SURVEY FOR VERTICILLIUM WILT OF TOBACCO IN QUEBEC, 1972

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Abstract

Verticillium wilt of tobacco was found to occur naturally in Quebec. The pathoqen in this case was not the highly virulent species Verticillium dahliae, but the less virulent V. nigrescens. Four commonly grown tobacco cultivars in Quebec were found to be susceptible to V. dahliae while only two were susceptible to V. nigrescens. Studies with 45 cultures of Verticillium from a wide range of hosts and geographical locations have indicated that some specilization occurs within the cultures in respect to host preference. Cultures from solanaceous hosts were more pathogenic on tobacco than cultures from non-solanaceous hosts.

Resume

On a observe l'apparition spontanée de la flêtrissure verticillienne du tabac au Quebec. Le pathogène observe n'étaient pas le très virulent Verticillium dahliae mais une espèce moins virulente V. nigrescens. Quatre cultivars couramment cultivés au Quebec étaient susceptibles à V. dahliae, mais deux seulement à V. nigrescens. Des etudes effectuées sur 45 cultures de Verticillium provenant d'hôtes et de secteurs géographiques très varies portent à croire qu'une certaine spécialisation se produit dans les cultures quant à la préférence pour l'hôte. Les cultures prélevées *sur* solanacées étaient plus pathogènes ***pour*** le tabac que celles provenant d'autres hôtes.

Verticillium wilt has become a limiting factor in tobacco production in New Zealand, where the disease is attributed chiefly to Verticillium dahliae Kleb. In 1971, 6.5%- of the total tobacco acreage of New Zealand was affected and one fifth of this area has been put out of production (Wright 1972). Verticillium wilt of tobacco has been known to occur elsewhere, including the U.S.A., but has generally been regarded as being unimportant (Lucas 1965). The disease in New Zealand is believed to have originated on tobacco planted in soil where potatoes and tomatoes had been grown. Similar climatic conditions exist in Quebec, where the major tobacco growing region is also an important potato growing area. Verticillium wilt caused by V. albo-atrum Reinke & Berth. is increasing rapidly in the potato crop and environmental conditions are suitable for development of the disease on tobacco in Quebec (Wright and Sackston 1973).

Verticillium wilt of tobacco is characterized by bright orange "tiger-stripe" discoloration of diseased leaves. External symptoms are not apparent until about the time of flowering. One of the first symptoms is wilting of the lower leaves, followed by the orange discoloration of the interveinal areas, which, as the disease progresses, turns brown leaving an orange border between living and dead tissue. Eventually all the leaves may become infected, often before they can be harvested (Thompson and McLeod 1959).

In 1972 a survey of the tobacco producing area of Quebec, primarily L'Assomption and Joliette counties, was undertaken to determine the presence of the disease in this province. With the advice and co-operation of Marcel Dupré of the Agriculture Canada Research Station at L'Assomption, Quebec, major tobacco growers in the province were located.

The ability of several strains of Verticillium dahliae and V. albo-atrum from various hosts and geographical locations in Quebec and elsewhere to attack and cause disease in tobacco was also investigated. In addition four commonly grown tobacco cultivars were tested for resistance to the disease.

Materials and methods

Thirty tobacco fields were visited twice durinq the 1972 growing season. The first circuit began early in August just before flowering. The second circuit of the tobacco survey began August 19 and the survey was terminated by September 9. Leaf samples from over fifty plants exhibiting Verticillium-like symptoms were collected. Midribs were removed and surface sterilized using a 50%

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sodium hypochlorite solution, and plated on V-8 juice agar. After 7-10 days incubation at 25 C the plates were examined for signs of Verticillium growing from the tissues.

Cultures of Verticillium used for inoculation of test plants were grown for 14 days on potato dextrose agar at 25 C. The cultures were then comminuted in a Waring Blendor for 3 minutes and the inoculum concentration adjusted to 30 x 10^6 propagules per ml using a haemocytometer.

Test plants were inoculated by the root dip technique. Forty-day-old seedlings were removed from the seedbed and all soil was removed from the roots by gentle washing. The seedlings were then placed for 5 min in a beaker containing the inoculum suspension before transplanting into randomized rows in field plots. The plants were observed routinely and isolations made from all plant showing symptoms of the disease.

The four commonly grown cultivars of Nicotiana tabacum L. used in the course of this investigation included the flue cured cultivars Delhi 34 and Hicks Broadleaf, and the cigar cultivars Ottawa 705 and RH 211.

The severity of the disease on each plant was estimated 90 days after inoculation and was recorded as the percentage of leaves showing symptoms of the disease.

Results

survey

In 1972 the only positive identification of Verticillium on tobacco in Quebec was from one plant of cigar tobacco (Nicotiana tabacum L. cv. Ottawa 705) collected August 10 at the Agriculture Canada Research Station, L'Assomption, from a field where clover had been grown previously. The lower leaves of this plant exhibited the characteristic orange tiger-stripe discoloration and were badly wilted. The plant was in flower at the time. The disease was not identified in samples from any other place in the province, although verticillium-like symptoms were observed at six other locations in L'Assomption, Joliette, and Rouville counties.

The isolate of Verticillium collected from L'Assomption was identified as V. nigrescens Pethybr. Although this species of Verticillium has been reported on other crops in the same area (Devaux and Sackston 1966), this is the first report of V. nisrescens causing wilt of tobacco in Canada or elsewhere. The pathogenicity of this isolate of Verticillium was verified by inoculation of healthy tobacco seedlings of the cigar tobacco cultivar RH 211.

In 1973 the disease was found again in an adjacent plot at the L'Assomption Research station, also on cigar tobacco cultivar Ottawa 705 (3 plants) and on the cigar tobacco cultivar Comstock Pomeroy (1 plant).

Pathogenicity of Verticillium cultures to tobacco

Symptoms of verticillium wilt occurred on plants of the flue-cured tobacco cultivar Hick Broadleaf inoculated with 25 of 45 Verticillium cultures tested (Table 1). However the typical tiger-stripe symptoms described by Thompson and McLeod (1959) did not develop in most cases. Early symptoms of the disease were characterized by chlorosis of the interveinal areas and wilting of the lower leaves. As the disease progressed the tissue became necrotic followed by a rapid drying out of the leaf. Pure cultures of Verticillium were isolated from all plants showing symptoms of the disease but not from the symptomless ones, nor from the controls.

susceptibility of four commonly grown tobacco cultivars to V. dahliae and V. nigrescens

All plants of the four cultivars inoculated with V. dahliae (isolate VIFT, Wright and Sackston 1973) produced severe symptoms of the disease by the time of flowering. In decreasing order of resistance these were Ottawa 705, RH 211, Delhi 34, and Hicks Broadleaf. cigar tobacco cultivars appeared more susceptible to attack by V. nigrescens. In descending order of resistance these were Hicks Broadleaf, Delhi 34, Ottawa 705, and RH 211.

Discussion and conclusions

Verticillium wilt of tobacco was found to occur naturally in Quebec in 1972 and again in 1973. The fungus in this case was not the highly pathogenic species V. dahliae but the less virulent V. nisrescens. symptoms on infected plants were not always the characteristic tiger-stripe discoloration of the interveinal areas of infected leaves, as described by Thompson and McLeod (1959), but often were merely severe chlorosis and/or necrosis accompanied by wilting of the lower leaves and puckering of the lamina. This is the first report of the disease in Canada and also the first report of V. nigrescens as a pathogen of tobacco.

V. nigrescens is, in general, a relatively weak pathogen and isolates vary in their pathogenicity to tobacco and other hosts. This variability has been observed by other workers (Aubé 1963, Devaux 1964).

studies on the pathogenicity of various cultures of V. albo-atrum and V. dahliae have shown that- the tobacco cultivar Hicks Broadleaf is susceptible to both V. dahliae and V. albo-atrum. Of the two species V. dahliae is far more virulent on tobacco. There appears to be some host specificity among strains; however, strains from both related and nonrelated hosts were capable of attacking tobacco and causing the disease.

Table 1. Pathogenicity of *Verticillium* cultures on Hicks Broadleaf tobacco

Culture	Species*	Source of original culture	Original host	Pathogenicity† on tobacco
V1	V. a.	La Moline		+
v3	V. a.	La Moline	Sunflower	+
v4	V. a.	La Moline	Eggplant	+
v5	V. a.	Mac. College, Que.	Sunflower	-
v7	V. a.	Ontario	Strawberry	-
V8	V. a.	Ontario	Dahlia	+
V9	V. a.	Ontario	Eggplant	+
V10	V. a.	Ontario	Shiro plum	-
v12	V. a.	Ontario	Maple	+
V13	V. a.	Ontario	Raspberry	+
V14	V. a.	Ontario	Rose	-
V15	V. a.	Ontario	Tomato	-
V16	V. a.	P. E. I.	Potato	+
V17	V. a.	California	Tomato	-
V27	V. d.	Ontario	Tomato	-
V29	V. d.	Ontario	Strawberry	-
V30	V. d.	Ontario	Tomato	++
V51	V. a.	Versaille	Melon	-
v53	V. a.	St. Germain, Que.	Potato	++
v55	V. a.	L' Assomption, Que.	Potato	++
v57	V. d.	Mac. College, Que.	Potato	+
V60	V. a.	Fredericton, N.B.	Potato	-
V63	V. d.	Summerland, B.C.	Squash	-
V65	V. d.	Summerland, B.C.	Nightshade	-
V67	V. d.	Summerland, B.C.	Sweet pepper	-
V69	V. d.	Summerland, B.C.	*Sisymbrium altissimum*	++
V70	V. d.	Summerland, B.C.	Cantaloupe	-
V72	V. d.	Summerland, B.C.	Lamb's quarters	-
v73	V. d.	Summerland, B.C.	*Capsella bursa-pastoris*	-
v74	V. d.	Summerland, B.C.	Tomato	++
V78	V. d.	Summerland, B.C.	*Amaranthus graecizans*	+
v79	V. d.	Summerland, B.C.	Hop	-
V81	V. d.	Summerland, B.C.	Strawberry	-
V84	V. a.	Dade Co., Florida	*Crotalaria spectabilis*	-
V85	V. a.	Dade Co., Florida	*Solanum nigrum*	++
V87	V. a.	Dade Co., Florida	Okra	++
V89	V. a.	Dade Co., Florida	Southern pea	+
V91	V. a.	Dade Co., Florida	Cuban squash	+
V93	V. d.	Ste. Dorthde, Que.	Eggplant	++
v94	V. d.	Ste. Clotilde, Que.	Eggplant	-
V96	V. a.	St. Augustin, Que.	Potato	++
v97	V. a.	Deschambault, Que.	Potato	++
V98	V. a.	Ste. Clotilde, Que.	Potato	++
v75	V. d.	Summerland, B.C.	*Lactuca scariola*	++
VIFT**	V. d.	Mac. College, Que.	Tobacco	++

* V. a. = *Verticillium albo-atrum*, V. d. = *Verticillium dahliae*.

† + = Mild symptoms, ++ = severe symptoms.

** Wright and Sackston 1973.

The majority of tested cultures found to be pathogenic to tobacco were from solanaceous hosts, primarily tomato and potato, both of which are closely related to tobacco.

Of the four tobacco cultivars used in the course of this investigation all were susceptible to V. dahliae, while only Ottawa 705 and RH 211 appeared to be susceptible to the less virulent species V. niarescens.

Verticillium wilt cannot at this time be considered a threat to tobacco production in Quebec. The Occurrence of V. nigrescens as a weak pathogen on tobacco should be taken as a warning to be on the alert for more serious developments in the future. The disease in New Zealand was first reported in 1944, and it was not until 1959, 15 years later, that it became a serious problem (Thompson and McLeod 1959). Efforts should be made to

develop suitable resistant cultivars which can be made available to growers. Growers should be made aware of the problem and be advised to practice the best possible field sanitation, to ensure adequate sterilization of seedbed soil, and to use only crops resistant to verticillium wilt in rotation with tobacco.

Acknowledgments

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