In year 2, WC in both the direct seed into standing stubble and broadcast into standing WW before WW harvest was winterkilled. Winter canola plants in the other three treatments were hurt by the cold but many survived. In year 3, voles infested the two standing stubble treatments during the winter (when snow covered the ground for 75 days) and ate WC plants mostly down to ground level. Voles did not infest the other three treatments. Seed yields during the 3-year experiment are shown in Table 1.

Important take-home messages from this experiment are: (i) We found no evidence that fresh wheat stubble is toxic to WC as evidenced by no foliar or root diseases in any year, and; (ii) an Adams County farmer successfully produces irrigated WC direct seeded into freshly harvested WW stubble after mowing the stubble and, therefore, apparently avoiding extensive WC seedling hypocotyl elongation as experienced in our study.

Table 1. Winter canola seed yields in three years and the 3-year average yield with five wheat residue management treatments at the Jeff Schibel farm near Odessa, WA.

	Seed yield (lbs/acre)			
	Year 1	Year 2	Year 3	3-yr avg.
Stubble burned + disked	3092	2832	2776 ab	2900
Stubble burned + direct-seeded	3020	2678	2795 ab	2831
Stubble chopped + moldboard plowed	3246	1830	3158 a	2745
Direct seeded into undisturbed stubble	2988	**	2218 bc	
Broadcast into standing wheat	*	**	1939 c	
Statistical significance	ns (p = 0.40)	ns (p = 0.06)	p < 0.001	ns (p = 0.52)

* The broadcast into standing wheat before harvest treatment was not present in year 1.
** Canola killed by cold temperatures in 2014.
ns = No significant statistical differences at p<0.05.

Soil Microbial Communities in a Long-Term Dryland Camelina Cropping Systems Experiment

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Camelina is a potential alternative and oilseed biofuel crop for wheat-based cropping systems of the Inland Pacific Northwest (PNW). We investigated the effect of this relatively new rotational crop on soil microbial communities. Camelina is a brassicaceous crop that contains glucosinolates which, upon cell rupture during the decay of residue, hydrolyze to produce isothiocyanates. Dimethyl-disulphide is a compound that is associated with the roots of camelina. Production of isothiocyanates and dimethyl-disulphide contribute to the "biofumigation effect" which can reduce the inoculum of soilborne pathogens. However, the non-selectivity of these compounds has potential to also impact beneficial soil microorganisms.

An 8-yr cropping systems experiment was initiated in 2009 at Lind, WA, to compare a 3-yr rotation of winter wheat (WW) -camelina (C)-summer fallow (SF) to the typical 2-yr WW-SF rotation. Microbial biomass and community composition were determined using phospholipid fatty acid analysis (PLFA). The abundance of fungi, mycorrhizae, Gram positive and negative bacteria, and total microbial biomass all declined over the 3-yr period in the WW-C-SF rotation. All microbial lipid biomarkers were significantly less in SF compared to WW (Fig. 1). The 2-yr WW-SF rotation demonstrated few differences in microbial lipid abundance and community structure between the rotation phases. Decline in microbial abundance and shift in community structure (Fig. 2) of the 3-yr WW-C-SF rotation was likely due to the combination of a

brassica crop followed by a fallow period. The stability of microbial communities in the 2-yr rotation was likely a result of a 140-yr history of the monoculture WW-SF cropping system in the low precipitation (<12-inch annual) zone of the PNW.

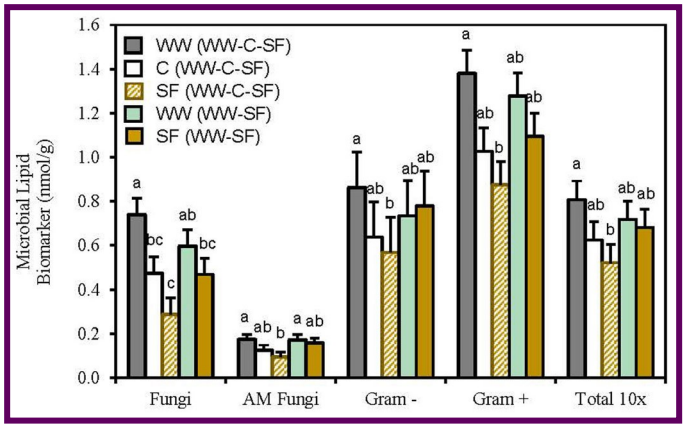

Figure 1. Soil microbial lipid abundance. Biomarker groups and total PLFA (T-PLFA) concentrations (nmol/g) of soil. Values are least square means for crop by rotation treatments. Error bars indicate standard error. Values within each biomarker group with different letters are significantly different ($p \leq 0.05$).

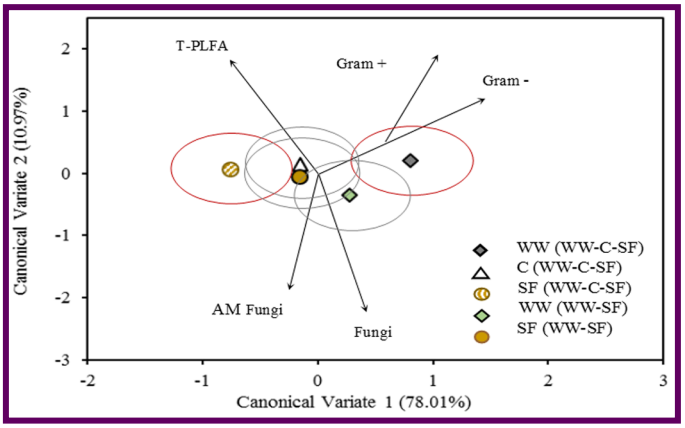

Figure 2. Canonical variates for lipid biomarker groups. Biomarker groups and total PLFA (T-PLFA) of soil from 2011 to 2015. Vectors represent standardized canonical coefficients and indicate the contribution of each biomarker group to each canonical variate. Each point represents the group centroid mean and is accompanied by a mean ellipse at the 95% confidence interval (Treatments groups that differ significantly have confidence ellipses that do not intersect).

Effect of Planting Date on Winter and Spring *Camelina sativa* Biotypes

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The vast majority of camelina varieties are spring biotypes. However, winter biotypes also exist that require vernalization to flower and consequently exhibit different patterns of growth. These winter types have yet to be evaluated in field trials because camelina traditionally is a spring planted crop. The purpose of this experiment was to evaluate both spring and winter camelina biotypes planted at different times throughout the growing season. Five different planting dates were used, with two fall planting dates, October 5 (F1) and October 24 (F2), and three spring planting dates, April 5 (S1), April 22 (S2), and May 10 (S3). A total of eighteen camelina varieties, consisting of fifteen spring and three winter biotypes, were used in the variety trial, and each of the varieties was replicated three times per planting date. The field trial was located at Cook Agronomy Farm in Pullman, WA.

Although winter biotypes reportedly have superior cold tolerance, we did not observe any significant differences in winter survival between the two biotypes. Despite average temperatures of 26.7°F and temperatures as low as -11°F, negligible rates of winter-kill were observed in both winter and spring types. This result was not surprising, as spring types exhibit cold tolerance comparable to that of winter wheat and prolonged snow cover likely buffered the plants from the extreme cold. Every fall-planted variety reached the rosette stage before being covered by snow for more than 90 days. All fall-planted varieties flowered before the end of May and were ready for harvest by mid-July. For both S1 and S2, the spring and winter types flowered in synchrony, indicating that the vernalization requirement of the winter types was met by the cool, early spring conditions. S1 reached 50% flowering around June 10, S2 around June 18, and S3 (spring types only) around June 25, and all three were ready to harvest by mid-August. However, the winter varieties in S3 were not thoroughly vernalized and exhibited significant delay in flowering (Photo 1). These varieties did not start flowering until the end of July, had just started seed set by harvest, and ultimately had significantly low yields. This disparity in yields is depicted in Figure 1. Figure 1 also illustrates the differences in yields of winter and spring biotypes across all planting dates. Excluding S3, the winter types out yielded the spring types in every other planting date,