# DUAL-PURPOSE CANOLA MANAGEMENT IN THE PACIFIC NORTHWEST

# Abstract

Winter canola is primarily grown for seed production in the inland Pacific Northwest. However, early seeded winter canola may also be utilized as a forage or silage crop. The effect of grazing and swathing on seed yield is dependent on the time of planting and biomass harvest. In some instances, grazing and swathing have been shown to decrease seed yield, while in other instances there is no negative effect. Canola forage tends to be high in protein and low in fiber and should be supplemented with additional high fiber forage. In the correct circumstances, grazing or swathing of winter canola biomass in the fall prior to seed harvest can increase gross revenue.

# Introduction

In the Pacific Northwest, winter canola is almost exclusively used for seed production with virtually no grazing or utilization of forage. However, in the vegetative growth stage, winter canola can be a nutritious and productive forage or silage crop. Dual-purpose canola, also referred to as "canolage" in this article, is the catch-all term that refers to the practice of using vegetative summer or fall growth of winter canola as a forage source for livestock, regardless of whether it is grazed, green chopped, hayed, or ensiled. The crop is subsequently taken to seed harvest the following summer. Producers can mechanically harvest the forage as silage or use livestock to directly graze it to meet specific economic or ecological outcomes. Canolage may be grown in a monoculture or mixed with companion crops to improve forage quality. In this guide, a multispecies planting is referred to as "intercropped canolage." The nuanced differences between the various systems may determine the suitability of a particular system to an individual grower's operation.

Previous Extension publications and research highlighted the utility of canola as a forage and silage crop (Fransen et al. 2017; Llewellyn et al. 2017). These studies mostly relied on swathing to harvest the forage or assessed the effect of mowing on canola seed production. Frequently, swathing is referred to as simulated grazing in these trials. Due to the ease of replication, swathing trials are generally more statistically robust than grazing trials and can include multiple varieties and agronomic treatments. However, grazing with cattle has a different impact on the plants than swathing and should be considered separately, when possible. The majority of grazed canolage research has been conducted in Australia and, to a lesser extent, in the southern Great Plains of the United States (Bushong et al. 2018), where mixed crop-livestock operations are more common. Most of the grazing work conducted in Australia has used sheep rather than cattle (Dove and Kirkegaard 2014; Kirkegaard et al. 2008; McCormick et al. 2012; Sprague et al. 2014). Large-scale sheep operations are not common in the Pacific Northwest. This publication details the current state of knowledge on grazing animals on canola in the inland Pacific Northwest and compares canola grazing to mechanically harvested canola forage and subsequent impacts on seed yield.

## *Forage and Seed Yield with Swathing*

Canola forage does not lend itself well to dry hay production. Swathed canola generally has a water content above 90% when cut. Additionally, canola has a thick leaf petiole, and the waxy cuticle that covers the leaf makes it difficult to achieve optimal moisture content for dry hay (18–22% moisture) (Figure 1). If canola forage did reach sufficiently low moisture content, the wide, thin leaves would easily crumble and be pulverized during the baling process. For these reasons, mechanized forage harvest of canola should be targeted for fresh green chop or ensiling, which only requires moisture content of approximately 65%.

Figure 1. Photo demonstrating the long, thick petiole and broad-leaved nature of canola. These factors make hay production with canola impractical. (Photo by D. Maxfield.)

Planting date, cutting height (or growing point height), and number of harvests all can affect subsequent canola seed yield. However, in dryland studies assessing different planting times in the inland Pacific Northwest, the effect of swathing was shown to vary from year to year (Neely et al. 2015). In the dryland trials, early seeded and swathed canola yielded more seed than canola planted on conventional seeding dates and not swathed. Yet, in other years it reduced seed yield (Figure 2). The variable yield response may be due to differences in winter severity and residual soil moisture between years and locations. Anecdotal observations indicated that winter canola may express significant stem elongation which results in the removal of primary growing points during mechanical swathing (Figure 3). When this occurs, axillary buds will break dormancy and cause the plant to send up multiple stems, creating a shorter and bushier plant the following season (Figure 4).

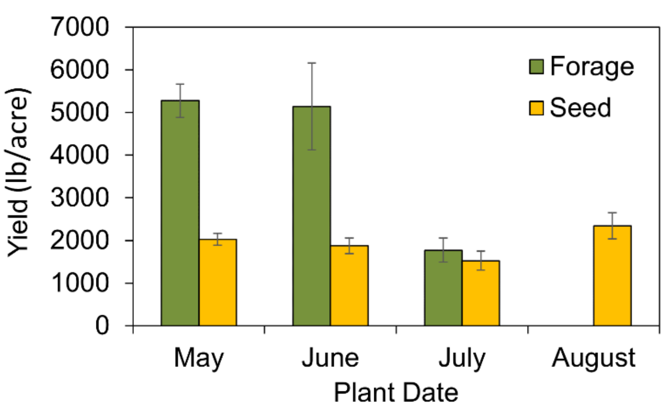


Figure 2. Impact of planting date on forage yield and subsequent seed yield the following year of winter canola. Plots were located near Moscow, Idaho, and received supplemental irrigation. (Adapted from Neely et al. [2015].)

Figure 3. Photo of early-planted winter canola plant that has been mechanically harvested three times. Each time the main growing points are removed, secondary and tertiary growing points branch out, sometimes leading to reduced plant height in mature canola at seed harvest time. (Photo by C. Neely.)

Figure 4. Harvesting winter canola vegetative growth in the previous season can reduce plant height the subsequent year if primary growing points are removed during forage harvest. Image shows canola with three forage harvests (left) compared to canola with no forage removed (right) during pod fill. (Photo by C. Neely.)

A study assessing biomass accumulation over time from a May planting showed that the rate of biomass accumulation is rapid until approximately 900 growing degree days (GDD) after planting, after which the rate of growth slows dramatically, or even declines, when averaged across three years of data (Figure 5). GDD was calculated with a base temperature of 39.2°F. An economic assessment also indicated that gross income from combined forage and seed harvest was maximized when canola was swathed at 887–982 GDD after planting (Figure 6). Figures 7 and 8 visually demonstrate the ability of canola to produce forage and regrow following forage harvest.

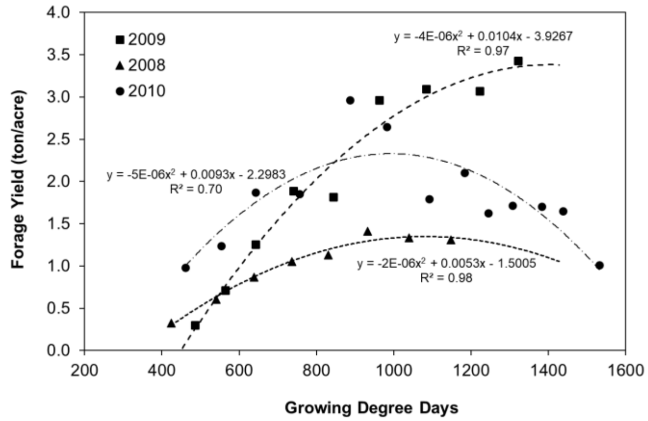


Figure 5. Biomass accumulation of dryland winter canola planted in May based on growing degree days from a study near Moscow, Idaho. (Adapted from Neely et al. [2010] and Walsh et al. [2012].)

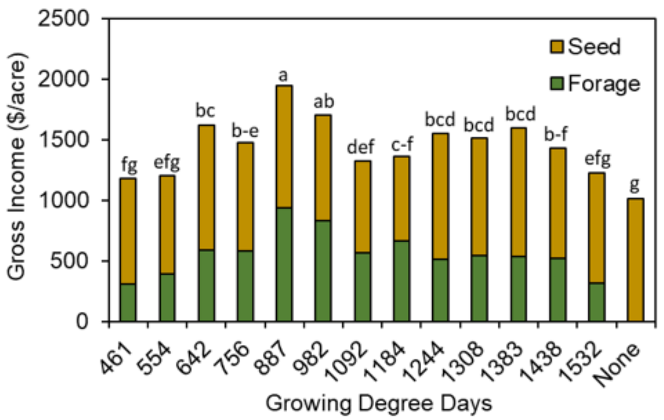


Figure 6. Change in gross income over time according to number of accumulated growing degree days when forage is cut from May-planted winter canola. Estimates calculated using harvested forage and seed yield and assuming forage value of $200/ton and seed value of $0.25/lb. (Adapted from Walsh et al. [2012].)

The most robust data on grazing canolage systems were collected in Australia using sheep. Researchers in Australia determined that the timing of grazing is a critical component in determining whether grazing will impact seed yield. Canola grazed when it is too small is vulnerable to being plucked from the ground, whereas grazing large canola plants may damage the buds and reduce seed yield (Kirkegaard et al. 2012). Additionally, intense and prolonged grazing can reduce yield, while limited grazing often does not result in a yield reduction. Later grazing warrants lighter grazing in order to allow the plants to recover and properly produce buds for seed production. While the results from Australia are useful, they are likely different than the results that would be expected in the inland Pacific Northwest. Unlike the inland Pacific Northwest, Australian winters are relatively mild. The Australian grazing experiments used sheep, while cattle are more likely to be used in the inland Pacific Northwest.

Figure 7. When planted in May or June, winter canola can obtain canopy heights of approximately two feet. (Photo by C. Neely.)


Figure 8. Winter canola biomass accumulation study near Moscow, Idaho, in 2009 showing progression of biomass regrowth when harvested on the following dates: June 25 (A), July 2 (B), July 9 (C), July 16 (D), July 23 (E), July 30 (F), August 6 (G), August 13 (H), August 20 (I), and unharvested (J). (Photo by C. Neely.)

A series of cattle grazing observations were conducted in Washington from 2017 to 2019 to provide insights into the effects of live animal grazing on canola seed yield. The results from these trials indicated that a variety of yield outcomes are possible when grazing winter canola (Table 1). Trials conducted near Dusty, Washington, in 2017 and Creston, Washington, in 2019 resulted in feasible canola seed yields (Figures 9 and 10). Lightly grazed canola at Dusty in 2017 resulted in a seed yield approximately equal to the control. The 2017–2018 Dusty trial did not include replications, which prevents any statistical comparisons. The replicated trial near Creston during the 2019–2020 growing season showed a 1,020 lb/acre (36%) decline in seed yield when the grazed canola was compared to the non-grazed control treatment. The Dusty 2019–2020 trial was planted in May of 2019 with the objective of attaining two separate grazing events. However, the May planting date resulted in terminal drought stress and plant death during the fall of 2019. The non-grazed control plots resulted in complete crop failure, and only the most intensely grazed portions of the field were able to be harvested with a resulting seed yield of 700 lb/acre. The intensely grazed canola likely reduced the late summer water usage, which sustained the canola through to harvest. In this way, grazing might be used to decrease early seeded winter canola water usage. However, in studies by Fransen et al. (2017) and Holman et al. (2021), grazing has been shown to have a negative effect on seed yield when compared to non-grazed canola planted using traditional planting dates in late August.

Figure 9. Heavy cattle grazing treatment on early seeded winter canola near Dusty, Washington, during the summer of 2017. (Photo by I. Madsen.)

Figure 10. Severe cattle grazing treatment is shown in the foreground on early seeded winter canola near Dusty, Washington, during the summer of 2017. In the severely grazed pasture there was extensive hoof damage and the cattle had completely defoliated the canola. (Photo by I. Madsen.)

The trials conducted in the inland Pacific Northwest have resulted in a few important findings. Extremely early seeded canola, even when being grazed, is susceptible to drought-induced yield reductions. Preliminary data suggest that canolage should be seeded in late June or early July with the intention of grazing in September. Additionally, grazing intensity appears to impact subsequent seed yield, indicating that grazing management is a key factor in successfully implementing a dual-purpose crop.

Table 1. Impact of cattle grazing treatments on seed yield of early planted winter canola in Washington State.

| | **Grazing Pressure** | **Yield (lb/acre)[a]** | |
|---|---|---|---|
| Dusty 2017–2018[b] | Heavy | 2,460 | |
| | Severe | 2,140 | |
| | Light | 3,320 | |
| | Non-grazed | 3,380 | |
| Dusty 2019–2020[c] | Severe | 700 | |
| | Non-grazed | 0 | |
| Creston 2019–2020[d] | Heavy | 1,820 | b |
| | Non-grazed | 2,840 | a |

[a] Different letters indicated significant difference between treatments.
[b] No replication.
[c] May-planted canola affected by aphids and drought.
[d] Replicated strips with commercial combine. Seed yields were significantly different at $p<0.05$.

# Forage Quality

Canola forage is quite high in protein and extremely low in fiber and percent dry matter, which can result in a high-quality silage with relative feed values equal to or exceeding that of wheat or alfalfa forage (Llewellyn et al. 2017). In fact, brassica forages are so digestible that they should be treated more as a feed concentrate than a true forage (Cassida et al. 1994). If grazing canola, livestock should have access to pasture with high-fiber roughage or confined livestock should have high-fiber roughage mixed into feed rations with canola forage for proper rumination. Dry matter content of canola forage has been shown to range from 9.4–34.2%, depending on the timing of the biomass harvest (Neely et al. 2015). Moisture content has been shown to decrease as harvests are delayed later into the summer. There are regional markets for silage in the dairy production regions of southern Idaho and central Washington. Figure 11 compares typical forage quality among two common forage sources and canola.

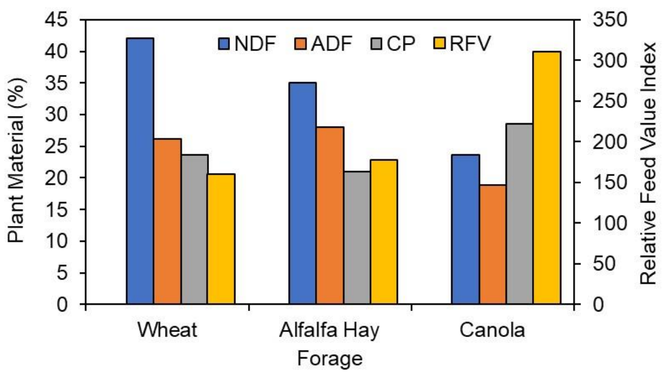


Figure 11. Approximate values for neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), and relative feed value (RFV) across two common forage crops and canola. Values given for canola and wheat (fresh forage) from Stamm et al. (2018), and values given for alfalfa hay (premium class) from Shewmaker and Seyedbagheri (2022).

# Canolage Intercropping

Companion cropping interseeded forage grasses such as triticale, oats, or millet with the canolage can improve forage quality and yield. In the case of canolage intercropped with triticale, increasing the triticale seeding rate was found to increase the overall forage yield. However, this decreased the viability of the canola stand. Similarly, when oats were mixed with canola in forage plantings near Davenport and Creston, Washington, the percent dry matter of the forage was shown to increase. Both acid detergent fiber (ADF) and neutral detergent fiber (NDF) have also been shown to increase with the inclusion of grasses. While the overall protein concentration of monoculture canolage is higher than intercropped canolage, the additional fiber is advantageous for grazing ruminants. This may be a preferred management strategy if an adjacent grass pasture is not available and providing grass hay is not economically viable. To avoid potential nutritional toxicities, growers should monitor nitrate and sulfate levels in canola forage. Canola can accumulate both compounds with high fertility or when grown in stressful environments (Fransen et al. 2017; Zhang et al. 2005).

# Implications for Soil Health

Canolage may result in improved soil health as it can incorporate up to four of the five principles put forth by the NRCS as best management practices for soil health (Fuhrer 2021). Since canolage can be planted anywhere from four to twelve weeks earlier than conventionally produced winter canola, the prolonged growing time produces a number of benefits. It not only provides ground cover more months out of the year, thereby reducing erosion, but the additional root growth also improves carbon contributions to the soil and possibly improves soil organic matter, water infiltration, soil microbiological activity, and competition with weeds over time. Intercropping multiple species may accentuate many of these benefits compared to monoculture canolage. Lastly, reintroducing and grazing livestock on canolage may help with nutrient cycling and also may add microbial diversity to the soil.

# Potential Scenarios for Dual-Purpose Canolage

Due to the uncertainties associated with the practice of canolage, it is unlikely to become a widespread and continuously used management practice in dryland systems in the inland Pacific Northwest. However, as a responsive management approach under appropriate environmental conditions, canolage may improve the overall financial viability of canola and dryland cropping systems in the inland Pacific Northwest. There are specific scenarios in which canolage may work especially well:

***Canolage following unusually dry springs***: Dryland annual forage systems in the inland Pacific Northwest are generally limited by terminal drought in September. Following unusually dry springs, forage supplies in the region generally become limited and forage prices increase. Dual-purpose winter canola may be used to extend the forage season from late summer into the fall and take advantage of the high forage prices. This can be accomplished in the winter wheat-fallow cropping systems typical of Northeast Oregon and Central Washington where stored soil water makes winter canola establishment possible in June or July, even in dry years. In this scenario, the canola forage may be profitable enough to serve as a stand-alone crop, even if drought or winterkill terminate the crop prior to seed harvest the following year.

***Canolage following unusually wet springs***: In unusually wet years, fields in the annual cropping region of eastern Washington and northern Idaho may lie fallow due to prevented planting of spring crops. In these years, canolage may be seeded early in the summer after rains have ceased and can achieve multiple forage harvests with less chance of terminal drought occurring. The same principle may apply to low-lying areas of fields that are slow to dry out in the spring.

***Mixed livestock-crop operations***: In the scablands area of eastern Washington, much of the suitable grazing land is adjacent to farmland. In areas such as this, under mixed livestock-crop operations, canolage may be used to increase herd size or reduce feed costs. Abundant access to adjacent grazing lands lends itself well to supplementing the low-fiber content of canolage. This system may also work well where growers use pivot irrigation in creek bottoms throughout the scablands.

# *Core Management Practices and Considerations*

The following are some additional practices that should be considered for successful canolage:

***Provide additional fiber***: Canola on its own is a high-protein, low-fiber forage. To ensure proper rumen function, additional fiber may be provided through adjacent high-fiber grass pasture, supplemental hay, or through companion planting higher fiber forages such as oats, millet, or wheat with the canola. The use of adjacent pasture has been demonstrated to be especially effective when the water supply is located in or near the high-fiber pasture.

***Forage testing***: Monoculture canolage may have high nitrates or sulfates, depending on the soil fertility (Zhang et al. 2005). It is advisable to test the forage prior to grazing. If high nitrates are suspected, ensiling forage can reduce nitrate concentrations by 30 to 50%. Additional information on nitrates and sulfates in forage can be found in *Dual-Purpose Winter Canola in the Pacific Northwest: Forage Management* (Fransen et al. 2017).

***Planting date***: Planting dates range from early May to mid-July for canolage. The earlier planting date might lead to increased forage cuttings and forage yield but may also lead to terminal drought in the fall and winterkill. The appropriate planting for a given situation should be determined based on the urgency of the forage need and the amount of available moisture.

***Grazing time***: Grazing date is dependent on the planting date and should be based on the stage of the canola rather than a calendar date. Canola should be grazed in the vegetative growth stage and when plants are between one and two feet in height. Maximum dry matter is achieved at around 900 GDD (Neely et al. 2010; Walsh et al. 2012).

***Economics***: When determining whether to implement canola production practices, the relative prices of canola seed and forage must be considered. Neely et al. (2015) reported canolage forage yields as high as 3.6 ton/acre. Seed yield in canolage systems has been shown to range from 147 to 3,380 lb/acre in the inland Pacific Northwest. The large variation in seed yield can be due to a number of factors, including planting date, winter survival, and grazing intensity. The relative prices of forage and seed are likely to determine the economic viability of a canolage production system.

# *Advantages and Disadvantages of Canolage*

***Advantages***:

- In the inland Pacific Northwest, dryland forages are typically limited by terminal drought. Canolage seeded in the late summer can serve to extend the forage season.
- Canolage produces two revenue streams generated from the same field, thereby effectively reducing the cost of fallow in the winter wheat-fallow region.
- Canolage production can use earlier seeding dates than conventional canola, which generally results in more consistent stand establishment. Late seeding dates in the dry regions are plagued by poor stand establishment resulting from declining moisture as summer progresses.
- Potential soil health benefits from increasing the length of time that roots are actively growing, increasing plant diversity in the case of mixed canolage, and introducing livestock onto cropland.

***Disadvantages***:

- In some years, using a canolage management practice results in decreased seed yield or terminal drought and crop failure. If the price for canola seed is high and forage low, canolage systems will likely not be profitable.
- Canolage management practices may have a high opportunity cost, especially on farms lacking animal production. The additional concerns of water and fencing can frequently make canolage unprofitable.

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