A Disease Prediction System for Ascochyta of Field Pea

Year 3 Summary and Three Year Summary

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Thank you to the cooperators for providing their time and resources towards this project.

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FIELD PROOFING A DISEASE PREDICTION SYSTEM FOR ASCOCHYTA IN FIELD PEA IN ALBERTA

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Abstract

Ascochyta blight is a fungal disease that, under favorable disease development conditions, can severely reduce field pea yields and seed quality, and cause crop lodging. In 2005, 2006, and 2007 field trials were conducted at 5 sites in north central Alberta to evaluate a disease prediction system and pea yield response, thousand kernel weight, and level of ascochyta infection of seeds when Headline® was applied to control ascochyta blight. Each plot had dimensions of approximately 200 ft by 80-100 ft, depending on the size of the sprayer used. Field selection was based on: high plant populations with a minimum of 75 plants/m2, good weed control, even crop emergence, and high rhizobium nodulation. Starting at the end of June, an ascochyta prediction system was used to predict the level of ascochyta risk. The prediction system assessed: canopy density, canopy humidity, presence of disease, and the short-term (5 day) weather forecast. At each location, the four criteria were assessed (non destructive plant evaluations) biweekly and the total scores influenced when the plots should receive Headline fungicide. In 2005 and 2006 all 10 locations reached the minimum 65 prediction score. In 2007, 4 of the five locations reached the minimum 65 prediction score. In Addition, the 2007 site at Linaria was lost due to hail damage. In 2005, final yields revealed a significant yield increase from Headline application at all 5 locations with a range yield increase of 14-35%. In 2006, 3 out of 5 showed a significant yield increase with a range yield increase of 14-35%. In 2007, 3 out of 4 sites showed a significant yield increase of 5-19%. The average yield increase from Headline application in 2005 was 26%, in 2006, 15.5% and 2007, 12.4%. Over three years a significant yield increase occurred at 12 out of 14 locations with an average yield increase of 18%. Significant differences in thousand kernel weight occurred at 3 out of 5 sites in 2005, 4 out of 5 sites in 2006 and 2 out of 4 sites in 2007. Seed samples were also sent to 20/20 Seed Labs to detect the level of Ascochyta infection. There was a slightly higher Ascochyta infection level in the seed samples that were not treated with Headline. The results showed that Headline was successful in reducing yield losses due to Ascochyta blight and that the Ascochyta prediction system proved to be helpful in predicting the onset of disease.

Background

In Alberta, ascochyta blight, also known as mycosphaerella blight, has become the number one field pea disease and is one of the major limiting factors to field pea production. This complex consists of 3 different fungi species: A. pisi Lib (leaf and pod spot), P. pinodella (foot rot), and M. pinodes (seedling blight). This seed and stubble born disease proliferates under moist, humid conditions and symptoms include black or purple spots on the leaves, stems, and pods and increased crop lodging. No known genetic or varietal resistance has been found to solve this complex. Proper use of fungicides is the only practice that can control this disease, which occurs in all areas receiving good moisture from July through August.

Many areas in Alberta have the potential to consistently produce higher yielding pea crops due to ample rainfall during the growing season in most years. This also nearly guarantees ascochyta appearance at full flower to pod filling. The effects of this disease are seen through reduced yields, premature lodging, and in some cases, reduced seed quality and germination. Flattened crops are difficult to harvest and will deteriorate with further rainfall, resulting in further yield losses. In Western Canada, average yield losses are estimated to be 10% but losses of up to 80% have been reported (Park and Lopetinsky, 1999).

Headline by BASF was the fungicide used in this project to determine the effectiveness of fungicide application based on an ascochyta scoring system. Headline works systemically within the leaf and has superior rainfastness. Fungicide must be applied early to protect the crop because it will not kill the disease. Producers should consider applying fungicide if the crop canopy is dense and wet, rain is in the forecast, and a yield increase is expected that will pay for the fungicide application (Pearse, Saskatchewan Agriculture, Food and Rural Revitalization). Timing is crucial in deciding when and if fungicide application is needed. If fungicide application is deemed necessary, it is important that spraying occurs prior to the closing of the canopy so that the lower stems and leaves receive treatment. Damage that has already occurred from disease cannot be repaired by fungicide, but if disease pressure continues, applying fungicide will prevent further damage. More than one application may be needed if disease persists and can be applied 10-14 days after the previous treatment. However, it is not economically feasible for field pea producers in Alberta to apply fungicide more than once to their crops. The use of a disease prediction system could make the need for fungicide application decision easier to make.

Project Objectives

- To field proof an effective and easy to use ascochyta prediction system that aids producers in determining the ascochyta disease risk in their fields.
- To document ascochyta disease effects on yield, seed size and seed ascochyta infection levels.

Climatic Information

Precipitation and climate patterns were monitored in this project because moisture is a key factor in the spread of ascochyta blight.

	Meteorological Site
Month	**Barrhead**
May rainfall	28.5
June rainfall	33.5
July rainfall	76
August rainfall	7
Total rainfall	145

Figure 1: Summary of monthly rain averages from May to August 2007

Research Sites

All research sites were provided by private cooperators and were located in the Barrhead/Westlock districts. Fields were selected in early June 2007 based on beneficial management practices including: uniform plant stands, proper plant populations, excellent nodulation, and proper weed control.

Cooperators:

- Clifford and Greg Cyre (Barrhead)
- Nick Jonk (Westlock)
- Richard Krikke (Linaria)
- Richard and Rick Mueller (Manola)
- Jerold VanAssen (Neerlandia)

Each plot layout consisted of a randomized complete block with 4 replicates for each of the sprayed and not sprayed treatments. The plots were approximately 200 ft in length and 80-100 ft in width depending on the size of the sprayer used. Below in Figure 2 is the plot plan for the 2007 trial year.

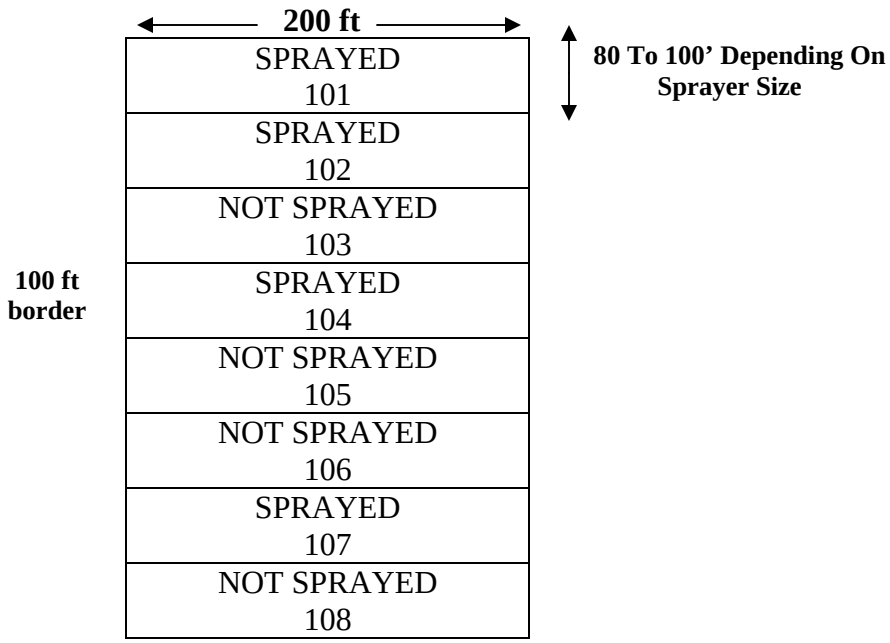

Figure 2: Ascochyta trial plot plan for 2007

Data Collection and Analysis

Emergence

Emergence counts were done in early spring. Emergence was measured by counting the number of plants present in 0.5 m^2. Four counts were taken at each plot and then averaged to obtain one number. Emergence counts were converted from plants per 0.5 m^2 to plants per 1 m^2.

Nodulation

In early June, plants were removed from the soil to determine the number of nitrogen fixing nodules. At each site, 4 plants per plot were assessed for nodulation and all sites showed high nodulation. Nodules showing a pink color indicated nitrogen fixation.

Ascochyta Scoring (Ascochyta Prediction System*)*

In 2003, Ken Lopetinsky, Pulse Research Agronomist with Alberta Agriculture, Food and Rural Development and Sheri Strydhorst, PhD student at the University of Alberta, developed a modified ascochyta prediction system that helps in determining if fungicide application is needed to prevent severe losses. This system was updated in 2006. The

research plots were scored at 4 locations within the plot area for the level of ascochyta infection starting at the end of June and continued on a biweekly basis until the total prediction score reached or exceeded 65. The cooperators completed the scouting at the edges of the plot in a non-destructive manner to the plants and returned to the same area of the plot for each visit. To determine the total prediction score, 4 characteristic scores were taken at the same locations within the plot, which were then averaged to obtain one value. The characteristic scores (1, 2, 3, and 4) were then summed at each visit to obtain the final prediction score. If the prediction score was less than 65, no fungicide application was deemed necessary but field inspections were continued on a biweekly basis. If the prediction was 65 or greater and disease was present, the fungicide spray application was recommended. Please refer to Appendix A for the ascochyta prediction system.

Yield

Replicates of each treatment at every site were harvested in August. The area harvested depended on the size of the combine or swather header, which ranged from 22-25 ft. The harvested sample from each plot was weighed in an electronic weigh wagon and a small sub sample was then kept for seed quality analysis. Yield was recorded in pounds per plot and then converted to kilograms per hectare.

Thousand Kernel Weight

Thousand kernel weight was calculated for each treatment to determine the seed size. From each subplot, a sample of 100 seeds was weighed and then multiplied by 10 to determine the thousand kernel weight.

Seed Quality Analysis

Seed sub samples were sent to 20/20 Seed Labs in Nisku, AB to determine the percentage of seed infected with ascochyta. This is a standard test that is offered to pea producers.

Statistical Analysis

Statistical analysis of the yield and thousand kernel weight data, along with the percentage of seed infected with ascochyta, was completed by using the ANOVA statistical program of APL Stats, 1987. The Least Significant Difference (L.S.D.) $P \leq 0.05$, was calculated to determine significant differences between treatments and the Coefficient of Variance (C.V.%) was calculated to determine the level of precision of the experimental technique. A small value for the coefficient of variance signifies high precision between replicates.

Application of Fungicide

All designated subplots were sprayed with Headline by BASF, a foliar fungicide. The time of spraying was based on field scouting observations and on the scores obtained twice a week from the ascochyta prediction system. Once the final prediction score reached or exceeded 65, spraying the fungicide commenced. The plots were sprayed by a custom sprayer at the recommended rate, with a minimum of 20 gallons of water per acre. Custom spraying was required because of the need for a high clearance sprayer that would not damage the crop canopy.

Results

Data collection began with emergence counts. All five cooperator sites showed high emergence, as plant populations exceeded the recommended 75 plants per meter square. All sites had high rhizobium nodulation with good coloration. Sites ranged from good to excellent nodulation with small to large clumps of nodules on the main root. The emergence counts for all sites are shown below in Figure 3.

	Location				
	Barrhead	Westlock	Linaria	Manola	Neerlandia
	Average of 4 Counts				
Emergence (plants/m2)	87	91	83	91	85
Cultivar	Cooper	SW Courosel	Canstar	Canstar	Cooper

Figure 3: Emergence counts at all sites in plants per m^2.

Ascochyta scoring began at the end of June. Determined by the Ascochyta scoring system (Appendix A), four out of five sites reached an estimated risk value of 65.

	Location				
Prediction Score	Barrhead	Westlock	Linaria	Manola	Neerlandia
First Visit	55	50	48.6	50	30
Second Visit	60		49.9	80	45
Third Visit	70		62		65
Fourth Visit	90				

Figure 4: Summary of the prediction scores obtained from the ascochyta prediction system at each site.

The results and statistical summary of the yields are presented in Figures 5, 6, and 7.

	Location *(Yield Average of 4 Replicates)*			
Treatment	Barrhead	Westlock	Manola	Neerlandia
Sprayed with Headline (kg/ha)	6209a	5300a	4617a	5379a
Not Sprayed with Headline (kg/ha)	5571b	5052a	4047b	4508b
Difference kg/ha	638	248	570	871
Difference bu/ac	9.5	3.8	8.5	12.9
Percent Yield Increase	11.4	4.9	14.1	19.3
L.S.D	432	606	238	394
C.V.	2.3	3.7	1.7	2.5

Figure 5: Yields in kg/ha for Headline fungicide treatments and no fungicide treatments.
Note: a, b… within columns, values followed by the same letter are not significantly different.

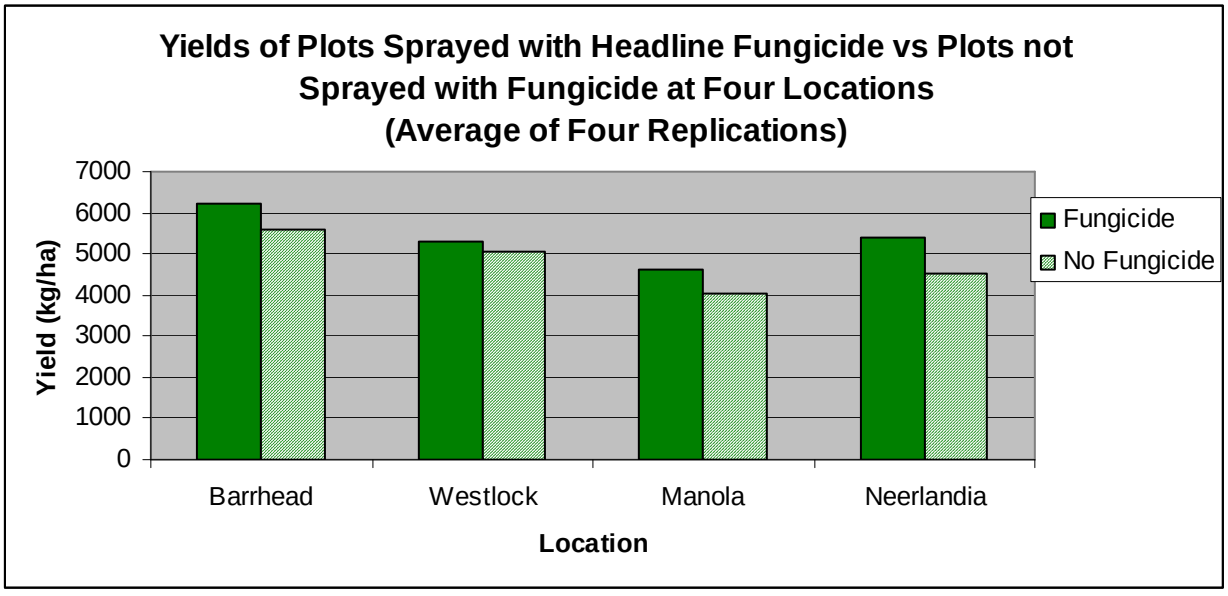

Figure 6: Field pea yield comparison in kg/ha over 4 locations between Headline fungicide treatments and no fungicide treatments in 2007.

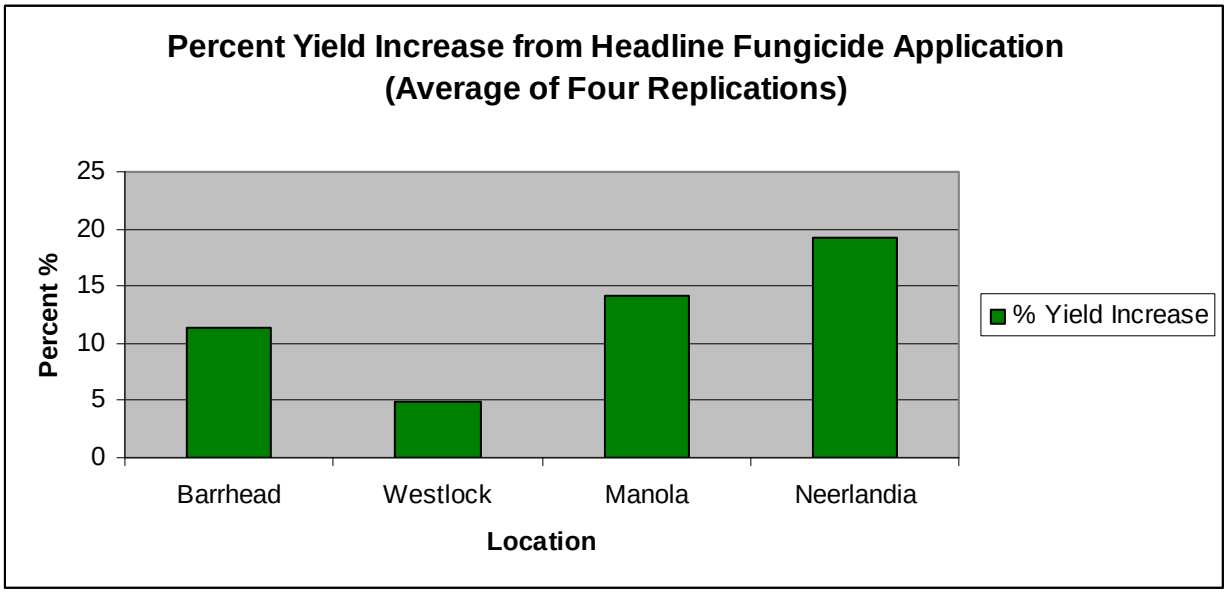

Figure 7: Percent yield increase associated with Headline fungicide application over four sites in 2007.

The average thousand kernel weight in grams for both treatments at each site is summarized below in Figure 8 and a graphical depiction of the results are presented in Figure 9.

	Location *(1000 K. Wt. Average of 4 Replicates)*			
Treatment	Barrhead	Westlock	Manola	Neerlandia
Sprayed with Headline	359a	264a	249a	336a
Not Sprayed with Headline	352a	254a	232b	311b
Average	356	259	241	324
L.S.D	22	16	12	25
C.V.	2.0	2.0	1.6	2.4

Figure 8: Average thousand kernel weight for both treatments at four sites.
Note: a, b… within columns, values followed by the same letter are not significantly different.

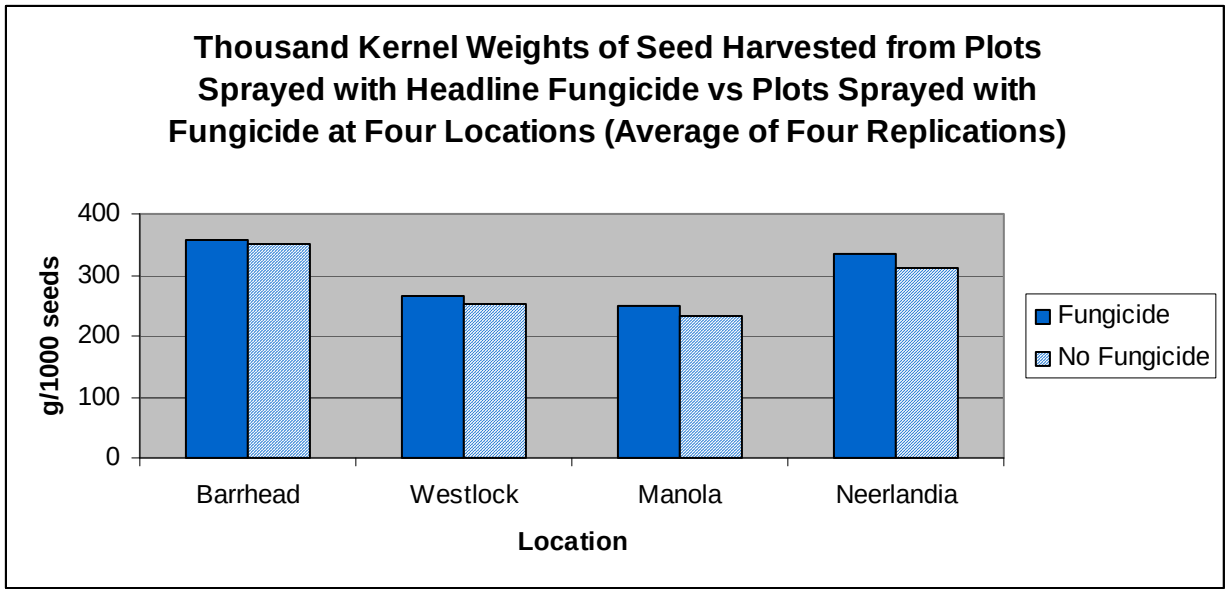

Figure 9: A graphical comparison of the thousand kernel weights obtained from plots treated with Headline and untreated plots over four locations in 2007.

The results are presented in percentages of seed infected with ascochyta below in Figures 10 and 11.

	Location *(Average of 4 Replicates)*			
Treatment	Barrhead	Westlock	Manola	Neerlandia
Sprayed with Headline	1a	0.4a	2.5a	0.4a
Not Sprayed with Headline	2.5a	2a	2a	1.6a
Average	1.8	1.2	2.3	1
L.S.D	3	6	2	4
C.V.	49.5	163.9	67.7	55.9

Figure 10: Summary of the percentage of seed infected with ascochyta between plots treated with Headline and untreated plots over four locations.

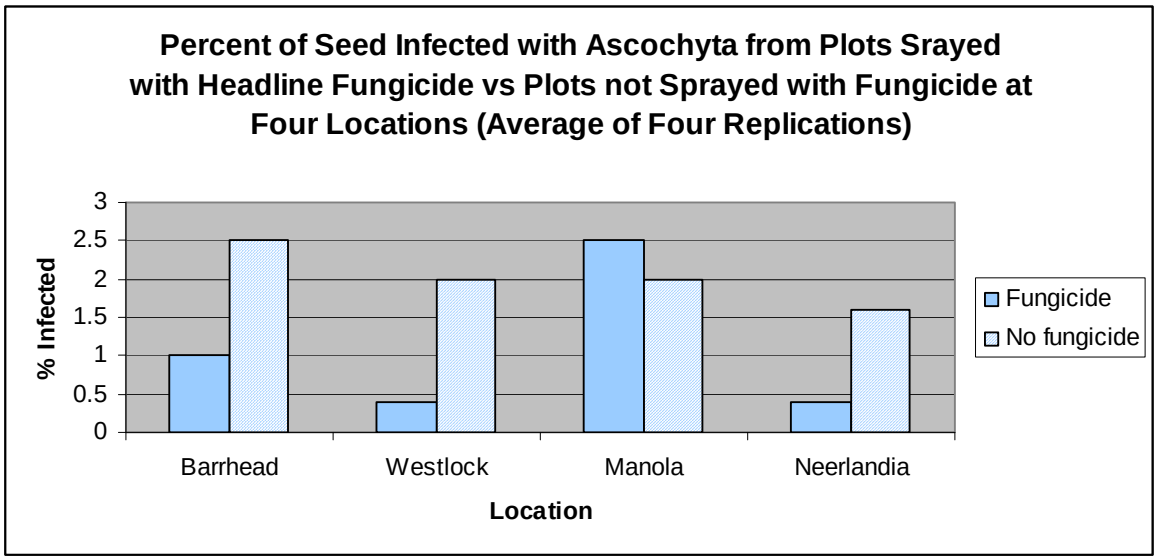

Figure 11: A graphical comparison of the percentage of seed infected with ascochyta between treated and untreated plots over four locations in 2007.

References

Bretag, T.W., P.J. Keane, and T.V. Price. 2006. The epidemiology and control of ascochyta blight in field peas: a review. Australian Journal of Agriculture Research. 57:883-902.

Lopetinsky, K., Blade, S., Hwang, S.F., and Ozipko, G. 2001. Field evaluation of ascochyta blight control with Bravo 500® on field pea in northwest Alberta. Project # 99-NW-03.

Park, B and K. Lopetinsky. Eds. 1999. Agdex 142/20-1. Pulse Crops in Alberta. Alberta Agriculture, Food and Rural Development. Edmonton, AB. p37-88.

Pearse, P. Provincial Plant Disease Specialist, SAF. Mycosphaerella Blight in Field Pea.

\2007 Producer Evaluation

1.Was the prediction system score sheet easy to use and was it effective at determining if fungicide application was needed?

Comments:

Yes, will use the score cards in the following years.
Yes, if the score sheet is followed it will give you the timing for spraying.
Yes, I wonder about the difference between 15 points for a moderate canopy and 30 points for a heavy canopy. That is almost half the points needed to spray.

2. Comment on the overall spraying time based on the score sheet and the date of actual spraying. Was it too early, on time, or too late?

Comments:

I felt that I sprayed a little early, but there was rain in the forecast so we sprayed. The results were very good, so early is probably better.
I think that it looked good. We got hail on August 5, so it was hard to assess.
Peas were sprayed on time July 14th according to score sheet.
Just right – if you get a sprayer.

3.Was the 2007 Ascochyta project of help to you?

Comments:

Yes, I am learning to time applications and score disease, as well as see advantages of spraying.
Yes, peas appeared better where we sprayed.
Yes, there was a yield increase, good standability and clean of disease.
Yes, I feel in the future the worst case scenario is I will get my money back when I spray.

4. General comments about the project?

Comments:

Valuable study to prove the advantages of spraying headline to stop yield losses due to ascochyta.
The score sheet is easy to use

Appendix A: Ascochyta Scoring System

June 2006

Field ID _____

Source: K. J. Lopetinsky[1] and S Strydhorst[2] 2002
[1]Ag Research Division, AAFRD, Barrhead [2]University of Alberta, Edmonton, Alberta, Canada

Time Period

Characteristic	Estimation Risk Scale				Prediction Score 1	2	3	4	5	6
1. Crop canopy	Thin 0	Moderate 10	Mod/Heavy 15	Heavy 30						
2. Leaf wetness/humidity/ dew at noon	None 0	Low 10	Moderate 20	High 40						
3. Percent of plants (crop), showing symptoms	None 0	Low (<20%) 15	Moderate (20-50%) 25	High (50-100%) 40						
4. 5 day weather forecast	Dry 0	Unset 10	Showers 15	Wet 20						
TOTAL										

The estimated risk value is 1+2+3+4= estimated risk value. If the estimated risk value is less than 65, no fungicide application is deemed necessary, but field inspections should continue on a bi-weekly basis. If the estimated risk value is +65, the fungicide spray application is recommended.

Pea Ascochyta Prediction System Project - Three Year Summary

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Table 1: Yields in 2005, 2006, and 2007 for Headline fungicide treatments and no fungicide treatments.
Note: a, b… within columns, values followed by the same letter are not significantly different.

Yield														
	Location													
	2005					2006					2007			
Treatment	Barrhead	Manola	Shoal Creek	Sunniebend	Westlock	Linaria	Dapp	Vega	Manola	Neerlandia	Barrhead	Wesltock	Manola	Neerlandia
Sprayed (kg/ha)	5957a	5032a	5532a	6306a	5840a	5671a	5206a	5116a	4425a	6049a	6209a	5300a	4617a	5379a
Not Sprayed (kg/ha)	5138b	4410b	4133b	4653b	4405b	4534b	4727b	4891a	3811a	4975b	5571b	5052a	4042b	4508b
Difference (kg/ha)	819	622	622	1399	1435	1137	479	225	614	1074	638	248	570	871
Difference Bu/ac	12.2	9.2	9.2	20.8	21.3	16.9	7.1	3.3	9.1	16.0	9.5	3.8	8.5	12.9
Percent Yield Increase	15.9	14.1	14.1	33.8	32.6	25.1	10.1	4.6	16.1	21.6	11.4	4.9	14.1	19.3
L.S.D	607.6	746.6	746.6	871.1	368.1	1001.7	126.7	567.2	663	301	432	606	238	394
C.V.	3.4	5.0	5.0	8.7	2.3	6.2	0.9	3.6	5.1	1.7	2.3	3.7	1.7	2.5

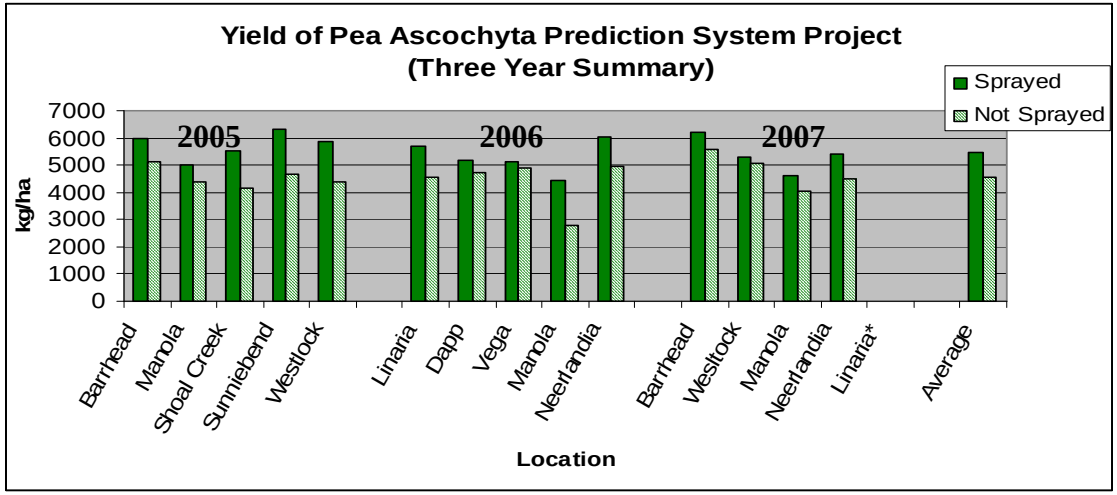

Figure 1: Field pea yield comparison in kg/ha for 15 locations over three years between Headline fungicide treatments and no fungicide treatments.
***Site lost due to hail**

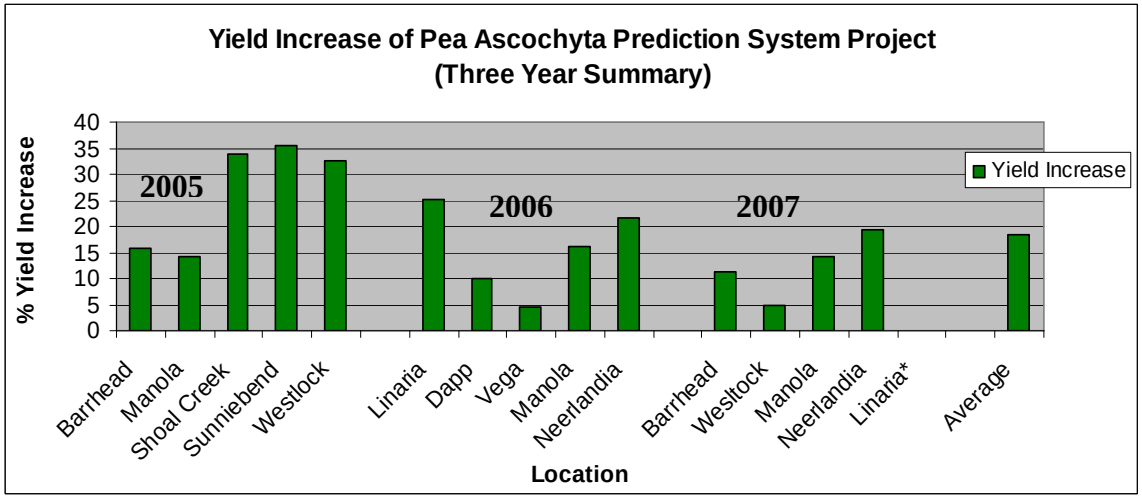

Figure 2: Field pea percent yield increase comparison in kg/ha for 15 locations over three years between Headline fungicide treatments and no fungicide treatments.
***Site lost due to hail**

Table 2: Thousand kernel weights in 2005, 2006, and 2007 for Headline fungicide treatments and no fungicide treatments.
Note: a, b… within columns, values followed by the same letter are not significantly different.

Thousand Kernel Weight														
	Location													
	2005					2006					2007			
Treatment	Barrhead	Manola	Shoal Creek	Sunniebend	Westlock	Linaria	Dapp	Vega	Manola	Neerlandia	Barrhead	Wesltock	Manola	Neerlandia
Sprayed (kg/ha)	281a	302a	280a	280a	270a	276a	302a	278a	264a	264a	359a	264a	249a	336a
Not Sprayed (kg/ha)	279a	296a	239b	243b	233b	245b	284b	259b	260a	234b	352a	254a	232b	311b
Average	280	299	259	261	251	261	293	269	262	249	356	259	241	324
L.S.D	42.4	20.2	18.9	7.7	14.9	21.6	14.9	15.6	10.0	26.3	22	16	12	25
C.V.	4.8	2.1	2.3	0.9	1.9	2.6	1.6	1.9	1.2	3.3	2.0	2.0	1.6	2.4

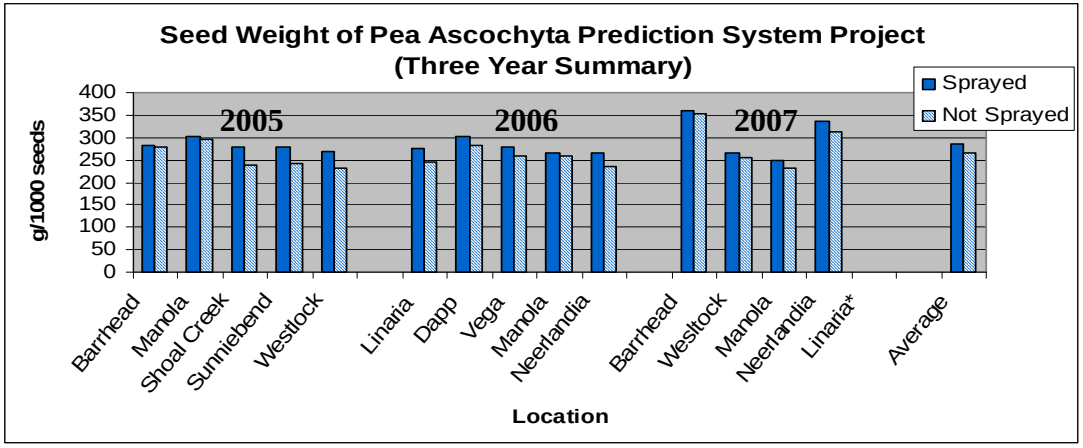

Figure 3: Field pea seed weight comparison in g/1000 seeds for 15 locations over three years between Headline fungicide treatments and no fungicide treatments.
***Site lost due to hail**

Table 3: Percent of seed infected in 2005, 2006, and 2007 for Headline fungicide treatments and no fungicide treatments.

Percent of Seed Infected														
	Location													
	2005					2006					2007			
Treatment	Barrhead	Manola	Shoal Creek	Sunniebend	Westlock	Linaria	Dapp	Vega	Manola	Neerlandia	Barrhead	Wesltock	Manola	Neerlandia
Sprayed (kg/ha)	5.4	1.3	5.8	9.0	2.0	9.0	1.6	0.3	0.48	1.6	1.0	0.4	2.5	0.4
Not Sprayed (kg/ha)	7.9	5.3	13.3	18.5	3.9	12.1	4.3	2.3	1.4	4.3	2.5	2.0	2.0	1.6
Average	6.6	3.3	9.5	13.8	2.9	10.6	2.9	1.3	0.93	2.9	1.8	1.2	2.3	1.0

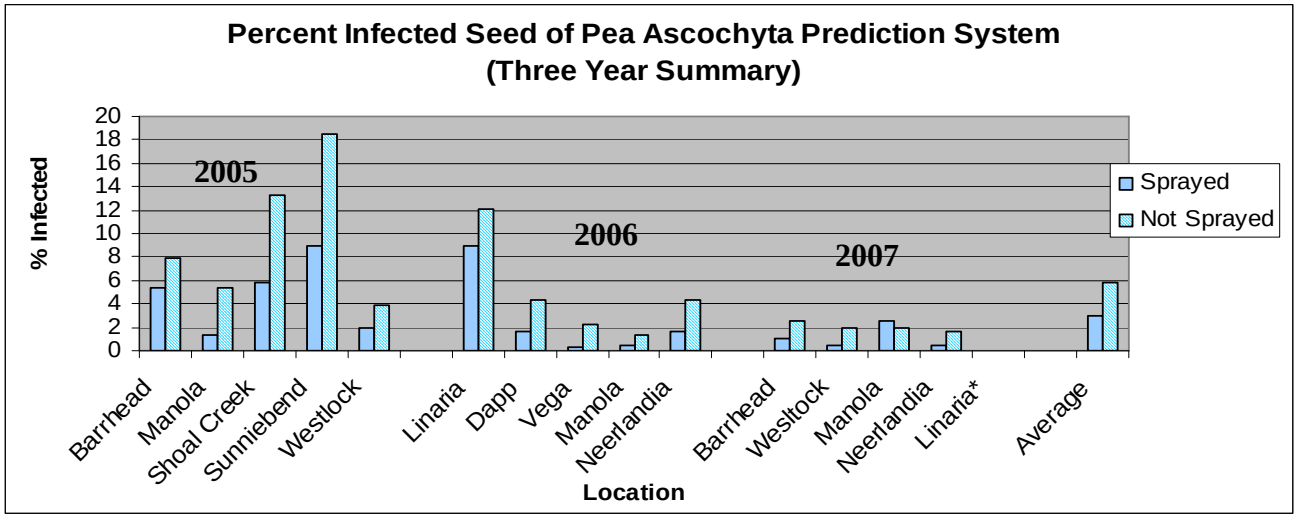

Figure 4: Field pea percent infected seed comparison in percent for 15 locations over three years between Headline fungicide treatments and no fungicide treatments.
***Site lost due to hail**