DOES WINTER WHEAT VARIETY IMPACT SUBSEQUENT SPRING CANOLA PERFORMANCE IN THE INLAND PACIFIC NORTHWEST?

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ABSTRACT

Successful stand establishment is one of the most crucial aspects of canola production. While significant research has been done on determining optimal planting dates, rates, and depth, considerably less work has been devoted to looking at allelopathic impacts wheat cultivar may have on canola establishment. In the inland Pacific Northwest, dryland canola is rotated in a cropping system dominated by winter and spring wheat. The objective of this study was to determine if the previous winter wheat variety impacted early season growth and ultimately end of season seed yield, oil content, and protein content in spring canola. In spring 2022, spring canola was bulk planted over the top of the 2021 soft white (SWW) and hard red (HRW) winter wheat variety trials in Pullman and Reardan, WA. Differences were detected in spring canola for stand count, leaf number, canopy cover, seed oil, and seed protein based on previous winter wheat variety, but differences were generally inconsistent across trials and locations. 'WB4311', 'AP Dynamic', 'LCS Shine', 'Resilience CL+', and 'Puma' all showed some negative impact on early season growth at both sites, while 'SY Clearstone', 'WB4311', 'WB4303', and 'WA8309' all showed striking reductions in stand counts at Reardan. Cold weather following planting and flea beetle damage in Pullman likely created unwanted variation that made detecting differences more difficult. More research is needed to examine how consistent these differences are across environments.

INTRODUCTION

Background & Justification

- Allelopathy occurs when compounds from living plants or plant residue inhibit or negatively impact the growth of subsequent plants and has been documented in many crops including wheat and canola.
- Limited research has found some wheat cultivar differences in allelopathy on germinating canola seeds under laboratory settings, but no field research has been conducted in the inland Pacific Northwest with its unique climate, soils, and winter wheat cultivars.
- Successful stand establishment is one of the most crucial aspects of canola production and variety selection of the preceding winter wheat crop could influence canola establishment.

Objectives

The overall goal is to determine if differences exist in early season growth of spring canola based on the previous winter wheat cultivar in the rotation. This information would allow producers to select winter wheat cultivars for their canola rotations that maximize chances of successful canola stand establishment and avoid cultivars that may have detrimental impacts on germination and emergence.

Specific objectives of this study are to:

1) Document differences in spring canola time to emergence, canopy cover, leaf number and plant height based on previous winter wheat variety.
2) Determine if early season impacts, if present, translate into differences in spring canola seed yield, seed oil content, or seed protein content.

MATERIALS & METHODS

Experimental Design and Analysis

- Trials were conducted at two sites in Eastern Washington State (Pullman and Reardan) during the 2022 growing season and analyzed as an RCBD design.
- Previous winter wheat variety was the main treatment.
- Spring canola was planted on top of the previous year's winter wheat variety trials. SWW and HRW trials were separate and so data were analyzed separately. Entries differed by location also and so locations were analyzed separately.
- 1.5 x 4.3 m and 1.5 x 5.5 m plot dimensions were used at Pullman and Reardan sites, respectively.
- Analysis of Variance was done using PROC GLM in SAS. PROC MEANS with the STDDEV option was used to generate standard deviations.

Data Collection

- Early season measurements were taken 2, 3, 4, 5 weeks after planting (WAP) at Pullman, but 4, 5, 6, 7 WAP at Reardan due to delayed emergence from cold weather.
- Stand counts were taken from 1 linear m of row from an inside drill row of each plot.
- Canopy cover was determined using the Canopeo phone app to convert green pixels from plot images into black and white images and converted into percent green canopy.
- Leaf number plant^{-1} and plant height were done manually.
- Canola plots were mechanically harvested with a small plot Wintersteiger combine.
- Seed oil and seed protein content were estimated using a FOSS NIRS machine.

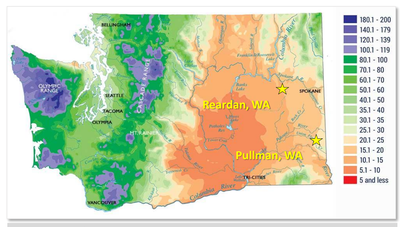

Figure 1. Map of trial locations planted in Spring 2022.

Figure 2. Bird netting was installed after harvest of winter wheat variety trials to ensure straw remained in place until the following spring.

Figure 3. Spring canola was planted into the winter wheat residue the following spring with a no-till hoe drill.

RESULTS & DISCUSSION

SPRING CANOLA EARLY SEASON GROWTH

- Previous winter wheat variety impacted subsequent early season spring canola canopy cover ($p<0.05$)
  - Of SWW varieties tested in both locations, 'AP Dynamic', 'LCS Shine', 'Resilience CL+', and 'Puma' were in the lowest group ($p<0.05$) at both sites for the final canopy cover measurement (Fig. 4 & 5)
  - 'SY Clearstone', 'WB4311' and 'WB4394' had less canopy cover than 'Whistler' and 'Battle AX' in the HRW trial at Reardan ($p=0.10$) (Fig. 6)
- Number of leaves per canola plant 5 WAP differed by previous wheat variety at Pullman ($p=0.08$ and $p=0.11$ for SWW and HRW trials, respectively) (Fig. 5 & 7)
  - 'VI Voodoo CL+', 'ARS-Crescent', 'ARS-Selbu 2.0' were lower than 'ARS-Castella', 'Jasper', 'LCS Artdeco', 'LCS Jefe', 'OR2x2 CL+', and 'Puma' in the SWW trial
  - 'Canvas' and 'WB4311' were lower than 'Kairos', 'Scorpio', and 'SY Clearstone' in HRW trial
- Spring canola stand counts following certain HRW varieties at Reardan trended ($p=0.10$) lower (Fig. 8)
  - These varieties included 'SY Clearstone', 'WB4303', 'WB4311', and 'WA8309'

SPRING CANOLA SEED HARVEST

- There was no difference in spring canola seed yield based on previous wheat variety for SWW and HRW trials at either location (Table 1).
- There were differences ($p<0.05$) detected for both spring canola seed oil (Fig. 9) and seed protein (Fig. 10) at the Reardan location based on the previous winter wheat variety.
  - 'Stingray CL+' and 'VI Frost' produced lower seed oil content in spring canola compared to 'ARS-Crescent', 'Devote', 'Pritchett', 'WB1529', and 'Xerpha'
  - 'ARS-Crescent' and 'WB1529' produced the lowest seed protein in spring canola compared to 'VI Frost', 'Appleby CL+', 'LCS Jefe', 'Resilience CL+', and 'WA8290'
- There was also a trend towards seed protein being 1-2 percentage units higher following HRW than SWW.

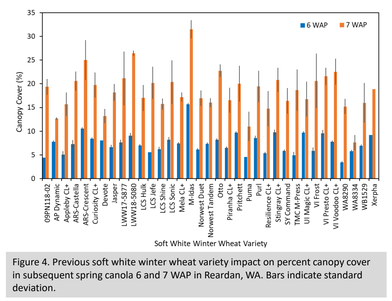

Figure 4. Previous soft white winter wheat variety impact on percent canopy cover in subsequent spring canola 6 and 7 WAP in Reardan, WA. Bars indicate standard deviation.

Table 1. Table of significance for measurements taken on early season growth and harvested seed samples of spring canola following different winter wheat varieties at two locations in 2022. Ratings were taken 2, 3, 4, 5 WAP for Pullman and 4, 5, 6, and 7 WAP for Reardan due to delayed emergence.

Location / Variety Trial	Stand Counts (plants lin row m^{-1}) First Rating	Stand Counts Sec. Rating	Stand Counts Third Rating	Stand Counts Fourth Rating	Leaf Number (leaves plant^{-1}) Third Rating	Leaf Number Fourth Rating	Canopy Cover (%) Third Rating	Canopy Cover Fourth Rating	Plant Height (cm) Third Rating	Plant Height Fourth Rating	Seed Yield (kg ha^{-1})	Seed Oil (%)	Seed Protein (%)
Pullman													
Soft White Winter	NS	NS	NS	NS	NS	p=0.08	--	*	--	--	NS	NS	NS
n	*108*	*108*	*108*	*108*	*108*	*108*	--	*108*	--	--	*162*	*161*	*161*
Hard Red Winter	NS	NS	NS	NS	NS	p=0.11	--	NS	--	--	NS	NS	NS
n	*53*	*53*	*53*	*53*	*53*	*53*	--	*54*	--	--	*90*	*90*	*90*
Reardan													
Soft White Winter	NS	NS	NS	NS	NS	NS	*	*	NS	NS	NS	*	*
n	*105*	*105*	*105*	*105*	*105*	*105*	*104*	*104*	*105*	*105*	*151*	*162*	*162*
Hard Red Winter	p=0.08	*	p=0.10	p=0.08	NS	NS	NS	p=0.10	NS	NS	NS	**	*
n	*60*	*60*	*60*	*60*	*60*	*60*	*59*	*60*	*60*	*60*	*72*	*90*	*90*

p>0.05 = NS; p<0.05 = *; p<0.01 = **; p<0.001 = ***; n=number of observations

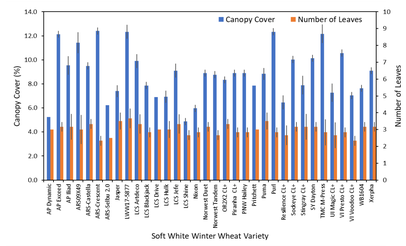

Figure 5. Previous soft white winter wheat variety impact on percent canopy cover and number of leaves plant^{-1} in subsequent spring canola at 5 WAP in Pullman, WA. Bars indicate standard deviation.

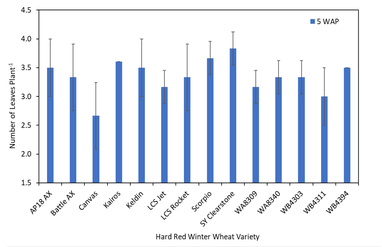

Figure 7 Previous hard red winter wheat variety impact on number of leaves plant^{-1} in subsequent spring canola in Reardan, WA. Bars indicate standard deviation.

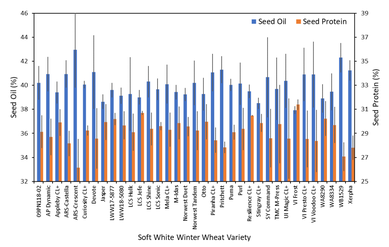

Figure 9. Previous soft white winter wheat variety impact on seed oil and protein in subsequent spring canola in Reardan, WA. Bars indicate standard deviation.

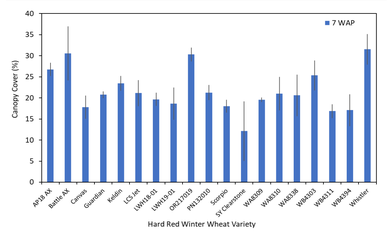

Figure 6. Previous hard red winter wheat variety impact on percent canopy cover in subsequent spring canola at 7 WAP in Reardan, WA. Bars indicate standard deviation.

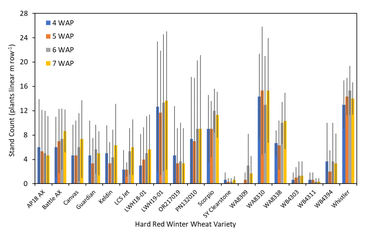

Figure 8. Previous hard red winter wheat variety impact on stand count in subsequent spring canola 4, 5, 6, and 7 WAP in Reardan, WA. Bars indicate standard deviation.

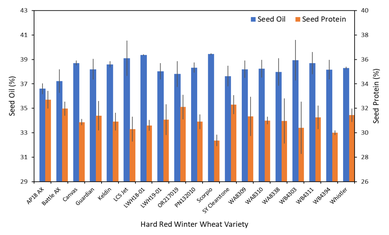

Figure 10. Previous hard red winter wheat variety impact on seed oil and protein in subsequent spring canola in Reardan, WA. Bars indicate standard deviation.

CONCLUSION

- Spring canola stand counts were quite variable, likely due at least in part to the use of a hoe-opener drill which is less precise than a disc drill. This, combined with prolonged, exceptionally cold weather following canola planting likely decreased emergence and survival of spring canola seedlings.
- The higher spring canola seed protein following the HRW trial at Reardan was possibly a result from higher residual N left from additional N applied to those varieties to boost grain protein.
- Though inconsistent, these differences in spring canola growth indicate some potential for differences in allelopathy of winter wheat varieties and warrant further investigation under additional environments.

ACKNOWLEDGEMENTS

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