CAMELINA: POTENTIAL OIL SEED ROTATION CROP FOR THE WILLAMETTE VALLEY

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Camelina (*Camelina sativa*) is a new oilseed crop in the Pacific Northwest that can be grown as a feedstock for biodiesel and aviation fuel (jet fuel), to provide a needed rotation crop for grass seed producers in the Willamette Valley, and as a source of oils rich in omega-3 fatty acids. Camelina is adapted to production on marginal soils and low levels of agricultural chemical inputs. In addition, camelina does not cross pollinate with vegetable seed crops, eliminating the potential conflict among growers possible with other oilseed crops.

Most agronomic research to date on camelina production has been conducted in semi-arid climates found in Montana, or in the dry inland parts of the Pacific Northwest states. Several fundamental agronomic practices needed to be identified for production of camelina in the wet conditions typical of the Willamette Valley. With that goal, the performance of camelina under Willamette Valley conditions was examined in field trials over a three-year period (2007-08, 2008-09, and 2009-10) at OSU's Hyslop Farm. This study was part of a multi-state cooperative research program on camelina with field trials located in Corvallis and Pendleton, Oregon; Moscow, Idaho, and Lind, Washington. Participating institutions included Oregon State University, Washington State University, and the University of Idaho.

The research had three basic objectives:

1. Determine optimum planting time and method for camelina
2. Determine optimum nitrogen and sulfur fertilizer application rates for camelina
3. Evaluate potential camelina cultivars for use in the Willamette Valley

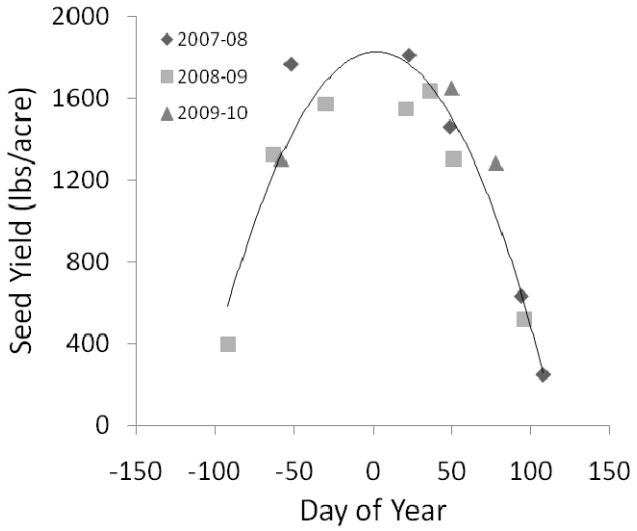
To determine the optimum planting time and method for camelina, the cultivar Calena was planted on various dates beginning in early autumn through spring. Planting dates varied from year to year and were chosen based in part on the field conditions extant at the time of planting. Extremely wet or cold conditions at the time of planting or shortly thereafter caused the loss of two planting dates over the 3-year period, in the months of November and December. At each planting date, two methods of planting were examined – planting by using a drill or by broadcast planting of the seed. The seeding rate was the same for all trials, 5 lbs/acre. Nitrogen was applied at 25 lbs N/acre for each planting date.

Nitrogen fertilizer rates were evaluated in trials sown with the cultivar Calena in February of each year. Six rates of nitrogen fertilizer were applied (0-, 20-, 40-, 60-, 80-, and 100-lbs N/acre) following emergence of the crop by using an orbit air spreader. Two sulfur rates (0- and 20-lbs S/acre) were broadcast applied on to the plots.

Eighteen cultivar entries were sown on multiple planting dates over the 3-year period of the trials. The cultivars were sown in plots by using a Wintersteiger plot drill. All treatments including planting date and method, fertilizer, and cultivar, were replicated 4 times. Nitrogen was applied at 25 lbs N/acre for each planting date of the cultivar evaluation trials. All field trials were laid out in a randomized block design. No herbicides were used in the production of the crops. The camelina seed crop was harvested by direct combining. Oil concentrations in the seed and oil yield will be reported in a later update.

Camelina is an unusual crop in that seed yields were symmetrically distributed by planting date with the greatest yields centered about January 1 (DOY 0), and lowest seed yields were attained when the planting was done earliest in autumn or latest in the spring (Figure 1). By plotting seed yield data from the three seasons against planting dates, and fitting the combined data to a 2nd order regression function, this symmetrically distribution of camelina seed yields across planting dates was identified. The planting dates on the x-axis in Figure 1 are plotted as day of year (DOY) counting backwards to January 1st in the fall and from January 1st in the spring.

Figure 1. Influence of planting date (day of year) on camelina seed yield in the Willamette Valley.



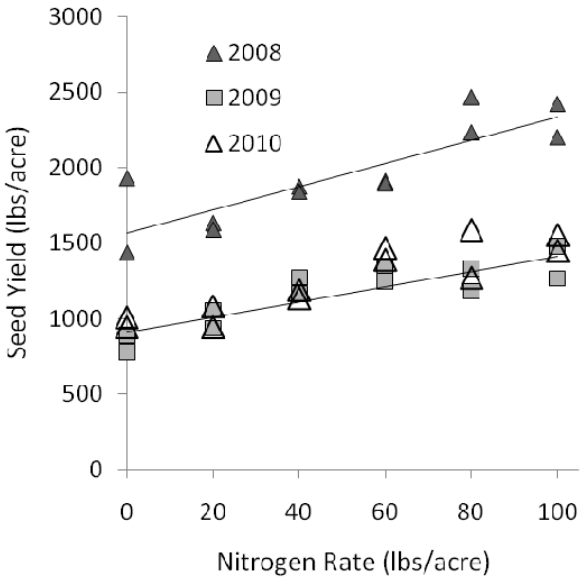
Analysis of the data over the three years suggests that sowing within a planting window extending from -60 DOY (November 1st) to + 60 DOY (March 1st) maximizes seed yield of

camelina. Within this planting window, camelina has the potential for 1200 lbs/acre or greater seed yield. Planting outside this window, earlier than -60 DOY in the fall or later than +60 DOY in the spring, camelina can be expected to yield less than 1200 lbs/acre based upon on the three years of data in the study. While this planting window maximizes seed yield, the logistics of planting during the wettest stretch of the year in the Willamette Valley need to be carefully considered.

There were no differences in seed yield among planting by drill or broadcast planting methods, nor was there an interaction of planting date and planting method. This means that growers can further reduce the cost of production by broadcasting the seed rather than drilling the crop with a planter, and makes planting in wet weather a better prospect.

Camelina was responsive to nitrogen fertilizer applications. Seed yield increased with quantity of nitrogen applied, with the greatest yields observed at nitrogen rates of 60 lbs N/acre or greater (Figure 2). However, our analysis revealed that there were no significant differences in camelina seed yield among rates greater than 80 lbs N/acre. Seed yield responses to N were essentially the same in 2009 and 2010, and while overall yields were greater in 2008, the seed yield response to N application rates was the same. Sulfur application (20 lbs S/acre) slightly improved camelina seed yield in one of the three years of the trial. There were no interactions of sulfur and nitrogen on camelina seed yield in any of the years.

Figure 2. Effect of nitrogen fertilizer rate on camelina seed yield in the Willamette Valley.



Seed yield varied among cultivars and planting date in the cultivar trials. For instance, seed yield ranged from 884 lbs/acre to 1757 lbs/acre in the February-sown 2010 trial while from a similar planting date in February in 2009, yields ranged from 338 lbs/acre to 613 lbs/acre. Averaged over planting dates within the acceptable planting window (November 1 to March 1), cultivar performance ranged from the top-yielding Celine at 1079 lbs/acre to the poorest yielding and seemingly poorly adapted GP07 at 512 lbs/acre (Table 1). GP07 had the lowest individual seed yields in all of the field trials. Seed yields in the cultivar trials might have been higher had higher N rates been used than 25 lbs N/acre.

Seed yields in 2009 and 2010 were clearly lower than in 2008 (Figure 2). Although from crop emergence to harvest, rainfall was near normal in 2009 (97%) but seed yield was clearly lower than in 2008 when rainfall during the emergence to harvest period was only 80% of normal. Extremely heavy rainfall events and the associated humidity in May 2009 contributed to increased incidence of downy mildew observed in the plots. The wet weather and downy mildew may have been involved in the reduced seed yield observed in 2009. Unusually wet conditions in spring 2010 brought 16.51 inches of rainfall from the beginning of March until the end of June (164% of normal) and may have contributed to the incidence and severity of downy mildew seen in 2010. Again, yield might have been reduced by downy mildew incidence that ranged up to 20% infected plants/plot in 2010. Nitrogen or sulfur nutrition did not appear to influence the presence of downy mildew in the field, but no downy mildew was observed in fall-planted camelina.

In plants where downy mildew was most severe, abortion of the lower pods (manifested as red pods) in the inflorescence was observed. The white hyphae and sporangiophores seemed to be most concentrated in the central stem axis of the inflorescence, especially in the youngest portions of the inflorescence. As the inflorescence matures, the hyphae-affected region migrates to the least mature portion of the inflorescence leaving behind red aborted pods in the lowest (most mature) part of the inflorescence.

Table 1. Cultivar seed yield performance averaged over years and planting dates .

Cultivar	Seed yield (lbs/acre)
Celine	1079
Calena	1078
GP67	1063
SO-1	1060
Ligena	1040
SO-3	968
Blaine Creek	947
GP48	934
SO-4	920
Columbia	872
SO-5	829
GP41	826
Cheyenne	811
Suneson	807
SO-2	783
GP42	776
SO-6	744
GP07	512

Camelina is a promising oil seed rotation crop. Several cultivars appeared to be adapted to Willamette Valley conditions and would likely produce economic yields when planted within the suggested planting window and fertilized with at least 60 lbs N/acre. Further work needs to be done to identify effective, economical methods for weed control, as well as strategies for controlling downy mildew.

This article is dedicated to the memory of the late Daryl Ehrensing, a key contributor to the data presented here. This research was funded by the US Department of Transportation Sun Grant and the Agricultural Research Foundation.