(14.36%), flax (14.90%) and canola (12.69%) did not differ significantly from one another but were significantly greater than wheat (5.50%) and *Arundo* (6.70%) which did not differ from one another. Carbon to nitrogen ratio for these crops was as follows: camelina (109:1), flax (72:1), canola (117:1), wheat (39:1) and *Arundo* (25:1). Overall fiber trends were similar between camelina, flax and canola, which are in the families, Brassicacea and Linaceae (flax), but variable from wheat and *Arundo*, which are in the Poaceae family. High cellulose content in camelina, flax and canola suggest that these varieties have good potential as cellulosic feedstocks, but the high lignin content indicates that cellulose would be difficult to extract from these crops. However, plant residues with a high C:N could be ideal for soil amendments and carbon sequestration. Lower contents of complex compounds in wheat and *Arundo* may have resulted from the presence of grain in the wheat sample and immature *Arundo.* A slight indication that management practices or location could impact levels of carbon compounds in plant residues was also noted in preliminary findings. Further research on the nature and properties of specific lignin and cellulose compounds in these crops would be necessary to fully understand their potential uses and hindrances. Understanding the biochemical make up of these products can allow producers and researchers realize the potential uses and overcome difficult production barriers.

Oilseed Crop Fertility

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A project was established as part of the WA State Biofuels Cropping Systems Program (see http://css.wsu.edu/biofuels/final_report_2008/), to 1) Develop baseline growth and nutrient uptake curves to characterize major oilseed crop nutrient needs; 2) Develop nutrient (primarily nitrogen and sulfur) management recommendations for major oilseed crops that maximize oil yield and quality, 3) Disseminate information on oilseed crop fertility management to growers in extension bulletins, and to the scientific community in peer-reviewed journal articles and 4) Evaluate phosphorus requirements of oilseed crops, and rotational benefits of oilseed alternatives on subsequent crops of wheat.

Winter canola was planted on chemical fallow at Davenport and Pullman in fall 2007. Treatments consisted of a range of nitrogen rates (0 to 160 lb N/acre in 40 lb increments with 15 lb S/acre) applied in treatments replicated four times in a randomized complete block experiment design. Winter canola failed to establish at the Pullman location due to lack of moisture. At Wilke, establishment was acceptable but the stand suffered major damage due to a June 2008 frost and was abandoned. Spring canola was sown on the winter site near Pullman; spring canola and camelina were sown on a new site near Davenport. Camelina failed to establish. Spring canola was grown to maturity and harvested to determine seed yield, oil yield and oil quality (oil yield and quality analysis is pending).

An additional P rate study was conducted north of Kamiak Butte to determine phosphorus requirement for oilseed crops (canola, camelina, and flax) compared to lentil in 2008.

There was a curvilinear response to N rate for spring canola at both locations. At both locations, the slope of the response indicated 4.5 lb seed yield increase with each lb of nitrogen applied. There was an 87 lb/ac (15.5%) seed yield response to sulfur at Davenport but no response at Pullman. Nitrogen application timing did not influence yield. There was no significant effect of P rate. This may be a result of elevated residual phosphorus levels, crop growth limited by water availability, or increased crop phosphorus uptake efficiency for all species.

Composition of Cereal Crop Residue in Dryland Cropping Systems

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Cereal crops and cultivars vary in their composition, and also in their decomposition and contribution to soil organic matter. Large quantities of cereal crop residue that decompose slowly present an obstacle to the adoption of minimum till or no-till seeding, conversely lower quantities of crop residue that decompose more rapidly may leave the soil vulnerable to erosion by wind and water. Decomposition of cereal crop residues is associated with fiber and nutrient content, and growers have observed differences in decomposition among cultivars; however, little information exists on their residue characteristics. Cultivars of spring barley, spring wheat, and winter wheat grown at four locations in eastern Washington over two crop years were analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), C, and N contents, and this information related to straw hemicellulose, cellulose and lignin content. Acid detergent lignin was highest in spring barley (9.9%), and least in winter wheat (9.2%) and hard white spring wheat (9.5%). Fiber components and nutrient content varied by location, precipitation zone, and cultivar. Residue in the drier year of the study had lower NDF, ADF, ADL, C, and C:N ratio. Foot-rot (*Fusarium* spp.) resistant winter wheat cultivars had higher NDF, ADF, and ADL than susceptible cultivars. The analysis used to determine fiber content of straw is expensive and labor intensive. In 2009 we are developing near-infrared spectroscopy (NIRS) as a rapid, non-destructive, chemical-free method to predict residue fiber and nutrient content. Future research will also include residue tannin analysis to help predict straw decomposition. Fiber and nutrient characteristics of residue from wheat and barley cultivars currently produced in the Pacific Northwest can be used to predict residue decomposition in cropping systems that conserve soil and water, and enhance build-up of soil organic matter.

From the Genetic Model *Arabidopsis thaliana* to the Oil-seed Crop *Camelina sativa*

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The Neff lab studies how external light signals and internal hormone-regulated pathways control seedling development in the model genetic organism *Arabidopsis thaliana*, a plant in the brassica family. We have recently begun translating some of the genetic knowledge gained from these studies for manipulating seedling and adult growth in the closely related oil-seed crop *Camelina sativa*. To do this we have employed and improved previously published methods for transformation of genetically engineered DNA. Using this technique we have initiated a genetic screen for gene-over-expression and gene-deletion mutations that modulate the elongation of seedlings as they transition from growth in the dark (under the soil) to growth in the light. We have also initiated genetic, physiological and biochemical studies to further characterize a family of DNA binding proteins that regulate plant size. Our initial studies suggest that over-expressing a unique mutation in one of these family members leads to larger seeds and taller, more robust seedlings; both traits that may lead to enhanced stand establishment and yield in dry-land cropping systems. In addition to continuing to study the activity of these and other genes in *Arabidopsis* and *Camelina*, we are also working on identifying similar genes in wheat and barley with the ultimate goal of generating taller seedlings that still maintain semi-dwarf growth as adult plants.

Camelina Survives Bitter Cold Air Temperatures

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Lind experienced very cold air temperatures and high winds in December 2008. During the 3rd week of December, there was a full day of high wind (average wind speed 27 mph with gusts to 38 mph) where the maximum air temperature for the day was 8 degrees F. There was about two inches of snow cover on the soil prior to the windstorm, but afterwards more than 80% of the ground was bare. Then, on the evening of December 16-17, air temperatures dropped to a low of –10 degree F and stayed below 0 degree F for 12 hours.

Following this bitterly cold night with essentially no snow cover, we conducted "grow out" tests of camelina sampled in the field. We initially feared that the cold had killed the camelina, as the cotyledon leaves of plants appeared to be dead. However, after more than a week on the lab bench, camelina sprouted its first true leaves (Fig. 1). Camelina in the field survived the cold. With one year of data from an extremely cold winter event without snow cover, we feel that camelina (at least the Calena variety) may have as much cold tolerance as most winter wheat varieties.

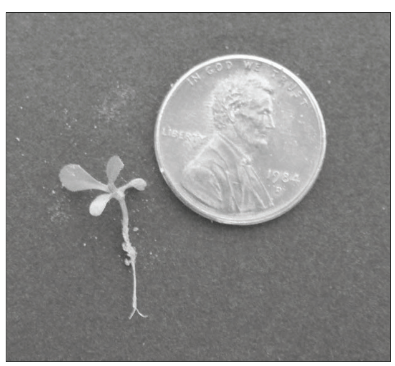

Fig. 1. First true leaves of a camelina plant emerge after more than a week wrapped in a wet towel on a laboratory bench. The plant was collected from a field without snow cover following a night of –10 degree F air temperature. Such preliminary observation indicates that camelina has excellent cold tolerance similar to that of winter wheat.