Nutritional Evaluation of Forage Barley Varieties

Presented to the 2017 Saskatchewan Beef Industry Conference
Regina, Saskatchewan
by
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General introduction

• Whole crop barley
  – Principal forage source for feedlot and dairy operations in western Canada
  – >250 varieties (CFIA 2013)
  – Tremendous variation among varieties
    • Feed/malting; 2 row/6 row; Hulled/hulless; smooth/rough awn

Image courtesy: google images
Barley Silage

• Great deal of agronomic information on growing barley
• Many growers focus on yield potential
• Quality focus tends to come from optimal harvest and ensiling management
• Limited information on feed quality of the various barley varieties for silage
• Forage NDF content: 40 – 70% (Undersander 2012).

• Barley silage typically 40 to 50% NDF

• NDF digestibility varies among forages and among varieties within forages.

• Higher NDF digestibility – Dairy cattle
  • Higher DMI
  • Higher milk production
  • Higher availability of dietary energy

  (Oba and Allen 1999; Hoffman and Combs 2004)
• High NDFD barley silage varieties to growing/finishing cattle could potentially
  – Increase DMI
  – Replace barley grain for silage without affecting performance
    • Higher digestibility = higher available dietary energy
      – Improve rumen pH
• Limited information available on effect of NDFD of barley varieties on performance of beef cattle
Phases

• Phase 1
  • Evaluation of the Nutritional and Neutral Detergent Fiber Digestibility Characteristics of Barley Forage Varieties Commonly Grown for Silage in Western Canada

• Phase 2
  • Evaluation of barley varieties varying in NDF digestibility and level of inclusion in the diet on feedlot performance, rumen fermentation, passage rate and total tract digestibility characteristics

• Phase 3
  • Further evaluation of effects of variety and stage of maturity of barley forage on NDF digestibility and nutritional characteristics over multiple crop years
Nutritional evaluation of common barley varieties grown commercially for silage in western Canada

Materials and Methods

• 135 silage samples over 2 years
• Selected 80 samples at mid-dough stage
  – 7 varieties represented in both years
• Analyzed for nutrients plus, pH, VFA, lactate, ammonia, NDF digestibility
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<tr>
<th></th>
<th>Conlon</th>
<th>CDC Copeland</th>
<th>CDC Cowboy</th>
<th>Falcon</th>
<th>Legacy</th>
<th>AC Metcalfe</th>
<th>Xena</th>
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<td>Smooth awn</td>
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Image courtesy: [http://www.ndsuresearchfoundation.org/conlon](http://www.ndsuresearchfoundation.org/conlon)  
[www.saskforage.ca](http://www.saskforage.ca)  
[www.ag.ndsu.nodak.edu](http://www.ag.ndsu.nodak.edu)
Effect of variety of barley for silage on CP content (P < 0.01)

Variety of barley

CP, % DM
Effect of variety of barley for silage on ADF content (P < 0.01)

Variety of barley:
- Conlon
- CDC Copeland
- CDC Cowboy
- Falcon
- Legacy
- AC Metcalfe
- Xena

ADF, % DM
Effect of variety of barley for silage on NDF content (P < 0.01)

Variety of barley

Conlon  CDC Copeland  CDC Cowboy  Falcon  Legacy  AC Metcalfe  Xena
NDF, % DM
35  37  39  41  43  45  47  49  51

Legend:
a  abc  ab  abc

Note: Varieties marked with the same letter do not differ significantly at P < 0.01.
Effect of variety of barley for silage on starch content (P < 0.01)

Variety of barley

Starch, % DM

- Conlon
- CDC Copeland
- CDC Cowboy
- Falcon
- Legacy
- AC Metcalfe
- Xena
Effect of variety of barley for silage on TDN content (P < 0.01)

Variety of barley

Conlon  CDC Copeland  CDC Cowboy  Falcon  Legacy  AC Metcalfe  Xena

TDN, %

58  60  62  64  66  68  70

a  a  b  ab  ab  b  ab
Effect of variety of barley for silage on 30-h NDFD (P < 0.01)

Variety of barley

Conlon  CDC Copeland  CDC Cowboy  Falcon  Legacy  AC Metcalfe  Xena

NDFD$_{30h}$, % NDF

20  23  26  29  32  35  38  41
Effect of variety of barley for silage on NDF pool (P < 0.01)

*Digestible NDF calculated as DNDF = 100 - INDF
Conclusions

• Barley varieties grown for silage in western Canada were inherently different in terms of chemical composition and digestibility parameters
  – CDC Cowboy had greatest ADF and NDF contents and lowest starch content
  – CDC Cowboy had the highest 30 hr NDFD and greatest DNDF content

• Question does the greater NDFD\textsubscript{30h} of CDC Cowboy offset the greater fibre and lower starch content in terms of animal performance?
Phase 2

Effect of NDF digestibility and level of inclusion of barley varieties grown for silage on performance and carcass quality of growing and finishing beef cattle

Materials and Methods

• Barley varieties selected based on NDFD$_{30h}$ results from Phase 1
  • CDC Cowboy (High, 37.0%)
  • CDC Copeland (Intermediate, 31.1%) and
  • Xena (Low, 28.8%)
  – Seeded, treated, harvested and ensiled similarly

• Animals
  • 288 crossbred weaned steers (680 lbs)
  • 24 pens – 6 per treatment with 12 head per pen
  • Target slaughter weight (1375 lbs)
# Treatments

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Effect of variety of barley for silage on backgrounding diets

Fiber fractions in the diet

- ADF
- NDF

Energy values

- NEm
- NEg

**CDC Cowboy**  | **CDC Copeland**  | **Xena**
Effect of level of inclusion of barley for silage on backgrounding diets.
Effect of *variety* of barley for silage on backgrounding performance

![Graph showing the effect of variety of barley on end body weight (BW) and average daily gain (ADG). The bars represent CDC Cowboy, CDC Copeland, and Xena varieties.](image-url)
Effect of level of inclusion of barley for silage on backgrounding performance

End BW

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Effect of level of inclusion of barley for silage on finishing performance

No effect of variety of barley on finishing performance
Conclusions

• Barley varieties vary considerably in terms of chemical composition and NDF digestibility

• CDC Cowboy had the greatest NDFD$_{30h}$ (% of NDF basis) of varieties tested;

• However, selecting barley varieties based on NDFD$_{30h}$ (% of NDF basis) may not provide consistent results due to agronomic and environmental factors.
Conclusions

• Barley varieties with greater NDF content will have a negative effect on performance of growing cattle

• Finishing performance was improved for steers previously fed high silage inclusion diets during backgrounding due to compensatory gain and due to backgrounding ADG and BW
Acknowledgements

- Saskatchewan Agriculture Development Fund
- Canadian Cattleman’s Association
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- University of Saskatchewan
- Dairy Smart Nutrition
- Cumberland Valley Analytical Services
- Beef and Dairy Producers