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Performance of Soybean-based Rotations in Manitoba: Yield and Quality

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Introduction

- *Rapid expansion of Manitoba's soybean industry has resulted in more than a 5-fold increase in seeded acreage over the last 15 years, with nearly 1.6 million acres of soybean grown in Manitoba in 2023.*
- *Research regarding the effects of including soybean in rotation in this region is limited, however.*
- *The overall objective of this study is to determine the agronomic, economic and environmental viability of various soybean rotations in Manitoba. As part of this, crop yield and quality are being assessed.*

Materials and Methods

In 2014, a field study was initiated on a Newdale clay loam soil north of Brandon, Manitoba to assess five 2- and 3-year rotations (Table 1). Recommended varieties of glyphosate-tolerant soybean (S), CWRS wheat (W) and Liberty-tolerant canola (C) were grown.

Table 1: Rotation Treatments

2-year	soybean-canola	SC
	soybean-wheat	SW
3-year	soybean-wheat-canola	SWC
	soybean-canola-wheat	SCW
	soybean-soybean-wheat	SSW

The appropriate stubble treatments were established in 2014 and 2015, and rotations were assessed from 2016 through 2021. Treatments were arranged in a Randomized Complete Block Design (RCBD) with each phase of each rotation present in each year (Fig. 1).

Crops were direct-seeded into stubble using a ConservaPak seeder. Generally-accepted management practices were employed. To allow disease assessments untreated soybean seed was used, and fungicides were applied only where serious yield loss was expected.

Grain yield was determined by plot combine, with straw chopped and returned. Percent protein and oil in harvested seed was determined by NIR, test weight using an integrated module, and seed weight by seed counter.

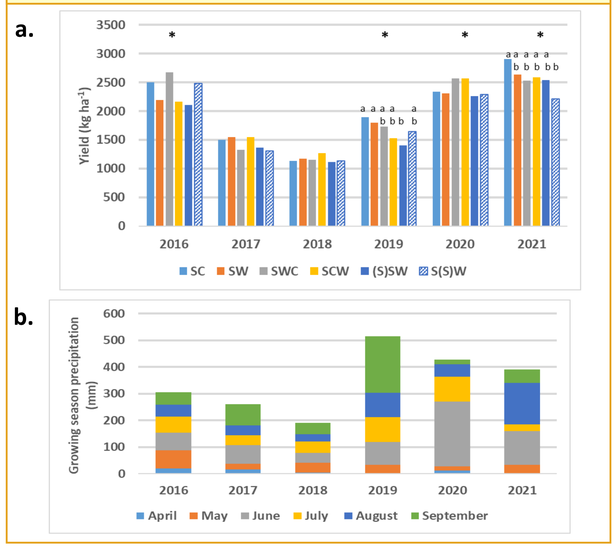
Figure 1. Rotation study located north of Brandon, MB at AAFC's Phillips Farm

Results and Discussion

Yield

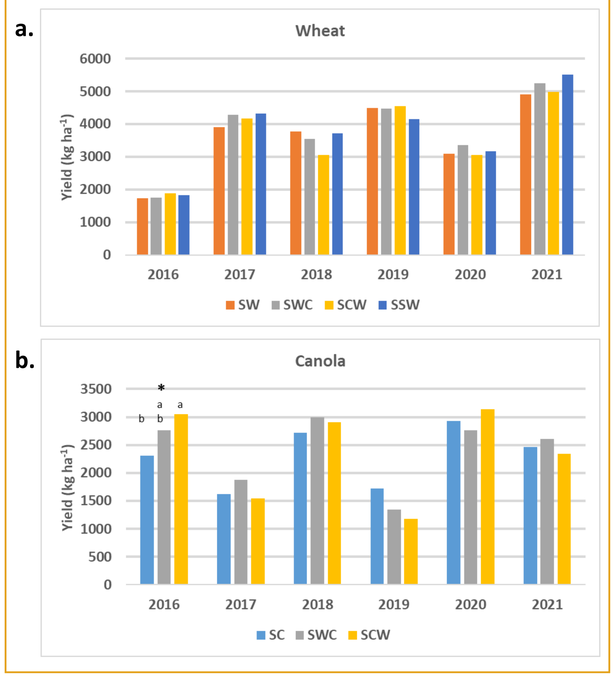
- Yield potential of soybean varied among years (Fig 2a), and was influenced by the amount and timing of precipitation which varied from 60% to 160% of the long-term average over the period 2016-21 (Fig. 2b).
- Weather extremes, including a dry spring and wet fall conditions with early snow in 2019, and heavy rains in late June 2020, characterized these years.

Figure 2. Soybean yield (a) and cumulative growing season precipitation (b) for the period 2016 through 2021.



*Indicates a significant effect of rotation based on analysis of variance by crop and by year, with rotation treatment and replicate considered fixed and random, respectively. Bars within a year with the same letter are not different based on Tukey's test; no lettering indicates that no differences were noted. P≤0.05 is considered statistically significant.

Figure 3. Yield of wheat (a) and canola (b) as affected by rotation for the period 2016 to 2021.

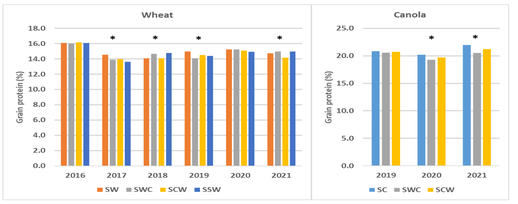


- Rotation influenced soybean yield in 4 of 6 years (Fig. 2a). While effects were not consistent across years, SSW has tended to be among the lower yielding rotations in more recent years.
- Rotation did not influence wheat yield (Fig. 3a), and affected canola yield in only 1 of 6 years (2016) with higher yields evident in SCW than SC (Fig. 3b).

Grain quality

- Rotation rarely affected either seed weight or test weight (data not presented).
- Average percent protein varied across years from 33% (2017) to 39% (2020) in soybean (data not presented), and from 14% to 16% in wheat (Fig. 4).
- In soybean, rotation resulted in small differences in % protein in 3 of 6 years, but no clear trends were evident across years (data not presented).
- Rotation affected % protein in wheat in 4 of 6 years, and in canola in 2 of the 3 years assessed (Fig. 4).

Figure 4. Percent protein in wheat grain and canola seed as affected by rotation (2016-2021).



- Although rotation did not have a consistent effect on % protein in wheat or canola, it is interesting to note that crops that did not follow soybean were often among those treatments with slightly less protein (SCW for wheat, SWC for canola) (Fig.4).
- Percent oil was generally inversely related to protein (data not presented).

Summary

- Effects of rotation often accrue slowly over time with changes in the plant soil system.
- In the current study, weather extremes over the past 8 years have contributed to marked variations in yield potential across years.
- Rotation has had limited effects on the yield and quality of wheat and canola to date. In contrast, rotation affected soybean yield in 4 of 6 years, although effects were not consistent over years.
- While results suggest that some differences may be starting to emerge among rotations, it will be important to confirm these trends over time since rotations that may perform well in the short term will not necessarily be optimal in the long term.
- This study is set to continue until 2026.

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