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

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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 (Young et al 2008). 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. 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) 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) Determine the effects of seeding date and rate on oil and meal quality; and 3) evaluate the effect of row spacing of spring canola on yield in high residue conditions without burning.

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 have been established near Okanogan and Bridgeport from 2007 to 2010 and near Pullman in the spring of 2008 and 2010 to explore our objectives. Winter canola was seeded at 4 lbs and 8 lbs/A on August 12 and 25 at Okanogan in 2008, and on August 19 in 2009. In addition winter canola was planted at 2, 4, and 6 lbs/A on August 31, 2009. Roundup Ready® (RR®) Camas winter canola was
planted at all of the Okanogan sites. The drill used was a modified JD HZ drill. Modifications included a grass seed box for accurate seed rates, 10, 13, or 15’’ shovels to move the hot soil out of the seed row, and 55 lb packer wheels to insure good seed-soil moisture contact.

In addition to seeding rate and date experiments, research plots were established in fall 2008 and 2009 at two locations on Wade Troutman’s land near Bridgeport to determine the effect of planting with or without shovels. In 2008, (2,500 ft elevation) winter canola was seeded on August 20 at a rate of 7.2 lbs/A, and in 2009 (1,500 ft elevation) winter canola was seeded August 20 at 6.5 lbs/A. Both years Camas RR® canola was planted with the same John Deere HZ deep furrow drill as the Okanogan sites. In the fall of each year, winter canola plants were counted to determine plant establishment. Plants were recounted in the spring to determine plant survivability over winter. All plots were harvested with a plot combine to determine yield. Samples were provided to Dr. Burke’s group to determine oil quality.

In 2007 the Palouse Conservation District contracted with the Washington Department of Ecology to develop a project examining wide row spacing of spring canola in heavy residue situations. In Pullman, two treatments of standard and wide row spacing spring canola were established in plots in 2008 and 2010. Plots were 410’ x 10’ and planting dates were April 12, 2008 and April 10, 2010. Plots were direct seeded into heavy spring wheat residue with a Seed Hawk™ air seeder with hoe openers with 11-inch and 22-inch rows. The depth of seeding was one inch. The seeding rate of Rapier spring canola was 5 lbs/A. Both years the seed was treated with the Helix Xtra™. In 2010, the soil temperature at planting was 52°F. The plots were sprayed in crop for broadleaf weeds on May 10, 2010 with Select™ herbicide.

**Results and Discussion**

**Research:** The 2008-2009 growing season was 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, even with shovels on. This was true for August seeding dates in 2007 also. On the August 25<sup>th</sup> seeding date for 2008, 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. However in 2010, results were different because of extremely cold weather in early October and November. Seedlings from an August 30<sup>th</sup> planting were all killed because of below freezing temperatures and lack
of snow cover (Fig. 2). The 4 lb and 8 lb rates planted on August 19th survived (Fig. 2) although they were injured.

On the August 19th seeding date, yield was 1,355 lbs/A for the 8 lb/A rate and 820 lbs/A for the 4 lb/A rate. Spring wheat and spring canola were replanted in the August 30th plots which contained the frozen winter canola plants. One week before harvest in 2010 a hail storm destroyed both the spring canola and spring wheat crops.

At Bridgeport, an experiment was initiated in 2008-2009 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 less than 2.5" below the soil surface. At this site (2,500 ft) yield averaged 1,010 and 955 lbs/A for the shovels and no-shovels respectively. Although yield was similar, the crop population was more uniform using shovels, which would provide better competition against weeds (Fig. 3).
For the 2009-2010 (1,500 ft elevation) growing season, yields for the shovel and no shovel treatments were again similar. The shovel treatment yielded 1,695 lbs/A, and the no shovel treatment yielded 1,750 lbs/A. We discovered in 2010 the importance of applying pod sealant at the appropriate time to realize the full benefit of the chemical. Pod sealant needs to be applied at the proper stage of pod development which is when the pods are yellow. Performance of the sealant decreases when applications are made to pods that are light to dark brown. We seeded our plots several days earlier than the grower seeded the field surrounding our plots, and our canola was more mature (light brown pods) than the grower’s canola (yellow pods) when the pod sealant was applied (Fig. 4). A week to 10 days after pod sealant was applied a wind storm (gusts to 40-45 mph) hit the region. Although the pod sealant saved both ours and the grower’s canola, our canola experienced considerably more seed shatter than the grower’s canola (Fig. 5). Because of the large amount of seed shatter that occurred (Fig. 6), we vacuumed the soil in two 0.25 m² areas per plot (Fig. 7), cleaned the samples and added the shattered seed amount to our grain samples. Seed loss due to wind shatter ranged from 192 to 543 lbs/A and averaged 495 lbs/A and 445 lbs/A for the shovel and no shovel treatments, respectively.

Figure 4. Differences in maturity of canola pods in research plots (light brown) and surrounding field (yellow) led to shattering differences.

Figure 5. Non-shattered pods in grower’s field (left) and shattered pods in plot area (right). Note the characteristic white ‘flags’ of the remaining pod sheath.

Figure 6. Shattered canola seed in research plots.

Figure 7. Vacuuming to recover shattered seed.
At Pullman in 2008, spring canola yield in standard 11-inch row spacing was 1,615 lbs/A compared to a yield of 1,590 lbs/A in wide, 22-inch row spacings (same seeding rate for both spacings). For the 2010 study, yields were again similar regardless of row spacing, although lower than the 2008 yields. The standard row spacing yielded 735 lbs/A and the wide row spacing yielded 725 lbs/A. Future implications are that wide rows could reduce machine and fuel costs by reducing the number of opener shanks on the drill while maintaining yield equal to narrow row spacing.

**Pest Management.** We noted a moderate population of ladybird beetles (larvae, juveniles, and mature) in the field that were feeding on an infestation of aphids (Fig. 8). Because of the population of beneficial insects, no insecticide was applied to the plots.

Figure 8. Despite aphid infestations (left), insecticide applications were not required due to a significant ladybug population (right).

All experiments at Okanogan and Bridgeport had heavy infestations of feral rye, which was controlled with glyphosate (Fig. 9).

Figure 9. Feral rye at Okanogan and Bridgeport was controlled with glyphosate.
**Partnership and Community Development:** In 2008 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 Department of Agriculture. This past year a feed/nursery store stated that it would act as a local distributor to livestock producers for the meal produced from the CCT crusher/processing facilities. In addition NRCS has joined forces with the partnership. 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 greatly expanded 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. A potential exists for 20,000 acres of canola to be grown annually on tribal land. Based on USDA-ARS research, there is a potential of two million gallons of oil production and 6,500 tons of high protein canola meal 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 per year to operate CCT logging trucks and school buses for one 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.

**Impact/Potential Outcomes:** In only 3.5 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 15 acres in 2007 to 260 acres in 2010 and has stated that winter canola is now his “money crop.” A second grower in Douglas Co. 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. He has increased his winter canola acreage from 200 acres in 2007 to 900 acres in 2010 and commented that “Winter wheat is now my rotational crop to control weeds that have escaped the canola crop.”

The infrastructure of the partnership is constantly becoming more involved and productive. This past winter the local Okanogan nursery/feed store has “joined” the partnership and will store and distribute the protein meal (from the processing plant) for livestock producers. Other new partners include the Okanogan and CCT NRCS offices as well as the USDA-Risk Management Agency. The USDA-Risk Management Agency used data generated by this research to establish crop insurance for winter canola in Douglas and Okanogan Counties, and Ferry County is also interested in establishing crop insurance for winter canola. This has generated a lot of interest in local growers this past fall. Winter canola acreage for Okanogan and Douglas Co. has increased from 200A in 2007 to almost 2,000A in 2010.

WSU Extension specialists Karen Sowers and Dennis Roe, along with two cooperating canola growers will team to create case studies for winter canola production in Central Washington.
Lastly, we have assisted the CCT in organizing a budget for the startup of their crushing/processing plant, advised them on planting canola on tribal land, and procuring field equipment for needed operations.

**Affiliated projects and funding:** One scientist and technician from the USDA-ARS Land Management and Water Conservation Unit work 60% of their time on the North Central WA winter canola project. They also provide all the field equipment and trucks for transporting machinery to the research sites. The scientist was also requested to collaborate on the WSU Oilseed NIFA grant proposal and the WSU Climate Change/Carbon grant.

**Publications:** Posters have been created describing the research and the organization of the canola partnership, and most recently shown at the Washington Bio-Energy Research Symposium, November 2010 in Seattle. An article about this research was featured in the October 2010 edition of *Agricultural Research*, published by the USDA-ARS, and in the October 23, 2010 edition of the *Capital Press*, a regional agricultural newspaper. In addition, local newspapers in Omak, Oroville, and Wenatchee, WA included information about this research in recent articles.

Invited presentations were given at the National Canola Association meeting in Longbeach, CA, November 2010, and at the Washington State Canola Commission meeting in Pullman, WA, July 2010. Presentations were also given to the Rotary and Kiwanis Clubs of Okanogan and the growers of Douglas Co. on the partnership and research in North Central WA.

**Proposed Future Research/Extension:**

**Research:** We will conclude (weather permitting) the initial seeding date and rate study. We will evaluate the timing and rates of three herbicides for the control of feral rye in winter canola. We will also initiate a study in cooperation with two NRCS offices to learn how to seed canola into abandoned farmland and depleted pasture lands. To assist the USDA-Risk Management Agency with their crop insurance information, we will initiate studies examining spring canola rate and row spacing studies.

**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. In 2011 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.

**Extension/Outreach:** One or two field days are being planned for 2011 in Okanogan and/or Douglas Counties. In the fall/winter 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.

**References:**
