

INHERITANCE OF RESISTANCE TO ASCOCHYTA BLIGHT IN LENTIL

Venkata R. Vakulabharanam¹, A. E. Slinkard², A. Vandenberg¹

¹Department of Crop and Horticultural Sciences & Plant Ecology, ²Crop Development Centre
University of Saskatchewan, 5 1 Campus Drive, Saskatoon, SK S7N 5A8, Canada

INTRODUCTION

Lentil (*Lens culinaris* Medik.) ranks among the oldest and the most appreciated food legumes of the Old World. Lentil is one of the more nutritious and tasty food legumes with a protein concentration of about 250 mg/kg. Canada is the second largest lentil producer and the largest exporter in the World (Slinkard, 1996). Saskatchewan traditionally produces 80 to 90% of the Canadian lentil crop. Saskatchewan producers are the only ones in the world who can successfully produce Laird lentil which is the quality standard in many lentil markets (Slinkard, 1996).

Ascochyta blight, caused by *Ascochyta fabae f. sp. lentis* Gossen, is the most important disease of lentil in Western Canada. This disease can be serious, especially in wet growing seasons, and losses can be as high as 70% due to reduction in yield and quality (Gossen and Morrall, 1983). Ascochyta is specific to lentil and does not affect other pulse crops. The symptoms appear from the seedling to the mature plant stage. Spots, which are initially light grey but become tan-coloured with a darker brown margin, develop on the leaflets, stems and pods. The centres of the spots are light coloured and become speckled with tiny, black fruiting bodies (pycnidia). Control measures include use of disease-free seed, crop rotation, and use of resistant cultivars. Seed treatment with thiobendazole plus carbathiin (Crown) greatly reduces the level of seedborne ascochyta infection in planting seed. Chlorothalonil (Bravo) is a protectant fungicide which reduces disease severity and seed infection by inhibiting spore germination.

OBJECTIVE

The main objective of this study was to determine the mode of inheritance of resistance to ascochyta blight in four resistant lentil cultivars/lines: ILL 5588, Indianhead, PI 339283 and PI 374118. A second objective was to determine whether any of the genes for ascochyta resistance in these four parents are allelic.

MATERIALS AND METHODS

Seven lentil cultivars/lines, four resistant (ILL 5588, Indianhead, PI 339283, PI 374118) and three susceptible (Eston, Laird, ZT4), were crossed in all possible combinations except reciprocals during fall, 1994-95. F₁ plants of the 16 successful crosses were grown in the greenhouse during the winter of 1994-95 and F₂ plants were grown in an irrigated ascochyta nursery during the summer of 1995. F₂ plants were

harvested individually and 50 seeds of each plant were plated on agar media to determine percentage seedbome ascochyta infection. Fifty plants were randomly selected from each of the 16 crosses for this analysis. $F_{2,3}$ rows of these 13 crosses were grown in an ascochyta nursery in 1996, but the data were of limited value. Chi-squared tests of goodness-of-fit to various one and two gene ratios were calculated to determine the mode of inheritance of resistance in these various crosses. Additional crosses were attempted during the winter of 1995-96 to replace the missing crosses and F_1 plants were grown in the greenhouse during the summer of 1996. Growth chamber screening of the resulting F_2 plants was conducted during the winter of 1996-97. Fifty $F_{2,3}$ rows of 13 crosses were grown in an irrigated ascochyta nursery in the field during the summer of 1997 and harvested in bulk. Fifty plants from each of the five missed crosses were also grown during the summer of 1997 and harvested individually. Parents were also grown to determine the percentage of seedbome ascochyta infection. Hundred seeds from each of the $F_{2,3}$ rows and fifty seeds from each F_2 plants (of missed crosses) were plated on agar media and the percentage of seedbome ascochyta infection was determined. Percentage of seedbome ascochyta disease infection on parents was also determined. Chi-squared tests for the goodness-of-fit were calculated to confirm the F_2 ratios obtained in 1995.

Table 1. Best Fit Segregation Ratios For Reaction To Seedborne Ascochyta Infection In F2 Populations Of Lentil In the Field

CROSS	DISEASE REACTION	
	F ₂ (Res : Sus)	F _{2:3} (Res : Inter: Sus)
<u>With Indianhead</u>		
Indianhead X Eston	1:3	1:2:1 *(poor fit)
Indianhead X ZT4	3:13	3:6:7
Indianhead X Laird	1:3*(poor fit)	1:2:1
Indianhead X ILL 5588	13:3	10:3:3
Indianhead X PI 339283	13:3	10:3:3
<u>With ILL 5588</u>		
ILL 5588 X Eston	3:1	9:6:1
ILL 5588 X ZT4	15:1	3:6:7
ILL 5588 X Laird	15:1	1:2:1
ILL 5588 X Indianhead	13:3	10:3:3
ILL 5588 X PI 374118	All:0	9:6:1
<u>With PI 339283</u>		
PI 339283 X Eston	15:1	1:2:1
PI 339283 X ZT4	15:1	3:6:7
PI 339283 X Indianhead	13:3	10:3:3
PI 339283 X PI 374118	3:1	1:2:1

Res=Resistant; Sus=Susceptible; Inter=Intermediate

Table 2. Best Fit Segregation Ratios For Reaction To Foliar Ascochyta Infection In Two F2 Populations Of Lentil In the Greenhouse

Cross	Disease Reaction
	(Resistant:Susceptible)
PI 339283 X ILL 5588	15:1
PI 374 118 X Indianhead	15:1

RESULTS AND DISCUSSION

Analysis of parents grown in an irrigated disease nursery in 1995 showed that Eston lentil was the most susceptible parent with about 55% seedborne ascochyta infection followed by Laird (23%) and ZT4 (20%). Among the resistant parents, PI 339283 was the most resistant with zero percent seedborne ascochyta infection followed by PI 374118 (0.8%), ILL 5588 (5.0%) and Indianhead (5.6%). A seedborne ascochyta infection level of 12% was used to separate resistant and susceptible plants in the segregating populations. The analysis of F_2 plant data for the 13 crosses (Table 1) showed that the ascochyta resistance in Indianhead lentil is governed by a single recessive gene as reported by Andrahennadi (1994). Resistance in ILL 5588 is governed by a single dominant gene in crosses with the susceptible parent Eston, as reported by Andrahennadi (1994). However, two dominant genes for ascochyta resistance are apparently segregating in crosses between ILL 5588 and the other two susceptible parents. Resistance in PI 339283 apparently is governed by two dominant genes (15:1) in crosses with two of the susceptible parents. Growth chamber study of the lentil seedlings from F_2 seeds in the two missed crosses, Indianhead X PI 374118 and PI 339283 X ILL 5588 gave a good fit to the 15 resistant : 1 susceptible ratio (Table 2).

Analysis of the data from $F_{2,3}$ rows grown in an irrigated ascochyta nursery in the field during the summer of 1997 showed that ZT4 lentil was the most susceptible parent with 48% seedborne ascochyta infection followed by Laird (45%) and Eston (22.5%). Indianhead was the most resistant parent with 2.5% seedborne ascochyta infection followed by ILL 5588 (3%) and PI 339283 (5%). Lentil line PI 374118 showed 17.6% seedborne ascochyta infection and was considered as susceptible parent. A seedborne ascochyta infection of 0-5%, 5-10% and >15% was used to separate resistant, intermediate and susceptible $F_{2,3}$ lines respectively. Chi-squared test for goodness-of-fit confirmed the F_2 ratios obtained in 1995 with the resistant parent Indianhead. However, some of the $F_{2,3}$ ratios were inconsistent with ILL 5588 and PI 339283. So, it was difficult to determine exact number of dominant genes present in these two resistant parents. It was also confirmed that the genes for resistance in Indianhead were different from those in PI 339283. Data from F_2 plants of those missed crosses were of little use because of the small sample size (data not shown), however, they show that the genes responsible for resistance to ascochyta blight are different in ILL 5588 and PI 339283. Crosses with ZT4 shows the presence of an epistatic gene ZT4 which modifies the disease reaction of the resistant genes when present in homozygous recessive condition.

CONCLUSIONS

Ascochyta resistance in Indianhead is determined by a single recessive gene.

Ascochyta resistance in ILL 5588 is determined by one or more dominant genes.

Ascochyta resistance in PI 339283 is determined by a single dominant gene.

Lentil line PI 374 118 shows no resistance to ascochyta blight

Genes responsible for the ascochyta resistance in PI 339283 are different from those in ILL 5588 and Indianhead.

ZT4 lentil shows an epistatic gene when present in homozygous recessive condition modifies resistant genes in the parents Indianhead, ILL 5588 and PI 339283

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