WASHINGTON STATE UNIVERSITY EXTENSION

DUAL-PURPOSE WINTER CANOLA IN THE PACIFIC NORTHWEST: FORAGE MANAGEMENT

Washington Oilseed Cropping Systems Series

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Dual-Purpose Winter Canola in the Pacific Northwest: Forage Management

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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Introduction

As winter canola (*Brassica napus*) continues to gain acceptance as a viable broadleaf crop in the predominantly cereal rotations of the Pacific Northwest (PNW), dual-purpose winter canola is beginning to gain interest. Not only does canola provide benefits, such as improving weed control, breaking disease and pest cycles, and increasing water infiltration, but Washington State University (WSU) research has also shown increased wheat yields following a canola crop (Hang et al. 2009). As the name suggests, dual-purpose winter canola serves two purposes: fall forage or silage and grain harvest. Canola forage could be advantageous in the inland PNW where late summer and fall pasture is often in short supply. While grown successfully elsewhere (mainly Australia; Kirkegaard et al. 2008), the feasibility of dual-purpose canola in the PNW has not been thoroughly investigated. Our study investigates the effect of different fertilizer rates and timing on forage and grain yield as well as nitrate and sulfur accumulation in winter canola.

Dual-Purpose Winter Canola at a Glance

- Can be grown for fall forage or silage and harvested for grain the following summer (Figure 1).
- Provides late summer and early fall grazing source for livestock (Figure 2).
- Canola forage is moderate to high in protein and low in fiber.
- Value of forage/silage can offset potential grain yield loss (Neely et al. 2015).

Figure 1 shows the various options available when growing winter canola. Dual-purpose canola is depicted on the left side of the flow chart (i.e., late summer and early fall growth can be grazed or ensiled, growth resumes before winter, and the oilseed crop is harvested the following summer). Conventionally grown winter canola is typically planted later than dual-purpose, grows to a size in the fall that is sufficient to survive winter, and is then harvested the following summer.

Nitrogen (N) and sulfur (S) are two key plant nutrients required by canola to achieve a productive oilseed yield (Grant and Bailey 1993). We predict N and S fertilization will also affect forage yield and nutrient composition. Additionally, the effect of forage harvest on oilseed yield has been inconclusive in previous work from the PNW (Neely et al. 2015) and needs to be further quantified.

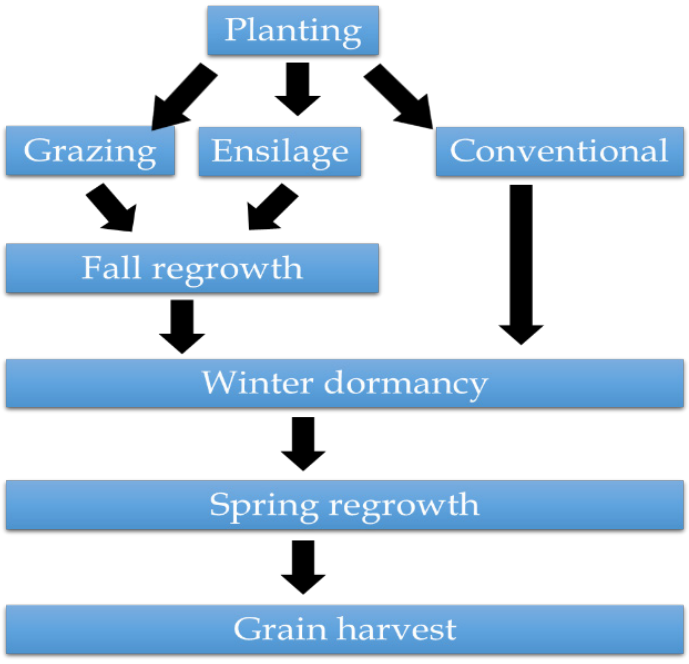

Figure 1. Winter canola timeline.

Figure 2. One use of dual-purpose canola is grazing during late summer when grass and other forage sources are dry.

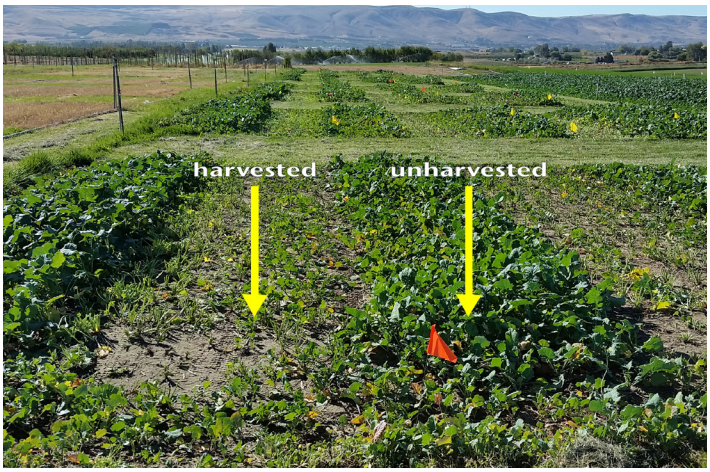

Figure 3. Dual-purpose canola plots immediately following forage harvest in mid-October.

Recent Research

Different rates of N and S fertilizer were applied to winter canola plots at Prosser, WA to determine the effects on forage and grain yield. Plant tissue nitrate (NO_3) and sulfur (SO_4) concentrations were measured to ascertain if N and S fertilization affected forage NO_3 or SO_4 levels. Table 1 shows the N and S fertilization treatments. Ammonium sulfate and urea were used because they are standard fertilizer forms in conventional farming. A N stabilizer (Agrotain) treatment was included to observe its effects on yields and forage N and S concentrations.

Roundup-Ready winter canola HyCLASS 154RR was planted in mid-August; fertilizer was applied at one-third of the total rate and disked-in pre-plant. Soil tests were used to determine phosphorus and potassium rates to be consistent with standard recommended rates. For consistent stands, the crop was irrigated by overhead sprinkler. In a dryland setting, weather conditions may make establishing a successful stand difficult and produce different results than observed in our study if rainfall is not adequate to meet the needs of canola. In October, approximately 60 days after planting, forage was harvested, leaving six inches of stem for regrowth (Figures 3 and 4).

The remainder of N and S was topdressed in late March, prior to crop bolting. Irrigation was terminated in late May, allowing adequate time for pods to dry before grain harvest. Plots were harvested in early July using a Hege plot combine; harvested oilseed was cleaned and weighed to determine yield (Figure 5).

What Did We Learn?

Forage canola yields were similar among the fertilizer treatments (P = 0.13; a P value >0.05 indicates there is not a significant difference between the treatment

Figure 4. Plots eight weeks after forage harvest. Note the regrowth in the harvested treatments.

Figure 5. Harvesting mature canola with plot combine.

means), and averaged 0.92 tons of dry matter (DM) per acre in 2014 (Table 1). As expected, forage DM content was low, averaging 10.9% (Table 1). This low DM would make it extremely difficult to produce a dry, baled hay crop in October when the initial crop moisture content ranges from 87% to 91%, as we observed in our study. Dry matters were different among fertilizer treatments ($P < 0.01$; a P value <0.05 indicates there is a significant difference between the treatment means), with treatments receiving lower rates of N and S having higher DM content. This high moisture content can lead to scours in cattle grazing canola. Supplementing dry hay will reduce the overall moisture content of their diet. Providing hay will also increase the amount of fiber cattle are consuming, which may reduce the chance of acidosis and help maintain proper rumen function.

Additional information on forage quality and ensiling canola forage can be found in a companion publication FS260E Dual-Purpose Winter Canola in the Pacific Northwest: Silage Production.

Winter canola crop stands in all treatments thinned dramatically over the winter. However, the canola compensated from the loss by increased bolting, branching and re-branching during spring regrowth to completely fill the above ground canopy. We did not find any differences in stand survival between the fertilizer treatments applied prior to planting.

Dual-purpose canola yielded significantly less ($P < 0.01$) than conventionally grown canola (Table 1). Grain yields were not different among fertilizer treatments ($P = 0.11$). The lack of response to fertilizer treatments indicates that applying 100 lb N/acre and 0 lb S/acre fulfilled canola's requirements for N and S. We also did not observe a benefit from Agrotain application. This is likely because fertilizer was incorporated into the soil in the fall and topdressed in the spring, reducing the risk for volatilization. If urea cannot be incorporated into the soil via tillage, rainfall, or irrigation, the use of Agrotain may be beneficial.

Fall-harvested winter canola forage was analyzed for nitrates (NO_3) and sulfur (SO_4). There were significant differences between fertilizer treatments for both NO_3 ($P < 0.01$) and SO_4 ($P < 0.01$). As seen in Figure 6, observed canola forage nitrate levels were very low. Nitrate levels less than 0.25–0.30% are generally considered safe. While canola can accumulate levels of nitrates toxic to cattle, canola in our study was not subjected to any major environmental stressors. Factors such as drought, lack of sunlight, frost, hail, disease, or extreme temperatures can cause NO_3 accumulation. Increased application of N fertilizer can also increase nitrate levels in canola; this is evident in Figure 6 and has also been reported on by Zhang et al. (2005).

Sulfur levels increased as S fertilizer application increased (Figure 7). Sulfur levels greater than 0.3–0.4% of the diet are considered toxic and could be fatal (Kandylis 1984). Observed forage S levels would be of concern if grazed or canola silage was fed as a single source to cattle. Sulfur fertilization should be applied after canola has been grazed in the fall or harvested as silage in October to minimize the levels of S in canola forage.

Conclusions and Recommendations

N and S fertilization had no effect on forage yield.

Early results suggest canola forage needs no more than 30 lb N/acre and requires 0 lb S/acre in the fall for forage

Table 1. Winter canola forage and grain yields at Prosser, WA (2014).

Treatment*		Forage Dry Matter (%)	Forage Dry Matter Yield (ton/acre)	Conventional Oilseed Yield (lb/acre)	Dual Purpose Oilseed Yield (lb/acre)
Nitrogen	Sulfur				
100	0	11.4	0.95	1486	910
100	20	11.3	0.98	1622	1258
100**	20	12.9	0.60	1637	997
100	40	11.2	0.99	1375	983
200	0	11.6	0.98	1669	1108
200	20	9.0	0.94	1595	1229
200	40	9.4	1.07	2077	1318
200**	40	10.9	0.83	1956	1283
Average		10.9	0.92	1677	1136
$LSD_{0.05}$=		1.70	n.s.	n.s.	n.s.

*1/3 of fertilizer was applied in the fall and the remainder in the spring at bolting.
**Agrotain application.
Least Significant Difference (LSD), if the means have a greater difference than the LSD the means are significantly different from each other.
Non-significant (n.s.), if the LSD is n.s., no mean is significantly different from another.

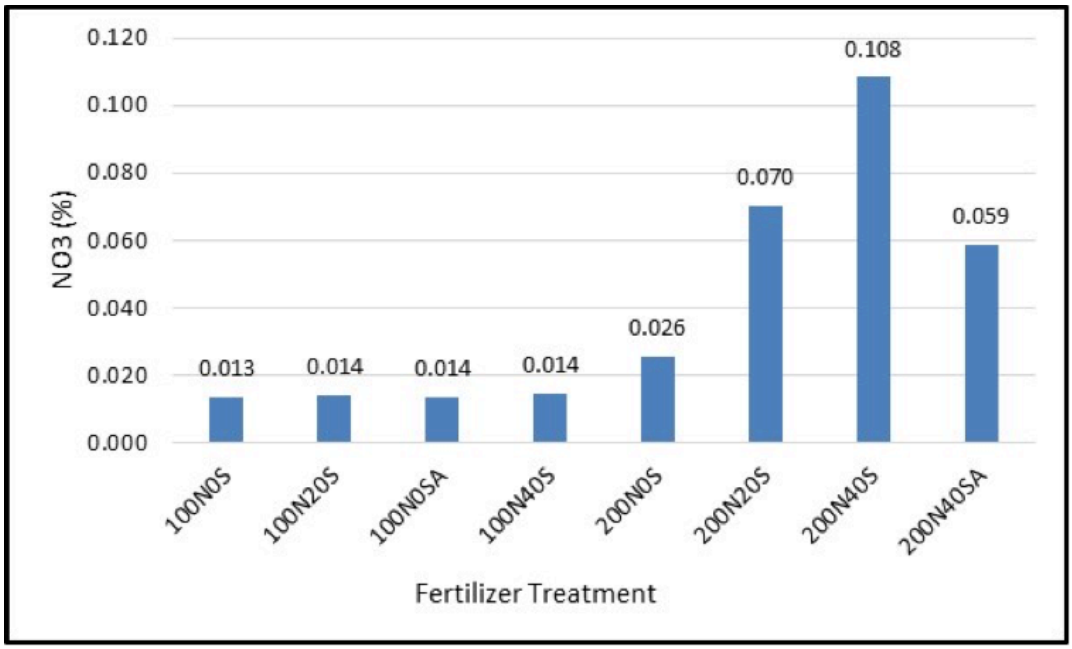

Figure 6. Influence of fertilizer treatment on forage nitrate. Note: $LSD_{0.05}$= 0.050. Least Significant Difference (LSD), if the means have a greater difference than the LSD the means are significantly different from each other.

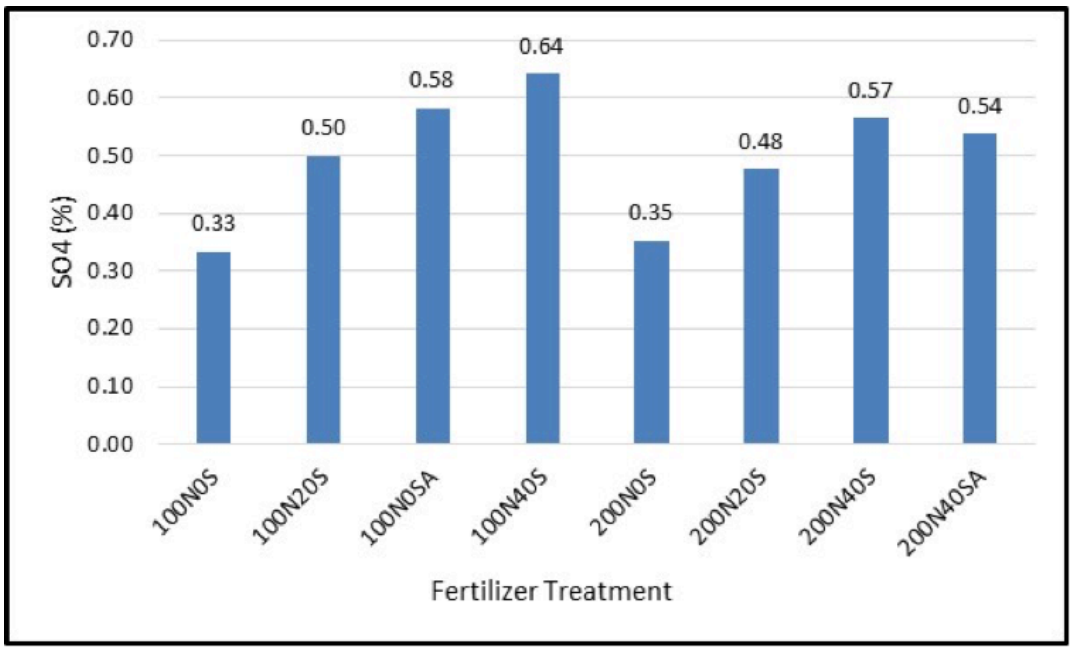

Figure 7. Influence of fertilizer treatment on forage sulfur content. Note: $LSD_{0.05}$ = 0.09. Least Significant Difference (LSD), if the means have a greater difference than the LSD the means are significantly different from each other.

production. Additional N and S application will increase forage nitrate and S concentrations.

Applying S in the fall increased S levels in canola forage.

Sulfur fertilization for dual-purpose winter canola should be applied after forage is grazed or harvested to reduce the risk of sulfur toxicity to ruminants grazing in the fall.

Winter canola did not respond to Agrotain.

When Agrotain was used, no benefit was provided to forage or oilseed yields. If urea is incorporated into the soil by tillage, precipitation, or irrigation, the use of Agrotain is not likely to improve forage or grain yields.

Dual-purpose canola had lower oilseed yields than conventionally grown canola.

Producers will need to assess the value of canola forage to determine if the forage crop will make up for the potential grain yield reduction.

These results are from a single year.

Additional research is needed to determine if similar results can be achieved over years.

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