Title: Stand establishment of winter canola in the low- to intermediate-rainfall zones of the Pacific Northwest.

PI: Frank Young

Technical Support: Funding provides half-time support for an Associate in Research and time slip personnel through the Crop and Soil Sciences Department, Washington State University.

Background: Approximately 60% of the cereal and grain legume production areas 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. Recently a grower in Douglas County, WA experienced a $1.45/bu dockage in his winter wheat because of feral rye contamination. 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. This crop therefore is considered a high risk to produce. Even at best, an avid winter canola producer in an 11-inch rainfall zone experiences a 20% failure rate of establishing winter canola (Painter and Roe 2007). Traditional deep furrow planting techniques for winter wheat are not as reliable for winter canola because canola is very sensitive to the hot, dry soil covering the emerging seedling. At the present time, there has been no research conducted in the non-irrigated, low-to intermediate-rainfall zones to improve canola emergence and stand establishment. In addition there is no previous research on either date or rate of canola seeding in this area or summer fallow techniques to raise the soil moisture line above 4-5 inches. The vast majority of winter canola research has been conducted in irrigated systems at Prosser and Lind, WA and pre-irrigated systems at Pendleton, OR.

Objectives

Research: (1) To determine the optimal seeding date, rate, and method for winter canola in the low- and intermediate-rainfall regions of the PNW to improve stand establishment, seedling survival, and crop yield. (2) In addition, determine the effects of seeding date and rate on oil and meal quality. (3) Evaluate summer fallow primary tillages to raise the soil moisture line.

Partnership and Community Development: Create a partnership in North Central WA, focusing on the Colville Confederated Tribes to improve human and animal health, improve self-sustainability, and stimulate the local economy by creating jobs and keeping the dollar local.

Methods: Sites were established near Ralston, Okanogan, and Bridgeport in 2009 to explore our objectives. In 2008, seeding dates were August 12 and 25 at Okanogan and August 6, 19, 26, and September 30 at Ralston. Seeding rates were 4 and 8 lbs/A at Ralston and Okanogan. Roundup Ready® Camas winter canola was planted at the Okanogan site and Rapier was originally planted at the Ralston site. The first Ralston plantings failed and plots were replanted September 30 at rates of 5, 7, and 10 lb/A using the variety Salute. The planting methods and machinery used at these sites were the same as in 2007 with two exceptions. During 2008, 10-in
shovels were used rather than 13- or 15-in shovels and depth adjustment was refined in an effort to avoid the previous problem of uneven row emergence. Additionally, when the Ralston plots were replanted, a conventional double-disk opener drill was used to plant the canola.

In addition to seeding rate and date experiments, research plots were established in fall 2008 at two locations on Wade Troutman’s land near Bridgeport to determine the effect of planting with or without shovels. Site 1 (2,500 ft elevation) was seeded on August 20 at a rate of 7.2 lbs/A, and site 2 (1,500 ft elevation) was seeded August 21 at the same rate. Both sites were planted with the same John Deere HZ deep furrow drill as the Okanogan and Ralston sites. Camas RR® winter canola was planted at both Troutman sites. Plants were counted fall 2008 and spring follow-up counts were conducted to determine the winter survival. Plots were harvested July 23-25, 2009. Crop yield and seed, oil (for biofuel), and meal (for feed) quality were determined.

In 2009, the seeding rate and date study is being repeated in Okanogan, WA and the methodology study is repeated near Bridgeport, WA. Camas RR® winter canola was planted at 4 lb/A and 8 lb/A on August 19 and at 2, 4, and 6 lb/A on August 31, 2009. On August 20, the Bridgeport site was planted at 6.5 lb/A to Camas winter canola with and without 10" shovels in front of AcuPlant® openers. Seed was placed approximately 0.75" into moisture, leaving 1.5" of dry soil flowing back over the furrow. Treatments were replicated six times and plots were 5' x 100', each containing four rows spaced 28" apart. A modified John Deere HZ 714 deep furrow drill with 55 lb steel packer wheels and a grass seed box attachment for accurate seed delivery was used at both sites. Plant populations were recorded in marked areas in all plots on September 22. Counts will be made in the spring to determine winter survival. All plots were sprayed on October 2, 2009 with glyphosate to control a heavy infestation of feral rye.

A preliminary summer fallow-tillage study was initiated in the spring of 2009 at Ralston, WA to raise the seed-zone moisture line in the soil for seeding winter canola. Treatments included no-till (chem fallow), and primary tillages of cultivation, sweeps, and disk followed by rod weeding as needed. A light disking of the site in the fall of 2008 to incorporate downy brome seed (Young and Thorne 2004) preceded the next year’s tillage operations. An initial soil moisture determination of the site was made May 6 at one-foot intervals to a depth of 6 ft. Subsequent soil moisture was sampled at 0-2", 2-4", and 4-8" depths.

**Duration:** These studies were initiated in the fall of 2007 and will continue at least through crop planting in 2010 and harvest in 2011. At this time other biofuel crops will be evaluated for production and economic possibilities in the low- to intermediate-rainfall zones. The soil moisture–tillage–fallow study will need to continue at least through 2012; and through 2014 if the effect of winter canola on subsequent winter wheat crops needs to be evaluated.

**Results and Discussion**

**Research:** The 2008-2009 growing season is the first year we have collected data from an August seeding date and methodology experiment. At Okanogan, winter canola emergence and stand establishment was extremely poor and no data was collected for the August 12 planting. Emergence was poor because of the 3 to 5" of soil flowing back over the seed in the furrows. On the August 25th seeding date yield was 1,340 lbs/A and 1,240 lbs/A for the 4 and 8 lb/A seeding
rates respectively (Fig. 1). This data would suggest that doubling the seeding rate is not economically feasible for an August planting.

At Bridgeport, experiments were conducted at two locations to determine if shovels were needed to move dry, hot soil out of the way for the emerging seedlings when the soil moisture line was only 1.5 to 2" below the soil surface. At the lower elevation site (1,500 ft) deer grazed the plots for about 5 months and data was not collected. At the high elevation site (2,500 ft) yield averaged 1,010 and 955 lbs/A for the shovels and no-shovels respectively. Based on yield alone, the data suggests that when the moisture is within 2" of the surface shovels are not needed. However, the crop population was more uniform using shovels, which would provide better competition against weeds (Fig. 2). Round-up ready canola enable effective in-season control of feral rye, which otherwise carpeted the crop fields.

No winter canola emerged and established in any treatments at Ralston, WA during the 2008-2009 growing season.

At Ralston, the initial percent soil moisture was similar within the same 1 ft increment on May 6, before the various tillages were conducted (Table 1). Data was not analyzed because it is a preliminary experiment and only one year’s data. On June 11, seed zone soil moisture was relatively consistent within an individual depth regardless of treatment. By June 30th, seed zone
soil moisture was lowest at the 2-4” and 4-8” depths in the no-till plots compared to the tilled plots. At the 0-2” depth soil moisture was extremely dry for all treatments. On August 13, soil moisture was similar for all plots within the 0-2” and 4-8” depths. At the 2-4” depth, soil moisture was 1.4 to 1.8% less in the no-till treatment compared to the tilled treatments.

Table 1. Initial soil moisture to six feet in May and seed zone soil moisture to eight inches in fallow at Ralston, WA in 2009.

<table>
<thead>
<tr>
<th>Soil depth</th>
<th>No-till</th>
<th>Sweep</th>
<th>Cultivate</th>
<th>Disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1’</td>
<td>11.0</td>
<td>10.9</td>
<td>11.1</td>
<td>10.9</td>
</tr>
<tr>
<td>1 – 2’</td>
<td>9.6</td>
<td>9.7</td>
<td>9.2</td>
<td>9.2</td>
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<tr>
<td>2 – 3’</td>
<td>8.3</td>
<td>8.3</td>
<td>7.8</td>
<td>8.5</td>
</tr>
<tr>
<td>3 – 4’</td>
<td>6.6</td>
<td>6.3</td>
<td>5.9</td>
<td>7.3</td>
</tr>
<tr>
<td>4 – 5’</td>
<td>6.6</td>
<td>6.6</td>
<td>6.7</td>
<td>7.2</td>
</tr>
<tr>
<td>5 – 6’</td>
<td>6.8</td>
<td>6.8</td>
<td>7.2</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Seed zone soil moisture (%) by date

<table>
<thead>
<tr>
<th>Date</th>
<th>0 – 2”</th>
<th>2 – 4”</th>
<th>4 – 8”</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 11, 2009</td>
<td>6.4</td>
<td>11.3</td>
<td>11.2</td>
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<tr>
<td>June 30, 2009</td>
<td>3.8</td>
<td>9.0</td>
<td>10.3</td>
</tr>
<tr>
<td>August 13, 2009</td>
<td>6.3</td>
<td>8.1</td>
<td>10.2</td>
</tr>
</tbody>
</table>

*The entire site was disked in the fall of 2008 to incorporate downy brome seed into the soil to hasten weed seed germination. No further tillage was conducted in the no-till plots whereas designated plots were swept, cultivated or disked (followed by rod weeding) after May 6.

Partnership and Community Development: This past year our USDA-ARS research group created and formed a working partnership for North Central WA consisting of seven agencies including: Colville Confederated Tribes (CCT); USDA-ARS; WSU Extension; local farmers; local schools; WA State Biofuel Project; and WA State Dept. of Agriculture. The partnership was formed for the purpose of producing an alternative crop to provide food, fuel, and jobs to the region. At the present time, research and education has focused on winter canola production and self-sustainability of the CCT and area growers. Five years ago, local CCT members invited USDA scientists to determine the potential of growing canola for biofuel. The research began as a couple of small hand-seeded plots and has since expanded to numerous locations evaluating seeding dates, rates, and planting methodologies. In addition, growers have expanded greatly
the number of acres planted to winter canola, and grower and tribal crushing facilities are continuing to be established.

The CCT have an extremely high potential to benefit from production of winter canola on tribal lands. Products of harvested canola seed include vegetable oil used for food and biodiesel fuel, and meal from the crushing process can be used for livestock feed. Up to 20,000 acres of canola could be grown annually on tribal land. Based on USDA-ARS research, there is a potential of two million gallons of oil and 6,500 tons of high protein canola meal production per year.

A unique feature of the region’s canola production is that the markets are located on the CCT land. Enough biodiesel could be produced to operate CCT logging trucks and school buses for a year. Canola meal produced would provide protein for more than 10,000 head of cattle per winter. The combined gross potential revenue would be $8.8 million per year to tribal and surrounding communities. The revenues from biodiesel fuel would remain in the homes of local residents. According to WSU research, the revenue and savings could circulate through the local economy up to three times.

The USDA-ARS group organized and co-hosted a Canola Recognition Day on October 21, 2009 at the Paschal Sherman Indian School (PSIS). Participants from the partnership shared their experiences working with the CCT to develop a viable winter canola crop. The highlight of the day was explaining to the PSIS children about canola and biofuel (Figure 3) and filling a PSIS school bus with biofuel from canola (Figure 4). The canola used in this process was produced by a local grower on trusted CCT land, crushed by another local grower, and processed by WSU/CCT Ferry County Extension. Following the school activities, the more than 40 attendees visited seeding date and rate research plots at Ed Townsend’s and the canola crushing and oil processing facility of the CCT.

In addition to the above event, two canola production field days were hosted in May at Wade Troutman’s (Bridgeport) and Ed Townsend’s (Okanogan). Topics of conversation included production problems, agricultural benefits and diversity, marketing, community sustainability and the region’s partnership. More than 50 people attended the event.
**Impact/Potential Outcomes:** In only 2.5 years of conducting research in North Central WA, the impact has been beyond our wildest dreams. Because of our activities in the region, one grower has increased his production of winter canola from 15A (2007) to 120A (2008) to 240A (2009). He stated his profits were higher with canola than winter wheat in 2009 and that now he is a “canola farmer” rather than a “wheat farmer!!” A second grower built a canola drill patterned after our research drill that has wider row spacing and small shovels to improve stand establishment compared to his previous drill.

The infrastructure of the partnership with CCT is constantly becoming more involved and productive. We initially provided PSIS with 20 gallons of biodiesel for the Canola Recognition Day. The overseer of the school’s buses immediately asked where he can get a constant supply of biodiesel. We donated 80 more gallons and are working currently with PSIS, CCT energy department, WSU Extension, and local growers to provide canola seed to be crushed, processed, and ultimately transported to the school to be used in buses. Currently two producers have more than 60T of canola to sell and be crushed and processed (1T canola = approximately 100 gal). We are also working with PSIS to procure a 250 gallon shuttle to transport the biodiesel from the processing facilities to the school. For the next several years (2010 to 2012) the partnership needs to continue to organize, improve, and refine their infrastructure for commercial field to fuel and food production of canola.

**Publications:** A poster has been made describing the organization of the canola partnership. In the fall of 2010 an extension bulletin will be written in conjunction with Okanogan, Ferry, and Douglas County WSU extension agents on canola production in north central WA. A minimum of one peer reviewed manuscript will be submitted at the conclusion of the seeding date, rate, and methodology research.

**Future Directions in the Upcoming Year**

**Research:** We will conclude (weather permitting) the initial seeding date, rate, and methodology study. We will refine other winter canola production practices such as varieties and fertility regimes for north central WA. In addition we will initiate the large-scale, farmer cooperated summer-fallow tillage study at Ralston.

**Program and Community Development:** We will continue to work with the partners to refine the infrastructure and improve the internal operations to make the system more economically viable. This coming year we will work with: local growers to sell their canola to CCT for crushing; WSU/CCT Ferry County Extension to process the oil; and local schools to transport the biofuel for use in school buses.

**Literature Citation:**