Impact of application of foliar fungicide on ensiling properties, feed value and core microbiome of barley silage

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Foliar fungal diseases of barley

Scald - *Rhynchosporium commune*

Net blotch - *Pyrenophora teres*
  - Net form
  - Spot form

Spot blotch - *Cochliobolus sativus*

Leaf rust - *Puccinia hordei*

Lignification and leaf shedding as a result of fungal infestation

Nutritive value and digestibility of barley
Foliar fungicides

- Protect crop canopy
- Decrease lignification
- Increased grain fill
- Improved nutritive value

*Haerr et al. (2015)*
Corn silage
1, 2 and 3 times fungicide applications

Poole 2009

Figure 1: Effect of green leaf retention on barley yield

Figure 2: Effect of fungicide application on ADF and NDF content of corn silage
Introduction

Hypothesis

Foliar fungicide application will increase barley silage quality and alter the bacterial and fungal core microbiome during ensiling and aerobic exposure relative to untreated barley.

Objectives

Evaluate impact of foliar fungicide application on ensiling properties and feed value of barley silage.

Evaluate impact of foliar fungicide application on bacterial and fungal core microbiome during ensiling and aerobic exposure.
In fungicide sprayed (FSP) treatments, fungicide Twinline® (BASF, Missisauga, ON) was applied at flag leaf emergence stage @ 0.5 L/ha while Untreated (UN) did not receive fungicide application.

Harvested at mid-dough stage
Chop length – 9.5 mm theoretical chop length - Minisilos
Materials and Methods

Minisilo study

Triplicate minisilos per treatment
Sampled after 3, 7, 14, 21 and 60 d of ensiling

Aerobic stability

Triplicate samples from d 60 silage

2 thermal iButtons per container
for silage temperature

iButton for ambient temperature

Sampled after 3, 7, 14 and 21 d of aerobic exposure
Materials and Methods

Chemical analysis

Samples of fresh forage, silage during ensiling and aerobically exposed silage
  pH, VFA, lactic acid, ammonia, WSC

Samples of fresh forage, silage during ensiling
  DM, CP, ADF, NDF, starch, ash

Microbial analysis

Samples of fresh forage, silage during ensiling and aerobically exposed silage
  MRS medium – LAB
  Nutrient agar – total bacteria
  SDA medium – yeast and mold
Materials and Methods

DNA extraction

DNA extracted using FastDNA™ spin kit (MP Biomedicals)
DNA quantified using NanoDrop 3300

Sequencing

Illumina MiSeq
Analyzed by QIIME 1.9.1
Sequences clustered into OTUs

Statistical analysis

Mixed model procedure of SAS for repeated measure
Ensiling parameters and microbial data
Parameters not significant for treatment × time analyzed as RCBD
d0 and d60 of ensiling and d21 of aerobic exposure
Results and Discussion

Fungicide application decreased net blotch (P = 0.008) (Turkington et al. personal communication)

Figure 3: Effect of foliar fungicide application on ADF and NDF content of barley silage

Figure 4: Effect of foliar fungicide application on water soluble carbohydrate (WSC) and starch content of green feed barley (Day 0)
Figure 5: Effect of foliar fungicide application on silage pH, total VFA and lactic acid concentrations
Figure 6: Effect of foliar fungicide application on LAB, yeast and mold counts

Results and Discussion
Figure 7: Bacterial and fungal OTUs of barley green feed, silage after 60 d of ensiling and 21 d of aerobic exposure
Results and Discussion

Figure 8: Effect of foliar fungicide application on bacterial core microbiome during ensiling and aerobic exposure.

FSP, fungicide sprayed; UN, untreated; D0, 60, 21 AS, Day 0 and 60 of ensiling and 21 days after aerobic exposure.
Results and Discussion

Figure 9: Effect of foliar fungicide application on fungal core microbiome during ensiling and aerobic exposure.

FSP, fungicide sprayed; UN, untreated; D0, 60, 21 AS, Day 0 and 60 of ensiling and 21 days after aerobic exposure.

Figure 9: Effect of foliar fungicide application on fungal core microbiome during ensiling and aerobic exposure.
Figure 10: Effect of foliar fungicide application on silage temperature after aerobic exposure

Figure 11: Effect of foliar fungicide application on aerobic stability
Fungicide application
  Preserved the forage nutrients (WSC, starch) with likely protection of crop canopy
  Lower ADF and NDF content

Fungal OTUs decreased during ensiling and aerobic exposure across treatments and fungicide sprayed barley had lower abundance of order Saccharomycetales after 21 d of aerobic exposure relative to untreated barley

Further research is needed to evaluate the effect of fungicide application of barley silage on performance and carcass characteristics of growing and finishing beef cattle
Acknowledgement
Thank you

Alberta barley