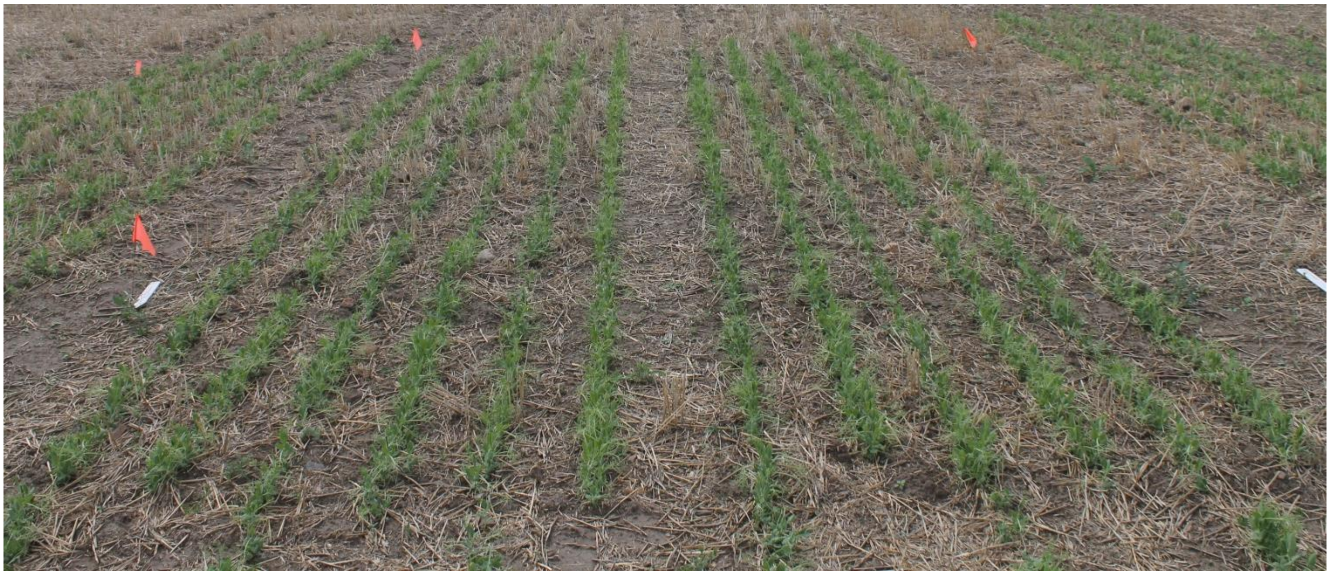
ADOPT #: 20170391(Scott)
ADOPT #: 20170392 (Melfort)

2018 Annual Report for the Agriculture Demonstration of Practices and Technologies (ADOPT) Program



Project Title: Production Management Strategies to Improve Field Pea Root Health

Project Number: Scott: 20170391; Melfort: 20170392

Producer Group Sponsoring the Project: Western Applied Research Corporation and Northeast Agriculture Research Foundation

Project Location(s):

- Scott Saskatchewan, R.M. #380 Legal land description: NE 17-39-20 W3
- Melfort Saskatchewan, R.M. #428 Legal land description: SE 30-44-18 W2

Project start and end dates (month & year): April 2018 and completed February 2019

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Objectives and Rationale

Project objectives:

The objective of this project was to demonstrate an effective management strategy to improve pea root health in aphanomyces contaminated soils.

Project Rationale:

Aphanomyces euteiches is an important disease of field pea which is caused by a complex of root pathogens. Cultural and chemical control options are available to reduce the impact of this disease, but none have been highly effective when used individually. Therefore, utilizing multiple control strategies to minimize the effects of Aphanomyces is the most effective way to improve pea root health. Furthermore, the study will closely follow a recent study, where the use of herbicides, nutrition, inoculants, and seed treatments were compared to low-yielding input management practices. Results of the study showed improved plant tolerance to Aphanomyces due to enhanced plant health earlier in the season, and in return increased yields. Overall, this demonstration will help producers identify which management strategies will result in the greatest increase in plant health and subsequent crop yield. Economic analysis will also aid producers in determining, which practice(s) can be the most productive and cost-effective.

There are several studies focusing on individual factors that influence the severity of aphanomyces on root health. Previous research by Teasdale et al. (1997) reported that an application of a dinitroaniline herbicide inhibited the production of motile zoospores, the infecting propagule of the pathogen. The study indicated that the inhibition of the pathogen motility resulted in a 2- week delay of the infection. This delay resulted in additional plant growth that allowed the peas to better withstand the effects of subsequent disease development.

These results coincide with a separate study by Thygesen et al. (2004) which found that advanced plant root growth combined with the presence of arbuscular mycorrhizal resulted in increased tolerance to pea root- rot disease. Furthermore, Bodker et al. (1998) indicated that arbuscular mycorrhizal fungus increased phosphorus uptake and the phosphorus concentration in the plant, which correlated to a reduction in disease development in peas. Furthermore, Dr. Syama Chatterton indicated that using a seed treatment that targets root rot complexes combined with a fungicide application may prove effective to improve the buffering capacity of peas to aphanomyces.

A more recent study was conducted at three sites in 2016 and 2017 to determine if a combination of herbicides applied PRE and POST with foliar applications and inoculants would reduce the effect of aphanomyces on pea root health. The results from this trial indicated that best management practices including proper inoculation, application of starter fertilizer, and seed treatment combined with foliar micronutrients to result in improved plant tolerance to aphanomyces. Consequentially, they reported a yield increase compared to treatments in which low- yielding management practices where utilized. The yield differences were attributed to overall enhanced plant health earlier in the season, allowing the plants to more effectively buffer the effects of aphanomyces on root growth (Saskatchewan Pulse Growers Agronomy Workshop Presentation, 2017).

Methodology and Results

Methodology:

The demonstration will be set up as a randomized complete block design (RCBD) with four replicates and three treatments at Scott, SK (Table A1) and Melfort, SK (Table A2) in 2018. The treatments compared different management strategies to limit the effect of aphanomyces on pea root growth and development. Soil samples for residual nutrients and aphanomyces spore levels were conducted at both locations in the spring.

Table 1: Demonstration treatment list of different management strategies

Treatments:

1. Conventional management strategy [a]
2. Enhanced management strategy [b]
3. Intensive management strategy [c]

[a] **Conventional:** PRE-seed glyphosate; starter fertilizer (N, P, K); liquid inoculant; no seed treatment; no fungicide application of phosphite salts

[b] **Enhanced:** PRE-seed glyphosate/ trifluralin; starter fertilizer (N, P, K); granular inoculant; seed treatment; fungicide of phosphite salts

- Seed treatment: Intego Solo + Apron

[c] **Intensive:** PRE-seed glyphosate/ trifluralin; starter fertilizer (N, P, K, S); granular inoculant; seed treatment; fungicide of phosphite salts; foliar nutrient application

At Scott, prior to seeding, soil samples were collected at three depth increments (0-15 cm, 15-30 cm, and 30-60 cm) in order to determine fertilizer rate recommendations (Table A1). The soil test recommendations were used to determine a fertilizer requirement based on a 40 bu ac^{-1} canola crop. Glyphosate and Aim were applied 3 to 5 days prior to seeding. CDC Arbarth, a yellow pea variety suitable for the location, was seeded using an R-tech drill with 10-inch row spacing on wheat stubble. Further details regarding treatment applications can be found in Table A1.

At Melfort, residual nutrient levels were used to base fertilizer recommendations for a 40 bu ac^{-1} pea crop (Table 1). There was 37 kg ha^{-1} of 46-0-0 side-banded along with 17 kg ha^{-1} of 11-52-0 seed-placed in the conventional and enhanced management treatments. In the intensive management treatment, 27 kg ha^{-1} of 46-0-0 was side-banded, along with 17 kg ha^{-1} of 11-52-0 seed-placed, and 23 kg ha^{-1} of 21-0-0-24 was broadcasted. There was no need for potassium containing fertilizers in any treatment. Further details regarding treatment applications can be found in Appendix A2.

Data Collection:

Plant densities were determined by counting numbers of emerged plants on 2 x 1-meter row lengths per plot approximately two weeks after crop emergence. NDVI ratings were taken using a hand held Greenseeker and were conducted at 4, 8 and 12 weeks after emergence. Yields were determined from cleaned harvested grain samples and corrected to the required moisture content. Seed protein was also collected as an additional seed quality indicator. The economic analysis was conducted by calculating the cost and subsequent return of each agronomic practice. The economic equation took into consideration the yield (bushel per acre) per treatment and price per bushel to determine gross income ($ per ac) minus the total cost [cost of seed ($ per bushel), seed treatment ($ per acre), inoculant ($ per acre), fertilizer ($ per acre), herbicide ($ per acre), phosphite salt fungicide ($ per acre), foliar nutrient ($ per acre) and equipment cost ($ per acre)] to determine net grain ($ per acre). Equipment costs include the cost of labor, fuel and all other associated costs. Weather data was collected and recorded from an on-site station provided by FarmersEdge®. Long-term weather data was collected from Environment Canada.

Growing Conditions:

In Scott, SK the 2018 growing season started out moderately dry in April with only 8.5 mm of precipitation. May, June, and August were far below the long-term average, while July and August were above. Overall, when looking at the accumulated amount of precipitation in 2018 from April to October, there was 12.2 mm less than the long-term total. Throughout the growing season, May and September 2018 were both 5°C colder than the long-term average while May and June were 2-3°C warmer. The temperature was very similar to the long-term average in July and August. Growing degree days were higher than the long-term average for the months of April – June, and lower for the remaining months (Table 3). Two destructive environmental events occurred during the growing season: a wind storm of 157 km hr^{-1} gust on June 9th and a hail storm on July 21st.

At Melfort, May and June were warmer than normal, while July was similar, and August through October was cooler (Table 4). Every month during the growing season, received less precipitation than normal, except September (Table 4). Yet, May through August was within 10 mm of the normal total precipitation received for those months. The harvest season began earlier than in previous years, however, periodic rain and snow in September resulted in harvest delays. Fortunately, this trial was combined before the harvest delay occurred. Overall, the growing season was near normal, albeit had 44.2 mm less rain on average.

Table 2. Mean monthly temperature, precipitation and growing degree day accumulated from April to October 2018 at Scott, SK

Year	April	May	June	July	August	Sept.	Oct.	Average
--*Temperature (°C)* --------------------------------------								
2018	-2.2	13.6	16.6	17.5	15.9	6.4	1.6	11.3
Long-term^{z}	3.8	10.8	14.8	17.3	16.3	11.2	3.8	12.4
Precipitation (mm)								
2018	8.5	35.6	58	85.8	20.2	57.3	8.2	265.4
Long-term^{z}	24.4	38.9	69.7	69.4	48.7	26.5	17	277.6
---*Growing Degree Days*----------------------------------								
2018	32.5	268	436.5	306.7	346.9	86.2	12	1476.8
Long-term^{z}	44	170.6	294.5	380.7	350.3	192.3	12.5	1432.4

^{z}Long-term average (1985 - 2014)

Table 3: Mean temperatures and precipitation collected from the Environment Canada Weather Station at Melfort, SK., for May to October 2018.

	May	June	July	August	September	October	Average/Total
--- Temperature (°C) ---							
2018	13.9	16.8	17.5	15.9	6.9	0.9	12.0
Long-Term^{x}	10.7	15.9	17.5	16.8	10.8	3.3	12.5
--- Precipitation (mm) ---							
2018	38.5	46.6	69.5	43.2	42.0	8.9	248.7
Long-Term^{x}	42.9	54.3	76.7	52.4	38.7	27.9	292.9

^{x}Long-Term Climate Normal from Melfort Environment Canada Weather Station (1981-2010)

Analysis

The data was statistically analyzed using the PROC MIXED in SAS 9.4. The residuals were tested for normality and equal variance to meet the assumptions of ANOVA. The means were separated using a Tukey's Honestly Significant Difference (HSD) test with level of significance at 0.05. Replications were treated as random effect factor whiles treatments were fixed-effect factors.

Results & Discussion

Plant Density

Plant counts consisted of 2 x 1-meter long rows per plot counted based on the number of pea seedlings found. Scott's plant counts took place on June 18th, Melfort's occurred on June 25th and there was no significant treatment effect on pea establishment at either location (p=0.9792 and p=0.4288, respectively). Overall, Scott's average plant density was slightly lower at 77 plants m^{-2} while Melfort had a plant density that was higher than anticipated and averaged 114 plants m^{-2}.

Disease Ratings

Disease incidence was rated prior to the first phosphite salt fungicide application, one week after the first phosphite salt fungicide application or 7 DAIA (days after initial application). This rating also served as a rating prior to the second application. The last rating was taken one week after the second application or 14 DAIA. Disease was rated for total disease (both root and leaf diseases) on a 0 – 10 scale.

At Melfort, disease was rated on July 14th, July 20th, July 27th and August 3rd. There was no disease symptoms recorded until August 3rd, when the last rating took place. As expected, due to minimal disease symptoms being recorded, there were no significant treatment effects on the ability to control disease (p = 0.2441).

At Scott, disease ratings were conducted on July 13th, July 20th and July 31st. There was significant treatment effects on July 13th (p=0.0048) between conventional and intensive management strategies (Figure 1). Disease ratings on July 20th and July 31st show no significant treatment effects (p=0.1151 and p=0.3256, respectively).

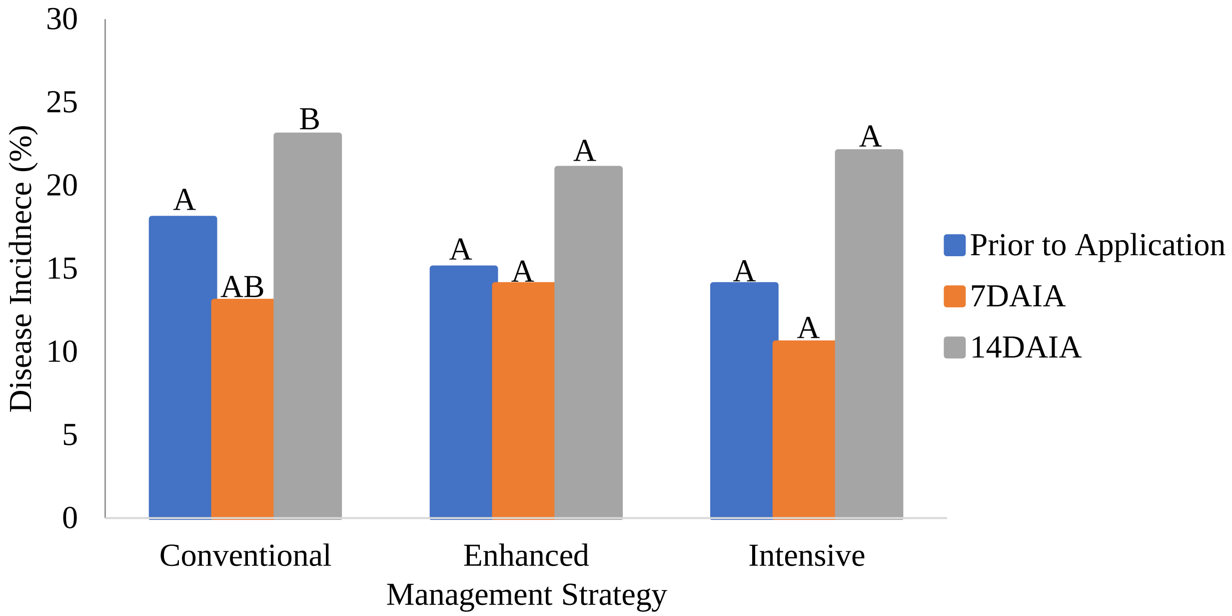

Figure 1: Overview of the three disease ratings from Scott, SK. Disease was rated for total disease of both root and leaf diseases on a 0 – 100 scale (Table A3). Significant treatment effects were seen prior to the first application (p=0.0048) between conventional and intensive management strategies. No treatment effects were seen at 7DAIA (days after initial application) and 14 DAIA (p=0.1151 and p=0.3256, respectively).

Vigor

Vigor ratings (NDVI), at both locations were taken at 4 weeks, 8 weeks, and 12 weeks after emergence. At Scott, NDVI was taken on July 3rd and July 31st, due to the maturity of the crop NDVI at 12 weeks was not taken. There was no significant treatment effects on NDVI ratings at 4 weeks (p=0.7766) and at 8 weeks (p=0.964) after emergence. In Melfort, SK, NDVI was taken on July 9th, August 7th, and Sept 4th. There were no significant treatment effects on NDVI ratings 4 weeks (p=0.9177) and 12 weeks (p=0.3554) after seeding, but there was at 8 weeks (p=0.0229). At this time, the conventional and intensive treatments had similar ratings at 0.72, while the enhanced treatments were significantly more at 0.74. Although there were some significant treatment differences found, due to only significance being found at a single timing, the significant effects have little agronomic importance.

Yield

Grain yields at both locations were assessed by cleaning and weighing the entire combined sample after drying to achieve equal moisture content. The cleaned weights were then calculated into kg ha^{-1} and bu ac^{-1} after correcting for 16% moisture content.

Although there were yield differences up to 9 bu ac^{-1} between the three management strategies at Scott, a significant difference was not detected. This is likely attributed the variation that occurred within the plots (Figure 2). With a seeding rate of 80 seeds m^{-2} average yields at Scott were 32.7 bu ac^{-1} (2197.4 kg ha^{-1}) for the conventional management strategy, 36.9 bu ac^{-1} (2475.1 kg ha-1) for the enhanced management strategy and 41 bu ac^{-1} (2752.0 bu ac^{-1}) for the intensive management strategy. Therefore a yield difference of 9 bu ac^{-1} was seen between the conventional and intensive strategies. This increase in yield could be accredited to the additional phosphite salt fungicide and nutrient applications as a decrease in disease was seen throughout the treatments in the plant foliage and roots. Overall, the average yield between the three management strategies was 36.8 bu ac^{-1} or 2474.8 kg ha^{-1}.

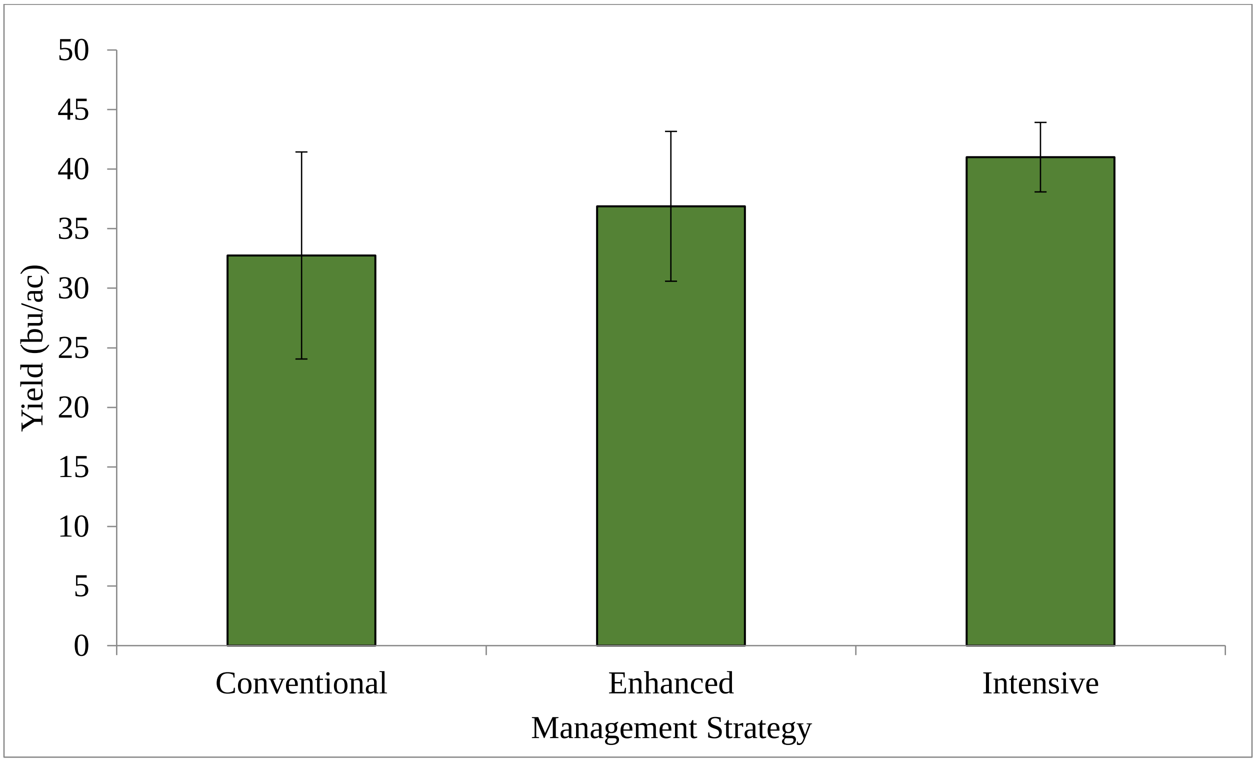

Figure 2: Average yield response to three different management strategies at Scott, SK in 2018

At Melfort, the treatments did not result in any significant yield differences (p=0.5597) and averaged 5942.4 kg ha^{-1} or 88.3 bu ac^{-1}. This effect was expected, as there was little disease present and differences in vigor detected. It is interesting to note, that despite the increase in inputs used in the management systems, there is still no significant difference in the treatments, despite little disease present (Figure 3).

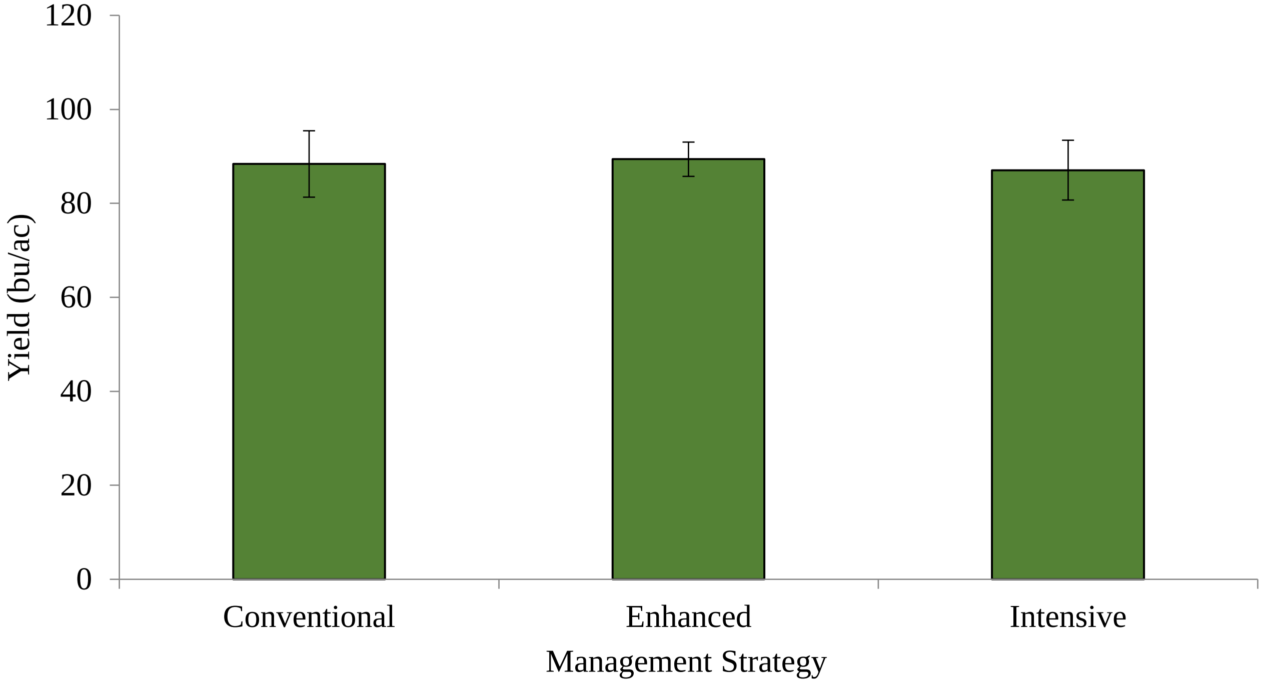

Figure 3: Average yield response to three different management strategies at Melfort, SK in 2018

Protein

At Scott, protein analysis was conducted on a cleaned subsample from each plot. There was no significant difference in proteins between the three different management strategies (p=0.1087) and protein content was 20%. At Melfort, a cleaned subsample from each plot was sent away for protein analysis. As expected, as yields were relatively similar, there was no significant difference in the protein content of the three treatments (p=0.63). Overall, average protein content was 22.6% which is similar to expected levels.

Economics

For both locations an economic analysis was done. The economic equation took into consideration the yield (bushel per acre) per treatment and price per bushel to determine gross income ($ per ac) minus the total cost [cost of seed ($ per bushel), seed treatment ($ per acre), inoculant ($ per acre), fertilizer ($ per acre), herbicide ($ per acre), phosphite salt fungicide ($ per acre), foliar nutrient ($ per acre) and equipment cost ($ per acre)] to determine net grain ($ per acre). Equipment costs include the cost of labor, fuel and all other associated costs.

Within the total cost expenses, the factors that do not differ throughout treatments are seed and fertilizer costs. The main factors within the total cost expenses that did influence net gain was seed treatment, herbicide, inoculant (liquid versus granular), phosphite salt fungicide, foliar nutrients, and equipment costs. Intego solo and Apron Maxx RTA was excluded in the conventional strategy as opposed to the enhanced and intensive management strategies. The addition of the seed treatment increased the enhanced and intensive total costs by $33.84/ac. Conventional management strategy used liquid inoculant priced at $3/ac as opposed to $13/ac of granular inoculant that was used in the enhanced and intensive management strategy (Figure 4). The addition of treflan and phostrol in the enhanced and intensive strategy increased the herbicide cost $9.07/ac and the fungicide cost $10.84/ac over the conventional strategy. The foliar nutrient addition of Rogue II increased intensive total costs by $11.65/ac over the conventional and enhanced. The extra costs associated with the enhanced and intensive treatments exceeded the yield gain, therefore, the net gain ($/ac) of the enhanced and intensive management strategies compared to the conventional is lower (Figure 4).

At Scott a seeding rate of 80 seeds m^{-2} average yields at Scott were 32.7 bu ac^{-1} (2197.4 kg ha^{-1}) for the conventional management strategy, 36.9 bu ac^{-1} (2475.1 kg ha-1) for the enhanced management strategy and 41 bu ac^{-1} (2752.0 bu ac^{-1}) for the intensive management strategy. With grain priced at $7/bushel, the net gain for the conventional strategy was $61.67/ac, the enhanced strategy was $18.36/bu and intensive strategy was $30.94/ac (Figure 4). In order for the enhanced strategy to be more profitable than conventional, enhanced yield would need to increase by 10.4 bu ac^{-1} for a net gain of $61.976/ac. While the intensive management strategy would need a yield increase of 4.4 bu ac^{-1} to be more profitable, at $61.74 ac^{-1}, than the conventional management.

	Conventional	***Enhanced***	***Intensive***
Yield (bu/ac)	32.7	36.9	41.0
Price ($/bu)	7	7	7
Gross Income ($/ac)	228.90	258.30	287.00
Seed ($/ac)	48.73	48.73	48.73
Seed Treatment ($/ac)	0	33.84	33.84
Fertilizer ($/ac)	22.5	22.5	22.5
Herbicide ($/ac)	28.28	37.35	37.35
Inoculants ($/ac)	3.00	13.00	13.00
Fungicides ($/ac)	0.00	10.84	10.84
Foliar Nutrients ($/ac)	0.00	0.00	11.65
Equipment ($/ac)	64.72	73.68	78.16
Total Cost ($/ac)	167.23	239.94	256.06
NET Gain ($/ac)	61.67	18.36	30.94

*Equipment costs includes labour, fuel, and all other associated costs

Figure 4: Economic analysis for Scott, Saskatchewan comparing the three management strategies

At Melfort, a higher plant density of 114 plants m^{-1} can account for one of the possible explanations of their higher overall yield. Conventional averaged the second highest yield at 88.6 bu ac^{-1} (5945.0 kg ha^{-1}) resulting in the most profitable net gain of $452.97 ac^{-1}. A net gain of $387.26 ac^{-1} occurred from 89.6 bu ac^{-1} (6015.0 kg ha^{-1}) yield from the enhanced management strategy. Lastly, the intensive management strategy resulted in a yield of 87.7 bu ac^{-1} (5885.0 kg ha^{-1}) and a net gain of $357.84 ac^{-1}. For enhanced or intensive to be as profitable as the conventional management strategy there yield would have to increase by 10.4 bu ac^{-1} and 12.7 bu ac^{-1}, respectively.

	Conventional	***Enhanced***	***Intensive***
Yield (bu/ac)	88.6	89.6	87.7
Price ($/bu)	7	7	7
Gross Income ($/ac)	620.20	627.20	613.90
Seed ($/ac)	48.73	48.73	48.73
Seed Treatment ($/ac)	0	33.84	33.84
Fertilizer ($/ac)	22.5	22.5	22.5
Herbicide ($/ac)	28.28	37.35	37.35
Inoculants ($/ac)	3.00	13.00	13.00
Fungicides ($/ac)	0.00	10.84	10.84
Foliar Nutrients ($/ac)	0.00	0.00	11.65
Equipment ($/ac)	64.72	73.68	78.16
Total Cost ($/ac)	167.23	239.94	256.06
NET Gain ($/ac)	452.97	387.26	357.84

*Equipment costs includes labour, fuel, and all other associated costs

Figure 5: Economic analysis for Melfort, Saskatchewan comparing the three management strategies

Conclusions and Recommendations

The objective of this project was to demonstrate an effective management strategy to improve pea root health in aphanomyces contaminated soils. The three management strategies that were utilized included conventional, enhanced, and intensive. The intensive management strategy included an application of phosphite salt fungicide and foliar nutrient application to result in a 9 bu ac^{-1} increase compared to the conventional management strategy. However, the additional costs of the phosphite salt fungicide and foliar nutrient resulted in a lower net gain when compared to the conventional strategy. The application of the phosphite salt fungicide and foliar nutrient did result in lower disease pressure on the plant foliage and roots**.** Overall, the increase of the yield does not pay for the additional cost of the extra applications. While there may not be an economical benefit, the increase in plant foliage and root health shows that the application of a phosphite salt fungicide and foliar nutrient may have environmental benefits. These benefits could possibly decrease aphanomyces spore levels, therefore creating good soil health for future years. For instance, C. Grau (1977) stated that trifluralin has been shown to effectively lower the production and motility of aphanomyces root rot spores. Similarly, Dr. Syama Chatterton indicated that using a seed treatment that targets root rot complexes combined with a fungicide application may prove effective to improve the buffering capacity of peas to aphanomyces. Therefore, there may be non-grossing benefits such as reduced spore load, resulting in a less severe infestation in future years and overall good soil health.

Despite the test site being tested positive for Aphanomyces, there was little disease symptoms present in Melfort, SK. This is likely due to the dry conditions throughout the study period, which in turn provided non-ideal conditions for Aphanomyces growth. With the little disease present, it was expected, that there would be minimal yield differences between the treatments attributed disease control but rather to differences in inputs. This was not the case, as all three management levels resulted in similar yields and protein levels. If the environment was more conducive to Aphanomyces development in the earlier parts of the growing season, we would have expected the treatments to result in large differences. Therefore, we recommend that this demonstration be tried again. This will allow us to see if results will remain the same under a potentially different climate.

Supporting Information

Acknowledgments

The Western Applied Research Corporation would like to thank the Ministry of Agriculture for the funding support on this project. We would like to acknowledge Herb Schell and our summer staff, Jaden Kapiniak and Jolene Gruber, for their technical assistance with project development and implementation for the 2018 growing season. This report will be distributed through WARC’s website and included in WARC’s and Agri-ARM annual reports.

Furthermore, the Northeast Agriculture Research Foundation would like to express our gratitude to the Saskatchewan Ministry of Agriculture’s ADOPT program for funding this demonstration and providing signage. We would also like to thank Western Applied Research Corporation for being the lead on this project and collaboration with us once again.

Appendices

Appendix A

Appendix A1. Agronomic and treatment application information during the growing season at Scott, 2018.

	Product	Rate	Date
Fertilizer	blend of 10-40-0-6	30 lb/ac seedplaced	May 23rd
Variety	Arbarth	80 plants/ m^2 + 30% M 285 lb/ ac	May 23rd
Seed Treatment	Intego Solo Apron Maxx RTA	19.6 mL/100kg seed 325 mL/100kg seed	May 23rd
Inoculant	Liquid and granular		May 23rd
Herbicide	Glyphosate RT 540	0.67 L/ac	May 23rd
	AIM	0.81 L/ac	May 23rd
	Treflan	3.34 kg/ha	May 23rd
	Viper ADV	400 mL/ac	June 21st
	UAN	0.81 L/ac	June 21st
Phosphite Salt	Phostrol Fungicide	2.9 L/ha	June 4th,18th
Foliar Nutrient	Rogue II	1 L/ac	June 21st
Fungicide	Priaxor	180 ml/ ac	July 9th
	Lance WDG	170g/ac	July 23rd
Harvest			September 6th

Table A2. Agronomic and treatment application information during the growing season at Melfort, 2018.

	Product	Rate	Date
Fertilizer	46-0-0 11-52-0 21-0-0-24	*as per Methodology mentioned about*	May 28th
Variety	Carver	80 plants/ m^2 (30% M, 94% germination, 232 g TKW)	May 28th
Seed Treatment	Intego Solo Apron Maxx RTA	19.6 mL/100kg seed 325 mL/100kg seed	May 28th
Inoculant	Cell-Tech pea (granular) Nodulator XL (liquid)	3.8 lb/ac 75 mL/ac	May 28th
Herbicide	Glyphosate RT 540 Trifluralin Viper ADV Assure II	510 mL/ac 930 mL/ac 400 mL/ac 300 mL/ac	May 23rd May 23rd June 19th June 25th
Phosphite Salt	Phostrol Fungicide	1.2 L/ac	June 13th,27th
Foliar Nutrient	Rogue II	1 L/ac	June 20th
Fungicide	Priaxor Lance WDG	180 ml/ ac 170g/ac	July 13th July 27th
Harvest			September 5th

Table A3. Disease Scale

Rating	**Percent disease damage to foliage and roots**
0	No Disease (0%)
1	1-10%
2	11-20%
3	21-30%
4	31-40%
5	41-50%
6	51-60%
7	61-70%
8	71-80%
9	81-90%
10	91-100%

Abstract

Abstract/Summary

Aphanomyces euteiches is an important disease of field pea which is caused by a complex of root pathogens. To determine the effects of three management strategies to reduce the effect of Aphanomyces on field pea health and overall yield a small plot field study was completed. Treatments varied by pre-seed herbicide applications, plant nutrition, phosphite salt fungicide, seed treatments and inoculants used.

Scott and Melfort Saskatchewan conducted this study on soil testing positive for Aphanomyces. Both locations had a drier year so a decrease overall of root and foliar disease symptoms present throughout the growing season was seen. Melfort resulted in a pea yield and quality that was relatively unaffected by treatments. It was expected that the increasing intensity of the management treatments would result in increased pea yields and quality, which was not the case. Scott saw a decrease in disease pressure when comparing intensive to conventional strategies in both the foliage and roots; this resulted in a 9 bu ac^{-1} increase from conventional to intensive management. Although, the increase in yield was not enough to account for the increase of costs from the phosphite salt fungicide and foliar nutrient application, this resulted in the conventional strategy having a higher overall net gain compared to intensive.

While there may not be an economical gain when additional applications are used, these treatments have further benefits. For instance, C. Grau (1977) stated that trifluralin has been shown to effectively lower the production and motility of aphanomyces root rot spores. Also, a recent study in 2016 and 2017 at three locations in Saskatchewan indicated that best management practices including inoculation, starter fertilizer, and seed treatment, combined with foliar micronutrients resulted in improved plant tolerance to aphanomyces (Saskatchewan Pulse Growers Agronomy Workshop Presentation, 2017). Similarly, Dr. Syama Chatterton indicated that using a seed treatment that targets root rot complexes combined with a fungicide application may prove effective to improve the buffering capacity of peas to aphanomyces. Therefore, there may be non-grossing benefits such as the spore load being reduced, resulting in a less severe infestation in future years and overall good soil health.

Extension Activities:

This project was featured in the Scott Field Day pamphlet and posters that were distributed throughout the surrounding Wilkie, Landis, and Unity areas. Signs stating the objective of this demonstration with acknowledgment of the ADOPT program and the Saskatchewan Ministry of Agriculture were posted in front of the plots. A fact sheet will be generated and distributed on the WARC website as well as all Agri-ARM and WARC events to ensure the information will be transferred to producers.

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