Title: Development of Camelina Varieties Resistant to Group 2 Herbicides

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Background:
Camelina has a potential as an oilseed and valuable rotation crop in the dryland farming areas of Eastern Washington but is extremely sensitive to ALS-inhibitor (group 2) herbicides. Earlier work identified a mutation that conferred tolerance to these herbicides and we are now breeding this mutation into a high yielding, high oil content variety.

Objective:
Perform selections of a herbicide (imidazolinone and sulfonyl urea) tolerant (HT) line from a cross between our herbicide tolerant line and the cultivar Calena and evaluate additional germplasm for breeding potential.

Methods:
Replicated field trials of 50 lines from breeding population A were planted in 4 locations: Davenport (Wilke farm), LaCrosse, Ralston and Pullman. Yield and data were taken mainly from the Davenport and Ralston experiments, where stands were most uniform. Oil content was determined for four replications of each line. Other data taken included heading date and rate of stand establishment.

Plots of other accessions and breeding lines were also planted in the Wilke Farm nurseries. These included 24 accessions from the national germplasm repository that performed well in preliminary experiments in 2012; five lines from Sustainable Oils; and 153 and 192 lines from Ht breeding populations 1 and 2, respectively. The latter two populations were derived from crosses between our original mutant SM4 and two Sustainable Oils lines, 2040 and 2050.

Results and Discussion:
Results from the replicated field trials indicated that 17 of the lines yielded similarly to Calena, the high yielding cultivar chosen to cross our SM4 mutation to. Oil content analysis indicated nine of these cultivars had 37% oil content or higher. These nine lines will be selected for yield and oil content analysis this coming summer to select one or more lines for potential HT cultivars.

Individual plants were selected from 345 plots from F3 breeding populations 1 and 2. Individual plants were again selected from each line in the greenhouse to establish F5 lines for field analysis this summer.
We examined lines from the national germplasm center and private companies in replicated yield trials at Davenport. Some of the accessions were heterogeneous and single plant selections were made. Five of the accessions yielded more than our check cultivar Calena. Crosses were made between some of our best HT breeding lines and the five lines that out-yielded Calena.

A program of recurrent selection for large seed size was initiated by intercrossing the four largest-seeded germplasm accessions with three HT breeding lines. After self-fertilizing the F1s, F2 seed was planted in plots in Pullman and sprayed with Beyond to select the HT trait. Roughly 100 individual plants with large seed pods were visually selected, since large seeded plants typically have larger pods. Seed from the individual plants were then sized using a series of screens. Seed from the 12 largest seeded lines were then planted and intercrossed in the greenhouse. Seed from this second cycle of intercrossing was again planted in the greenhouse to generate seed for a second cycle of selection this summer. The project will indicate what type of progress can be made in increasing seed size by conventional recurrent selection from diverse germplasm.

We completed construction of two large recombinant inbred populations that are both segregating for seed size and oil content, as well as some other performance related traits. Analysis of these lines in field plots will begin this summer and will indicate whether there is an inverse relationship between seed size and oil content as has been suggested in one report.

**Impact and Potential Outcomes:**
Cultivars grown in the PNW to date have generally consisted of selected European cultivars, and the selections were not made in the PNW. There is great potential for breeding cultivars better adapted, and higher yielding in the PNW by making and intercrossing selections under our environmental conditions. High yielding HT cultivars will be an advancement in adaptation in the PNW because of the importance of group 2 herbicides in our cropping systems. Cultivation of these varieties will eliminate much of the risk of Camelina production for growers, especially those that are new to growing oilseed crops.

**Proposed Future Research/Extension for 2014/2015:**
The nine selected HT lines from breeding population A will be evaluated in replicated field trials this summer to select one or more lines for release as an HT cultivar in 2014 or 2015.

Roughly 300 lines from breeding populations 1 and 2 will be analyzed for yield and oil content in plots in Davenport this summer. This will be used to establish a second cycle of breeding lines for possible future release.

Early generation selections will be made from crosses between our first generation lines of high yielding HT cultivars and accessions we have identified that have higher yield potential than any cultivars grown in the PNW.

Preliminary analysis of our recurrent selection population for large seed size and our two mapping populations will shed light on what progress can be made breeding large seeded camelina varieties and whether this has a penalty in yield or oil content.