

Part 1. Oilseeds and Other Alternative Crops

Expanding Camelina Adaption and Marketability by Breeding



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Camelina has potential as a rotation crop in dryland farming areas of the Pacific Northwest. Several genetic traits have been identified that either make the crop more adaptable to our wheat-based cropping systems or expand its marketing potential. One problem with currently available varieties is the extreme sensitivity to sulfonylurea and imidazolinone herbicides, which prevents their use in crop rotations using these chemistries, especially in rotations with Clearfield wheat varieties. We used a mutagenesis approach to identify lines with reduced sensitivity to these herbicides. One line carried a mutation that provided resistance to residual levels of both types of herbicides (Walsh et al. 2012). Lines carrying the gene showed no herbicide injury when planted into soils where the herbicide Beyond was applied at four times the recommended rate the previous season. The mutation has been bred into a high yielding, high oil background and is being amplified for release in 2016.

A second breeding objective is a variety that will be more widely accepted for edible oil purposes. Although this market is already expanding, camelina oil has not been approved by the FDA partly due to the erucic acid content. Current camelina varieties have erucic acid contents of approximately 3% while canola and other oils are less than 1%. Our cooperator at Montana State University, Dr. Chaofu Lu, has identified a mutation causing low (~0.5%) erucic acid. This trait is being bred into our highest performing lines for release as a low-erucic, herbicide tolerant variety for cooking/salad oil.



Variation in seed size in different Camelina breeding lines.

A third focus of the breeding program is larger seed size for better emergence and stand establishment. Camelina's small seed requires a very shallow seed depth at planting which can make stand establishment difficult under dryland conditions. We have begun a recurrent selection program for large seeds after crossing our advanced lines to the largest seeded camelina germplasm available. The objective is to determine if it is possible to make larger seeded varieties that have similar or better yields and oil contents.

Walsh, D.T., E.M. Babiker, I.C. Burke, and S.H. Hulbert. 2012. Camelina Mutants Resistant to Acetolactate Synthase Inhibitor Herbicides. *Molecular Breeding*: Volume 30:1053-1063

Canola-Wheat Integration in the Inland Pacific Northwestern U.S.



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The inland Pacific Northwestern U.S. (iPNW) has a diversity of environments and soils, but lacks crop diversity, and is one of the few global wheat growing regions without significant oilseeds in rotation. Although major interest in regional energy crops and rotational diversification spurred feasibility research on iPNW canola food, feed and fuel production as

far back as the 1970s, canola adaptation has lagged behind other semi-arid wheat regions for various socioeconomic, ecophysiological and agronomic reasons. Global dietary changes, biofuel demand, genetic advances and public/private investments in regional processing facilities have increased iPNW canola acreage from 7,000 in 2011 to 31,000-43,000 over the past two years.

While canola management largely relies on wheat farm equipment, agronomic approaches require strategic adjustments to account for physiological differences between canola and cereals including seed size, seedling morphology and responses to temperature extremes. Climate change predictions for the region threaten to exacerbate current hot and dry summers and research aims to develop and adapt flexible winter and spring canola-based systems to regional water and temperature stressors in each zone. The iPNW is challenged with having the lowest annual precipitation percentage (20 to 40%) during the growing season of any of the major semi-arid canola producing global regions. The WA Oilseed Cropping Systems Project, funded by the WA State legislature, is conducting research on planting, fertilization, pest control strategies, variety performance, and cropping systems to successfully establish improved winter canola integration in the dry zones and spring canola in the wet zones.

The adaptation of winter and spring canola will somewhat mirror the rotational placement of winter and spring cereals within each zone, with some spring canola potentially replacing fallow during wet years in the intermediate rainfall, flex crop zone. Economic analysis of oilseed break crop benefits such as weed and disease control will help to demonstrate the medium-term economic benefits of crop diversification to support the growth of a regional canola industry in the iPNW. Projected acreage required to match existing Washington processing capacity is around 700,000 acres, far below the 1:1 wheat to canola production levels being approached in the western Canadian Prairies.

Pan, W.L., F.L. Young, T.M. Maaz, and D.R. Huggins. 2016. Canola Integration into Semi-Arid Wheat Cropping Systems of the Inland Pacific Northwestern U.S. An invited submission to a special issue in Journal of Crop and Pasture Science. Accepted for publication.

Improving Economics and Sustainability of Winter Wheat/Fallow Rotation with Oilseed Crops

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Dryland winter wheat production in large areas of the Palouse region is under a wheat-fallow rotation cropping system. In this system wheat is grown once in a 2 year period; 10 months of fall sown wheat and 14 months in fallow to conserve moisture and store winter precipitation necessary for the wheat crop during the next season. The system could potentially be improved by adding an additional cash crop and converting a 2-year rotation into a 3-year rotation: winter wheat/cash crop/fallow. For growers to use a 3-year rotation, the cash crop would need to provide equal or greater value than 33% of the wheat crop. Some oilseed crops for biodiesel production show promise as cash crops in this 3-year rotation, but there has been no side by side comparison of novel biodiesel crops alongside more traditional ones.

This field trial will provide a side by side comparison of traditional and novel oilseed biodiesel crops in eastern Oregon's semiarid climate. The objective of the project is to evaluate the agronomic, environmental and economic feasibility of growing, processing and co-product utilization of thirteen crops (canola, oriental mustard, camelina, safflower, sunflower,

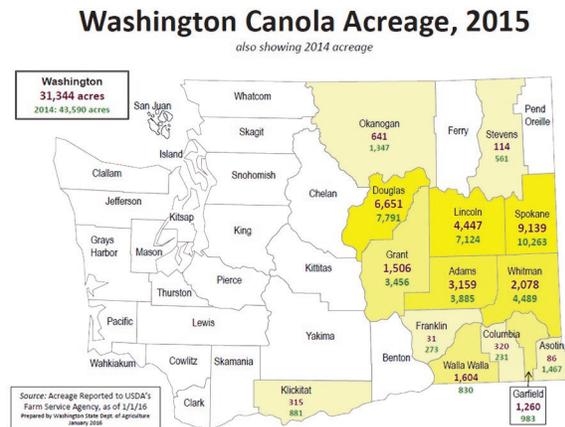


Figure 1. Courtesy of M.B. Lang, WSDA