

AIM Research Trial Report: **Effect of Legume Species on Potato Early Dying Complex**
Working Group: Soil Improvement
Crop Year: 2020
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Project Rationale:

There have been many questions from potato producers regarding how different species of forage legumes may differentially host *Verticillium dahliae* and root lesion nematodes, causal agents of potato early dying (PED) complex. Past research in PEI has indicated that red clover is a preferred host for both of these pathogens. However, there is little research on other forage legumes like alfalfa and white clover in comparison with grass species.

Project Overview:

In the spring of 2019, two fields in Western Prince Edward Island were planted with strips of the following forage species: double cut red clover (RC), alfalfa and timothy (ALF), white clover and festolium grass (WC), birdfoot trefoil (TRE), grass as a non-legume check. Festolium grass was planted at both sites, but did not establish well at the Wallace Properties site in Alma, so the comparison was done using Italian ryegrass which was planted in the same field directly next to the festolium strip.

Both fields were planted with the same grain drill on the same day in May 2019 using the same seeding rates. Each strip is four widths of the grain drill, except for the festolium strips that were 2 widths of the seeder. Each strip was also planted with barley at approximately 40 lbs per acres as a nurse crop.

Soil chemical, *Verticillium* and nematode testing was completed at planting in the spring of 2019. It was then completed again in the fall of 2019, spring of 2020, and fall of 2020. Samples were taken using dutch augers with multiple auger samples per strip, mixed and submitted as a composite sample for each treatment strip.

Both fields were planted to potatoes in 2018. Both fields will again be planted to potatoes in 2021. Yield and quality in the potato crop will be assessed in the fall of 2021.

Results:

For the Wallace Properties (WP) field, there was very little change in soil chemical characteristics across the four sampling periods. No trend in improvement in soil organic matter was noticeable. P and K levels were very high at trial establishment, though both P and K values were lower by across all treatments by the fall of 2020. No hay crops were removed from the field over two years, so these declines are interesting to note.

In the Dock Corner Farms (DCF) field, there is a bit more variability in soil characteristics. There appears to be a trend toward slightly higher organic matter in the festolium treatment strip than in the primarily legume strips. Phosphorus levels appear to be the lowest in 2020 in the alfalfa treatment strip (though still listed as High +). The red clover treatment was the only strip to not see a considerable decrease in potassium across 2020; however, this may be due to higher residue levels above ground. Soil chemical

analysis before planting potatoes in 2021 will likely provide a more accurate picture of the soil characteristics. There was a crop of hay removed from the DCF field in 2020.

Table 1: Biomass data from Wallace Properties and Dock Corner Farms fields in June 2020

Treatment	Fresh Weight Tonnes/acre	Dry Matter Tonnes/acre	Crude Protein % on DM basis	TDN % on DM basis
DCF – Trefoil	0.729	0.179	22.3	87.0
DCF – Grass	0.756	0.189	19.0	82.2
DCF – White Clover	0.768	0.203	24.4	91.6
DCF – Alfalfa	0.735	0.235	20.6	80.3
DCF – Red Clover	0.854	0.234	21.9	87.4
WP – Alfalfa	0.749	0.262	16.7	74.3
WP – Red Clover	0.813	0.198	20.6	81.2
WP – White Clover	0.806	0.233	21.1	87.3
WP – Grass	0.791	0.272	7.4	76.7

Both fresh weight and dry matter yields were not very different across all treatments and both fields. The lowest crude protein percentages in both fields were in the grass treatments. Among the legume treatments, the alfalfa treatments had the lowest protein and total digestible nutrient (TDN) levels, which may be due to the maturity of the alfalfa at the time of biomass sampling (past flowering).

Table 2: *Verticillium dahliae* populations by treatment at Dock Corner Farms (DCF) field across 2019 and 2020, expressed in cells per gram of soil.

Treatment	May 2019	October 2019	May 2020	October 2020
Red Clover	9395	9748	4271	6962
Alfalfa/Timothy		8593	3169	10866
White Clover/ Festolium		9311	8958	7195
Festolium		7244	5136	3500
Trefoil/Festolium		--	--	6837

In the DCF field, the birdsfoot trefoil did not establish well. It was not evident in 2019, with some volunteer clover and grass being most evident. Trefoil was more evident in 2020, with considerably more biomass in the treatment strip.

In the fall of 2019, there was negligible change in the populations of *V. dahliae*. In the spring of 2020, populations of *V. dahliae* decreased substantially from October 2019 in all treatments except the white clover/festolium (WC) treatment. By October 2020, *V. dahliae* populations had largely returned to levels similar to October 2019, except for the Festolium grass treatment, which at 3500 is now 63% lower than the starting population of the field. This tracks with festolium grass not being a host of *V. dahliae*.

Table 3: Root lesion nematode populations by treatment in Dock Corner Farms field across 2019 and 2020, expressed in nematodes per kg of soil.

Treatment	May 2019	October 2019	May 2020	October 2020
Red Clover	5855	10494	12669	23611
Alfalfa/Timothy		5816	1740	14399
White Clover/ Festolium		5816	1727	11735
Festolium		9614	3444	7637
Trefoil/Festolium		--	--	9730

In the fall of 2019, root lesion nematode (RLN) populations remained mostly unchanged for alfalfa/timothy (ALF) and white clover/festolium (WC) treatments; however, RLN numbers were notably higher for red clover (RC) and the festolium (GRASS) treatments. In the spring of 2020, RLN numbers for the ALF, WC and GRASS treatments substantially decreased from the fall, which numbers increased for the RC treatment. RLN numbers in October 2020 increased dramatically for all treatments, with RC still having the highest numbers at over 23,000 per kg of soil. However, all of the treatments have a population higher than the threshold value established by Kimpinski of AAFC using the same counting method of 5000/kg of soil.

Table 4: *Verticillium dahliae* populations by treatment at Wallace Properties (WP) field across 2019 and 2020, expressed in cells per gram of soil.

Treatment	May 2019	October 2019	May 2020	October 2020
Red Clover	7489	9405	5716	5727
Alfalfa/Timothy		9444	8444	8686
White Clover/ Festolium		6185	6176	5089
Italian Ryegrass		6582	10048	8738

For *V. dahliae* populations in the WP field, changes between sampling dates are not as large as in the DCF field. RC and ALF treatments appeared to have slightly higher *V. dahliae* levels in the fall of 2019 than the WC and GRASS treatments. In May 2020, the GRASS treatment rose the highest level after being second lowest in the preceding October. October 2020 levels were not largely different than levels in May for all treatments, with all being within the margin of error provided by the lab for these tests. After two full seasons of forages, none of the treatment strips were considerably different from the starting population of the field for *V. dahliae*.

Table 5: Root lesion nematode populations by treatment in Wallace Properties field across 2019 and 2020, expressed in nematodes per kg of soil.

Treatment	May 2019	October 2019	May 2020	October 2020
Red Clover	1742	19931	848	9661
Alfalfa/Timothy		2319	2257	2061
White Clover/ Festolium		5653	6296	6765
Italian Ryegrass		14568	5847	7820

The starting population of RLN was comparatively low (at 1742 per kg of soil). It may be that our sample did not reflect the true population of RLN. By the fall of 2019, RLN numbers for ALF increased only slightly, while populations increased more than 10 times for RC. The WC treatment had a more moderate increase, while the GRASS treatment was similar in increase to RC.

By the spring of 2020, populations of RLN decreased substantially for the RC and GRASS treatments while remaining quite steady for the ALF and WC treatments. In October 2020, ALF and WC treatment populations continued to remain very similar to the past two sampling dates. The population in the RC treatment again multiplied by a factor of 10, while the GRASS treatment population also increased more than 10-fold.

Summary:

While there are differences across the two fields and some slight changes in treatments due to differential establishment of the forage crops, these observations can be made from the first two years of soil testing data:

- *V. dahliae* populations did not change dramatically over time, regardless of the forage species grown. *V. dahliae* populations in October 2020 were highest for the alfalfa/timothy treatment in both fields, but due to margin of error in testing and in-field variability, it is difficult to say if there is a true difference in *Verticillium* between the legume species.
- For the field where festolium established well, it resulted in noticeably lower *V. dahliae* levels by October 2020. However, this trend was not replicated in the WP field where Italian ryegrass was the grass treatment.
- The red clover treatment strips provided the highest number of root lesion nematodes in both fields by October 2020, both well above threshold value for damage in the Russet Burbank variety.
- The response to alfalfa/timothy was significantly different between the two fields. In the WP field, RLN numbers were initially quite low before increasing substantially in the October 2020 sample. In the DCR field, RLN populations remained low at all sampling dates and had the lowest population in October 2020.
- RLN response to white clover appears to be intermediate between red clover and alfalfa.
- RLN response to grass (either festolium or ryegrass) was similar across both fields, also intermediate between red clover and possibly alfalfa.
- Birdsfoot trefoil proved difficult to establish through direct seeding, with only limited growth in one of the two fields.
- Festolium establishment was also substandard in both fields.

2021 project plans:

Before potato planting in 2021, both fields will again be sampled for soil chemistry, *Verticillium* and nematodes. Harvest samples (minimum 4 per strip) will be harvested in the fall of 2021 and graded for yield and quality.