PATHOGENICITY OF CERTAIN VERTICILLIUM ISOLATES FROM FRUIT AND VEGETABLE HOSTS TO SOME ORNAMENTALS[1]

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Abstract

The pathogenicity of eleven isolates of Verticillium albo-atrum R. & B. cultured from naturally infected fruit and vegetable hosts was determined on twelve genera of ornamental plants. Plants of each genus were infected by one or more isolates and the symptoms ranged from flaccidity and yellowing of lower leaves to complete wilting. The incubation periods, however, varied to a great extent depending upon the host. The isolates differed in their pathogenic ability but host specificity was not evident.

Introduction

The importance of the disease caused by the fungus Verticillium albo-atrum R. & B. and related species can not be overemphasized since the fungus is one of the most ploephagous pathogens known. The recorded hosts of pathogenic Verticillia are numerous (3, 5, 15, 17). Over 70 families of dicotyledonous plants have been found to be susceptible to this fungus (7). Despite such a wide host range, a high degree of specialized parasitism has also been noted in isolates obtained from peppermint (6, 11), Brussels sprouts (9) and pepper (10). Apart from the reports of such host-specificity, marked differences in pathogenic ability are known to exist among various isolates of the pathogen in different areas (1, 2, 4).

The main purpose of the present investigation was to determine the pathogenic ability of a number of isolates of Verticillfum albo-atrum R. & B. obtained from certain fruit and vegetable crops toward a group of ornamental hosts belonging to twelve genera on which the disease symptoms had not been adequately described and definite proof of pathogenicity was lacking.

Materials and Methoda

The isolates of the pathogen were secured by direct isolation of naturally-diseased peach, apricot, cherry, shiro plum, strawberry, raspberry, honeysuckle, eggplant, tomato and potato plants and from lettuce seeds, A brief description of each isolate is presented in the Table 1.

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Table 1. Host, sources and the type of resting body of the isolates of Verticillium albo-atrum employed.

Host	Source	Resting body
Apricots	Vineland, Ontario	Microsclerotia
Cherry	" "	"
Peach	" "	"
Strawberry	" "	"
Raspberry	" "	"
Lonicera	" "	"
Shiro plum	" "	"
Tomato	" "	"
Eggplant	" "	"
Potato	Charlottetown, P.E.I.	Dark mycelium
Lettuce seed	Ottawa, Ontario.	Microsclerotia

The dark mycelium type of isolate was unquestionably Verticillium albo-atrum R. & B. as interpreted by most authors (2, 4, 8, 14, 15, 17). Opinions differ regarding the nomenclature of the microsclerotia-producing cultures. Some authors regard them as V. dahliae Kleb. (2, 8, 14, 17), a distinct species. The present writer shares the view of Rudolph (15) and others (4, 11, 18) who consider the latter group as belonging to the species Verticillium albo-atrum R. & B.

The following ornamental plants were selected from Rudolph's index (15) for infection experiments: Antirrhinum majus L. (snapdragon), Callistephus chinensis (L) Nees (China aster), Dianthus caryophyllus L. (carnation), Geranium sanguineum L. (blood-red geranium), Helichrysum bracteatum Ndr. (strawflower), Impatiens sultani Hook. f. (garden balsam), Lathyras odoratus L. (sweet pea), Lupinus polyphyllus Lyndl. (lupine), Mentha piperita L. (peppermint), Monarda odoratissima Benth. (horsemint), Petunia hybrida Vilm. (garden petunia) and Senecio cruentus (Mass.) D.C. (cineraria). All test plants were raised from commercially available seeds and clones, and a drastic selection was made for morphological uniformity of the seedlings prior to inoculation.

At least twenty seedlings (4-6 weeks old) of each host were inoculated by soaking the washed roots in a homogenized suspension of each isolate for 16-18 hours. The inoculum was prepared from 14-21 day old cultures and consisted of microsclerotia, mycelium and conidia (approx 4×10^4/ml). The inoculated seedlings were potted in steam-sterilized soil and placed on greenhouse benches. Hosts which did not show distinct symptoms in the greenhouse were tested under field condition during the summer to ascertain whether the natural environment would enhance the disease development. Before planting, the test plot was fumigated with chloropicrin as recommended by Wilhelm and Koch (19).

Both in the greenhouse and in the field the inoculated plants were observed carefully for over four months for external symptoms and finally reisolations were made from each plant to determine the infectivity of the fungus. The most dependable method of reisolation was to plate small pieces of petioles of lower leaves. The pieces were surface sterilized by rinsing them in a 1% solution of sodium hypochlorite for 10-15 minutes and plated directly on water-agar medium. Within 3-4 days the fungus appeared as white tufts of mycelium from the cut ends of the petioles (Fig. 1).

Results

Observations on symptomatology, incubation period and the severity of the disease on various hosts with the eleven isolates of the fungus were as follows:

The most rapid and severe development of the disease was noticed on lupine, strawflower and cineraria. The incubation period was 15-20 days with each of these hosts. On lupine the initial symptoms were flaccidity and drooping of the leaflets; occasionally, with some degree of twisting and curling. This condition was soon followed by collapse and drying of the petioles (Fig, 3). On the strawflower, at first, the lower leaves wilted and turned brown, but as the disease progressed the central leaves tended to twist and curl giving the plant a somewhat loose and ragged appearance (Fig, 2). Vandermeer (17) and Tompkins and Ask (18) have also noticed similar symptoms on lupine and strawflower respectively. The initial symptom on cineraria was flaccidity of the lower leaves. This condition was followed by greyish-green discoloration and necrosis of the lamina or portion of it delimited by the larger veins. Finally the whole leaf drooped (Fig, 5). In all of the above mentioned hosts the vascular discoloration caused by the fungus was rapid and the browning of vessels was conspicuous, All isolates employed were severely pathogenic to these hosts, and the disease symptoms were quite distinct while, on the other band, none of the isolates incited the disease on carnation and peppermint plants,

The rest of the hosts studied (china aster, garden balsam, sweet pea, petunia, geranium, snapdragon and horsemint) were infected by one or more isolates and the symptoms mainly consisted of yellowing and drying of lower leaves, although these external symptoms could easily be confused with the normal senescense of older leaves. Typical wilting of a petunia plant is shown In Fig. 4. By isolating the pathogen from lower leaves it was observed that all of the isolates were pathogenic to china aster, geranium, sweet pea and petunia, It was also interesting to note that the snapdragon was attacked by three ('eggplant', 'peach' and 'raspberry'), garden balsam by two ("Shiro plum" and Lonicera)

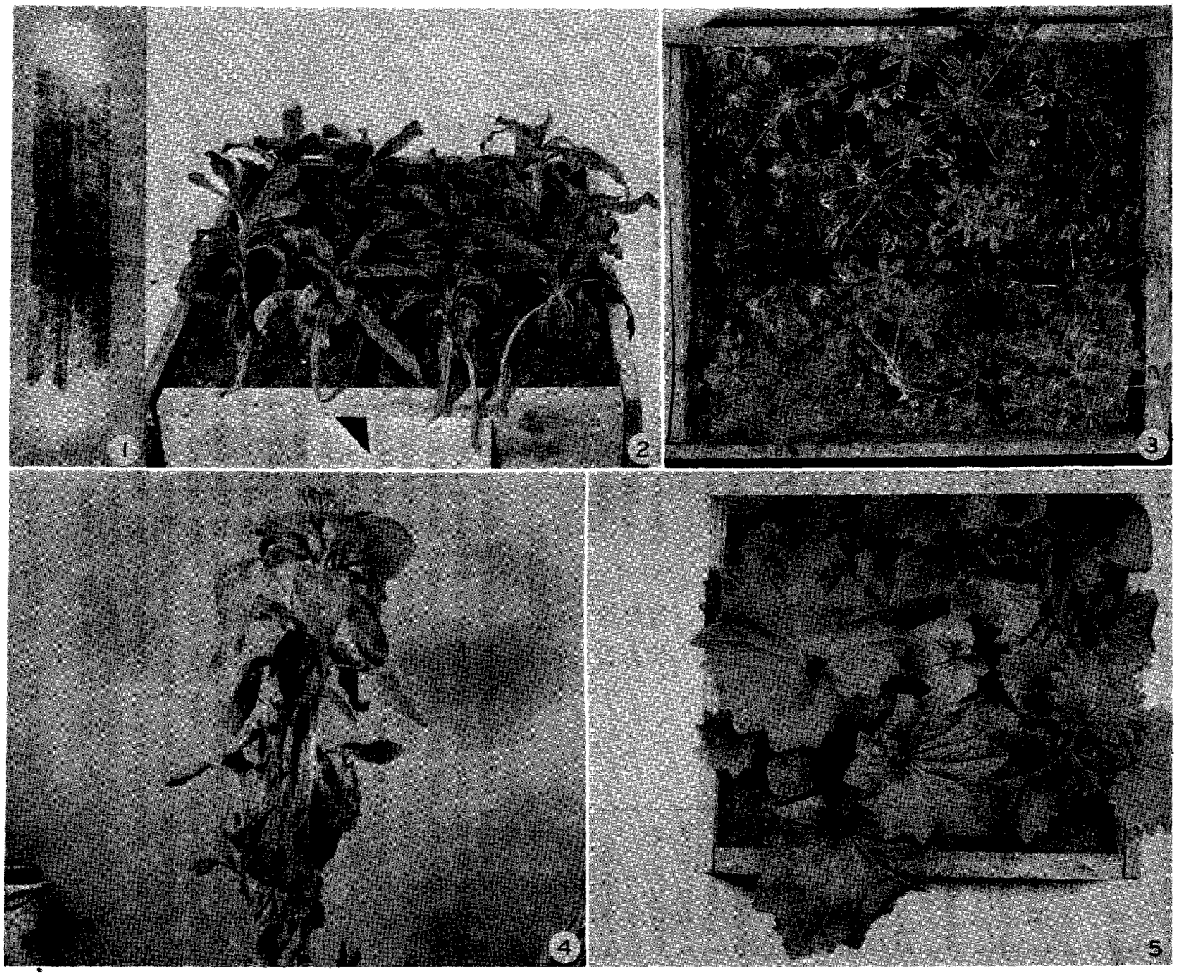

Fig. I. Tuft of mycelium of Verticillium at the cut ends of a petiole of Hetichrysum bracteatum Ndr.
Fig. 2-5. External symptom of Verticillium wilt on Helichrysum bracleatum Ndr., Lupinus polyphyllus Lyndl., Petunia hybrida Vilm., and Senecio cruentus (Mass) D. C.

and horsemint by one ('lettuce seed') of the isolates. The period of incubation, the severity of disease and the pathogen reisolated from the inoculated plants are presented in the Table 2.

Table 2. Period of incubation, disease severity and pathogenic isolates of the various ornamental hosts studied.

Host (common names)	Incubation period (days)	Severity of disease	Pathogenic isolates
1. Snapdragon	25-30	moderate	'eggplant' 'peach' 'raspberry'
2. China aster	40-45	very mild	all
3. Carnation	--	nil	none
4. Geranium	50-60	very mild	all
5. Strawflower	15-20	sevexe	all
6. Garden balsam	45-50	very mild	'Shiro plum' and Lonicera'
7, Sweet pea	25-30	mild	all
8, Lupine	15-20	severe	all
9, Peppermint	---	nil	none
10. Horsemint	50-60	very mild	'lettuce seed'
11. Petunia	25-30	mild	all
12. Cineraria	15-20	severe	all

Discussion

From the infection experiments the symptomatology of Verticillium wilt on the hosts studied seemed to follow a definite pattern, ranging from slight yellowing and flaccidity of lower leaves to complete wilting of all leaves, The disease apparently progressed from the base of the plant upwards. The symptoms were invariably associated with the presence of the fungus within the plant and the production of a brown substance in the vascular bundles was conspicuous in some of the hosts,, However, no attempt was made to characterize this brown substance,

Seven of the twelve hosts were susceptible to all isolates employed but the incubation period and the severity of the disease varied from host to host, In most instances the severity of the disease was correlated with the incubation period, For instance, with lupin, cineraria and strawflower the incubation period was short and the disease was severe, while with china aster, geranium and garden balsam the incubation period was long and the plants were mildly infected. However, a milder type of symptom expression with a shorter incubation period was observed in petunia and sweet pea.

Only two isolates were pathogenic to garden balsam and three to snapdragon and only one could infect Monarda while none of the isolates were able to cause disease in mint and carnation, The garden balsam has very few fungal diseases (13). These results strongly suggest that there are qualitative differences among the isolates, but at this stage no generalization can be made regarding the nature of the differences except for the fact that strict host-specificity was not evident in any of the isolates,

There seems to be a potential value of hosts like lupin, cineraria and strawflower in the study of Verticillium wilt problems because of their high susceptibility to the various isolates of the fungus and the short incubation period of the disease. There is also a strong possibility that any of the above mentioned hosts may be successfully used as indicator plants (18) when assessing the inoculum potential of Verticillium in soil, With respect to other ornamental hosts studied, the disease can best be diagnosed by isolating the pathogen from petioles of the lower leaves of a suspected plant,

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