

Agricultural Demonstration of Practices and Technologies (ADOPT)

FINAL REPORT

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UNDERSEEDING CLOVERS INTO FALL RYE IN THE SPRING

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Underseeding clovers into fall rye in the spring

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Introduction

The practice of using legume cover crops to extend the period of green cover, improve biodiversity, and fix atmospheric nitrogen is of interest to farmers in Western Canada, but the methods to accomplish these goals under the central Canadian prairie climate has not been established. There is a long potential period of growth following winter cereal harvest that could be used to produce nitrogen. However this August / September period can be very dry and topsoil moisture can be entirely lacking to establish a new cover crop. This demonstration attempted to establish annual clover species into winter wheat and fall rye in the spring following planting of that fall-seeded crop. It was hoped that the clover would survive and establish under the cereal and then produce biomass and nitrogen after the cereal crop had started to ripen.

The original proposal called for testing under fall rye, but we decided to test the same varieties under winter wheat as well. Winter wheat is less competitive, which could mean the clovers would compete excessively with the winter wheat. It could also mean that the clovers might establish better under the winter wheat than under fall rye.

Subterranean clover (*Trifolium subterraneum*) is commonly used in almond orchards as ground cover in California. Most cultivars require at least 12 inches of growing season precipitation. It has a prostrate, soil-hugging growth habit, which makes it suitable for erosion reduction. It dies in the summer after producing seed. This clover is also known to have some allelopathic activity in suppressing weeds.

Berseem clover (*Trifolium alexandrinum*) is a red-flowered annual clover also known as Egyptian clover. It is known a heavy N producer that won't survive the winter. It will flower in the year of planting. It is often used in combination with oat in the mid-west US as a cover crop following soybean and small grain harvest.

Crimson Clover (*Trifolium incarnatum*) is a summer annual in the northern Prairies but is a winter annual in southeastern US. It is not recommended in the northern US prairie states because of moisture limitation. It is commonly used in mixes with oats in cover crops for grain production and horticultural production. It is not tolerant to waterlogging, salinity or poor drainage. It is well-suited to interseeding into vegetative corn as a cover crop.

Persian clover (*Trifolium resupinatum*) is similar to Berseem clover but shorter. It is an annual with a prostrate or semi-erect habit. Persian clover is relatively tolerant of alkalinity, salinity, frost, and harsh rowing conditions. It has not been commonly used in cover crop mixes in the United States. It is typically lower yielding than crimson and berseem clovers under good moisture and soil conditions. It is considered more drought tolerant than Berseem clover. It grows wild at high elevations in Afghanistan.

Materials and Methods

Plots of winter wheat and fall rye were seeded in separate small trials. For each plot in this 5-treatment RCBD, two passes of the 4-row Fabro seeder were used with a resultant 12 ft by 8 ft plot. Only one plot was used for yield determination of the cereals. This trial was seeded on Nov 24 using Bono hybrid fall rye and Buteo winter wheat seed. Winter wheat was seeded at 102 lb/ac and Fall Rye was seeded at 86 lb/ac. Polymer-coated urea (ESN) was side-banded at seeding at 140 lb/ac. The winter wheat and fall rye established adequately with good conditions in October. Winter survival was excellent.

In the spring on May 9, clovers were seeded between the 12-inch rows of winter cereals. It was difficult to keep the seeder between the rows rather than tending to slide into the old seed rows. As a result, the clovers tended to be seeded quite close to the winter cereal, which likely reduced emergence. The plot seeder had no camera guidance. Clover was seeded at 20 seeds/m² based on seed size. The subterranean clover was a coated seed product, whereas the other clovers were not. They were treated with an appropriate rhizobial inoculant.

Clover plant were counted in two meter rows at the front and back of each plot. Clover plant heights were measured before harvest of the winter wheat and fall rye. Clover biomass was not taken because the plots had a lot of black medic that could not be readily distinguished from the clover and there was very little, patchy clover growth.

The winter wheat and fall rye were harvested on Aug 17, 207. The clover set a little seed and stopped growing.

CLOVER SPECIES	SEED RATE (LB/AC)	THOUSAND SEED WEIGHT (G)
SUBTERRANEAN	11.33	6.35 (coated seed)
PERSIAN	3	1.7
BERSEEM	6.1	3.25
CRIMSON	6.1	3.45

Results

There was no significant effect of clover on cereal yield. The underseeded clover was not expected to have a positive effect on the cereal yield under fertilized conditions. It also did not reduce yield of the cereal. Given the hot, dry summer conditions the clover underseeding was relatively unsuccessful. The subterranean clover had the best rate of plant establishment. The target seed rate was 215 seeds/m². Less than 10% of the seeds resulted in established plants in the winter wheat trial. The trials were not designed to compare establishment with rye or winter wheat, but it is surprising that that was more plant establishment in the fall rye than in the wheat. If there had been more than 5 inches of growing season precipitation, there likely would have been some regrowth in August in the clovers. Only the subterranean clover typically dies after setting seed, but the other clover types either died or never recovered from dormancy before freezing. There was a considerable amount of black medic in the trials which seemed to be better adapted to growing under the rye and winter wheat than the clovers.

Table 2. Cereal yield, clover plant establishment and height for fall rye trial.

FALL RYE TRIAL	CEREAL YIELD (BU/AC)	CLOVER PLANT /M2	CLOVER HEIGHT (CM)
BERSEEM CLOVER	76.3	14 BC	29 A
PERSIAN CLOVER	86.0	47 B	25 A
CRIMSON CLOVER	74.5	33 BC	22 A
SUBTERRANEAN CLOVER	71.6	99 A	4.9 B
UNSEEDDED	76.0	0 C	0 B
P<0.05	NS (0.08)	**	**
LSD	n/a	38	8.3

Table 3. Cereal yield, clover plant establishment and height for winter wheat trial.

WINTER WHEAT TRIAL	CEREAL YIELD (BU/AC)	CLOVER PLANT /M2	CLOVER HEIGHT (CM)
BERSEEM CLOVER	65.3	18.9 B	24.2 A
PERSIAN CLOVER	74.4	13.5 B	14.6 B
CRIMSON CLOVER	71.2	18.4 B	19.2 B
SUBTERRANEAN CLOVER	66.0	60.7 A	1.3 C
UNSEEDDED	69.4	0 C	0 C
P	NS (0.41)	**	**
LSD	n/a	37.4	4.8784

Langbank Field-Scale Demonstration

Photo: Immediate aftermath of seeding with a commercial-scale Seedmaster drill into established winter cereal on May 9.



There was a field-scale component of this trial located at Langbank. Fall rye and winter wheat was seeded in Sept 2016 at the Seedmaster farm using field-scale drill with 15 inch spacing. In the spring on May 9, the 100 ft drill was loaded with two mixes of clovers to each seed 40 ft strips. We had to mixed two types of clover because there wasn't enough clover seed to fill the canola seed boxes on the drill. There was a 20 ft section on the end that was left with no clover as a control. There were four replicates of each of the two clover mixes and they were seeded at 3.3 lb/ac. There was also a strip with Crimson clover alone at 3.5 lb/ac. Berseem clover was mixed with crimson clover, subterranean clover and Persian clover. This was seeded on both the winter wheat and fall rye for a total of 16 long strips. Each strip was hundreds of feet long. The tractor was equipped with autosteer so it could be guided to seed between the 15 inch rows of winter cereals, but it took some practice. There was a tendency for the drill to slide into the lower seed rows from the winter cereal seeding. This tendency could be corrected but took some operator skill, as there was no camera guidance on the system. Pictures and video of seeding clover with a 100-ft Seedmaster drill was posted on Twitter, which prompted some good discussion.

A video of the interseeding behind the 100 ft Seedmaster drill was posted on Twitter and got attention from Seedmaster and farmers. There was 300 media views of that video on Twitter.



The summer of 2017 was relatively hot and dry with only about 5 inches of growing season precipitation at Langbank. There was very good subsoil moisture for the winter wheat and fall rye to exploit, but very little of this was available to the clover. The clovers did not establish well at all at the Langbank site. The winter cereals (fall rye and winter wheat) were thick and vigorous. The areas where one could find clover tended to be where the spring seeding had damaged the winter cereal or where there was a larger gap between seed rows. There wasn't evidence that most of it had emerged by July 15. There was some topsoil moisture at the time of seeding in early May, but between the disturbance of the drill and moisture use by the winter cereal, it hurt the establishment of the clovers. After some pictures were taken of the few clover plants that did grow, this site was discontinued for data collection.

Photo: Langbank clover establishment was poor due to dry conditions.

Conclusions and Recommendations

The demonstration showed that it is difficult to adequately establish clover in winter cereals by seeding between the rows in the spring. The subterranean clover did establish better than Persian, Berseem or Crimson clovers under the difficult conditions of 2017. It may be possible to grow annual clovers for seed production by harvesting the winter cereal first and later harvesting the clover seed. In this demonstration, the clover did go to seed by September but the plants were very small and thin. If a lower seeding rate of winter cereals was seeded or wider row spacings were used, perhaps a double crop of clover seed could be harvested. This demonstration suffered from a dry summer.

Extension

The demonstration was visited on a tour on July 19, 2017 at the South East Research Farm. The demonstration was located a few miles south of the farm on Lamotte's land and was visited along with winter cereal variety trials and cereal agronomy trials. The Twitter video and pictures posted in May and July 2017 had good value in prompting discussion of seeding equipment considerations and types of clover used. It is important to show what didn't work for seeding cover crops as well as what does.

Abstract

Four species of clover were interseeded into established fall rye and winter wheat and compared with a non-interseeded control. The clover interseeding had no significant negative or positive effect on yield of the winter wheat and fall rye on a relatively dry growing season. The clover failed to adequately establish due to dry surface soil conditions following seeding and low growing-season rainfall. Some treatments had 90% seed or seedling mortality. Subterranean clover had higher plant establishment than crimson, Berseem or Persian clovers and seemed to be relatively tolerant of the difficult conditions. A video of field-scale interseeding of clover garnered considerable attention and discussion on Twitter.