

Canola Variety Effects on Soil Health Mediated by Nutrients and the Microbiome



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The rhizosphere is a highly active region for both biological and chemical processes and is analogous to the human gut, where microbial communities play critical roles in transforming nutrients for the health of the host. Plants interact with a host of both soil-borne diseases and soil-borne beneficial micro-organisms and extensive work across plant systems has documented that plant genotype interacts with the environment to determine these interactions. Work by our team has found that crop genotype is related to differences in siderophore activity in wheat rhizosphere and that crop genotype is also related to differences in the ability for beneficial microbes to protect against soil-borne antagonists in the Medicago rhizosphere. In canola, one of the barriers to adoption is the variability in its effects on subsequent rotational crops—in some cases canola enhances the yield of following crops but in other cases it decreases yield. Previous work by our team has documented that wheat and canola share core rhizosphere microbiome members and that these communities shift through time and under varying canola-wheat rotations. However, it is not currently known how these effects vary with canola variety or if these effects are consistent across our region. Understanding the biological and soil nutrient basis of these effects in relation to canola variety across our region will be important for both immediate recommendations for farmers seeking to incorporate canola into rotations as well as longer term efforts to improve soil health through the use of oilseed crops.

We plan to sample the microbiome of ongoing variety trials—both the loosely bound rhizosphere, which has been more closely linked to microbiome function, as well as the tightly bound rhizosphere, which has been found to vary more dramatically across plant varieties due to genetic differences. We will extract DNA and use 16S and ITS to inform us what bacteria and fungi are present, and plan to additionally use high-throughput qPCR to assess the abundance of key nutrient cycling genes. We will also conduct analysis of soil nutrients in the bulk soil to better understand connections between canola varieties, the microbiome, and soil health.

Managing Nitrogen for Winter Canola



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Currently, the yield-goal method is used to estimate nitrogen (N) rates for canola. In another words, N rate is determined based on unit N requirements (UNR), which is N requirement for a unit yield. A 12 site-year research study conducted across rainfall zones in WA found that approximately 7 to 17 lbs N per 100 lb seed yield is required for spring canola (UNR=7 to 17). In general, the higher the yield potential, the lower the UNR. When spring canola is grown in higher yield potential areas, it develops more vigorous root systems that allow greater access to soil nitrogen and water. Since winter canola yield potential vary substantially across rainfall zones, it is important that we provide the right UNR for farmers for winter canola.

We conducted a N response study on 7 site-years across rainfall zones of WA and OR in 2016-2018. The treatments included N rates from 0 to 200 lbs/acre and N application timing including spring, fall, and split (50% in spring and 50% in fall). A uniform rate of ammonium sulfate was applied for all treatments. We found that approximately 5 to 7 lb N per 100 lb seed yield is sufficient for winter canola across all rainfall zones (UNR=5 to 7). Notably, however, when soil test N is higher than 100 ppm in the 6-foot depth, yield response to

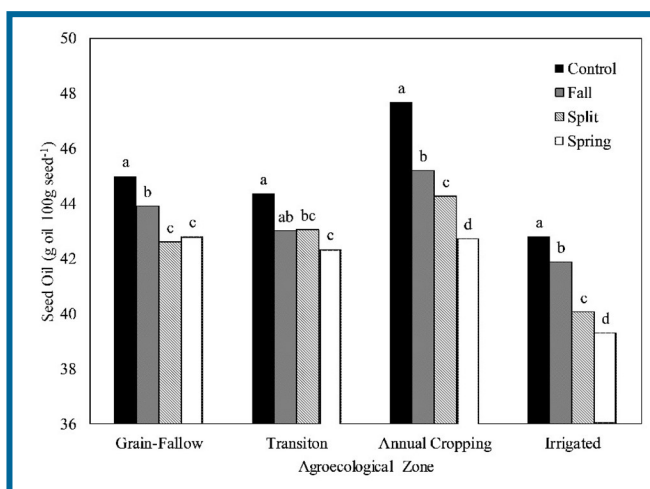


Figure 1. The relationship between average seed oil concentration and timing of N application for the different rainfall zones. Seed oil concentration marked by different letters above the bars are significantly different within each rainfall zone.

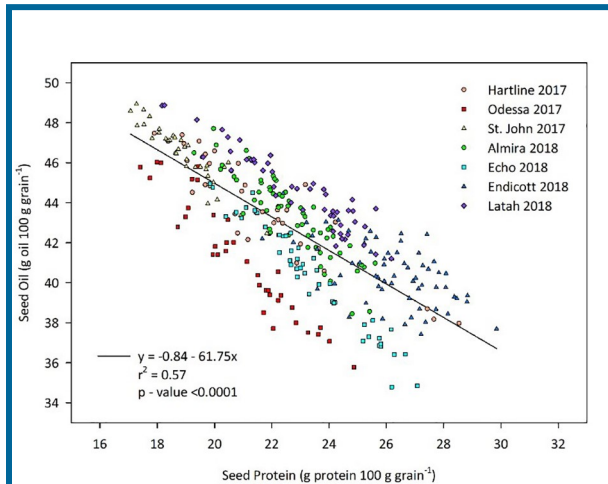


Figure 2. The inverse relationship between winter canola seed oil and protein concentration. Data points represent all treatment combinations from seven sites in the 2016–2017 and 2017–2018 crop years.

that winter canola seed oil concentration was lowest with spring N application in a field located in the high rainfall zone. For that same field, the next lowest oil concentration was the split applications between fall and spring, followed by fall application.

additional N fertilizer application is unlikely in winter canola, and this agrees with the study for spring canola. Therefore, farmers should determine N rate based on yield goal, UNR, and soil test.

Timing of N application affects N use efficiency, N availability to winter canola, and yield (Fig. 1). Spring application is a better practice than fall application in areas with high leaching potential, such as fields located in intermediate and high rainfall zones and sandy soils. In the high rainfall zone, if soil test N is higher than 100 ppm in fall, no fertilizer N application is needed; if soil test N is low, 30 lbs/acre N as starter is recommended and apply the remaining N in spring. Fall or splitting N applications between fall and spring in the low rainfall zone are good practices. Split application results in better yield in irrigated systems.

Canola seed quality is significantly affected by N management. Higher N availability leads to higher seed protein concentration. Typically, the higher the seed protein concentration, the lower the seed oil concentration (Fig. 2). Timing of N application also affects seed oil concentration, mainly as a result of the timing effect on N availability. For example, in the 7 site-year research, we found

Understanding the Epidemiology of Blackleg Disease of Canola in Northern Idaho and Eastern Washington

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The fungal pathogen *Leptosphaeria maculans* is the causal agent of blackleg disease of *Brassica napus*, otherwise known as canola. Due to the ability of *L. maculans* to infect every part of the plant during all developmental stages, blackleg is the most devastating disease of canola worldwide, with the potential to cause extreme crop damage and yield loss. In northern Idaho blackleg was first identified in 2011. Being a new disease in the region and the epidemiology of blackleg changing depending on climate, research has been conducted to understand the biology of *L. maculans* and its epidemiology specific to this region.

A major method of blackleg control is the use of resistant canola cultivars. This is a gene-for-gene mechanism in which a specific resistance gene in the plant confers resistance to *L. maculans* isolates that carry a corresponding avirulence gene. This gene-for-gene interaction can be highly effective, although this mechanism can break down over time with changes in the genetics of the pathogen much in the same way that we observe race shifts in stripe rust of wheat. To expand our understanding of the pathogen, a collection of 97 *L. maculans* isolates from eastern Washington were collected and screened in a plant host differential using multiple canola cultivars with known resistance genes. As of May 2020, 83 isolates have been screened. Gene frequencies (Fig. 1) show that 100% of the isolates contain AvrLm5-6-7-LepR1-LepR2. This data can be used by breeders to develop new canola varieties with enhanced resistance.

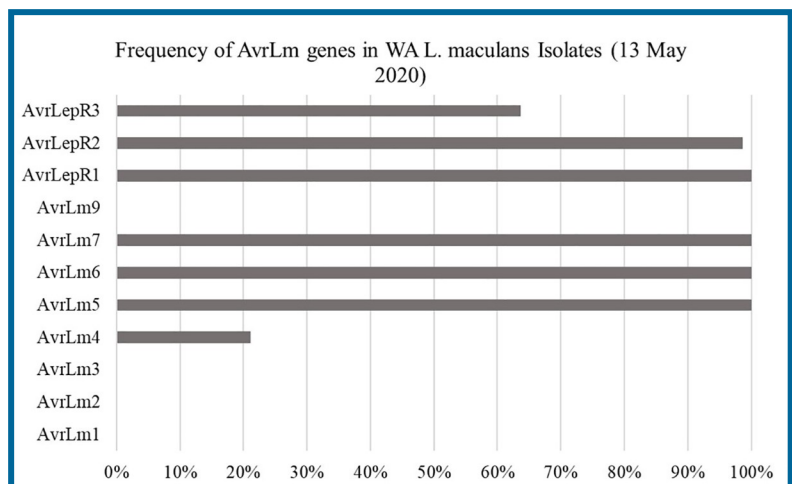


Figure 1. Frequency of AvrLm genes in the WA *L. maculans* isolates.