SASKATCHEWAN pulse Growers

Diversifying organic cropping options for the brown soils through intercropping

Dr. Myriam R. Fernandez

Agriculture and Agri-Food Canada Objective

SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Co-funders	Total Project Cost
$83,828.00	Completed	April 2016 – March 2022	Western Grains Research Foundation; Saskatchewan Wheat Development Commission	$251,484.00

Project Description

To determine if intercrops can reduce weed populations compared to sole noncompetitive crops, and the following spring wheat; to determine the nitrogen (N) benefit from legumes in intercrops to the following wheat compared to sole legume crops and green manure; to determine if intercrops have less disease than monocrops, and effect of previous intercrops/sole crops on leaf/root diseases; to determine the yield and quality of crops in intercrops at various ratios and of the following wheat, compared to monocrops; to determine the optimal seed ratio of the intercrops for achieving the greatest agronomic and economic benefit.

The objectives of this study conducted in the semi-arid Prairies were to determine:

- if intercrops can reduce weed levels compared to monocrops, and in the following sole crop;
- if intercrops have less disease than monocrops, and impacts on diseases in the following crop;
- the grain yield/quality of intercrops at various seeding ratios, and of the following crop;
- the soil nitrogen (N) benefit to the following sole crop; and
- optimal seeding ratios for achieving the greatest benefit.

Intercrops were grown from 2016 to 2018 on organically-managed fields. These were lentil-yellow mustard, field pea-oat, and soybean-flax, and their respective monocrops. A sole crop, durum wheat, was grown in 2018 and 2019 following the 2017 and 2018 intercrops, respectively. There were very dry conditions in 2017 and 2018 and excessive moisture in 2016.

Outcome

Below are the most important observations in both the intercrop years and the sole durum wheat crop years.

Intercrops: Levels of weeds (mostly non-perennial) were lower in intercrops relative to their respective legume monocrops. The non-legumes had a competitive advantage over the legumes, but crops reacted to competition differently. The legume crops, even at a full seeding rate in their intercrops, had a lower crop biomass and grain yield than their monocrops. Field pea was the most competitive legume when intercropped, while soybean would not be recommended for intercropping in this region. Mustard and oat performed better than expected based on their respective seeding ratios, while flax was the least competitive. The crop biomass and grain yield of mustard were not affected when intercropped at lower ratios combined with less than a full ratio of lentil. In addition, the grain weight of oat was higher when intercropped at lower rates with field pea. Based on these results under dry weather, a higher seeding rate of the legumes than what was used in this study would be of benefit under similar conditions.

Durum wheat following the intercrops: The impact of the intercrops was carried over to the following sole crop. The durum wheat grown after the intercrops had lower weed levels than after the legumes, a result of a lower weed seedbank in the former. In addition, soil N under 15 cm was higher following field pea-oat or oat than lentil mustard or mustard, which was reflected in a lower crop biomass and grain yield of the durum wheat grown after the Brassica crop and its intercrops.

Diseases and fungal populations: There was higher microbial diversity in the non-legumes than in the legumes. A comprehensive assessment of root rot severity and identification/quantification of fungi isolated from lesioned underground crop tissue revealed multiple pathogens, and weak pathogens/saprophytes in all crops. Most of them were Fusarium spp., some being responsible for Fusarium head blight (FHB) in cereals, while some of the fungi in the intercrops are known for their biocontrol potential. The intercrop lentil-mustard resulted in a lower severity of root rot in lentil, and lower levels of Fusarium pathogens, than in the lentil monocrop or the intercrop with the highest lentil ratio and lowest mustard ratio. In contrast, root rot in field pea intercropped with oat was higher than in the field pea monocrop attributed to the higher number of species, including Fusarium pathogens, that were similar between these two crop species than between lentil and mustard. These findings are of significance given that, in general, legumes can increase levels of Fusarium pathogens responsible for diseases in a variety of crops, including FHB.

Although intercropping field pea with oat would be best for achieving the highest growth of the following sole durum wheat, in order to help control Fusarium pathogens, growing legumes with crops such as mustard would be of benefit. This would be of great significance to the pulse industry given the continuing impact of Fusarium pathogens on legume roots and crop growth, and persistence of these populations in soil and crop residues over time. So far, these important legume diseases have not been able to be controlled successfully through crop breeding.

Our results have shown that it would be possible to promote the presence of the biocontrol fungi identified in this study through intercropping and/or rotations with mustard (or likely another Brassica species), which in addition to providing disease control might also promote crop growth and improve drought tolerance. However, its negative effect on soil N and growth of the following crop should also be considered. It would be expected that a legume crop (especially green manure) would help restore soil N after growing a Brassica monocrop or its intercrops at high ratios, especially when the companion legume grows poorly due to dry weather. Determining the impact of mustard or other Brassicas and its intercrops on the health and Nfixing ability of a following legume, would also be of importance given that these could compensate for the impact of the former crops/intercrops on soil N observed in this study. This would be of particular importance for organic and low-input crop production.

Given the environmental conditions under which these results were observed, intercropping trials over a range of soil and growing conditions would be of importance in order to identify the best combination(s) for a given region, environment, and objective, particularly in view of the expected environmental variability due to climate change.

This intercrop study examined various parameters in addition to those commonly reported from intercropping, as well as an examination of the following durum wheat crop. This has allowed a better understanding of intercrops and their multiple impacts, which is expected to help in their design. Given the nature of most of these findings, they are not expected to have been identified under non-organic or non-low input management, where synthetic chemical inputs would have most likely masked the range of impacts of this cropping system, and its effects on the following sole crop.

Research Objective

OBJECTIVE 1
To determine if intercrops can reduce weed populations compared to sole noncompetitive crops, and the following spring wheat.

OBJECTIVE 4
To determine the yield and quality of crops in intercrops at various ratios and of the following wheat, compared to monocrops.

OBJECTIVE 2
To determine the nitrogen (N) benefit from legumes in intercrops to the following wheat compared to sole legume crops and green manure.

OBJECTIVE 5
To determine the optimal seed ratio of the intercrops for achieving the greatest agronomic and economic benefit.

OBJECTIVE 3
To determine if intercrops have less disease than monocrops, and effect of previous intercrops/sole crops on leaf/root diseases.