A survey of carrot diseases on muck soils in the southwestern part of Quebec

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Six diseases of carrots (*Daucus carotae* var. *sativa)*, namely Cercospora blight *(Cercospora carotae)*, Crown gall *(Agrobacteriumtumefaciens)*, Alternaria blight *(Alternariadauci)*, Root knot *(Meloidogyne hapla)*, Sclerotinia rot *(Sclerotiniasclerotiorum)* and Aster yellows (Asteryellows mycoplasma), were observed in commercial fields on the muck soils in southwestern Quebec. The prevalence and incidence of the diseases are discussed.

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On a constaté la presence de six maladies de la carotte (*Daucus carotae* var. *sativa)*, soit la brûlure cercosporeenne *(Cercospora carotae)*, la tumeur du collet *(Agrobacterium tumefaciens)*, la brûlure alternarienne *(Alternaria dauci)*, la nodosité des racines *(Meloidogyne hapla)*, la pourriture sclérotique (*Sclerotinia sclerotiorum*) et la jaunisse (Asteryellows mycoplasma) dans les champs commerciaux des terres organiques du sud ouest du Quebec. L'importance et l'incidence de ces maladies sont discutees.

Introduction

Carrot (*Daucus carotae* L. var. *sativa* DC.), an important vegetable in Canada, is the second most important vegetable crop in Quebec. In 1989the production was 3348 ha, with value of $16 million (11). In this province it is grown mainly on muck soils from May to October. Carrots are prone to many diseases. Cercospora blight and Alternaria blight have been considered as the two most common foliar diseases in the southwestern part of Quebec (8,9,10). However, during the summer of 1987 it was not possible to isolate *Alternaria dauci* (Kuhn) Groves & Skolko, the fungus causing Alternaria blight. On the other hand, *Cercospora carotae* the causal agent of Cercospora blight was successfully isolated (1). Therefore a disease survey was conducted during the summers of 1988 and 1989 to identify and quantify the most common diseases attacking the carrots on the muck soils in the southwestern part of Quebec. The prevalence and incidence of diseases are reported here.

Materials and methods

The surveywas conducted in the muck soil region, located in the southwestern part of Quebec. The seven districts chosen for survey were Hemmingford, Napierville, Ormstown, Sherrington, Saint-Edouard, Saint-Michel, Saint-Rémi, and Sainte-Clothilde (Fig. 1). All the districts were surveyed in both years except for the district of St. Edouard which was not surveyed in 1989. At the beginning of the survey thirty and thirteen sampling locations were established in which a total of 168 and 113 fields selected at random were surveyed in 1988 and 1989, respectively. In each field ten plants were selected at random while walking in a diagonal path. The plants were brought to the laboratory and visually examined for the presence of disease syrriptoms (2,7).

Leaves with symptoms resembling those caused by Alternaria blight, either fresh or after overnight incubation in moist petri-dishes, were observed under the microscope for the presence of *A. dauci* spores,, using keys given by Groves and Skolko (3). Samples of lesions were also surface disinfested in a solution of 1% NaOCl for two minutes, rinsed twice in distilled water and plated on V8® juice agar (13). The plates were maintained for a week at 24°C under 16 hr day length provided by the cool white fluorescent light for the growth and sporulation of the pathogen (12). Many times the diseased leaves were collected early in the morning, before 0800 hr, to increase the chance of finding Alternaria spores prior to their release (6).

The prevalence of disease was calculated as the percentage of fields with a given disease and the incidence as the percentage of plants with a given disease.

Results and discussion

All six diseases were observed not only in most of the districts but also in most fields surveyed in 1988 and 1989 (Table la, 1b, 2a, 2b). In decreasing order of prevalence they were: Cercospora blight, Crown gall, Alternaria blight, Root knot, Sclerotinia rot and Aster yellows (Table 3).

Cercospora blight was the most common disease in all districtsfor both the yearssurveyed. It was present in 91% and 96% of the fields and in 99% and 92% of the plants sampled in 1988 and 1989, respectively (Table 3). Crown gall was present in all districts in 1988 but only in three districts, Ste. Clothilde, Sherrington and Napierville, in 1989 (Table la, 1b). It was present in 5% and 2% of the fields and in 28% and 14% of the plants sampled in 1988 and 1989, respectively (Table 3).

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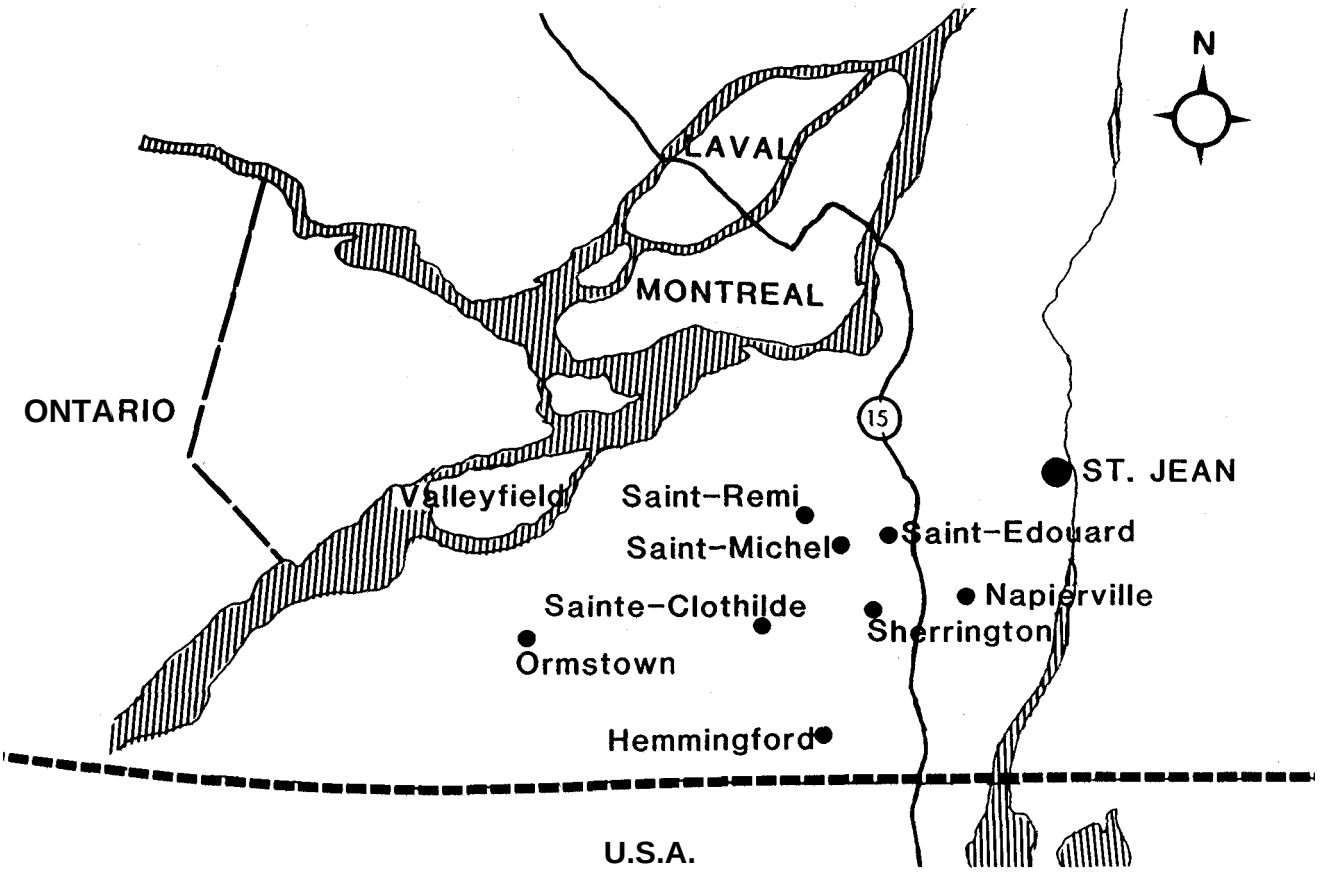

Fig. 1. Map of southwestern Quebec indicating the districts in which the survey was conducted.

Symptoms similar to those produced by A. *dauci* were present in all districts in 1988 and in four districts, Ste. Clothilde, St. Michel, Sherrington and Ormstown, in 1989. They were present in 5% and 1% of the fields and in 25% and 7% of the plants sampled in 1988 and 1989, respectively (Table 3). However, A. *dauci* was not found in any of the samples, instead Alternaria alternata (Fr.) Keissler was observed in all the samples reported as Alternaria blight. It is possible that the *A.* dauci is absent in this region and the symptoms resembling Alternaria blight are induced by A. alternata rather than A. *dauci.* The latter can occasionally attack senescent leaves of carrot and cause lesions on the leaves (4). It appears that the A. *alternata* is a secondary pathogen.

Root knot was present in five districts, Ste. Clothilde, St. Michel, Sherrington, Napierville and Ormstown, in 1988 and in three districts, Ste. Clothilde, Sherrington and Napierville, in 1989 (Table 1a, 1b). It was present in 2% and 4% of the fields and in 16% and 20% of the plants sampled in 1988 and 1989, respectively (Table 3).

Sclerotinia rot and Aster yellows were observed occasionally and seemed to be of only minor importance. Sclerotinia rot was present in four districts, Ste. Clothilde, St. Michel, Sherrington and Napierville, in 1988 and in five districts, Ste. Clothilde, St. Michel, St. Rémi, Sherrington and Napierville, in 1989. It was present in both years in 2% of the fields surveyed and in 13% and 15% of the plants sampled in 1988 and 1989, respectively (Table 3). Aster yellows was found only in 1988. It was present in all districts surveyed except for St. Michel in 1% and 13% of the fields and plants sampled, respectively (Table 3).

A given disease did not necessarily occur in the same location in successive years (9). Cercospora blight was the most common disease in both years. It is well managed with fungicides. However, because of the disadvantages of fungicide usage (pollution, resistance), we should concentrate on other methods to manage the disease. A. alternata is not a major problem in the muck soil region, as it is very well controlled by the fungicides used to manage Cercospora blight.

Crown gall was more important in 1988 than in 1989 probably due to differences in climatic conditions. No management methods are used by the producers for the control of Crown gall except for the long term rotations with immune crops (2). However, it is an increasing problem and much research has been done on biological control of this disease in other crops (5). Root knot, Sclerotinia rot and Aster yellows were not prevalent at all in both years, so they may not cause a significant loss in yield.

Table 1a. Percentage of carrot fields with various diseases observed in seven districts located on muck soils, in the southwestern part of Quebec, during the summer of 1988.

DST*	SL**	FLD***	Diseases****					
			Cercos. blight	Alternaria blight	Scler. rot	Root knot	Crown gall	Aster yellows
Ste .	1	3	100	33	33	67	0	0
Clothilde	2	5	100	100	0	20	0	0
	3	15	100	0	0	13	27	13
	4	9	100	22	33	11	11	22
	5	1	100	100	0	0	0	0
	6	4	100	75	0	75	100	0
	7	2	100	50	50	50	100	0
	8	3	100	0	33	0	33	0
	9	3	100	67	67	33	67	33
St. Michel	10	8	100	0	13	0	25	0
	11	3	100	0	33	33	0	0
	12	3	67	33	33	33	0	0
	13	3	100	67	0	33	33	0
St. Rémi	14	3	100	67	0	0	0	67
St. Edo.	15	7	100	29	0	0	14	58
Sher.	16	11	100	0	18	9	9	9
	17	5	100	20	40	0	40	0
	18	6	100	33	0	0	0	17
	19	4	100	25	0	50	75	0
	20	2	100	50	50	50	0	0
	21	3	100	67	0	33	0	0
	22	3	100	33	0	0	33	0
	23	26	100	19	12	19	50	4
	24	1	100	0	100	0	0	0
	25	5	100	20	0	20	40	0
Napierville	26	1	100	0	100	0	100	0
	27	15	100	13	0	0	40	7
	28	3	100	0	33	0	0	0
	29	1	100	100	100	100	0	100
Ormstown	30	10	100	20	0	10	10	50

* DST = Districts: St. Edo. = St. Edouard, Sher. = Sherrington.
** SL = Sampling locations where fields were selected.
*** FLD = Fields: Number of fields surveyed.
**** Diseases: Cercos. blight = Cercospora blight, Scler. rot = Sclerotinia rot.

Table 1b. Percentage of carrot fields with various diseases observed in six districts located on muck soils, in the southwestem part of Québec, during the summer of 1989.

DST*	SL**	FLD***	Diseases****					
			Cercos. blight	Altemaria blight	Scler. rot	Root knot	Crown gall	Aster yellows
Ste.	3	15	47	0	0	7	0	0
Clothilde	4	9	100	22	22	33	33	0
	6	4	100	0	50	100	75	0
St. Michel	10	8	75	13	38	0	0	0
St. Rémi	14	3	100	0	33	0	0	0
Sher.	16	7	100	0	0	0	0	0
	18	6	100	17	0	0	0	0
	19	4	100	0	0	25	0	0
	22	3	100	0	0	0	0	0
	23	26	100	a	12	42	15	0
	25	5	100	20	0	0	0	0
Napierville	27	15	100	0	33	13	40	0
Ormstown	30	6	100	17	0	0	0	0

* DST = Districts: Sher. = Sherrington.
** SL = Sampling locations where fields were selected.
*** FLD = Fields: Number of fields surveyed.
**** Diseases: Cercos. blight = Cercospora blight, Scler. rot = Sclerotinia rot.

Table 2a. Percentage of plants with various diseases, per field, observed in seven districts located on muck soils, in the southwestern part of Quebec, during the summer of 1988.

DST*	SL**	FLD***	Diseases****					
			Cercos. blight	Alternaria blight	Scler. rot	Root knot	Crown gall	Aster yellows
Ste.	1	3	83	10	3	25	0	0
Clothilde	2	5	45	24	0	1	0	0
	3	15	100	0	0	2	4	2
	4	9	96	4	4	1	1	2
	5	1	100	20	0	0	0	0
	6	4	100	4	0	7	13	0
	7	2	87	7	3	3	7	0
	8	3	84	0	3	0	3	0
	9	3	96	8	5	1	11	1
St. Michel	10	8	93	0	3	0	3	0
	11	3	100	0	3	3	0	0
	12	3	67	10	7	3	0	0
	13	3	57	27	0	3	3	0
St. Rémi	14	3	83	10	0	0	0	6
St Edo.	15	7	94	6	0	0	1	7
Sher.	16	11	96	0	3	3	1	1
	17	5	98	4	8	0	10	0
	18	6	90	2	0	0	0	1
	19	4	91	2	0	4	6	0
	20	2	60	10	20	10	0	0
	21	3	72	7	0	3	0	0
	22	3	96	1	0	0	4	0
	23	26	98	4	1	2	10	0
	24	1	100	0	10	0	0	0
	25	5	82	3	0	2	8	0
Napierville	26	1	87	0	7	0	3	0
	27	15	94	4	0	0	7	1
	28	3	93	0	3	0	0	0
	29	1	58	6	6	1	0	1
Ormstown	30	10	95	2	0	1	1	7

* DST = Districts: St. Edo. = St. Edouard, Sher. = Sherrington.
** SL = Sampling locations where fields were selected.
*** FLD = Fields: Number of fields surveyed.
**** Diseases: Cercos. blight = Cercospora blight, Scler. rot = Sclerotinia rot.

Table 2b. Percentage of plants with various diseases, per field, observed in six districts located on muck soils, in the southwestern part of Québec, during the summer of 1989.

DST*	SL**	FLD***	Diseases****					
			Cercos. blight	Altemaria blight	Scler. rot	Root knot	Crown gall	Aster yellows
Ste.	3	15	96	0	0	3	0	0
Clothilde	4	9	98	1	2	2	2	0
	6	4	100	0	6	7	6	0
St. Michel	10	8	89	3	9	0	0	0
St. Rémi	14	3	82	0	2	0	0	0
Sher.	16	7	93	0	0	0	0	0
	18	6	98	3	0	0	0	0
	19	4	83	0	0	1 '	0	0
	22	3	86	0	0	0	0	0
	23	26	100	1	2	10	1	0
	25	5	93	1	0	0	0	0
Napierville	27	15	99	0	6	1	8	0
Ormstown	30	6	95	2	0	0	0	0

* DST = Districts: Sher. = Sherrington.
** SL= Sampling locations where fields were selected.
*** FLD = Fields: Number of fields surveyed.
**** Diseases: Cercos. blight = Cercospora blight, Scler. rot = Sclerotinia rot.

Table 3. Percentage of fields and of plants with different diseases observed in 1988 and 1989 on muck soils in the southwestern part of Québec.

Diseases	Fields %		Plants %	
	1988	1989	1988	1989
Cercospora	91	96	99	92
Alternaria	5	1	25	7
Sclerotinia	2	2	13	15
Root knot	2	4	16	20
Crown gall	5	2	28	14
Aster yellows	1	0	13	0

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