Alternaria Blight of Pea

L. SUSURI, Visiting Scholar, D. J. HAGEDORN, Professor, and R. E. RAND, Specialist, Department of Plant Pathology, University of Wisconsin-Madison, Madison 53706

ABSTRACT

Susuri, L., Hagedorn, D. J., and Rand, R. E. 1982. Alternaria blight of pea. Plant Disease 66:328-330.

A foliage and pod blight of pea (*Pisum sativum*) incited by *Alternaria alternata* is described for the first time. The predominant foliage symptoms in the field were tannish brown, oval lesions 5–8 mm in diameter, with indefinite margins. Greenhouse-grown plants showed numerous small purple-black lesions, which led to premature desiccation of the affected tissue. High-moisture treatments before and after inoculation, high conidial concentrations in the inoculum, moderate incubation temperatures, inoculation of older plants, and addition of Tween 20 to the inoculum favored infection. None of 28 pea cultivars tested was resistant or moderately resistant.

A conspicuous leaf spot and blight of processing pea (*Pisum sativum* L.) has been observed occasionally in Wisconsin in commercial production fields, especially in 1968 and 1976. Isolates of the causal fungus of the disease were identified as *Alternaria alternata* (Fr.) Keissl. at the Centraalbureau voor Schimmelcultures, Baarn, The Netherlands. To our knowledge, this is the first report of this disease on pea. Saad and Hagedorn (4) reported a similar disease of processing bean (*Phaseolus vulgaris* L.) in Wisconsin in 1969. Although this pea disease is quite striking, we believe it is of minor economic importance because it occurs only sporadically. Diseased plants are scattered randomly in the field and are rarely great in number. We report here symptomatology of the disease, environmental relationships involved in infection and disease development, and cultivar reactions to the disease.

MATERIALS AND METHODS

The *A. alternata* isolate we used was maintained on potato-dextrose agar (PDA) slants at 4 C by periodic single-spore transfers. Inoculum was prepared by growing the fungus at room temperature (21 C) in PDA plates for 15 days under continuous light (1,500 lux). We removed conidia by adding sterile, distilled water and gently rubbing the surface of the culture with a rubber spatula. Conidia were then filtered through a double layer of cheesecloth. Inoculum in most experiments was a suspension containing 6×10^5 conidia per milliliter of sterile, distilled water; Tween 20 was added to the spore suspension at the rate of 1 ml/L. Inoculum was applied to 5- to 6-wk-old pea plants with an atomizer attached to an air line that delivered 15 lb/in.^{2} pressure.

Pea plants were grown at 24 C in a greenhouse in 15-cm pots in a steamed soil-sand-peat mixture (3:1:1). Before inoculation, plants were placed in a moist chamber at 18–20 C for 24 hr. After inoculation, they were kept in a moist chamber for 1–4 days, then moved to greenhouse benches.

Disease severity ratings were recorded 7–10 days after inoculation: 0 = healthy, 1 = slight, 2 = moderate, 3 = severe, and 4 = plant dead. Disease indexes were calculated from Sherwood and Hagedorn's (5) formula, with data for randomized and replicated treatments from experiments that were repeated two to three times.

RESULTS

Symptomatology. The field-grown

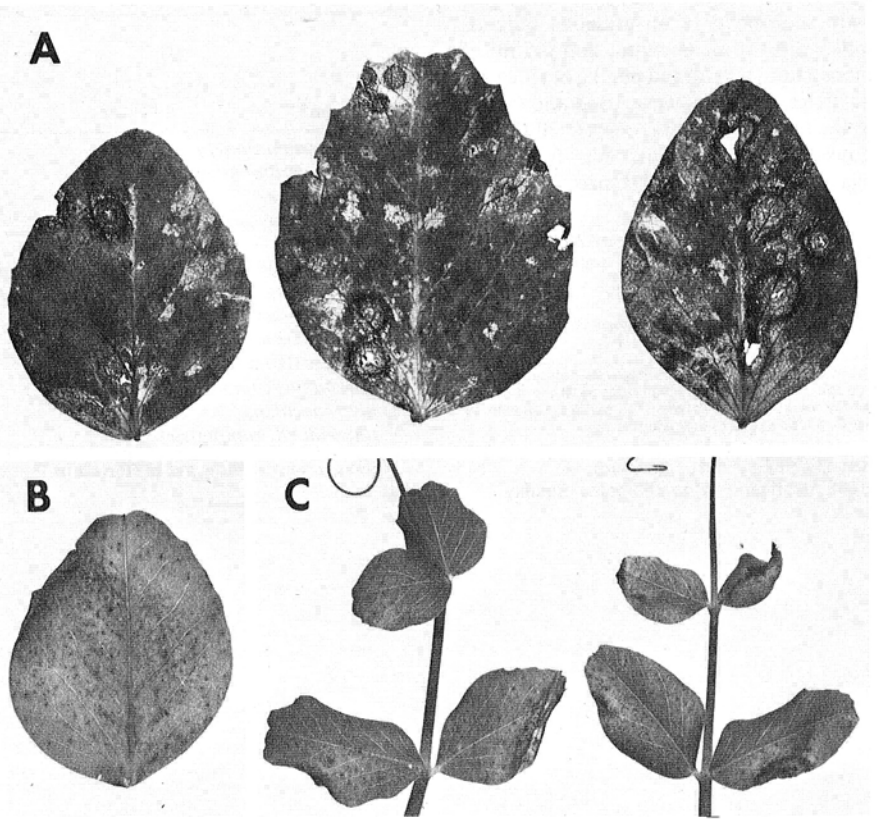

Fig. 1. Leaf symptoms of *Alternaria alternata* infection on peas: **(A)** Leaves with large, conspicuous oval lesions typical of foliage symptoms in the field. **(B)** Leaf inoculated in the greenhouse, showing numerous small lesions on ventral side. **(C)** Leaf lesions and beginning of blighting from numerous infections in the greenhouse.

Current address of first author: University of Prishtina, Agricultural Faculty, 38000 Prishtina, Yugoslavia.

Accepted for publication 21 December 1981.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. §1734 solely to indicate this fact.

0191-2917/82/04032803/$03.00/0

diseased plant from which *A. alternata* was isolated had large (5–8 mm in diameter), conspicuous, generally oval lesions on the foliage (Fig. 1A), especially on the stipules. Lesions covered up to half of the leaf or stipule surface area. Concentric rings, typical of *Alternaria* diseases, were well developed. The center of the lesions was tannish brown, the edges a faded green. The margins between diseased and healthy tissue were poorly defined. Overall size and vigor of diseased plants were slightly reduced.

By contrast, individual lesions on foliage, stems, or pods of greenhouse-inoculated pea plants were ordinarily restricted in size and purplish black in color, but without definite margins (Fig. 1B). Because lesions were so numerous, they caused rapid desiccation of individual leaflets (Fig. 1C) and of whole leaves plus adjacent stipules. Symptoms on pods varied. On half-mature pods, tiny (less than 1 mm in diameter), black, raised, superficial flecks remained localized. Disease development was very severe in younger pods (Fig. 2); the many small (about 1 mm in diameter), almost black lesions were slightly sunken and scattered irregularly over the pod, sometimes causing premature desiccation and shriveling of the pod.

Disease initiation. Because initial experiments with inoculum concentrations of 2×10^3 to 1×10^5 conidia per milliliter did not produce severe infection, we studied the effects of spore concentration on disease severity. Twenty plants (four pots) of Dark Skin Perfection or Alsweet peas were inoculated with suspensions of 5×10^4, 5×10^5, and 6×10^5 conidia per milliliter 45 days after they were planted. Plants were kept in a moist chamber at 18 C with an 8-hr photoperiod for 24 hr before and 72 hr after inoculation, then placed on a greenhouse bench at 24 C.

Small (0.5–1 mm in diameter) brown lesions were noted as early as 3 days after plants were removed from the moist chamber. Foliage lesions were numerous (up to 75 per leaflet), and as they grew slightly, they often blighted the foliage in 7–10 days. The reactions of Dark Skin Perfection and Alsweet differed only slightly. Disease indexes of plants inoculated with 6×10^5, 5×10^5, and 5×10^4 spores per milliliter were 70, 50, and 30, respectively. Uninoculated control plants remained healthy.

Rubbing pea leaves with a cheesecloth pad saturated with inoculum was inferior to the atomization inoculation method because it was more tedious and fewer lesions developed. Adding Tween 20 to the inoculum at 1 ml/L of conidial suspension increased disease severity, but adding V-8 juice at 10 ml/L did not, nor did adding Carborundum to the inoculum or the leaves.

Covering the peas with a plastic bag (1) or placing them in a moist chamber for 24 hr before inoculation increased uniformity and severity of disease, as did post-inoculation incubation in a moist chamber. Disease indexes of plants incubated at high moisture for 24, 48, 72, and 96 hr after inoculation did not differ significantly.

Typical disease indexes for inoculated plants of Alsweet and Dark Skin Perfection peas at ages of 15, 30, and 45 days were 17, 12, and 45, respectively. Alsweet plants often showed a slightly higher disease index than Dark Skin Perfection plants.

To evaluate the effect of temperature on disease development, we inoculated Dark Skin Perfection and Alsweet plants after a 24-hr preinoculation exposure in a moist chamber. Immediately after inoculation, the plants were held for 72 hr in a moist chamber at 18–20 C

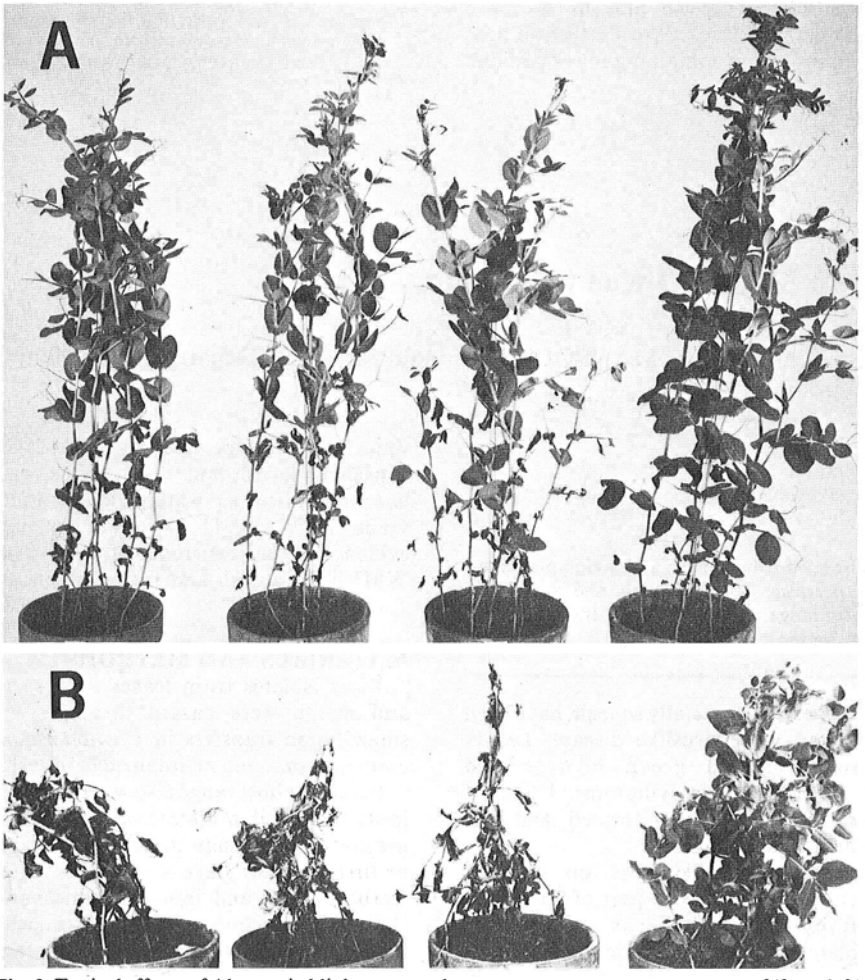

Fig. 2. Typical effects of Alternaria blight on greenhouse-grown peas at temperatures of (from left) 16, 20, and 24 C; uninoculated plants on the far right. **(A)** Blighting of lower foliage on cultivar Cobri. **(B)** Complete blighting on highly susceptible cultivar Margo.

Table 1. Disease indexes[a] for pea cultivars inoculated with *Alternaria alternata* and incubated at three temperatures in the greenhouse

	Temperature			
Cultivar	**16 C**	**20 C**	**24 C**	**Mean[b]**
Margo	100.0	100.0	100.0	100.0 a
Nunhem 7-76	68.0	88.5	93.5	83.3 b
Florix	75.5	90.0	68.5	78.0 b
Primette	93.5	60.0	75.0	76.2 b
Conquette	66.5	100.0	58.5	75.0 b
L-862	76.0	60.0	78.5	71.5 bc
Odé Danielle	62.0	100.0	51.0	71.0 bc
L-1009	47.5	71.5	65.0	61.3 c
Circo	84.0	47.0	51.0	60.7 c
L-993	43.0	72.5	66.0	60.5 c
Corfu Canner	58.0	55.0	65.0	59.3 cd
Sommette	50.5	78.0	49.5	59.3 cd
Medalist	59.0	54.0	61.0	58.0 cd
A-45-38	48.5	68.0	47.0	54.5 cd
Perfect K-3	62.0	47.5	53.0	54.2 cd
Perfect A	58.0	48.5	54.0	53.5 cd
L-340	50.5	57.5	49.0	52.3 cd
Target	53.0	57.0	45.5	51.8 cd
Alsweet	56.5	47.0	51.5	51.7 cd
Dark Skin Perfection	57.5	41.0	54.5	51.0 cd
Polarette	41.5	57.5	47.0	48.7 cd
Cobri	37.0	48.5	60.0	48.5 cd
Dane	45.0	53.0	46.0	48.0 cd
Early Sweet 8615	47.0	48.5	44.0	46.5 d
Perfection	45.5	32.5	28.5	35.5 d
Conner	39.5	30.0	35.0	34.8 d
5147	40.0	26.0	38.5	34.8 d
Canjoy	29.5	39.0	31.0	33.2 d

[a] Disease index: 0 = all plants healthy; 100 = all plants dead.

[b] Means followed by the same letter are not significantly different ($P = 0.05$) according to Tukey's honest significant difference (HSD) test. Two-way analysis of variance (ANOVA) does not show a temperature effect.

before being moved to greenhouses at 16, 20, 24, or 28 C. The experiment was repeated three times. Disease indexes were similar at all temperatures, but disease developed more rapidly and uniformly at 20 C.

Cultivar reaction. Twenty-eight pea cultivars were studied for disease reaction at postinoculation temperatures of 16, 20, and 24 C. The chosen cultivars included a number used for processing, ranging from early, indeterminate, light green foliage types to late, determinate strains with dark green foliage. Many are used in North America, but 12 were early-maturing cultivars from northern Europe. Four Wisconsin breeding lines (L numbers) with nonwaxy foliage were tested to compare their susceptibility with that of normal, waxy-foliaged peas.

The peas were grown at 20–22 C and inoculated at the late blossom stage. Two trials were made, with at least three replicates per trial; each replicate was one pot containing five plants. Disease indexes were recorded 2 wk after inoculation.

Of the 28 cultivars, Canjoy peas had the lowest average disease index (33.2); however, this disease index was not significantly different from that for a number of the other cultivars (Table 1). Margo and several other cultivars appeared to be very susceptible. The nonwaxy character did not influence severity markedly. There was no significant interaction between cultivar and temperature.

DISCUSSION

Greenhouse experiments tended to substantiate field observations that *A. alternata* is a relatively weak pathogen of peas. However, the fungus could initiate severe disease over a wide temperature range (16–24 C) during prolonged periods (3 days) of high humidity. Paulus and Pound (3) found that infection of tomato by *A. tomato* was greatest at 26 C and least at 10 C. Stavely and Main (6) reported that 20 C was the best temperature for infection of tobacco by *A. tenuis*. Saad and Hagedorn (4) reported that disease development on beans inoculated with *A. tenuis* increased as temperature decreased in the range of 28–16 C.

Stavely and Slana (7) reported that leaf wetness was important for infection of tobacco by *A. alternata*; the number of lesions per plant increased as the wet period was prolonged. We found no increase in severity with increased exposure in a moist chamber beyond 24 hr.

Spore concentration in the inoculum greatly influenced the severity of disease development. Inoculum with concentrations of 6×10^5 conidia per milliliter gave higher disease indexes on both Alsweet and Dark Skin Perfection peas than inoculum containing fewer conidia. These results are similar to those of Milholland (2), who reported that a concentration of 1×10^6 *A. alternata* spores per milliliter was optimal for production of leaf lesions on blueberry. Saad and Hagedorn (4) also found that high spore concentrations were necessary to initiate consistently high levels of disease on beans caused by *A. tenuis*.

ACKNOWLEDGMENTS

This work was supported by the College of Agricultural and Life Sciences, University of Wisconsin, Madison (Project 120). We express our sincere appreciation to S. Vicen for preparing the illustrations.

LITERATURE CITED

1. Kirpal, S. A. 1969. Alternaria blight of groundnuts. Plant Dis. Rep. 53:397-398.
2. Milholland, R. D. 1973. A leaf spot disease of highbush blueberry caused by *Alternaria tenuissima*. Phytopathology 63:1395-1397.
3. Paulus, A. O., and Pound, G. S. 1954. The effect of air temperature on incidence and development of the gray leaf spot and nailhead spot diseases of tomato. (Abstr.) Phytopathology 44:502.
4. Saad, S., and Hagedorn, D. J. 1969. Symptomatology and epidemiology of Alternaria leaf spot of bean, *Phaseolus vulgaris*. Phytopathology 59:1530-1533.
5. Sherwood, R. T., and Hagedorn, D. J. 1958. Determining common root rot potential of pea fields. Wis. Agric. Exp. Stn. Bull. 531. 12 pp.
6. Stavely, J. R., and Main, C. E. 1970. Influence of temperature and other factors on initiation of tobacco brown spot. Phytopathology 60:1591-1596.
7. Stavely, J. R., and Slana, L. J. 1975. Relation of postinoculation leaf wetness to initiation of tobacco brown spot. Phytopathology 65:897-901.