Verticillium wilt of alfalfa in Quebec

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Verticillium wilt of alfalfa has been found at ten different locations in Quebec this year (1986). It is the first report of the disease in Quebec since it was first discovered in North America in 1976. The ten locations are: Sainte-Anne-de-Bellevue, Compton, Hbbertville, East Hereford, La Durantaye, Lennoxville. Richelieu, Saint-Dominique, Stanstead, and Waterville. Until now, most alfalfa seed has been treated with thiram for this disease. It is not clear at this time whether infested seed and debris were the causal agent of the spread or whether the transport of alfalfa hay or natural means of dispersion were involved.

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La verticilliose de la luzerne a été trouvée à dix endroits diffbrents au Québec cette année (1986). C'est la première fois que la maladie est détectée au Québec depuis son apparition en Amérique du Nord en 1976. Les endroits sont les suivants: Sainte-Anne-de-Bellevue, Compton, East Hereford, Hbbertville, La Durantaye, Lennoxville, Richelieu, Saint-Dominique, Stanstead et Waterville. Jusqu'à maintenant, la plupart des semences de luzerne étaient traitbes au thirame. On ne sait pas encore si l'apparition de la maladie est due à la semence contaminbe, au transport de foin de luzerne infecté ou à des vecteurs naturels de dispersion.

Introduction

Verticillium wilt of alfalfa (*Medicago sativa* L.) is the most important disease of this crop in Europe. The notable damages it causes and its rapid dispersion in many countries of the world have lead research scientists to investigate it more thoroughly since 1950 in Europe (10).

Verticillium albo-atrum Reinke and Berth. was reported in North America for the first time in 1962, in alfalfa experimental plots at the Normandin research station in Quebec but was eradicated (4). In 1976, it reappeared in north-western United States (5, 7) and has now made its way to the eastern states where it was identified in Wisconsin in 1980 and in Wyoming, Montana, Minnesota, Pennsylvania, and New York in 1981 (8, 9, 11). Although no seed treatment with a fungicide has been required within the U.S.A (1), seeds imported into Canada from infested areas, must be treated.

After its first appearance in Quebec, the disease was not seen again in Canada until 1977 when it was found in south central British Columbia (12). At the present time, *V. albo-atrum* is widespread in Ontario, contained in Alberta, occurs in southern Saskatchewan and is absent in Manitoba (Jim Chan, personal communication). A comprehensive review of the literature, and a general view of the situation were given in 1982 (6) and 1981 (2) respectively. Agriculture Canada also produced a technical bulletin in 1982 and published a revised version in 1983 (3). Due to the importance of the disease, an extensive nation-wide survey of the Verticillium situation in Canada was coordinated by Agriculture Canada from 1980 to 1982. Since 1983, the provinces were given the responsibility to survey their own territory. In 1986, the Plant Health Division of the Agricultural Inspection Directorate (Agriculture Canada) was asked to survey uninfested areas of Canada for Verticillium wilt of alfalfa as part of their mandate under the Plant Quarantine Act.

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General symptoms

Leaves of infected plants become pale yellow (Figs. 2, 3 and 4) or pinkish (Fig. 5) and later bleached and desiccated (Figs. 6 and 7). Young leaflets tend to curl inward (Fig. 7). Affected stems stay green until all the leaves are dead. Usually, a small number of stems on each plant is affected at first while the rest is intact. As the wilt progresses, the number of stems infected grows until the entire plant appears dried out. One of the most typical symptoms is the browning of the xylem easily seen on the surface of the root core when the root is cut transversely (Fig. 8) or decorticated (Fig. 9).

Isolation and identification of *V. albo-atrum*

Stems of suspected plants were cut in 3-cm-long sections, dipped in 70% ethanol during a few seconds and surface disinfected with 2% sodium hypochlorite during 2 min., plated on water agar, and incubated 3-5 days at room temperature (22°C). After microscopic examination, the *Verticillium*-like colonies were replicated on potato dextrose agar (PDA) for further identification and comparison with isolate no. 282 (our collection) isolated from an alfalfa seed lot by Jim Sheppard (Seed Pathology Laboratory, Laboratory Services Division, Agriculture Canada, Ottawa).

Pathogenicity test

One isolate of *V. albo-atrum* was inoculated by a root-dip method to 7-week-old alfalfa seedlings (cv. Saranac). After a 3-week incubation period, disease was noted using a 1-5 scale (1 = plant free of disease, 5 = plant dead) for aerial parts and roots separately after which the fungus was reisolated from roots and stems and positively identified as similar to the one inoculated.

While uninoculated plants were free of Verticillium wilt, inoculated plants were severely affected and showed typical

symptoms on leaves and stems (wilt index = 4.2), and in roots (root rot index = 4.2).

Areas affected by Verticillium wilt of alfalfa

Verticillium wilt has been found in 10 different locations in Quebec this year (Table 1). Unfortunately, no obvious pattern of infection between these places is visible. The percent incidence varies from 1 to 100%.the age of the stands varies from 2 to 7 years of age and the distribution ranges from southern Quebec, near the New York border, to northern Quebec near Lac Saint-Jean (Fig. 1). As expected, older fields are generally more infected than younger ones.

Although many alfalfa fields were surveyed during the summer months of 1986 in the whole province, the first suspected plants were observed only in mid-September. Will this be the rule in the future? If so, the disease will not affect the yield of the crop heavily. On the other hand, winter survival will certainly be low based on plant mortality and vigor this fall. It is also known that frost-hardening of plants is adversely affected by disease and consequently wilted plants are more susceptible to winter-killing.

Discussion

Generally speaking, although scattered in the southern agricultural part of Quebec, the most affected area is located in the Eastern Townships, between Lennoxville and the U.S. border (Agricultural region no. 5).

According to some producers, the disease may have been present last year in small patches, at least in Cornpton, since, in the fall of 1985, the same symptoms were observed in the same severely infected field in 1986.

At present, the exact origin or mechanism of introduction and dispersion of *V. albo-atrum* into Quebec is unknown. Seed was the first suspected source examined and a visit to locations such as Sainte-Anne-de-Bellevue, Lennoxville and Saint-Dominique showed that all alfalfa seed has been in fact treated with thiram prior to planting. However, the treatment is not completely reliable (6).

Table 1. Areas reported infected with *Verticillium* in 1986 in Quebec.

Location	% incidence	Age of the stand (years)	Isolation of *V. albo-atrum*
Compton			
Old stand	40	4	+
New stand	20	2	+
East Hereford			+††
Hebertville	10	---†	+
La Durantaye	10	---	+
Lennoxville (experimental plots)	80	3	+
Sainte-Anne-de-Bellevue			
Research plot	1	2	+
Forage stand	100	7	+
Richelieu	100	5	+
Saint-Dominique	40	3	+
Stanstead	---	---	---†††
Waterville			
Old stand	70	4	---
New stand	---	2	---

† Not known

†† Isolated and identified by Le Laboratoire de diagnostic, Service de la recherche en phytotechnie, MAPAQ

††† No isolation was tried but diseased plants were positively identified

Another possible source of the disease is alfalfa hay and because of the proximity of some of these infestations to New York, a contaminated state, the disease might have been introduced into the province by means of contaminated hay and

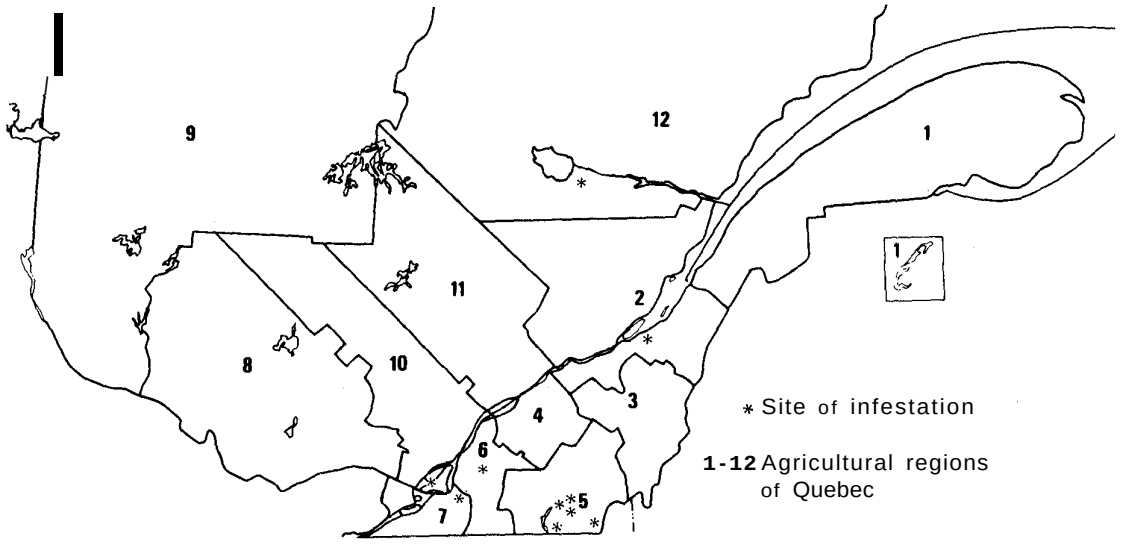

Figure 1. Locations of alfalfa crops infected by Verticillium wilt in each agricultural region of Québec.

later transmitted to locations further north. Again, this is all speculation.

What is obvious though, is that once present, this disease is very easily spread. But, whether the disease first established itself in these mature stands and was then transmitted to younger ones is hard to say. Spores present on the surface of infected stems or leaves and in the soil itself can be easily transported not only by wind and insects but also by people. All kinds of agricultural machinery used in the field or even cars can serve to carry spores from infected fields to healthy ones, not to mention contaminated hay.

The disease is now becoming widely established in places in North America north of the 45th parallel. In Canada, the disease is widespread in Ontario and B.C., contained in Alberta and has been reported on two occasions in Nova Scotia in 1981 and 1986 (Jim Chan, personal communication). In Alberta, where the disease has been contained by ploughing up the fields, it is believed this strategy is a practical solution. In British Columbia, where the disease is also prevalent, a similar suggestion was made of ploughing up the fields and replacing these with resistant cultivars as a disease management practice.

For these reasons, it is believed by the authors that complete eradication of this disease in Quebec is now unlikely; however, containment is still a possibility. The development of resistant cultivars well adapted to Quebec agricultural conditions is now a high priority.

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Figures 2–9. Symptoms of Verticillium wilt of alfalfa.
2. General appearance of an infected crop. 3. Early symptoms (bleached leaflet). **4.** Yellow leaves. 5. Pinkish leaves, 6. Desiccated leaves. 7. Curling of the leaflet. **8.** Brown ring in the root xylem. 9. Browning on the surface of the xylem.