

Leaf blotch on Laurier barley

R.V. Clark¹, W.L. Seaman¹, K.S. Clough², and J.D.E. Stirling³

An unusual leaf blotch has been observed on Laurier barley at several locations in eastern Canada. It was prevalent in late June and early July 1976 when high daytime temperatures and, in Ontario, high relative humidity levels were experienced. Other cultivars were free from the leaf blotch symptoms. The characteristic blotches appeared as irregular clusters of small necrotic spots surrounding a central brown spot, sometimes giving the appearance of an eyespot lesion, with varying amounts of chlorotic or light brown tissue. Attempts to identify a causal agent and to reproduce the symptoms by inoculation with affected leaf tissue were unsuccessful. Somewhat similar symptoms have been noted in certain barley cultivars affected by various stresses under conditions of high humidity. Examples include Laurier affected by powdery mildew, Perth affected by physiological brown spot, and Vanier treated with maneb or pirimicarb.

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Des symptômes exceptionnels de taches foliaires ont été observés sur le cultivar d'orge Laurier à plusieurs endroits de l'est du Canada. Ils étaient très répandus en fin de juin et au début de juillet 1976, période caractérisée par des températures diurnes chaudes et, en Ontario, par des taux d'humidité relative élevés. Les autres cultivars ne portaient pas ces symptômes. Les taches se présentaient en grappes irrégulières de petits points nécrotiques entourant une plage centrale brune, et lui conférant parfois un aspect de lésion ocellée, le tout accompagné de plus ou moins de tissus chlorotés ou brun pâle. Les essais d'identification de l'organisme causal ou de reproduction des symptômes par inoculation au moyen de tissu foliaire infecté se sont révélés vains. On a constaté des symptômes approchant chez certains cultivars d'orge exposés à divers stress en milieu de végétation très humide. Il y a, notamment, les cas de Laurier à la suite d'infection d'*oïdium* (blanc), de Perth atteint de la tache brune d'origine physiologique et de Vanier sous l'effet de traitement au manèbe ou au pirimicarbe.

In 1976 an unusual leaf blotch was observed on the recently released 6-rowed barley (*Hordeum vulgare* L.) cultivar Laurier (4) at several locations in eastern Canada. The leaf spot most commonly found on barley in the field in eastern Canada is spot blotch caused by the fungus *Cochliobolus sativus* (Ito and Kurib.) Drechs. ex Dastur, stat. imperf. *Bipolaris sorokiniana* (Sacc. in Sorok.) Shoem. Symptoms of spot blotch on leaves include dark brown, elongate spots with definite margins, the spots often coalescing to form irregular stripes (Fig. 1A). The blotches occurring on Laurier appeared first as clusters of small necrotic flecks or spots, usually surrounding a central dark brown spot (Figs. 1B, 1C). As the blotches enlarged the necrotic spots often formed a more definite ring and the surrounding tissue became chlorotic (Fig. 1E) or light brown (Fig. 1C). The blotches occurred on leaves of all ages but were more prominent on upper leaves.

In Ontario the condition was seen first at Ottawa in mid June in test plots of Laurier barley when plants were at the heading stage. At Brantford, the condition was prominent during the first week of July at the milky ripe stage of growth in a 0.5 ha planting of Laurier located within a large field of Herta barley; similar plantings of

Conquest and Vanier barley in adjacent blocks and of Herta in the large field were free from the symptoms. The unusual symptoms were also observed in test plots of Laurier at Kippen, Elora, and Arkell but were not seen at Douglas, where only typical spot blotch symptoms were observed (Fig. 1A). Late in the growing season spot blotch and barley yellow dwarf became severe on all cultivars, and it was much more difficult to distinguish symptoms at that time. Consequently the effect of the blotch on yield could not be assessed. The unusual symptoms were not seen on Laurier in Ontario in 1977 but were evident in trace amounts in 1978.

In late June and early July 1976 a similar condition was evident in plot and field plantings of Laurier barley in Prince Edward Island and Nova Scotia (Figs. 1D, 1E). As in Ontario, the blotch symptom (referred to locally as "splat") was common on and unique to Laurier. Other leaf spots were scarce in the Maritimes in 1976 so that this symptom was particularly striking. In 1977 the symptom was very rare on Laurier in P.E.I., but it was present in a plot of the cultivar Zumpakei (C.I. 692). Christensen (1) in 1933 also described symptoms on Zumpakei that were similar to those found on Laurier in Ontario and P.E.I. in 1976. In Quebec similar symptoms, described as large concentric lesions, were observed in Laurier in 1976 and 1977 (G.J. Pelletier, personal communication).

Isolation and inoculation tests

Attempts to isolate pathogenic fungi and bacteria from surface sterilized Laurier leaves showing blotches were

¹ Research Station, Agriculture Canada, Ottawa, Ontario, K1A 0C6 and Charlottetown, P.E.I. CIA 7M8

³ Contribution Nos 570 and 424, respectively

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unsuccessful. Under moist conditions *B. sorokiniana* sporulated profusely on the surface of many of the older senescent leaves from Ontario plants but did not develop on green leaves showing the unusual blotch symptoms. Samples of the leaf tissues and of sap expressed from green leaves with blotches were examined with the transmission electron microscope but no evidence of causal agents was detected.

In a series of tests conducted in growth cabinets (light period 16 h, 32,000 lux, 22°C; dark period 8 h, 16°C) affected leaves of various ages from Ontario fields were placed on the surface of a soil potting mixture in pots of Laurier and Vanier barley plants at the 4- to 5- leaf stage. Some of the test plants were enclosed in polyethylene bags for 4-6 days to provide conditions of high relative humidity and elevated temperatures. No symptoms developed in test plants growing in proximity to detached green leaves showing only the unusual blotch symptom, and there was no indication of *B. sorokiniana* development on the detached leaves. However in enclosed pots containing detached senescing leaves, symptoms of spot blotch developed on the test plants and *B. sorokiniana* sporulated profusely on the detached leaves. In some of the enclosed pots containing older necrotic leaves, powdery mildew (*Erysiphe graminis* DC. ex Mérat) developed on susceptible test plants; in a few leaves of Laurier the mildew-affected areas expanded to form light brown blotches surrounding a central dark brown spot (Fig. 1F). Plants not enclosed in polyethylene bags were free from symptoms except for the development on a few plants of symptoms similar to physiological brown spot described by Dickson (2).

In inoculation tests at Charlottetown, blotched leaf tissues from field-grown Laurier barley were ground up with distilled water and the suspension was sprayed on plants of Laurier barley in the greenhouse. Similar preparations from leaves showing no symptoms were used as checks. The plants were kept at 23°C and 60-75% relative humidity (RH) during the day and at 15°C and 98% RH during the night. No symptoms developed on any of the test plants.

Other blotch symptoms

Other unusual leaf blotches have been observed recently at Ottawa in barley cultivars in the field, greenhouse, and growth room following application of pesticides and/or exposure to periods of high humidity. In field plots of Vanier barley, blotch symptoms (Fig. 2A) were observed in late June 1977, a few days after the plants had been sprayed with maneb 80% WP, 7.3 kg active ingredient (a.i) per hectare, at the boot stage. The fungicide application was preceded and followed by several periods of wet, humid weather accompanied by high daytime temperatures; blotch symptoms developed only on the lower leaves and none developed on unsprayed plants or later when maneb was applied under less humid conditions.

In a greenhouse test, similar symptoms developed at heading time on plants of Vanier barley that had been

sprayed a few days earlier with the insecticide pirimicarb 50% WP, 0.25 g a.i. per litre, for aphid control. Following treatment, one group of plants was kept on a greenhouse bench, another was exposed to one 36 h period of 100% relative humidity at the late tillering stage, and a third group was exposed to two periods of high humidity, at the late tillering stage and 10 days later at the early flowering stage. Greenhouse temperature ranged from 15.6°C to 24°C but occasionally reached 38°C for short periods. Blotch-like symptoms developed on Vanier plants in the three groups but were more pronounced on plants exposed to the two periods of high humidity (Fig. 2B). Plants of three other cultivars in the test, Beacon, Bonanza, and O.B. 123-34, did not develop symptoms.

Recently in growth room plantings of the barley cultivars Massey and Perth, all plants developed nonparasitic brown spot symptoms (Figs. 2C,2D) at heading time under standard growing conditions. Plants of Perth that were placed in polyethylene bags for 4 days prior to heading to provide high humidity developed unusual leaf blotch symptoms (Figs. 2E,2F), but plants of Massey did not.

Discussion

The purpose of this report is to illustrate the unusual symptoms observed recently in Laurier and other barley cultivars growing under a variety of conditions. While at present no positive explanation of the factors responsible for the leaf blotches is evident, our observations suggest that the unusual symptoms are expressed by certain cultivars under conditions of variable temperature and high humidity. Factors triggering development of these blotches apparently may be parasitic or nonparasitic.

Physiological disease problems are often associated with unusual weather patterns. In Ontario records for the Douglas, Ottawa, Brantford, and Elora areas indicate that the weather in early June 1976 was very dry and hot; however, from mid June to mid July rainfall, humidity, and daytime temperatures were unusually high and night-time temperatures were low, especially at Brantford during the 4th week of June. In Prince Edward Island and Nova Scotia, the June 1976 weather was also hot and dry while July continued hot but with considerable rain; in 1977 all locations were generally cooler and wet, especially toward the end of the growing season.

Extensive studies by Christensen (1) indicated that nonparasitic leaf spots in barley could be cultivar specific, as in the case of the cultivar Zumpakei, but that they could also be related to nutrition and soil toxicity. None of the cultivars or lines grown with Laurier in the field in 1976 developed similar blotch symptoms, indicating that the reaction of Laurier to an unidentified stress, possibly mildew, is specific to that cultivar. However, the differential reactions observed with other cultivars under conditions of high relative humidity suggest that similar symptoms may be induced in cultivars such as Vanier and Perth.

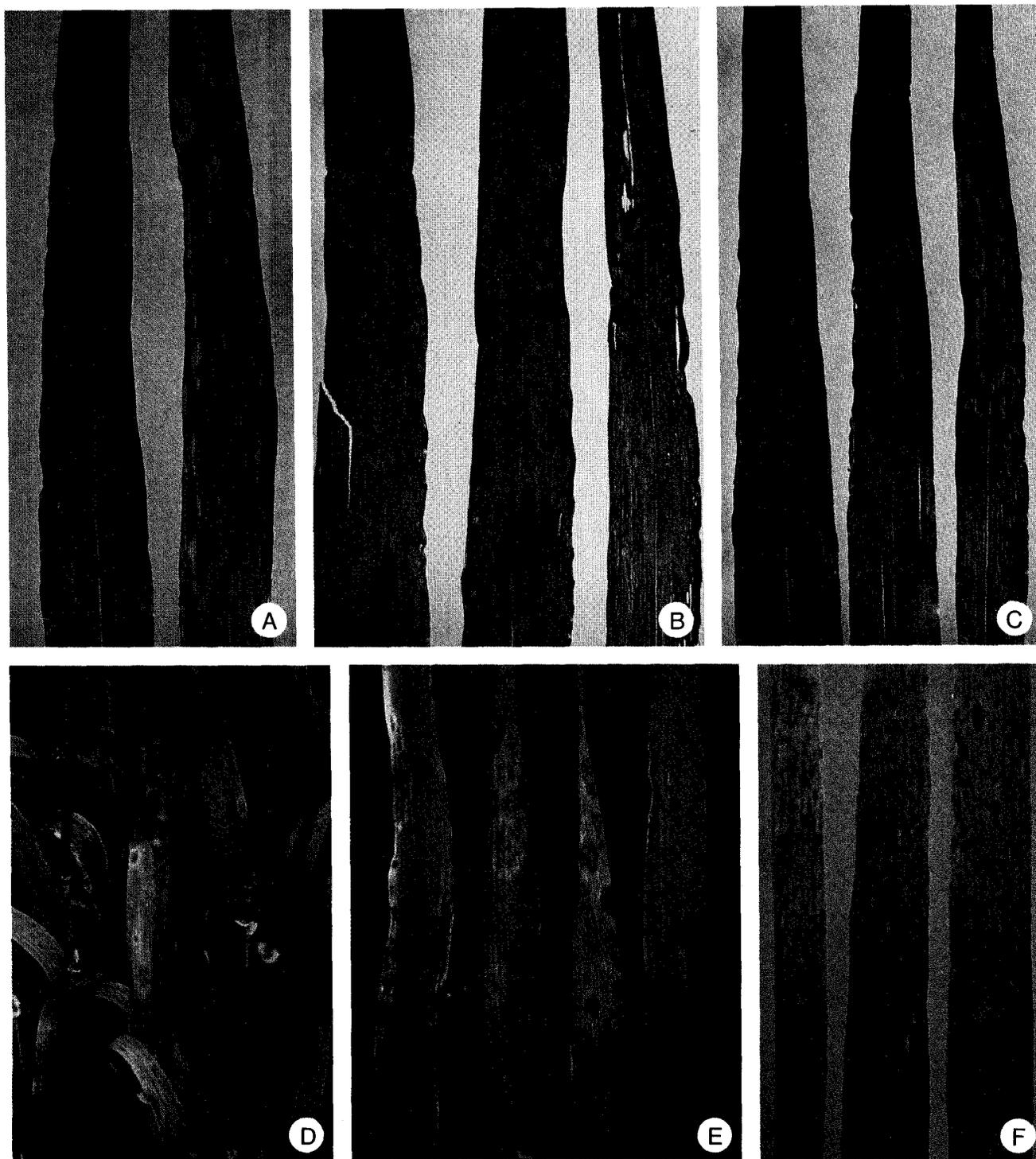


Figure 1 (A to F). (A) Spot blotch (*Cochliobolus sativus*) on Laurier barley, Douglas, Ontario, July 1976. (B and C) Leaf blotch on Laurier barley, Brantford, Ontario, July 1976. (D and E) Leaf blotch on Laurier barley, Charlettetown, P.E.I., July 1976, (F) Laurier barley affected by powdery mildew in a growth cabinet. Under conditions of high humidity many lesions included an area of chlorotic or light brown necrotic tissue not usually associated with the disease, and some of the lesions enlarged to form light brown blotches around atypical dark necrotic spots.

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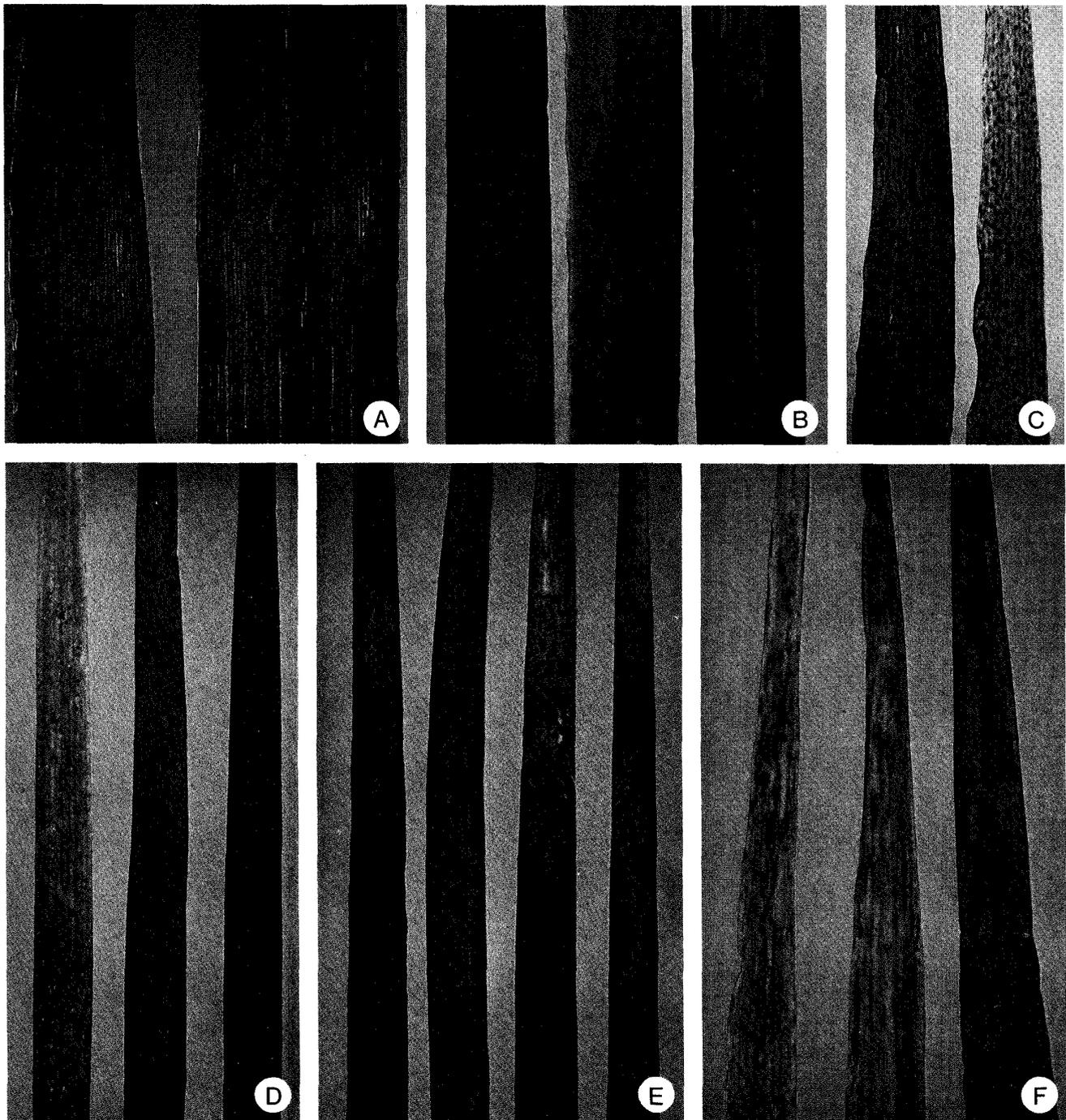


Figure 2 (A to F). (A) Leaf blotch on Vanier barley sprayed with maneb fungicide in field plots. (B) Leaf blotch on Vanier barley sprayed with pirimicarb insecticide and subsequently exposed to two periods of high relative humidity in the greenhouse. (C and D) Physiological brown spot on (C) Massey barley and (D) Perth barley at time of heading under standard growth cabinet conditions. (E and F) Leaf blotch on Perth barley grown under the same conditions as those in (D) except that plants were exposed to a 4-day period of high humidity just prior to heading. Similar blotches did not develop on Massey.

Recently Faris (3) reported that nonparasitic spotting of barley leaves before and after heading has considerable effect on seed yield, especially if the spotting is severe following heading. Thus the extensive blotching of upper leaves observed on Laurier in eastern Canada in 1976 may have had considerable effect on plant development and subsequent seed yield.

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