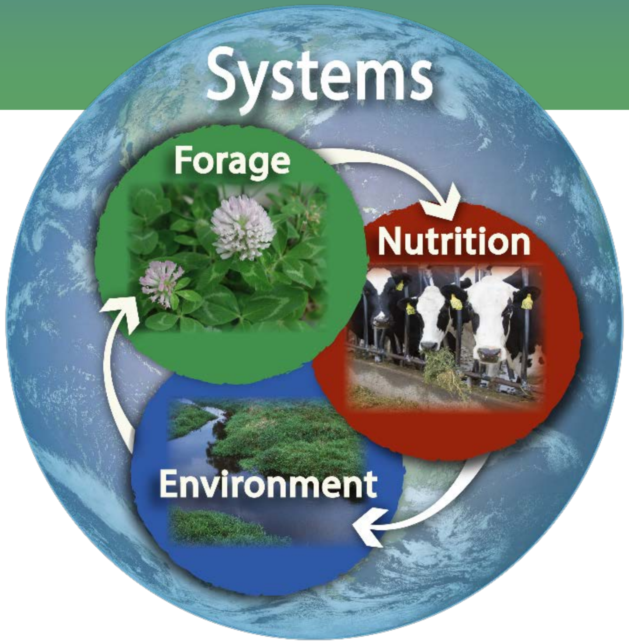


# QUESTIONS?

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