BIODIESEL FEEDSTOCK POTENTIAL IN THE WILLAMETTE VALLEY

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Introduction
Biodiesel feedstock crops grown in rotation with grass seed crops in the Willamette Valley can increase the profitability of grass seed production enterprises while reducing weed and disease problems. Rising fuel prices and international instability make the search for alternative fuel sources even more important, and at this point these fuels need to be imported from outside the region. Rather than import these fuels, it is possible for them to be grown and refined locally. Virtually all biodiesel sold in the Pacific Northwest is imported from the Midwestern US, while acceptance of biodiesel as a transport fuel in our region is very high. Local biodiesel processors are currently limited to using waste grease as a feedstock. Availability of inexpensive, locally grown feedstock will help to expand the biodiesel industry in the Pacific Northwest. Annual consumption of diesel in Oregon is 800 million gallons.

Potential Feedstock Crops
Soybean. Soybeans are the major source of oil for biodiesel in the US, but are not well adapted to the environmental conditions prevalent in the Willamette Valley. Under Willamette Valley conditions, oil yields for soybeans will be in the range of 15 to 25 gallons per acre based on OSU's research on the crop whereas the national average is 57 gallons per acre. No breeding and crop development programs are present in the Pacific Northwest, so the prospect of locally adapted soybean cultivars for the region is rather remote. The energy balance for soybeans is 3.2:1, according to the US Department of Energy.

Yellow Mustard. Yellow mustard (*Sinapsis alba*) has some potential as a biodiesel crop in the Willamette Valley, but we have no information on the adaptation of this crop at this time. We are currently conducting trials on yellow mustard. The crop has several attractive features including potential for good oil yields (about 100 gallons per acre at a projected 3000 lbs per acre seed yield). The crop has shown this level of seed yield performance at high rainfall sites in northern Idaho. Another reason to consider yellow mustard is that it is not a member of the genus *Brassica* like canola and so it does not fall under the production restrictions recently imposed by the ODA. The crop has a several drawbacks as well. The oil concentration in the seed is lower than canola (27% vs. 40%) and the meal is high in glucosinolates, making the meal not suitable for consumption by livestock. The meal might be saleable in the natural pest control market. The plant breeding program at the University of Idaho has released one commercial variety and is working on developing new lines. Only spring varieties of yellow mustard are available at this time. The energy balance for yellow mustard is unknown.

Sunflower. Sunflower has limited potential as an economic biodiesel crop in the Willamette Valley. The late maturity of the sunflower means that the crop's seed will mature and develop late in our production season requiring much irrigation water. Grown under irrigation, the oil yields of sunflower are very good, ranging from 90 to 100 gallons of oil per acre. The high cost of irrigation and low availability of water in late summer would likely prevent the economic culture of sunflower for biodiesel in the Willamette Valley. Like soybeans, no breeding program is present in the region for the development of locally-adapted varieties. The energy balance for sunflower is 2.6:1.

Canola. Winter canola is the best candidate for a biodiesel fuel rotation crop in the Willamette Valley. Winter canola can produce more oil per acre (100 to 200 gallons per acre) than any other potential biodiesel crop in the Willamette Valley. The meal remaining after processing is a rich source of protein, which can be fed to livestock and would be an additional source of income. Local feed processors are currently importing oilseed meal into the Pacific Northwest, so a ready market already exists for high quality, locally produced canola meal.

The most recent OSU winter canola cultivar trials for the Willamette Valley were conducted in the late 1980s. Seed yields in OSU's past canola trials in the valley have ranged from 1,533 to 3,726 lbs/acre depending on cultivar and year. OSU extension statistics indicate that grower yields of winter canola averaged 2,300 lbs/acre in the early to mid-1990s when limited commercial production was present in the Willamette Valley. Current regulations allow the production of canola for oil in the Willamette Valley with a special permit that can be obtained from the ODA.

Although the potential for high winter canola yield exists in the Willamette Valley, there has been only limited work done on yield trials and on the development of management practices. We conducted a trial in 2005 that examined spring nitrogen management and winter canola cultivar performance at Oregon State University's Hyslop Farm near Corvallis, Oregon. Seven cultivars and advanced lines of winter canola were examined in this trial, the first of its kind here in 15 years. Cultivars and advanced lines were sown at 6 lbs/acre on September 30, 2004 in 6-inch rows. Sowing depth was ½ inch. The seedbed was prepared in a field previously in fine fescue seed production trials for four years. Lime was applied at a 2 ton/acre rate and starter fertilizer of 48 lbs N/acre (16-20-0) was applied prior to seeding. This application also supplied phosphorus (not a limiting factor in the Willamette Valley) and sulfur. The experimental design was a split-plot with spring N fertilizer main-plots and cultivar subplots arranged randomly within 4 blocks. Each subplot was 8 feet x 50 feet.

Spring nitrogen treatments (0, 50, and 100 lbs N/acre) were made on February 18, 2005. Boron was also applied at 2 lbs/acre. K-Mag (21.5% K, 10.5% Mg, and 21.5% S) was applied at 100 lbs/acre after tissue analysis indicated critically low plant Mg. The crop was swathed with a specially-modified John Deere plot swather and combined with a Hege Model 180 plot combine with pickup attachment.

A spring nitrogen x cultivar interaction was evident in canola seed yield responses in 2005 (Table 1). All winter cultivars responded to a topdressing of 50 lbs N/acre with increased seed yield, but some cultivars benefited more by an additional 50 lbs N (100 lbs total spring N) than did others. Yields of Athena, UIC 02.2, UIC 3.1 were highest with 100 lbs spring N/acre while yields of Baldur, Ceres, Kronos, and UIR 3.5 were equal at 50 and 100 lbs spring N/acre. Maximum yield of all cultivars exceeded 4,000 lbs/acre, but it is unclear whether yields might have been different has timing of N application had been earlier or later or had N been applied in greater amounts.

Winter canola yields in our trial were very good considering that grass seed and winter wheat yields were reduced by 40% or more by high rainfall between March and May, and by abnormally high meadow vole populations.

Table 1. Spring N and cultivars effects on seed yield of winter canola.

Cultivar	Spring N (lb N/acre) 0	50	100
	(lb/a)		
Athena	2994	3387	4491
Baldur	3636	4428	4650
Ceres	3012	4017	3872
Kronos	3486	4287	4331
UIC 02.2	3367	3739	4819
UIC 03.1	2966	4021	4525
UIR 03.5	2819	3820	4185
Spring N mean	3186 a	3957 b	4410 c

Rotation with canola may improve grass seed growers' ability to control grass weeds since several herbicides are registered in Oregon for controlling grasses in canola. The presence of grass weeds in wheat was reduced when canola was included in the rotation. Canola has a strong taproot, which can penetrate soils that fibrous-rooted grasses cannot. Long-term traffic in grass seed fields produces high bulk density soil layers (pans) that reduce rooting of grasses.

Weed control consisted of an application of Select 2EC at 5 oz/acre and was made on November 10, 2004. The grass seed field was infested with annual bluegrass, and several other grass weeds as well as substantial quantities of fine fescue seed in the seed bank. The single application of Select 2EC provided near 100% control of these weeds. While Select provided excellent weed control, it was apparent that the crop growth and development was retarded for an extended period by this treatment. The crop remained stunted in the rosette stage and leaves were small and red-purple colored until late February. Some herbicide damage symptoms were apparent but were not completely consistent with this chemical. Other biotic or environmental factors likely played a role in the manifestation of these symptoms. Winter precipitation was abnormally low for the region. Once the canopy expanded in spring, especially in April, the soil surface was completely shaded and produced an environment not conducive to weed development. Our current trials with Treflan also showed excellent weed control in winter canola.

One limitation to the planting of winter canola in the Pacific Northwest is the potential for occasional poor stand establishment under dry fall conditions. Furthermore, late seedings made to coincide with late arriving fall rains have much lower seed yields than earlier seedings. However, where available, irrigation would likely increase the probability of a good fall stand of canola.

Work in wheat has shown that canola can be successfully direct-seeded (no-till planted) into wheat stubble in the Pacific Northwest in areas outside of the Willamette Valley, but it is not known whether it is possible to direct-seed winter canola into grass seed crop stubble.

Winter canola has another advantage over other potential biodiesel crops in that there is a nearby genetic improvement and breeding program at the University of Idaho. One component of this program's effort focuses on evaluating cultivars for seed and oil yield at many Pacific Northwest locations, including two in Oregon (Pendleton and Hermiston). The energy balance of canola has been calculated by the University of Idaho to be 4.2:1.

Cultivar and irrigation management trials in winter canola are underway in the 2005-06 season.

Potential Acreages of Biodiesel Feedstock Crops

The number of total acres harvested in the Willamette Valley is 909,866 according to the USDA's latest agricultural census data. The valley's grass seed acreage was 469,120 in 2004 and more than 500,000 acres have been in culture here for several years in the last decade. To be a successful rotation management tool in the Willamette Valley, biodiesel crops need to occupy about 100,000 acres. This reduction in acreage and rotation would not only alleviate the cause of many weed and disease problems of grass seed crops but would also eliminate the true cause of overproduction, too many acres grown. Historical acreages of grass seed crops when other cropping options have been available range from 250,000 to 375,000 acres.