Response of cultivars and breeding lines of *Phaseolus vulgaris* L. to the black pod fungus, *Alternaria alternata* in southwestern Ontario

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From 1981 to 1983, seventy to eighty commercial cultivars, breeding lines, and plant introduction lines of beans were tested for resistance to black pod disease caused by *Alternaria alternata* (Fr.) Keissler. The different degrees of susceptibility and resistance of these cultivars and lines are reported in this paper.

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Depuis 1981 jusqu'à 1983, environ soixante-dix a quatre-vingt cultivars commerciaux, de lignees genealogiques et lignees genealogiques introduites de haricots furent evaluees pour leur resistance a la brûlure alternarienne causee par *Alternaria alternata* (Fr.) Keissler. Les differents degres de susceptibilite et de resistance de ces cultivars et de ces lignees sont discutes dans ce rapport.

Introduction

Black pod disease of common beans (*Phaseolus vulgaris* L.) was discovered by Tu (1982). The causal organism, *Alternaria alternata* (Fr.) Keissler, is a weak parasite which colonizes the cavities of stomata of the actively growing plants (Dickinson and O'Donnell, 1977; Dickinson and Bottomley, 1980). In the fall, when senescence of plants begins and leaves and pods turn yellow, the fungus starts to flourish and tissues show a black mouldy appearance. Severely infected pods turn black and seeds from diseased pods often show varying degrees of grey discoloration (Tu and Park, 1983). The disease is widespread in southwestern Ontario, and each year losses due to 'pickers' and seed discoloration are estimated at 2 to 3 million dollars (Tu *et al.*, 1988). Approximately 63% of Ontario-produced dry beans were infected and/or infested with *Alternaria* spp. of which 56% was *A. alternata* (Tu, 1989). Fall rains that delay the harvest exacerbate this disease (Tu *et al.*, 1988). Seed discoloration reduces quality and marketability of white beans.

The control of black pod disease by chemical spray has been investigated and the results indicated that the fungus was tolerant to benomyl, dichloran and chlorathalonil but was sensitive to iprodione (Tu, 1983). Unfortunately, application of iprodione to control this disease is costly and not economically feasible. Furthermore, it may have adverse environmental implications. Measures other than chemical means are being examined to manage this disease. Early seeding and use of early maturing cultivars were suggested to ensure that harvesting could be completed before the arrival of the rainy season in the fall (Tu *et al.*, 1988). Alternatively, the disease might be controlled or alleviated by using resistant cultivars, since there were indications that some cultivars tended to have less severe symptoms (Tu and Park 1983). A series of screening trials were conducted to evaluate the susceptibility of some cultivars and lines in an effort to identify plants which might be of value to develop resistant cultivars.

Materials and methods

The cultivars, breeding lines, and plant introduction lines, that were submitted to the Ontario Cooperative Bean Variety Trial, were seeded in experimental plots at the Harrow Research Station. The experiments were conducted in 1981, 1982, and 1983. Each year, between seventy to eighty cultivars and lines were tested in completely randomized block design in four replications, each with 2 row-plots. The beans were seeded in the last week of May or first week of June, depending on weather and soil conditions. The disease developed naturally in field plots every year, usually starting in mid-season (late July) and progressively worsened toward maturity. Disease severity was scored on a 0-9 scale which corresponded to percentages of total leaf area with disease symptoms (i.e. 0 = 0-10%, 1 = 11-20%). The disease severity readings for leaves and stems were made between August 31 and September 15, and between September 15 and 21 for pods.

Results and discussion

The results (Table 1 and 2) showed that fifty-five commercial cultivars, breeding lines, or plant introduction (P.I.) lines had a disease severity rating of 0 to 4 indicating a high to moderate resistance to this disease in southwestern Ontario. Many of the resistant cultivars (Table 1) are currently recommended cultivars and could be adopted readily into commercial production in Ontario while the others along with breeding lines and P.I. lines (Table 2) could be used by breeders in the development of resistance to this disease. Resistance to *A. alternata* infection would contribute to the reduction in incidence and

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severity of Alternaria black pods and consequently reduce the 'pickers' and seed discoloration.

The present results should be helpful to growers, breeders, seed companies, and the Ontario bean industry.

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Table 1. Response of cultivars of common beans to *Alternaria alternata* infection in southwestern Ontario.†

Disease Severity Index‡ (0-9 scale)	Cultivar*
0.0 - 1.0	Rabia de Gato[1], A-553
1.1 - 2.0	Bunsi[6], C-202, Crestwood[5], ExRico 23[4], OAC Rico[4], Kaboon[9]
2.1 - 3.0	Duty[7], Fleetwood[9], Westland[6], Northland[6], Harofleet[8], Midnight[2], Stinger[6], Midland[6], Domino[2], Neptune[2], Swan Valley[2], OAC Gryphon[4], Black Magic[2], C-15[2]
3.1 - 4.0	OAC Seaforth[4], Harokent[9], Kentwood[9], Aurora[9], Admiral[8], Laureat[1], Flo[1], Mitchell[9], Dresden[9]
4.1 - 5.0	Seafarer[9], Steuben[9], Suncrest[5]
5.1 - 6.0	Sanilac[9]
6.1 - 7.0	-
7.1 - 8.0	Sacramento RK[8]

† This list may include some private cultivars. Interested parties wishing to obtain seeds should write directly to their respective sources.

‡ Based on a 0–9 scale, where 0 = <10%, 1 = 11–20% of pods with symptoms, 2 = 21–30%...and 9 = 91–100%. Thus, a score of 0 to 4.0 is considered to have high to moderate levels of resistance and a score of 4.0 to 9.0 to have moderate to high levels of susceptibility.

* The superscripts following each cultivar indicate the suppliers of seeds:
1. Dr. M.H. Dickson, N.Y. State Agric. Exp. Station, Geneva, NY; 2. Dr. J.D. Kelly, Michigan State University, Lansing, Michigan; 3. CIAT, Cali, Colombia; 4. Dr. T.E. Michaels, University of Guelph, Guelph, Ontario; 5. Gen–Tec Seeds Ltd., Woodslee, Ontario; 6. G.W. Thompson & Sons Ltd., Blenheim, Ontario; 7. Wilbur Ellis Co., Spokane, Washington; 8. Idaho Seed Bean Co., Twin Falls, ID; and 9. Dr. S.J. Park, Harrow Research Station, Harrow, Ontario.

Table 2. Response of common bean lines to *Alternaria alternata* infection in southwestern Ontario.†

Disease Severity Index‡ (0–9 scale)	Line*
0.0 - 1.0	P.I. 167.399[a]
1.1 - 2.0	P.I. 169.828[a], P.I. 171.803[a], P.I. 174.317[a], T7901[d], T8102[d], T8201[d], T8203[d], PVH32[h], OAC-5[e]
2.1 - 3.0	P.I. 169.920[a], P.I. 171.761[a], P.I. 203.958[a], NY2558[b], OAC-3[e], OAC-4[e], T8204[d], GT-0182[g], 1225022[h]
3.1 - 4.0	ISB-513[f], T8103[d], MO3[h], MO8[h], P.I. 169.880[a]
4.1 - 5.0	P.I. 169.894[a], P.I. 203.958[a], P.I. 173.047[a], OAC-1[e], 8BP-266[b], NY2114-12[b]
5.1 - 6.0	T8104[d], MO162[b], MO1[h], MO2[h], MO3[h]
6.1 - 7.0	Wisconsin RRR46[e], P.I. 165.435[a], GY-273[h], 1455005[h]
7.1 - 8.0	P.I. 165.616"

† This list includes some numbered lines, breeding lines and P.I. accessions. Interested parties wishing to obtain seeds should write directly to their respective sources.

‡ Based on a 0–9 scale, where 0 = <10%, 1 = 11–20% of pods with symptoms, 2 = 21–30%...and 9 = 91–100%. Thus, a score of 0 to 4.0 is considered to have high to moderate levels of resistance and a score of 4.0 to 9.0 to have moderate to high levels of susceptibility.

* The superscripts following each line indicate the suppliers of seeds:
a. Plant Introduction Station, U.S.D.A., Pullman, Washington; b. Dr. M.H. Dickson, N.Y. State Agric. Exp. Station, Geneva NY; c. Dr. D.J. Hagedorn, University of Wisconsin, Madison, WS; d. G.W. Thompson & Sons, Blenheim, Ontario; e. Dr. T.E. Michaels, University of Guelph, Guelph, Ontario; f. Idaho Seed Bean Co., Twin Falls, ID; g. Gen-Tec Seeds Ltd., Woodslee, Ontario; and h. Dr. S.J. Park, Harrow Research Station, Harrow, Ontario.

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