Large Seeded Camelina Breeding Lines with Potential for Public Release

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Camelina is a potential alternative crop for the sustainable intensification off dryland cropping systems, especially in the inland Pacific Northwest (iPNW). Despite minimal input requirements, strong adaptability to diverse environmental conditions and a "heart-healthy" fatty acid profile suitable for biodiesel and renewable jet fuel production, weed control is a big hindrance to the adoption of camelina into iPNW wheat rotations. Small seed size necessitates shallow planting and impacts germination in dryer soils, preventing good stand establishment and enabling weeds to establish significant populations. Additionally, very few herbicides labeled for use on camelina drastically limits options for controlling weeds once they establish. Development of larger seeded camelina varieties will boost germination and stand establishment, decreasing weed pressure.

The WSU Camelina Breeding program has developed several elite large seeded camelina breeding lines that also exhibit good agronomic performance. During the 2019 field season, 12 advanced large seeded breeding lines and 6 check varieties were tested in a replicated field trial in Pullman, WA. There were two seeding dates, May 10 and May 23, and at least four replicated plots (5ft x 9ft) of each genotype (16 for Calena and Suneson) per seeding date, arranged in a randomized complete block design (RCBD). Overall, the lines performed similarly in both seeding dates, so only means across seeding dates for each line is given.

Table 1 details the performance of each large seed line and check variety, sorted from largest to smallest single seed mass (1SM). Every large seeded line has significantly higher oil content and is significantly bigger than the check varieties, but there were no significant differences in 1SM or oil content within large seeded lines. Line #31 is promising, with the highest yield and high oil content. However, more environments/years are necessary to determine the top performing large seeded line(s). Fortunately, these large seeded lines were grown in single-location, replicated field trials in each of the 2017, 2018 field seasons. Seed samples from those field seasons have yet to be analyzed for oil content and fatty acid composition, but we do have yield and 1SM data for those lines.

Table 1. Grouped means for all Large Seed Breeding Lines + Check Varieties. 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	LargeSeed.23	1064.5a	1.83a	40.53ab	20.48ab	32.37ab	2.82bcd
8	LargeSeed.28	1028.9a	1.81a	39.02abcd	19.66bc	32.66ab	3.01abc
8	LargeSeed.26	1158.1a	1.81a	39.96abc	19.72bc	33.11ab	3.03abc
8	LargeSeed.30	1074.7a	1.78a	39.74abc	18.89bc	33.69a	3.14abc
8	LargeSeed.24	1134.1a	1.78a	40.53ab	20.14abc	32.51ab	2.92abc
8	LargeSeed.21	909.5a	1.77a	40.72a	20.55ab	31.98ab	2.82bcd
8	LargeSeed.22	1186.8a	1.76a	40.79a	19.49bc	32.88ab	2.91abc
8	LargeSeed.25	1144.5a	1.74a	39.97abc	19.58bc	32.87ab	3.17ab
8	LargeSeed.31	1271.7a	1.71a	40.04abc	19.78bc	32.19ab	3.21ab
8	LargeSeed.20	945.3a	1.70a	38.89abcd	20.01abc	31.65ab	3.21ab
8	LargeSeed.29	1163.1a	1.69a	39.58abc	19.97abc	32.30ab	3.24ab
8	LargeSeed.27	1114.8a	1.68a	40.15abc	20.01abc	32.90ab	3.34a
8	Cheyenne	1142.6a	1.33b	33.51d	18.37c	31.86ab	2.93abc
8	Midas	917.8a	1.32b	35.41cd	19.59bc	33.35ab	2.80bcd
32	Calena	1133.5a	1.28b	35.62cd	19.54bc	33.35ab	3.01abc
8	BlaineCreek	999.7a	1.26b	35.10cd	18.89bc	32.96ab	2.64cd
8	WA-HT1	1060.4a	1.24b	35.99bcd	19.06bc	33.57a	2.78bcd
32	Suneson	1072.7a	1.24b	36.04bcd	21.29a	31.37b	2.44d

Table 2 depicts the grouped means for all large seeded breeding lines across the 2017, 2018, and 2019 seasons. Overall, the lines seem to perform similarly across all years as they did in 2019. Line #31 stands out with second highest yield across three years. The addition of oil content and fatty acid composition data for 2017 and 2018 will help us identify the best large seed line(s) for release, hopefully in fall 2020.

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

Table 2. Grouped means for all Large Seed Breeding Lines across 2017, 2018, and 2019 seasons. There were no significant differences (Tukey HSD) between any means; "r' is the number of replicates per genotype.

r	Genotype	Yield (lbs/acre)	1SM (mg)
13	LargeSeed.24	933.6	1.67
14	LargeSeed.23	895.1	1.67
14	LargeSeed.30	915.4	1.66
14	LargeSeed.28	863.5	1.65
14	LargeSeed.26	975.1	1.65
14	LargeSeed.25	1028.9	1.64
14	LargeSeed.21	803.7	1.63
13	LargeSeed.22	959.6	1.61
14	LargeSeed.31	1015.4	1.60
14	LargeSeed.29	968.4	1.59
14	LargeSeed.27	927.8	1.57
14	LargeSeed.20	804.4	1.57

Spring Canola Large-Scale Variety Trials

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Small plot variety trials serve to assess the relative yields and traits of varieties. However, small plots do not capture the effect of landscape on different varieties. In order to assess the effect of landscape on yield and other important agronomic variables it is important to test varieties on a larger scale (Fig. 1). The large-scale variety trials are planted with a production scale drill and range from 400-600 ft in length. Each variety was replicated four times to allow for statistical comparisons of yield, nutrient concentration, and stand counts. During the 2019 growing season, large-scale variety trials were conducted at three locations. The varieties at each location varied based on what is commonly grown in each region. The variety trial locations were at Almira, WA, Davenport, WA, and Pullman, WA. At the Almira location, all the varieties except InVigor L233P were non -GMO. At the Davenport location a mix of non-GMO and GMO varieties were planted. At the Pullman location only RoundUp Ready varieties were planted. At both Almira and Davenport there were significant differences based on variety (Table 1). However, at Pullman, there was no significant differences based on yield. At the Davenport location NCC101S had the

Figure 1. Strip trials near Pullman, WA demonstrate the landscape variability which can be captured with large scale trials.