allele in *Arabidopsis*. Even with this 30% increase in hypocotyl length in camelina, we have shown that these larger seeds and taller seedlings can dramatically enhance emergence from deep planting (8 cm) in dry soil (Figure 2).

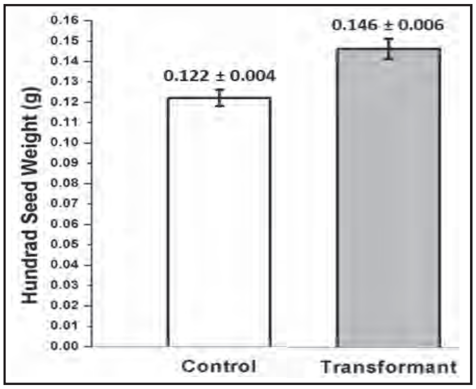

Fig. 1. Seed size is increased in *Camelina* The average weight of 100 wild-type (control) seeds is compared to the transgenic line used in Figure 2.

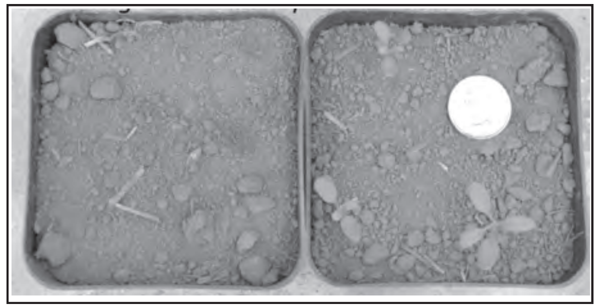

Fig. 2. *Camelina* plants expressing the *Arabidopsis sob3-6* mutation can emerge from deep planting in dry soil. Ten seeds (left: non-transgenic, right: transgenic) were planted on 1 cm of moist Palouse silt/loam and then covered with 8 cm of dry silt/loam. All seeds germinated however, no wild type seeds could emerge from this deep planting. Five transgenic seeds emerged and three survived. This experiment has been repeated twice.

Development of Camelina Lines Resistant to Group 2 Herbicides

Scot Hulbert, Ian Burke, and Ron Sloot, WSU

In the high rainfall, annual cropping zone, Group 2 residual herbicides (imidazolinones and sulfonylureas) continue to pose a major constraint to producing oilseed crops, particularly canola and camelina. After extensive field, greenhouse and laboratory testing, we have identified one mutant population in camelina that shows resistance to all Group 2 herbicides tested. This mutant occurred in the Cheyenne background and we have crossed it to Calena. Several large F2 families were planted in the field in June 2011 and sprayed with Pursuit. Seed from vigorous plants were harvested and planted in duplicate plots at Lind in late winter 2011. Seeds from single plants were again selected and were planted in yield plots this spring.

We hope to release a WSU cultivar in 2013 and we have already sent seed of the original mutant in the Cheyenne background to two different commercial breeding programs. We expect the SM4 mutation to be incorporated into several widely grown cultivars in the future, and expect this to reduce risks associated with camelina production in most regions.

Biennial Canola – A Three-for One Forage + Oil + Meal Crop

Robert Kincaid[1], Kris Johnson[1], Bill Pan[2], and Scot Hulbert[2]; [1]Dept. Of Animal Sciences; [2]Dept. Of Crop and Soil Sciences, WSU

Growing winter canola in eastern Washington is difficult without a fallow period or irrigation. Stand establishment after crop harvest in late summer can be problematic due to low soil moisture, and if seeding dates are later than recommended for the region, the canola plants may be too small to survive low winter temperatures. Good stands are not always easy to establish in late summer even when planting into fallow. A biennial canola study on 17 acres near Pullman examined early-planted, interseeded winter canola and spring peas as a potential source of forage, and a means of seeding into available soil moisture. Peas were planted on July 1, 2010, followed by canola seeding the next day. The field was swathed and windrows harvested on September 8, 2010, and the forage was ensiled. Lactating dairy cows were fed either a control total mixed ration (TMR), or a TMR with 9% canola/pea silage that replaced a portion of the alfalfa hay and corn silage. After 21 days the canola/pea silage was increased to 15% of the TMR.

Both peas and winter canola had good stands. Swathing yielded approximately 2000 lbs forage dry matter/acre at 31% DM. Ensiling the forage crop and feeding it as part of a TMR avoided potential problems that might occur with direct grazing. Most notably, nitrate-N concentration was reduced 80% by ensilage. The canola/pea silage was palatable to the cows and substituted well for alfalfa or corn silage into a TMR without affecting milk production or composition. Plant regrowth following swathing was sufficient for winter survival, and canola harvested in 2011 yielded 2200 lbs/acre. The grain was commercially processed for oil (biodiesel) and meal (animal feed), thereby completing the trifecta from a single crop planting. Biennial forage canola appears to be a viable option in crop rotation systems in dryland areas to diversify crop production and obtain forage for ruminants.

Oilseed Analysis at WSU

Ian Burke and Pat Fuerst, Dept. of Crop and Soil Sciences, WSU

The Weed Science laboratory provides oilseed quality analysis as a service in support of the field research component of the WA Biofuels Cropping Systems Research and Extension project. Data produced includes parameters such as oil yield from a seed crusher, total oil content, and fatty acid composition. Fatty acid composition is the key determinant of oil quality for biodiesel, and enables an evaluation of potential for biodiesel from canola, camelina, and other oilseed crops from seed samples produced in field plots. The objective of the research is to support research and extension personnel in developing input recommendations based not just on yield but on quantity and quality of oil.

Almost 2000 oilseed samples have been submitted for analysis by WSU researchers since 2008. The most recent set of samples (825 total) we are processing are from camelina trials at several locations in the PNW. Correlating crop yield and oil analysis by agroclimatic zones, varieties, fertilizer rates, and other factors will allow more site-specific crop recommendations to growers and processors for maximum potential seed and oil production.

Canola oil and meal after seed crushing. After being weighed, the samples are analyzed for oil composition and quality.

Winter Canola Seeding Rate and Date Study in North Central Washington

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Approximately 60% of the cereal production area of the PNW are characterized by the winter wheat/summer fallow system. This system is plagued by winter annual grass weeds such as jointed goatgrass, feral rye, and downy brome. Growers are becoming more interested in producing winter canola in this region to improve pest management strategies, diversify markets (food, fuel, and feedstock), and increase sustainability. However, winter canola stand establishment is a major impediment to growers in the non-irrigated, low- to intermediate-rainfall zones, so it is considered a high risk to produce. The majority of winter canola research has been conducted in irrigated systems at Prosser and Lind, WA and pre-irrigated systems at Pendleton, OR.

The objective of this four-year project was to establish baseline production information for winter canola production in north central WA, specifically seeding dates and rates that would result in successful stand establishment. "Camas" Roundup Ready® canola was planted at 4 and 8 lbs/A on July 28, August 10, and August 18, 2010. The July 28th planting did not survive a hail and rain storm on July 31 which crusted the soil and prevented emergence. The remaining four treatments (4 and 8 lbs/A seeding on