has the lowest erucic acid content of all, #43 had greater mean yield with significantly larger seeds (1.23 mg/seed) than #44 (1.05 mg/seed). Other promising lowE lines include #35, the highest yielding line (1339.3lbs/acre) with 1.91% erucic acid, and #38, the second highest yielding (1191.9 lbs/acre) and second highest oil content (43.22%) line with 1.56% erucic acid. Overall, #44 is inferior to the check varities in most of the agronomic categories, while #43 is competitive with the checks. Both #35 and #38 outperform the check varieties in both yield and oil content. With such low erucic acid content, we are confident #43 and #43, will maintain <2% erucic acid content across different environments/years. More testing is needed to confirm whether #35 and especially #38 will maintain <2% erucic acid content across different environments/years, but their higher yield potential may be worth that risk. Additionally, there is potential to mix lowE lines like #43 and #44 with higher erucic lines to dilute total erucic content below 2%. It is important to note that all lowE lines have significantly higher linoleic, α-linolenic, and total oil content than the checks.

Table 1. Grouped means for four elite LowE Breeding Lines and Check Lines. Lowercase letters denote significant differences (Tukey HSD) between means; "r" is the number of replicates per genotype.

r	Genotype	Yield (lbs/acre)	1SM (mg)	Oil (%)	Linoleic (%)	α-Linolenic (%)	Erucic (%)
8	LowE.44	876.8a	1.05b	41.57a	21.42ab	33.69a	0.46a
8	LowE.43	1021.1a	1.23ab	40.90ab	20.91abc	33.78a	0.57a
8	LowE.38	1191.9a	1.19ab	43.22a	22.16a	30.99b	1.56b
8	LowE.35	1339.2a	1.18ab	41.26a	18.35d	33.76a	1.91b
32	Suneson	1072.7a	1.24ab	36.04bc	21.30ab	31.37b	2.44c
8	BlaineCreek	999.7a	1.26a	35.10c	18.90cd	32.96ab	2.64cd
8	WA-HT1	1060.4a	1.24ab	35.9bc	19.06cd	33.57a	2.78cd
8	Midas	917.8a	1.32a	35.41c	19.59bcd	33.35ab	2.80cd
8	Cheyenne	1142.6a	1.33a	33.51c	18.37d	31.86ab	2.93d
32	Calena	1133.5a	1.28a	35.62c	19.54cd	33.35ab	3.00d

Biodiesel and renewable jet fuel are still good options for camelina oil, but development of lowE camelina lines suitable for human consumption will greatly expand the marketability and profitability of this crop. The WSU Camelina Breeding Program plans to publicly release lowE line(s) summer 2020.

*Note: The WSU Camelina Breeding Program released WA-HT1, a group II soil herbicide resistant variety, in 2018. All of these lowE lines have that herbicide tolerant trait and exhibit resistance to soil residual levels of group II herbicides.

Spring Canola and Chickpea Value in a Cereal Grain Rotation

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Canola (*Brassica napus* L.) has been a rotation option with wheat (*Triticum aestivum*) for farmers in the dryland cropping region of the Pacific Norwest for over 25 years, yet adoption has been limited because of market access, profitability and overall unfamiliarity with the crop. In 2014 a large-scale multi-year rotation study was initiated comparing spring wheat, canola and chickpea (*Cicer arietinum* L.) (1st year) in rotation with winter wheat (WW) (2nd year) and spring wheat (3rd year). The study was located at the WSU Wilke Research and Extension Farm which receives an average of 14 inches of precipitation. The experimental design was a randomized complete block with four replications and plot size 25x200 feet. Each crop rotation is examined over two cycles (i.e. 6 years) and was repeated in 2015 and 2016. Data presented here focuses on the three treatment crops and includes seed yield, production costs, and economic returns. Over the 6 years, spring wheat had the highest yield, averaging 2,134 lbs./ac (35.6 bu/ac), and there was no significant difference in yield between canola and chickpea 1,014 and 963 lbs./ac, respectively. Gross economic returns were calculated using local F.O.B. prices on September 15 each year, and canola and chickpea yearly contract prices. Chickpea and wheat had the greatest gross economic return at $214 and $199/ac, respectively, compared to canola at $166/ac. Production costs considered included only seed, fertilizer, and herbicide costs. Over the six years wheat had the lowest production costs at $100/ac, and canola and chickpea both averaged $116/ac. Overall wheat and chickpea produce the greatest economic return to growers over costs at $99 and $97/ac, respectively, and canola produced $48/ac over costs. In conclusion market price is a major component of potential profitability of wheat, chickpea and canola.

Treatment	Yield (lbs./ac)	Market Price ($/lb)	Gross Economic Return ($/ac)	Cost ($/ac)	Economic Return over Costs ($/ac)
Wheat	2134 a	0.093	199 a	100	99 a
Canola	1014 b	0.162	165 b	116	48 b
Chickpea	963 b	0.222	214 a	116	97 a
LSD (P<0.05)	134		21		21

Means within columns with different lowercase letters are significant (P<0.05).

Soil Water Dynamics with Camelina in a Three-Year Rotation in Washington's Winter Wheat-Fallow Region

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Camelina of the *Brassicaceae* family is a short-season oilseed with tolerance to water stress and frost. Camelina has been promoted as a potential alternative crop for the low-precipitation (<12 inch annual) Mediterranean-like climate region of inland Pacific Northwest where a monoculture 2-yr winter wheat-summer fallow (WW—SF) rotation is practiced by the vast majority of farmers. An 8-yr field experiment was conducted at Lind, WA to compare a 3-yr WW—camelina—SF rotation to the typical 2-yr WW—SF rotation. We conducted a detailed analysis of soil water dynamics of these two crop rotations throughout the experiment. Growing camelina reduced soil water content at the beginning of the fallow period, and this reduction resulted in an average of 0.83 inches less water at the time of WW planting and a 2.5 bushel/acre reduction in grain yield compared to WW—SF. Compared to WW—SF, we found that: (i) the deep-rooted broadleaf weed Russian thistle present in camelina most years was a likely reason for significantly greater in-crop soil water use, and (ii) the limited residue produced by camelina was likely responsible for greater evaporative loss during the spring-through-late-summer segment of fallow. These are the first findings from the Pacific Northwest drylands of greater water use by a cool-season spring crop versus WW as well as greater evaporative loss during the dry summer months due to lack of residue during fallow. In this experiment, extending the crop rotation to include camelina was costly in terms of water use, surface soil residue cover, soil water storage during fallow, and WW grain yield. Read the full article here: https://acsess.onlinelibrary.wiley.com/doi/full/10.2136/sssaj2019.05.0157.

Developing Diagnosis and Recommendation Integrated System for Micronutrients in Spring Canola

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Macronutrient and micronutrient concentrations in tissue tests vary between crop species. Additionally, tissue concentrations may also vary between varieties in a single crop species. In crops such as canola (*Brassica napus*) critical values might be used from a closely related crop species such as rapeseed (*Brassica rapa*), without validating the critical values for the crop of interest. In addition to the variations between and within species there may also be wide spatial variation within fields. In order to assess some of these variations and work towards establishing critical values in the inland Pacific Northwest we collected tissue samples from winter and spring canola trials in Washington. We sampled farm scale variety trials in order to assess the variation between crop cultivars and the variation across a field within individual cultivars. The strip were 40 feet wide by 600 feet long and contained five varieties replicated four times coming to total of 11 acres. The strip trial was established near Almira, WA following winter