SASKATCHEWAN pulse Growers

Potential for enhancing pea yield through improved Ascochyta pisi management

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SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Co-funders	Total Project Cost
$119,671.60	Completed	April 2012 – March 2015	Saskatchewan Ministry of Agriculture – Agriculture Development Fund (ADF)	$230,255.60

Project Description

To evaluate whether A. pisi and M. pinodes have different temperaure and moisture optima; to assess the role of seed infection with A. pisi on disease development in field pea; to assess yield loss due to A. pisi in a selection of European and Canadian field pea cultivars under field conditions; to determine genetic control of resistance to A. pisi.

Most of the research on A. pisi was conducted on garden pea about 45 years ago in Ottawa where growing conditions are quite different from those of field pea grown in Saskatchewan. This and the fact that high seed infection rates are observed in pea seed in southwestern Saskatchewan warrant further research to determine whether this disease is of economic importance in the province. Fungicide applications on pea have been promoted strongly in Saskatchewan in recent years, contributing to production costs and increasing the risk of fungicide insensitivity developing in fungal populations, especially in the case of strobilurin fungicides. We believe that our research will determine whether fungicide treatments are warranted to control A. pisi infection.

Didymella pinodes (syn. Mycosphaerella pinodes) and Ascochyta pisi are both causal agents of ascochyta blight on pea. The hypothesis is that these two pathogens have different climatic optima.

Objective 1: Growth chamber experiments were conducted to evaluate whether A. pisi and M. pinodes have different temperature and moisture optima. Assessment for disease severity was carried out 7 and 14 days after inoculation using a 0—10 scale grading system based on 10% incremental increases in the percentage of disease severity on leaves and stems. Plants were individually assessed and disease scores were converted to percentage of infected plant tissue using the class midpoint values. The average of four plants per pot was used for data analysis.

Objective 2: Two experiments were established in Saskatchewan, one at Saskatoon in all three years, one at the Canada-Saskatchewan Irrigation Diversification Centre at Outlook in 2012, and one at Milden in 2013 and 2014. Seeds of the green pea cultivar CDC Patrick with 14.5% A. pisi infection based on commercial seed testing results was located and was diluted with clean seed to obtain seed samples with 14.5, 10, 5 and 0.5% A. pisi infection. Field experiments were established using a randomized complete block design with four replications and plots of 1.2 ×3.7m. Seeding density was 86 seeds/m2 with a row spacing of 0.3 m. Pre—seeding herbicide treatments included Pursuit and Edge, Glyphosate at Outlook and Aim and Credit at Saskatoon in 2012. This was followed by post-seeding applications of Axial, Adigor, Centurion, Amigo and Basagran Forte at both locations. Edge was applied at Milden in both years, followed by Axial and Centurion post-seeding at Milden and Saskatoon. Plant emergence (number of plants/m row), seedling infection with A. pisi and D. pinodes, a second and a final disease severity rating was taken in all years. Assessments were conducted by evaluating 5 randomly selected plants per plot using a 10% incremental scale for disease severity. Mid class values were used for statistical analyses. Only seedling and final disease assessments for A. pisi are included. In 2013 and 2014, yield and A. pisi infection levels of harvested seed were also assessed using standard protocols.

Objective 3: Strip-'lot field experiments were established at Swift Current (AAFC Centre) and at Stewart Valley in 2012 and 2013 where regular, high incidence of A. pisi has been observed historically, to evaluate yield loss through A. pisi in Cooper and SW Midas (susceptible to A. pisi), and CDC Bronco and CDC Golden (resistant to A. pisi). In 2014 experiments were conducted at Swift Current and at Saskatoon under irrigation. Cultivars were subplot treatments seeded into plots of 2 × 6 m that had been treated with glyphosate as a pre-•eeding herbicide control treatment, and were sprayed with Solo post-•eeding. The main plot treatments were "fungicide application" and "no fungicides" to create plots with differential A. pisi infection levels. Dates of seeding, fungicide applications, disease assessments were evaluated. Severity of A. pisi and D. pinodes infection was assessed.

Objective 4: A set of 263 recombinant inbred lines (RILs) of a population named PR-⟐0 was developed at the University of Saskatchewan from a cross between CDC Bronco (moderately resistant to A. pisi) and Cooper (moderately susceptible to A. pisi) using the single seed descent method. These RILs had previously been tested in the F7 generation for their response to A. pisi in replicated greenhouse experiments. A range in disease severity from 6-⟐2% was detected. To substantiate the genetic differences in disease resistance in PR- 10, the 28 most resistant and the 28 most susceptible RILs (based on the greenhouse study mentioned above) together with the parents were assessed in a field experiment at Swift Current from 2012 to 2014, at Stewart Valley in 2013 and at Saskatoon in 2014.

Outcome

The main conclusion of this project is that Ascochyta pisi does not appear to pose a major risk to pea production in Saskatchewan. Seed infection with A. pisi was shown to have no or minimal effects on pea crop establishment, disease development or seed yield. Fungicide applications at low and moderate disease levels do not appear to have any benefit.

A. pisi undoubtedly has become more prominent over the past 10 years, but our results suggest that this is not because of different environmental requirements that would give this pathogen a competitive advantage over M. pinodes in some areas of the province. Growth chamber experiments revealed that both pathogens have a temperature optimum at 20 to 25°C. Requirements for leaf wetness periods for infection are also similar, rejecting the hypothesis of different climatic optima for the two pathogens.

Seed infection at or above 10% only had a minor effect on emergence. In only one out of six experiments did high seed infection level result in elevated A. pisi symptom development later in the season, but there were no differences in seed yields or A. pisi infection levels of harvested seeds in any of the experiments. In one out of six experiments A. pisi severity was reduced by 40 to 45% through fungicide applications, but there was no effect on seed yields, suggesting that A. pisi infection at up to 45% has minimal effect on pea performance and may not warrant fungicide applications. Higher infection levels in harvested seed in 2014 with moderate as well as low A. pisi symptom severity (45% maximum at Saskatoon, 15% at Swift Current) suggests that the severity of late season infection, possibly through ascospore showers, may be less dependent on the amount of disease in the crop, but more on particular environmental conditions.

Only low to moderate A. pisi levels resulted in significant differences in disease severity in only one of five experiments, which did not translate in yield differences. However, A. pisi infection levels of harvested seeds were higher in unsprayed compared to sprayed plots at Saskatoon in 2014, and at Swift Current where no significant differences in disease severity had been observed.

Low and highly variable disease also impeded the genetic study of RIL population PR-�0, and significant differences between parents were only found when pooling all six experiments. Field evaluation of PR- 10 suggests that disease resistance level in the parents may not be as different as previously thought, which puts into question the suitability of this population to study the genetic control of A. pisi resistance. The wide range of disease severity observed among RILs also suggests that more than one gene may be involved in the control of resistance.

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The main conclusion of this project is that A. pisi does not appear to pose a major risk to pea production in Saskatchewan. Seed infection with A. pisi was shown to have no or minimal effects on pea crop establishment, disease development or seed yield. Fungicide applications at low and moderate disease levels do not appear to have any benefit, in particular A. pisi infection at up to 45% has minimal effect on pea performance and may not warrant fungicide applications.

Research Objective

OBJECTIVE 1
To evaluate whether A. pisi and M. pinodes have different temperaure and moisture optima.

OBJECTIVE 4
To determine genetic control of resistance to A. pisi.

OBJECTIVE 2
To assess the role of seed infection with A. pisi on disease development in field pea.

OBJECTIVE 3
To assess yield loss due to A. pisi in a selection of European and Canadian field pea cultivars under field conditions