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DUAL-PURPOSE WINTER CANOLA IN THE PACIFIC NORTHWEST: SILAGE PRODUCTION

Washington Oilseed Cropping Systems Series

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Dual-Purpose Winter Canola in the Pacific Northwest: Silage Production

Abstract

The Washington State Oilseed Cropping Systems Research and Extension Project (WOCS) is funded by the Washington State Legislature to meet expanding biofuel, food, and feed demands with diversified rotations in wheat based cropping systems. The WOCS fact sheet series provides practical oilseed production information based on research findings in eastern Washington. More information can be found at: http://css.wsu.edu/oilseeds.

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WASHINGTON OILSEED CROPPING SYSTEMS
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Introduction

Winter canola (*Brassica napus*) is used as a break crop in the primarily cereal grain rotations of the Pacific Northwest (PNW). Research over the last 40 years has largely been focused on grain production. However, renewed interest in using canola as a dual-purpose crop has recently emerged. Work at Washington State University (WSU), the University of Idaho (UI), and in the Southern Great Plains has begun to illustrate the challenges and potential of dual-purpose canola. Canola forage has high protein (15–25%), low fiber, and very high moisture levels (85–90%; Neely et al. 2015). Canola can also accumulate levels of nitrates (Zhang et al. 2005) and sulfur that are toxic to ruminants. Ensiling has been shown to reduce levels of nitrates (Kincaid et al. 2012) and sulfur-containing compounds (Fales et al. 1987; Vipond et al. 1998), and allows forage to be preserved at a relatively high moisture content compared to haying. Unfortunately, the high moisture content of canola can lead to poor fermentation results and high amounts of effluent (an environmental pollutant; McDonald 1981). However, absorbents can be used to reduce the overall moisture of silage, improving fermentation and reducing effluent losses (Fransen and Strubi 1998).

Methods

Winter canola was planted in mid-August and harvested for forage approximately 60 days after planting. Yield results of canola forage can be seen in a companion publication FS262E Dual-Purpose Winter Canola in the Pacific Northwest: Forage Management. Six of the eight fertilizer treatments were used for the silage study. Forage from plots was combined by fertilizer treatment and ensiled with or without alfalfa cubes with four replications of each. Alfalfa cubes served as an absorbent and were added to target a 35% dry matter (DM) silage/alfalfa cube mixture. Ten pounds of fresh canola forage was packed into PVC silage tubes (Figure 1) and treated with 9×10^{10} colony forming units (CFU) of lactic acid-producing bacteria per pound of wet forage. The forage was ensiled for a minimum of 45 days. Effluent was drained and collected from each silage tube (Figure 2) and silage was removed and weighed to determine DM recovery. Samples were collected from pre-ensiled forage (Figure 3) and post-ensiled forage (Figure 4) to determine the effect of ensiling on forage quality.

Practical Application

In a large-scale production setting, adding an absorbent to reduce the moisture content of silage may present some challenges. Dispersing and incorporating an absorbent equally into a silage pit or bag must be done to ensure a consistent end product. While this can be done, an easier way may be to intercrop canola with another forage crop to increase overall silage DM. Kincaid et al. (2012) intercropped canola with

Figure 1. Loading (left) and packing (right) freshly harvested canola forage into ensiling tubes.

Figure 2. Effluent was drained and collected from the bottom of the ensiling tubes.

Figure 3. Pre-ensiled canola forage.

Figure 4. Post-ensiled canola after removing from tubes.

edible spring peas and reported a DM content close to 31%. Intercropping with a legume also provides the additional benefit of nitrogen fixation. Field wilting is also a practical approach to increase forage DM. However, field wilting is dependent on weather conditions. Soil contamination of the forage is also a risk when picking up canola after wilting. Bacteria from the soil can interfere with a successful fermentation, decrease palatability, and increase silage losses during fermentation. Intercropping and field wilting can also reduce transportation costs from the field. As forage DM increases, less water and more DM is hauled per load.

What We Learned

Forage Quality

As expected, canola forage and silage was high in protein and low in fiber. Fresh canola forage had a crude protein (CP) content of 19%. Ensiling reduced CP to 15%, but when alfalfa cubes were used as absorbents, CP was 18% after ensiling (Table 1). These protein values are comparable to alfalfa in early to mid-bloom. Neutral detergent fiber (NDF) was very low (22–23%) in pre-ensiled forage and canola silage. These are typical values for a Brassica forage but much lower than most legume and grass forages. The addition of alfalfa cubes increased NDF to 35%, which would be comparable to a high-quality legume. Ash was high in fresh canola forage and also in canola ensiled with and without alfalfa cubes. Brassicas are normally high in ash, and observed levels were within the typical range. Alfalfa cubes reduced the digestibility compared to canola forage and silage. Pre-ensiled canola and canola silage were highly digestible, indicating that canola is a high-energy feed in addition to being high in protein and low in fiber. Canola forage and silage with and without alfalfa cubes would provide cattle with a high-quality feed source with protein comparable to alfalfa but with fiber levels more comparable to concentrate feeds than other forages.

Fermentation Characteristics

Fermentation result averages can be seen in Table 2. Overall, canola silage ensiled both with and without alfalfa cubes had successful fermentations; inoculating the silage with lactic acid-producing bacteria likely played a major role in this. The addition of alfalfa cubes to canola silage increased silage DM to 33% compared to just 14% DM without alfalfa cubes. Canola silage ensiled with alfalfa cubes had a pH of 4.5, which would be acceptable for legume or grass hay (Ward and de Ondarza 2015). Canola/alfalfa cube silage also had good levels of lactic acid with little acetic acid and no propionic or butyric acid. Pure canola silage had much higher levels of volatile fatty acids (VFA) with lactic acid making up 80% of the total VFA. Canola silage had a lower pH when ensiled without alfalfa cubes. The higher moisture content of pure canola silage led to extensive fermentation and higher levels of acids compared with canola/alfalfa cube silage. Dry matter recovery data is not available due to a scale error which caused inaccurate results.

Effluent Production

The addition of alfalfa cubes significantly reduced the amount of effluent loss (Table 3). Canola ensiled without alfalfa cubes produce, on average, the equivalent of 44 gallons of effluent per ton of fresh forage compared to only 2 gallons per ton when canola was ensiled with alfalfa cubes. If we assume canola yields 1 ton DM/acre and has 14% DM, canola would yield just over 7 tons of fresh forage per acre. That means an acre of canola would produce over 300 gallons of effluent and a 40-acre field of canola would produce over 12,000 gallons of effluent. Managing silage effluent, or leachate, is part of a nutrient management plan as required by the Dairy Nutrient Management Act, RCW 90.64. It is important to account for the large volume of effluent that canola silage can produce and ensure your system can handle it. Reducing effluent production not only reduces the chances for water pollution but keeps valuable nutrients and minerals in the silage.

Table 1. Forage and silage quality.

	Crude Protein (%DM)	Neutral Detergent Fiber (%DM)	Ash (%DM)	Lignin (%DM)	24-hour Dry Matter Digestibility (%)	48-hour Dry Matter Digestibility (%)
Pre-ensiled canola forage	19	23	16	3	91	94
Canola silage + Alfalfa cubes	18	35	13	5	72	77
Canola silage	15	22	14	5	83	92

Table 2. Fermentation characteristics.

	Dry Matter (%)	Ammonia (%DM)	Total Acid (%DM)	pH	Total Volatile Fatty Acids (%DM)	Lactic (%DM)	Acetic (%DM)	Lactic (%TotalVFA)
Canola silage + Alfalfa cubes	33	1	7	4.5	7	5	2	71
Canola silage	14	2	14	4.3	14	11	3	80

Table 3. Effluent loss from canola silage.

Canola Silage	Effluent lost (gallon/ton)
Without absorbents	44
With absorbents	2

Takeaways

- Canola can be ensiled successfully with or without absorbents.
- Other studies have had less successful fermentation when canola silage was not inoculated.
- Absorbents should be used to retain nutrients and reduce effluent and thus the potential for water pollution.

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