This study showed that delaying planting until late May resulted in a slight decrease in flea beetle damage, perhaps due to a cessation of feeding as the adult flea beetles completed their life cycle and died, but any positive effect was far outweighed by yield losses associated with delayed planting. The study also showed that even with low flea beetle pressure, a foliar application of insecticide can be justified and will increase seed yields of spring canola. At a canola price of 17 cents per pound, the seed yield increase of 157 lbs. per acre observed in the trial has a value of $27 per acre. This should be enough to cover the cost of insecticide and application. Under higher flea beetle pressure, the economic return is likely to be greater.

Table 3. Mean flower date and days from seeding to 50% flowering of five Brassica cultivars with three seeding dates when grown near Moscow, Idaho in 2018 and 2019.

Seeding Dates	Flower Date	Days to Flower
April 25/May 1	June 15 [a]	49 [a]
May 8/May14	June 25 [b]	45 [b]
May 23/May 28	July 7 [c]	42 [c]
LSD (p=0.05)	0.3	0.3

Means within columns with different superscript letters are significantly different (*P*<0.05)

Canola in Cereal-Based Rotations: Agronomy and Soil Microbiology Update from Ritzville

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Two long-term canola cropping systems experiments were initiated in 2014 and 2016, respectively, on the Ron Jirava farm near Ritzville. In Study 1, canola is grown in a 4-year rotation of C-F-WW-F and is compared to WP-F-WW-F as well as a 2-year WW-F check. In Study 2, canola grown in a 3-year C-SW-F rotation is compared to 3-year rotations of WW-SW-F and WT-SW-F (all acronyms used are defined at the end of this report).

Some research highlights from Study 2 are briefly outlined here. Note that SW follows C, WW, and WT and that a 13-month fallow period occurs after SW in all three rotations. Overwinter precipitation storage in the soil has been significantly lower after canola in some, but not all, years compared to after WT or WW (Fig. 1). We are surprised by these data because in a previous 6-year study near Davenport there were never any differences in overwinter precipitation storage in the soil after canola versus wheat. To date, SW grain yields averaged over years at our Ritzville site have been significantly lower after canola versus WT and WW (Fig. 1).

Is the difference in overwinter precipitation storage in the soil the reason for the differences in SW grain yield among treatments? The answer is "not entirely". Figure 2 shows that 33% of the difference in SW grain yield among treatments is due to the amount of water in the 6-foot profile in late March. The remaining 67% of the grain yield difference among treatments is due to some other factors. The PhD dissertation research conducted by Jeremy Hansen in the above-mentioned Davenport study showed that soil microbial populations, including mycorrhizal fungi, were reduced with canola compared to wheat (click this link for the full report of this study https://www.frontiersin.org/articles/10.3389/fmicb.2019.01488/full). Is this same phenomenon also taking place in our Ritzville study?

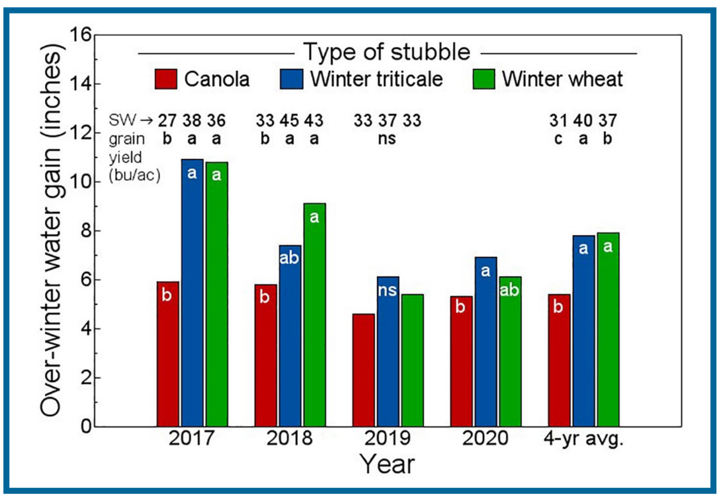

Figure 1. Overwinter gain in soil water in the 6-foot soil profile as affected by having canola (either spring or winter canola), winter triticale, and winter wheat as the previous crop. Soil water content at time of harvest of these crops was essentially identical every year. Stubble of the three crops was left standing and undisturbed after harvest. The numbers above the individual bars show spring wheat (SW) grain yield that was sown in late March into the stubble of the three previous crops. Letters within years (and averaged over the four years) followed by a different letter are significantly different at the 5% probability level. Ns = not significantly different.

Dr. Hansen is currently leading a study to determine if injecting mycorrhizal inoculum beneath newly emerged SW seedlings at our Ritzville site will enhance mycorrhizae populations and, if so, see how this affects SW grain yield. Concurrently, Dr. Tim Paulitz is conducting DNA sequencing of SW roots and soil adhering to the roots (i.e., rhizosphere soil) to measure the presence of numerous taxa of fungi and bacteria at the Ritzville site. We are excited about this research!

Finally, we need to state that there is no evidence that wheat yield is negatively affected when there is a year-long fallow period after a canola crop prior to planting wheat. On the contrary, there are numerous reports by scientists and farmers from around the world that show wheat yield is often enhanced when the previous crop is canola. Our collective research in the Pacific Northwest indicates that soil microbial biomass decline with canola is temporary and that soil microbial populations return to their previous levels in about one year.

Acronyms used: C, canola (either winter or spring canola); F, 13-month-long fallow; SW, spring wheat; WP, winter pea; WT, winter triticale; WW, winter wheat.

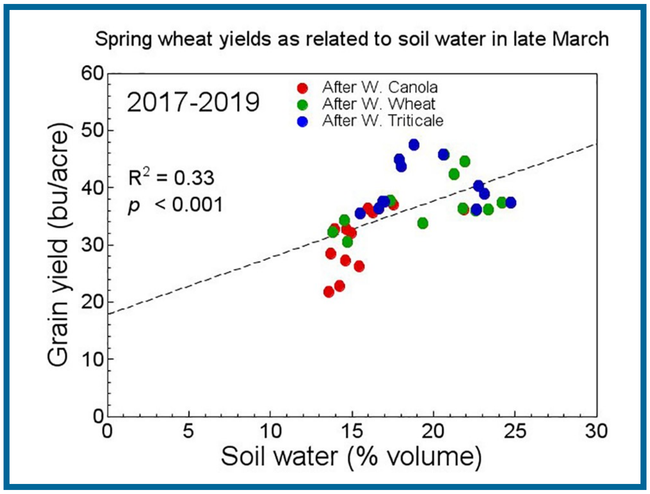

Figure 2. Relationship between soil water content in late March at time of sowing of spring wheat and the grain yield of spring wheat. The correlation coefficient (R^2) of 0.33 means that 33% of the difference in spring wheat grain yield following canola, winter triticale, and winter wheat is due to the amount of soil water in 6-foot soil profile in late March. The remaining 67% of spring wheat yield differences following canola, winter triticale, and winter wheat is due to other factors.

A Study to Support Phosphorus Fertility Recommendations for Winter and Spring Canola

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Phosphorus is an essential nutrient for crops. It is a structural element in many molecules such as ADP and ATP, nucleotides, nucleic acids, and co-enzymes. Sufficient amount of phosphorus supply during canola growing season ensures functionality of these molecules, strengthens seed formation, and prevents lodging as a result of better development of stem tissues. However, there are limited studies on phosphorus fertility strategies for canola (*Brassica napus*). In order to support phosphorus fertilizer recommendations for the Northwest, we initiated a small plot research on Washington State University Wilke Research and Extension Farm in the fall of 2019. We will use the small plot experiment to study yield and quality responses of winter canola to phosphorus application rate and application method. We established a field-scale research in Almira, WA to study spatial variability of such responses. In spring 2020, we were able to conduct one small plot research on Wilke Research and Extension Farm for a similar study for spring canola. In additional to phosphorus, the treatment included zinc which allows us to study the interaction effect of phosphorus and zinc on spring canola's yield and quality. We will repeat the study and conduct more research trials in 2021 and 2022. The results will be used to (1) determine agronomic and economic optimum rate for P for winter and spring canola yield and quality; (2) determine agronomic critical level for soil test phosphorus, above which no phosphorus should be applied; (3) determine the best placement strategy for P uptake, yield, and quality of winter and spring canola; (4) evaluate how soil and climate conditions affect crop yield response to P

Winter canola trial to study phosphorus fertility strategy (photo was taken on May 13, 2020).