

Impact of forage grass and legume crops management practices on seed production of forage, barley, wheat and canola crops growing in forage legume based rotation in western, Canada in 2014

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Introduction

There is a potential to improve soil quality and crop seed production by including forage legume crops with wheat and canola in the forage legume based rotation. This management practice can provide a substantial amount of mineral N to the succeeding crops grown during the forage legume based rotation. This occurs when a forage legume crop is killed with chemical prior to major crop planting in the following spring, thereby increasing the yield potential with a minimum input of nitrogen fertilizer. The data generated from the developing system will be used to give clear answers for the economic, biological, improvement in seed production of the forage seed, wheat and canola crops in the region. It will also clarify operational farm questions about the soil productivity and quality that arise about the cropping rotation.

Developing cropping rotations in the cold region of Western Canada, that are more economically conducive to increase seed production for wheat and canola crops grown in forage legume based rotation, will help in understanding the benefit of the forage based rotation on soil fertility, crop seed production and on the environment quality. There is limited data available on the impact of including forage legume crop (for seed production) on the seed production of the subsequent wheat, canola or barley crop growing in rotation and on the changes in soil quality in forage legume based rotation in the cold agriculture soil of north Alberta. Therefore, field studies need to be initiated to evaluate the significance of forage legume based crop rotation to increase and sustain wheat and canola seed production and enhance soil quality.

Materials and methods

The experimental site was established on June 1, 2013 at the Agriculture and Agri-Food Canada research farm in Beaverlodge, Alberta. The experiment treatments were consist of 8 agricultural management practices in four replications in a randomized complete block design in 2013 and a split-plot design in 2014 to 2018. The main plots (8m x 10 plot size) are the crop phases and the split-plots are the N (0, 45 and 90 kg N ha⁻¹) rates. To the benefit of the forage legume based rotation on soil quality, seed production and the economic return of the cropping systems will be determined in 2014 to 2016 by comparing the high input treatments vs to the low input treatments.

The agricultural management practices treatments were:

1. Continuous canola (C-C-C-C) rotation. Check treatment with low input.
2. Creeping red fescue, the second check treatment with low input.
3. Inoculated Red clover (IncRC)- RC – Wheat – Canola (Inoc.AC-AC-W-C) rotation. High input treatment.
4. Inoculated Alsike clover (AC)- Alsike clover-Wheat-Canola (Inoc.AC-AC-W-C) . High input treatment
5. Non inoculated Red clover (RC)- Red clover -Wheat- Canola (RC-RC-W-C)
6. Non inoculated Alsike clover (AC)- Alsike clover -Wheat- Canola (AC-RC-W-C)
7. Pea-Barley-Wheat-Canola (P-B-W-C). High input treatment
8. Wheat-Canola-Wheat-Canola (W-C-W-C). The dominant rotation in western

The plots were seeded on 1 June, 2013 to forage legume (red clover and alsike clover), creeping red fescue, and annual crops (wheat, canola and field pea). Fertilizer rate was applied according to the soil test recommendation for P (12-51-0), K and S, but follow treatments for N. No N fertilizer (46-0-0) applied in 2013.

Data collection

1. Nitrogen release from legume and forage legume: at legume harvest, put above ground residue into 6 litter bags (30 cm x 30 cm) per main plot and place the bags on the soil surface. The bags will be sampled over the following 2014 to 2016 years, once each month from May to September every year.
2. Soil sampling (fall 2014): Sample soil were collected after the harvest from each subplot for nitrate-N, ammonium-N, P and pH at 0-15, 15-30 and 30-60 cm depth for organic matter, organic nitrogen and mineralizable nitrogen and C. Soil samples at 0-15cm depth from the sub plot prior to seeding for soil structure stability measurement.
3. Grain and straw plant sample at flowering and harvest for seed yield and total N measurements in seed and straw were collected in 2014

Results and discussion

2014 was the second crop phases of the four year forage based rotation studies to investigate the significant of forage legume based crop rotation to increase and sustain wheat and canola seed production and enhance soil quality. There were no significant differences between low input and high input N treatments in the seed production of the barley in P-B-W-C rotation (Figure 1). The barley seed yield (3826 lb acre⁻¹) in P-B-W-C rotation with minimum nitrogen fertilizer input treatment (0 N application) was similar to the seed yield (4158 lb acre⁻¹) of high N input treatment (80.4 lb N acre⁻¹). Wheat under seeded with alsike clover (Wheat/AC-AC-W-C) produced 177 lb acre⁻¹ seed higher than the wheat under seeded with red clover (Wheat/RC-RC-W-C) with a minimum nitrogen fertilizer input (0 nitrogen application) as indicated in Figure 2.

The field pea, alsike clover and red clover provided the required N for barley and wheat in the above mention rotations. The seed yield of canola in W-C-W-C rotation produced seed yield values were significantly higher than the seed yield of canola in C-C-C-C practices under low and high N input treatments. The seed yield of canola was higher by 495 lb acre⁻¹ in low N treatment and by 873 lb acre⁻¹ in high N input treatment in W-C-W-C rotation as compared to C-C-C-C rotation (Figure 3). The red clover and alsike clover seed crops were under drought stress in 2014, seed yields were reduced (Figure 4). Following the completion of trials in 2016 a decision will be made as to whether the soil productivity and quality can improve by using management practices that include major crop to be rotated with forages legume crop.

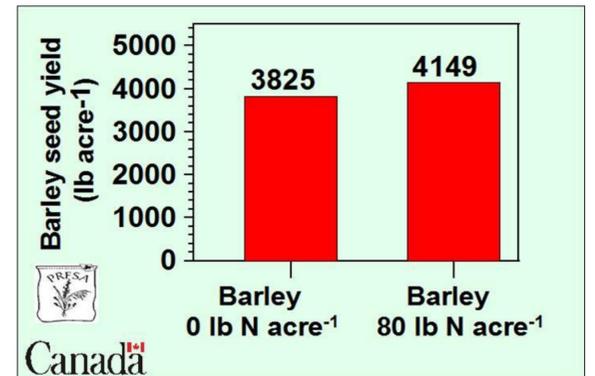


Figure 1. Barley seed yield in the in Pea-Barley-Wheat-Canola rotation with banded 0 and 90 lb acre⁻¹ nitrogen application in 2014.

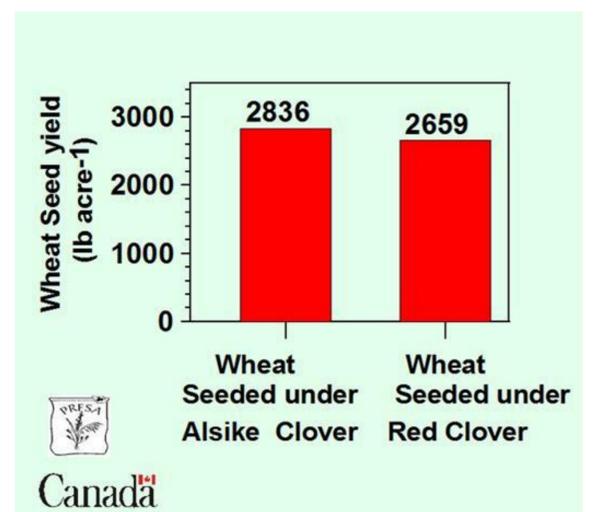


Figure 2. The seed yield in the of wheat under seeded with red clover or alsike clover in 2014.

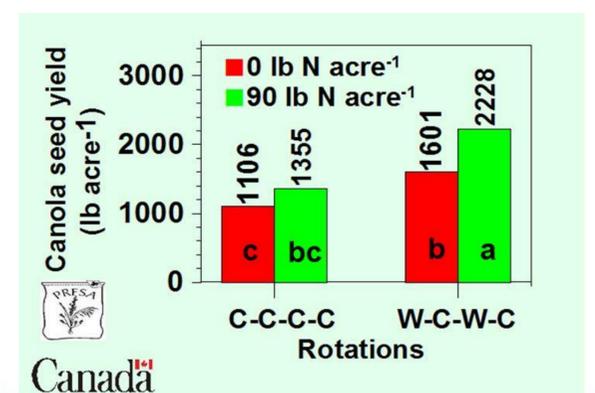


Figure 3. Canola seed yield in C-C-C-C and W-C-W-C rotations under banded 0 and 80 lb N acre⁻¹ nitrogen beside the seed in 2014.

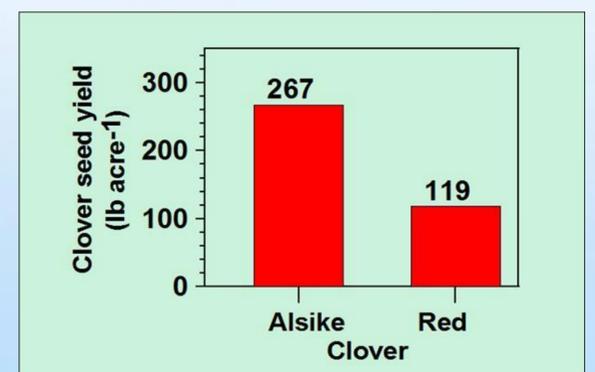


Figure 4. Alsike and Red clover seed yield within the forage based rotations in 2014.

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