lbs of N supply (fertilizer+soil sources) per 100 lbs expected seed yield. Phosphorus, potassium, and sulfur recommendations can be based on soil test levels with interpretations similar to those of cereals. Canola has a lower tolerance of seed-placed starter fertilizers than cereals so rates of nitrogen+potassium should not exceed 5 lb/acre.

There are several unknowns regarding canola fertility. In existing literature, nitrogen recommendations for canola are quite variable, ranging from 4 to 11 lbs nitrogen supply per 100 lb seed yield. There is also debate over the optimum timing of nitrogen application for winter canola to ensure high yields but minimize the potential for winterkill. Optimal placement of banded fertilizer at planting and canola root responses to banded fertilizer is poorly understood. Relatively little is known about how fertility management affects oil yield and quality in canola since the majority of studies assess only management effects on seed yield. Finally, very little is known about camelina nutrient requirements to optimize oil yield.

This project involves a series of experiments designed to assess canola and camelina seed and oil yield responses to nutrient rates and application timing. Studies are located near Prosser, Davenport and Pullman, WA. Winter canola studies were initiated at each location in fall 2007. Spring canola and camelina studies are planned for 2008 at Davenport and Pullman. Treatments include nitrogen and sulfur rates, fall-spring nitrogen application timing, and phosphorus rate responses. In fall 2007, winter canola failed to establish at Pullman due to inadequate seed zone moisture. Establishment was spotty at Davenport. Fall establishment of winter canola is a major challenge that will have to be overcome in order for this crop to be successfully grown in dryland environments.

Links to other extension resources on canola fertility:
Ontario, Canada: http://www.omafra.gov.on.ca/english/crops/pub811/8fert.htm#table81
Great Plains, U.S.: http://www.oznet.ksu.edu/library/crpsl2/mf2734.pdf
North Dakota: http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf1122w.htm
Montana: http://landresources.montana.edu/FertilizerFacts
Oregon State University: http://extension.oregonstate.edu/catalog/pdf/em/em8943-e.pdf

Management of Rhizoctonia Damping-off of *Brassica* Oilseed Crops in the PNW

SCOT HULBERT[1], EBRAHIEM BABIKER[1], TIMOTHY PAULITZ[2], AND KURTIS SCHROEDER[2]
1. DEPARTMENT OF PLANT PATHOLOGY, WSU
2. USDA-ARS ROOT DISEASE AND BIOLOGICAL CONTROL RESEARCH UNIT, PULLMAN WA

Rhizoctonia solani can cause pre and post-emergence damping off of *Brassica* oilseed species with adverse effects on stand establishment. In greenhouse experiments, we have examined resistance to two groups (AGs) of *Rhizoctonia solani* among various *Brassica* species and varieties. *R. solani* AG 2-1 is among the most virulent strains and can drastically reduce seedling emergence. *R. solani* AG 8 can cause seedling stunting and also infects wheat. A few *B. napus* canola varieties appeared more tolerant to both groups of the pathogen in greenhouse experiments. The hybrid cultivars Flash and Sitro, from the German company DSV, and the open-pollinated DeKalb variety CWH687 showed the best tolerance to the two *Rhizoctonia* groups. Camelina was similar in susceptibility to most canola varieties, as were yellow, brown and Ethiopian mustards. We have examined various chemical seed treatments on the incidence of seedling damping-off of canola in the greenhouse, inoculated with *R. solani* AG 2-1. We found the seed treatments to be mostly ineffective. Since the pathogen attacks the young hypocotyls, these tissues were not protected by non-systemic seed treatments. We are now developing assays to determine if the differences in greenhouse resistance among the canola varieties can be observed in the field.

Tall Wheatgrass Feedstock Evaluation

MARK STANNARD[1] AND STEVEN FRANSEN[2]
1. USDA PLANT MATERIALS CENTER, PULLMAN, WA
2. DEPARTMENT OF CROP AND SOIL SCIENCES, IAREC-PROSSER, WSU

Only a handful of grasses grow in Washington that produce enough biomass volume to warrant biofuel attention. Switchgrass has received the lion's share of the attention because it produces large volumes of biomass that can be

converted to ethanol. Unfortunately, switchgrass does not grow well in most of Washington without irrigation. Tall wheatgrass on the other hand has been grown in dryland sites of Washington for over 50 years. It also occurs throughout the Great Plains, western states and Canadian Prairie provinces. This widely adapted grass produces as much as 7 tons of biomass per acre. It is far from an ideal pasture/hay grass, but its biofuel potential is intriguing.

Tall wheatgrass stems make up a large percentage of the total biomass. Stems are mainly composed of cellulose and lignin, and the leaves have less of these structural carbohydrates. Structural carbohydrates are not optimal for ethanol production so ethanol production from tall wheatgrass might not be economical. However, gasification and direct combustion of tall wheatgrass are definite possibilities.

Gasification of tall wheatgrass feedstock involves heating the biomass in order to convert the material into combustible syngas. The syngas can be cleanly burned to produce heat or generate electricity. This process is in operation in Scandinavia. Direct combustion involves burning bales, pellets, or finely chopped feedstock. Direct combustion might be an option for rural people looking to reduce their reliance on natural gas and/or electricity to heat farm buildings and homes.

The Pullman Plant Materials Center in cooperation with WSU established a study at the Prosser Irrigation Agriculture Research and Extension Center to compare 4 tall wheatgrass varieties. One of the varieties, Szarvasi I, is a Hungarian line specifically developed for the European biofuel market. The Prosser data indicate that Szarvasi I is no better then the pasture/hay varieties currently being grown in North America. Plant Materials Centers in several western states are installing similar studies to determine if there are regional differences in yield, energy output, and plant adaptation.

Biofuel Feedstock Research in Irrigated Central Washington

AN HANG[1], STEVE FRANSEN[1], AND HAL COLLINS[2]
1. DEPARTMENT OF CROP AND SOIL SCIENCES, IAREC-PROSSER, WSU
2. USDA-ARS VEGETABLE AND FORAGE RESEARCH UNIT, PROSSER, WA

The biofuel feedstock trials and the search for better crops in our cropping system have been in our program since 2004 under irrigation of central Washington. Most of the temperate and sub tropical crops have been included in our trials from oil producing crops camelina, canola/rapeseed, crambe, mustard, safflower, soybean and sunflower to biomass crops as switchgrass for cellulosic ethanol. Camelina, a short growing season oilseed, belongs to the same family with canola and mustard which can be produced on marginal land with low energy input and is a short growing season crops. Camelina oil is a source of high quality oil with over 30% Omega-3 fatty acid and second to flax oil. Canola both spring and winter species can be produced well in Washington. Winter canola requires 10 months to mature and its yield doubled spring grown canola. Mustard is another *Brassica* species which tolerates more hash weather and low soil nutrient. Safflower produces well in Washington and uses less water than soybean and can produce high yield and high oil concentration. Safflower and winter canola can produce 1700 to 2500 lbs oil per acre. Soybean with maturity groups 000, 00, 0 can be grown in Washington and produced from 2950 to 3900 lbs per acre on sandy soil if enough irrigation is applied. Switchgrass is a perennial warm-season grass produces high biomass yield after the establishment year. Under irrigation we produce two harvestable biomass harvests per growing season. The first biomass harvest is taken in early July and the final in early October. Switchgrass is photoperiod sensitive with early maturing cultivars transitioning into winter dormancy earlier than later maturing cultivars. If allowed to transition into dormancy in the fall, we have not experienced winterkill problems in our environment and under our agronomic management practices.

Camelina Production in Irrigated Central Washington

AN HANG, DEPARTMENT OF CROP AND SOIL SCIENCES, IAREC-PROSSER, WSU

Camelina (*Camelina sativa* L.) is an ancient crop and is a native of northern Europe from Finland to Romania and east to Ural Mountains. Camelina is grown for its oil used as lamp oil, medicinal treatment and as an edible oil. It belongs to a large mustard family (Brassicaceae) like canola, rapeseed and vegetable mustard green and mustard seed. It is grown in marginal agriculture lands with low fertilizer and low soil moisture. Camelina is a short