Evaluating Resistance to Mycosphaerella Blight of Pea

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INTRODUCTION

Over 800,000 hectares of pea (*Pisum sativum* L.) were grown in Western Canada in 1997. As the production of field pea increases, producers face increased risk of severe losses in seed yield, seed weight and quality due to diseases. In Western Canada pea is attacked by three species of *Ascochyta: Ascochyta pinodes, Ascochyta pinodella (Phoma medicaginis var. pinodella),* and *Ascochytu pisi. The* most important one is *A. pinodes* Jones, the conidial stage of *Mycosphaerellu pinodes* (Berk. and Blox.) Vesterg Moderate or severe infection with M. *pinodes* can reduce yield 50-75% Only a low level of resistance to M. *pinodes* is available in *Pisum* and it occurs with a low frequency. Poor standing ability of the pea crop leads to premature lodging, which amplifies losses due to further buildup of mycosphaerella blight and the footrot complex. An improved evaluation system, involving the use of an appropriate scoring method and scoring disease severity when genetic differences are maximized, is required to effectively evaluate mycosphaerella blight resistance under field conditions. An effective and efficient evaluation system can be used to study the effect of varying levels of mycosphaerella infection on seed yield and seed size.

OBJECTIVES

The objectives of this study were to determine: 1) the best rating method and timing for detecting small differences in resistance to mycosphaerella blight infection in pea. 2) if different levels of resistance to mycosphaerella blight result in proportional losses in seed yield and seed weight in pea, and 3) if lodging increases the losses in seed yield and seed weight caused by mycosphaerella blight in pea.

MATERIALS AND METHODS

1. **Genotypes:** 1) JI **267,** JI 295, JI 296 and JI 710 (courtesy of John Innes Centre, UK),
   2) PI 184 128, PI 25 105 1 and PI 2806 16 (courtesy of Dr. Kraft, USDA),
   3) Three adapted cultivars: Bohatyr, Cameval and Express.
2. **Treatments:** 1) Control.
   2) Fungicide: Chlorothalonil (Bravo) sprayed 3-4 times during the growing season to minimize mycosphaerella blight infection on the plots.
   3) Non-lodging: a wire mesh placed over each plot before lodging occurred.
   4) Combination of fungicide plus non-lodging.
3. **Experimental design:** A randomized complete block design with three replications was used at the Saskatchewan Irrigation Development Centre, Outlook and the Preston Plots, University of Saskatchewan, Saskatoon in 1995 and 1996. Each plot consisted of 4 rows, 4 m long, and 30 cm apart.
4. **Inoculation:** About one month after seeding, finely chopped pea residue, heavily infected with *M. pinodes, was* spread over the experimental area.
5. **Disease assessment:** Foliage and stem infection on 10 individual plants were rated four times at two-week intervals on the basis of a six-point scale (see Tables 1 and 2).

6. **Seed yield:** Seed yield per plot was converted to kg ha-l.
7. **1000-seed weight:** Seed weight was based on weight of a 200~seed sample (g) from each plot x 5.

RESULTS AND DISCUSSION

Stem infection increased corn the first rating to the fourth rating at the physiologically mature stage. Thus, only data from the physiological mature stage are presented. Stem infection by M. *pinodes* on the PI lines and JI lines decreased from the control to the fungicide treatment to the non-lodging treatment to the combination of fungicide plus non-lodging treatment at the physiologically mature stage (Table 1). Lodging prevention reduced stem infection rating more than fungicide application. However, for the adapted cultivars, the fungicide treatment resulted in a lower stem infection rating than the non-lodging treatment. PI 184 128 had the lowest stem infection rating in this study.

Table 1. Stem infection ratings" for mycosphaerella blight on ten pea genotypes at the physiologically mature stage, averaged over years and locations

Genotype	Treatment				Mean
	Control	Fungicide(F)	Non-lodging	F+ nonlodging	
PI 184128	4.7	3.7	3.0	2.3	3.4
Bohatyr	5.8	3.3	3.3	2.6	3.8
PI 280616	5.7	4.1	3.5	2.6	4.0
PI 251051	5.5	4.0	3.1	2.6	3.8
CarnevaL	5.7	3.6	3.9	3:o	4.1
JI 267	5.9	4.4	3.7	2.8	4.2
JI 710	6.1	4.6	3.5	2.6	4.2
JI 296	6.5	4.5	3.3	2.4	4.2
Express	6.6	3.9	4.1	3.0	4.4
JI 296	6.5	5.2	4.4	3.2	4.8
Mean	5.9	4.1	3.6	2.7	4.1

S. E. (Genotype) = 0.30; *S. E. (Treatment) = 0.06; S.E. (Genotype x treatment) = 0.18.*

[z] *Stem infection rated on a six-point scale, where 0 = no visible reactiori, 1 =small flecks, 3 = few large lesions, 5 = many large lesions, 7 = main stems girdled and 9 = plant dead.*

The foliage infection also increased from the first rating to the fourth rating at the physiologically mature stage. Thus, only data from the physiologically mature stage are presented. The foliage response to infection by M. *pinodes* was different from the stem response, even though both stem and foliage infection ratings were the highest under the control and the lowest under the combination treatment (Table 2). In general, foliage infection was reduced from the control to the non-lodging treatment which was equal to the fungicide treatment, with the lowest foliage infection for the combination of fungicide plus non-lodging treatment. Again, for the adapted cultivars, the fungicide treatment consistently resulted in a lower foliage infection rating than the non-lodging treatment. PI 184 128 had the lowest foliage infection rating.

Table 2. Foliage infection ratings[z] for mycosphaerella blight on ten pea genotypes at the physiologically mature stage, averaged over years and locations

Genotype	Treatment: Control	Fungicide(F)	Non-lodging	F+ nonlodging	Mean
PI 184128	4.5	3.6	3.7	3.2	3.7
Bohatyr	5.6	3.5	3.9	2.9	3.9
PI 280616	5.0	3.8	3.4	3.1	3.8
PI 251051	5.1	3.9	3.9		4.0
CarnevaL	5.7	4.0	4.3	3.2	4.3
JI 267	5.5	4.4	4.3	3.6	4.4
JI 710	5.6	4.4	4.6	3.6	4.5
JI 296	5.9	4.6	4.5	3.5	4.6
Express	6.4	4.0	4.4	3.4	4.6
JI 296	6.1	4.5	5.0	4.0	4.9
Mean	5.5	4.1	4.2	3.3	4.3

S.E. (Genotype) = 0.17; S.E. (Treatment) = 0.06; S.E. (Genotype x treatment) = 0.20.

[z] *Foliage infection rated on a six-point scale, where 0 =immune, 1=<5, 3 =5-15, 5 =15-30, 7 =30-45, and 9 = over 4.5 % infected leaves.*

The yield of most genotypes increased from the control to the fungicide treatment to the non-lodging treatment to the combination of fungicide plus non-lodging treatment (Table 3). The average yield increase due to lodging prevention was greater than the yield increase due to fungicide application. The effects of fungicide application and lodging prevention on seed yield were additive (the fungicide by non-lodging interaction was not significant). Express was the highest yielding genotype.

Table 3. Mean seed yield of ten pea genotypes averaged over two years and two locations

Genotype	Treatment				Mean
	Control	Fungicide(F)	Non-lodging	F+ nonlodging	
	kg/ha				
PI 184128	2052	1969	2788	3102	2478
Bohatyr	3161	3764	3477	4023	3606
PI 280616	2239	2813	3232	3598	2970
PI 251051	1579	2175	2648	3027	2357
CarnevaL	3179	3682	3411	4261	3634
JI 267	2277	2556	3223	3646	2926
JI 710	1706	1944	2691	3161	2376
JI 296	2279	2684	3298	3785	3011
Express	3190	3907	3498	4378	3743
JI 296	2205	2760	3087	3928	2995
Mean	2387	2826	3135	3691	3010

S.E. (Genotype) =215; SE. (Treatment) =35; S.E. (Genotype x treatment) =110.

Like seed yield, 1 OOO-seed weight showed a similiar increase from the control to the fungicide treatment to the non-lodging treatment to the combination of fungicide plus non-lodging treatment (Table 4). Lodging prevention increased seed weight more than fungicide spraying. The effects of fungicide application and lodging prevention on seed weight were additive (the fungicide by non-lodging interaction was not significant). Bohatyr had the highest 1 OOO-seed weight.

Table 4. Seed weight of ten pea genotypes averaged over two years and two locations

Genotype	Treatment				Mean
	Control	Fungicide(F)	Non-lodging	F+ nonlodging	
	g/1000 seeds				
PI 184128	92	100	103	109	101
Bohatyr	242	254	2.64	279	260
PI 280616	141	149	156	161	152
PI 251051	97	103	104	108	103
Carneval	215	222	226	238	225
JI 267	99	106	111	117	108
JI 710	90	97	104	110	100
JI 296	107	116	124	130	119
Express	186	205	205	228	206
JI 296	105	112	118	125	115
Mean	137	146	151	160	149

S.E. (Genotype) = 3.8; *S.E. (Treatment)* = 0.43; *S.E. (Genotype x treatment)* = 1.4.

CONCLUSIONS

1. The critical evaluation time for rating pea genotypes for resistance to mycosphaerella blight was at physiological maturity under field conditions.
2. Rating of individual plants in a plot was superior to rating of individual plots (data not presented).

3. Stem infection rating was more reliable than foliage infection rating because of a smaller coefficient of variation and a wider range of means.
4. The three PI lines and Bohatyr showed a low level of resistance to *Mycosphaerella pinodes* in Western Canada. The three adapted pea cultivars yielded the highest, even though they suffered severe mycosphaerella infection.
5. The small differences among pea genotypes in resistance to mycosphaerella blight in this study did not result in proportional losses in seed yield or seed weight. However, the three adapted cultivars were characterized by having the highest reduction in foliage infection rating and the lowest reduction in seed yield for the fungicide plus non-lodging treatment vs the control treatment.
6. The effects of the fungicide treatment and non-lodging treatment were additive for seed yield and 1 OOO-seed weight. Thus, losses in seed yield and seed weight due to mycosphaerella blight could be reduced by incorporating genes for resistance to mycosphaerella blight, multiple application of chlorothalonil, improving lodging resistance or some combination.
7. The non-lodging treatment showed less stem infection than the fungicide treatment at the later growth stages, although the fungicide treatment showed more stem infection than the non-lodging treatment at the earlier stages (data not presented).

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