DISTRIBUTION IN ONTARIO OF VERTICILLIUM STRAINS CAUSING WILT OF POTATOES

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Introduction

Surveys of the important potato-growing areas in Ontario were made during the three growing seasons of 1964, 1965, and 1966 to determine the distribution and the relative prevalence of the strains, dark mycelial (DM) and microsclerotial (MS), of Verticillium albo-atrum Reinke and Berth within the province. Samples of stems from potatoes suspected of having wilt were collected from all fields visited and at the same time, where possible, the variety of potato involved, the seed source, and the previous cropping history of the field for the last two years was noted. Personnel of the Ontario and Canada Departments of Agriculture also sent in many samples.

Materials and methods

Sections of stems 2-3" long were surface sterilized, cut into small pieces and placed on acidified plates of potato-dextrose agar (PDA) plus streptomycin. Fungal colonies tentatively identified as Verticillium were transferred from the isolation plates and grown in pure culture on PDA at 20°C and 29.5°C for final confirmation as to strain. The cultures were classified as either DM or MS strains of V. albo-atrum and V. nigrescens, the presence of chlamydospores being used as the criterion for the latter species.

Table 1. Results of a survey during 1964, 1965, and 1966 of potato areas in Ontario. All figures refer to number of fields involved.

Variety	Fields Examined	Culture Type MS	DM	MS/DM	Nig.	Seed Source Maritimes	Ontario	Potatoes in last 2 years
Sebago	17	8	13	4	1	5	1	-
Kennebec	10	5	7	2		6	1	5
Cobbler	6	3	3		-	1	2	-
Cherokee	5	2	3			1	-	-
Other	17	6	10		2	-	3	2
Total 1964	55	24	36	6	3	11	7	7
Sebago	9	5	5	2	1	2	5	-
Kennebec	16	5	12	2	-	7	4	6
Cobbler	6		5		1	4	2	2
Cherokee	6	4	4	2	-	4	1	4
Netted Gem	1				1	-	-	-
Other	5	3	2			-	3	2
Total 1965	43	17	28	6	3	17	15	14
Sebago	19	12	6	1	2	9	7	8
Kennebec	26	10	19	3	2	14	9	16
Cobbler	10	9	2	1	-	4	4	4
Cherokee	6	3	3		1	4	2	3
Netted Gem	6	6	2	2	-	3	2	3
Kathadin	5	4	1		-	4	1	3
Other	4	3	1		-	2	2	2
Total 1966	76	47	34	7	5	40	27	39

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Results and discussion

Table 1 shows the number of fields of each potato variety examined, the distribution of Verticillium strains in each variety, the seed source and the cropping practice. Note that in all three years a few fields yielded both MS and DM cultures.

No correlation is apparent in Table 1 between variety, seed source, or cropping practice and the strain of V. albo-atrum present, with the possible exception of 'Kennebec'. This variety yielded a larger number of DM than MS cultures in all three years. Since 'Kennebec' is not resistant to the MS strain (1), no ready explanation of the bias is apparent. However, Table 1 indicates that more 'Kennebec' seed of Maritime than of Ontario origin is planted each year; since DM is the only strain present in potatoes in the Maritimes this could possibly account for the results noted herein.

Table II shows the distribution of strains by year within the 10 most important potato-growing counties of Ontario. Several additional counties, not shown in Table 11, were also visited and examined during 1964 and 1965.

Three of the ten counties surveyed showed a strong trend in favor of one or the other strain of Verticillium. Dufferin and Durham produced far more DM cultures than MS, and Wentworth, more MS than DM. There are, of course, many factors which could account for this; cropping practice and temperature are the two most obvious.

It is interesting to note that during 1964 and 1965 the total number of DM cultures isolated was greater than the total number of MS isolates obtained. However, this trend was reversed in 1966 with the MS cultures being more numerous

It is generally conceded that while the optimum temperature for growth on a petri dish for both DM and MS cultures is the same, the MS strain will grow at a higher temperature than DM strains, the latter strain being inhibited at 29-30°C.

Table III shows the weekly maximum air-temperature means from the second week of June to the last week of August. Table IV shows the weekly maximum soil-temperature means at the 10-cm level under sod for the same period of time. The data for both tables were obtained from the Guelph Weather Station.

An examination of Table II reveals that during 1964 the air temperature mean exceeded 81°F (27%) only during the week of July 25 with nine days from the last week in June to the end of July recording a maximum of 86°F (30°C) or higher. At no time during 1965 did the maximum air-temperature mean come close to 81°F and only one day during June and July exceeded 86°F. However, during 1966 the air

Table 2. Distribution by strains of V. albo-atrum in the 10 important potato growing counties of Ontario

County	MS			Total	DM			Total	nigrescens			Total
	64	65	66		64	65	66		64	65	66	
Dufferin		2	-	2	2	4	9	15	1	-	2	3
Durham		1	8	9	4	12	5	21		-	-	
Elgin	3	-	6	9	2	-	2	4		-	-	
Middlesex	2	-	5	7	1	2	2	5	1	-	-	1
Norfolk	1	2	2	5	1	2	1	4	-	1	1	2
Simcoe	4	2	7	13	9	3	7	19		-	-	
Waterloo	2	-	1	3	3	1	1	5		-	1	I
Wellington	1	-	4	5	-	-	-	0		-	-	
Wentworth	5	5	6	16	1	1	2	4				
York	3	4	7	14	3	3	5	11				
	21	16	46	83	26	28	34	88	2	1	4	7

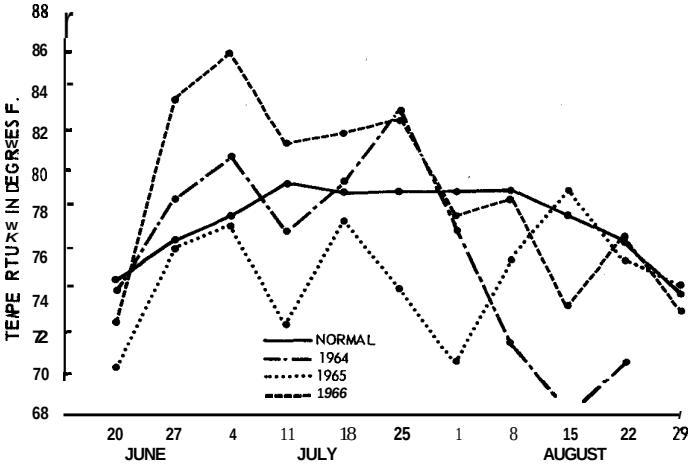

Table 3. Weekly maximum mean of oir temperature

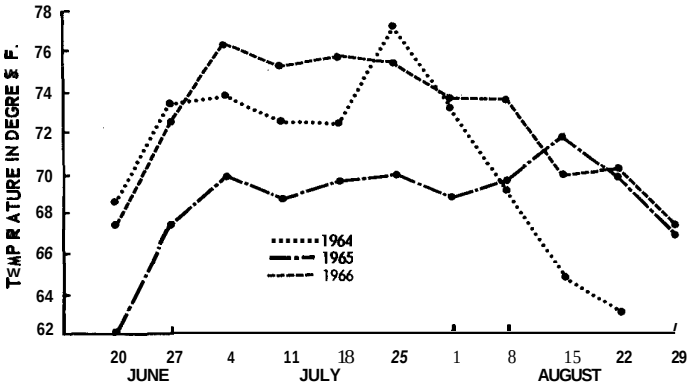

Table 4. Weekly maximum mean of soil temperature at 10 cm. level

temperature mean exceeded 81°F (27°C) from June 27 to July 25 with 16 days during this period recordinga maximum of 86°F (30°C) or higher. This, and the fact that the sun can heat the stems by insolation above the ambient air temperature, (Waggoner (6) noted the stem of a tomato was 91°F 10 cm above the soil line with an ambient air temperature of 83%) wouldsuggestthat the MS strain of V. albo-atrum would be favored over the DM strain in 1966. This would agree with Edgington and Waggoner's conclusions (2) in a parallel situation for 1964 in Connecticut.

During 1966 three of the cultures obtained from the same potato stems were mixtures of the DM and MS strains of V. albo-atrum. An examination of these isolates showed the presence of microsclerotia and dark mycelium on the same plate. This could be caused by infection of the potato plant by V. albo-atrum DM strain together with V. albo-atrum MS strain or by a species or strain of Verticillium which has both microsclerotia and dark mycelium present. When the inoculum was taken in the area where dark mycelium was present and transferred to fresh plates only a DM culture resulted. If the culture was taken where microsclerotia were present, only an MS culture resulted. Recently Schnathorst (4) demonstrated cross-protection between isolates of Verticillium in cotton plants. If this same phenomenon is exhibited in potato, then simultaneous infection of the plants by isolates of the DM and MS strains of Verticillium must have occurred in the field.

Smith (5) in his literature review refers to Verticillium tricorpus a species which normally exhibits dark mycelium, dark microsclerotia and chlamydospores. He suggests that Keyworth's "intermediate types" were actually V. tricorpus and not V. albo-atrum. However since Keyworth (3) makes no reference to chlyamdospores, Smith's conclusions may well be open to question.

Literature cited

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