Frequency and distribution of seedborne fungal pathogens in western Canadian canola-1989 and 1990

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In 1989 and 1990, composite samples of canola from crop districts in western Canada were tested for the presence of the seedborne pathogens Alternaria brassicae, A. raphani, and *Leptosphaeria* maculans. Each year, six hundred seeds from each crop district were surface disinfected before plating onto 20% V-88 agar. A. brassicae and A. raphani were more common in 1989 and were isolated most often from Alberta and the northern crop districts. The virulent form of L. maculans was found primarily in Saskatchewan, where it was recovered on average from 0.1% of seeds tested.

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En 1989 et 1990, les echantillons composes de canola provenant des districts agricoles de l'Ouest canadien furent etudies pour detecter la presence de pathogenes propagés par la semence, soit Alternaria brassicae, A. raphani, et Leptosphaeria maculans. Chaque année, six cent sernences de chaque district agricole furent desinfectees en surface avant l'ensemencement dans l'agar 20% V-88 agar. A. brassicae and A. raphani furent plus commun en 1989 et furent isolés plus souvent en Alberta et dans les districts agricoles nordiques. La forme virulente de L. *maculans* fut trouvee originairement en Saskatchewan, où elle fut recouverte a 0.1% en moyenne sur les semences evaluees.

Introduction

A number of seedborne fungal pathogens are present on canola seed harvested in western Canada (Martens ***et al.,*** 1984). Three of the more important ones are ***Alternaria brassicae*** (Berk.) Sacc. and ***A. raphani*** Groves & Skolko, the causal agents of alternaria blackspot, and ***Leptosphaeria maculans*** (Desm.) Ces. & de Not., the causal agent of blackleg. Field surveys for these pathogens and the diseases they cause have been reported over a number of years. The frequency of seed infestation by ***L. maculans*** has also been assessed (Petrie and Vanterpool, 1974), but recent information on average levels of seed infection is lacking. Although these pathogens are not found as frequently on the seeds as on the vegetative plant parts, their presence on the harvested seed coincides with their presence in the field. This survey examines their frequency and distribution on harvested seed.

Materials and methods

In 1989 and 1990, 2,123 and 2,992 samples respectively of canola (grades 1 and 2) were submitted in envelopes capable of holding 500g of seed to the Grain Research Laboratory (GRL) by primary elevator managers, oilseed crushing companies and canola producers. These samples were graded by the Inspection Division of the Canadian Grain Commission, composited at the GRL according to grade and crop districts, then subsampled for mycological tests. Seeds were surface disinfected by soaking in a 0.3% sodium hypochlorite solution for 1 min, then air dried under a laminar flow hood. Each year, 300 seeds of the No. 1 grade canola composite and an equal number of the No. 2 grade canola composite from each crop district were placed onto 20% V-8® agar in petri dishes, 15 seeds per plate, and incubated for 7 days at room temperature under a cycle of 12 hrs darkness and 12 hrs UV and fluorescent light. Although tested separately, results from the crop districts are reported as a compilation of both No. 1 and No. 2 grades. Too few samples of canola graded No. 3 were received to be composited by crop district and *so* have been left out of this report. The virulence of the ***L. maculans*** isolates was established by inoculating wounded cotyledons of 7-day old Westar canola seedlings with 10 µL of a 1 x 10^6 spore suspension. After growth for 10 days at 22°C, the cotyledons were examined for signs of necrosis. The cultural characteristics of ***L. maculans*** on V-8® agar were also examined according to the method of McGee and Petrie (1978).

Results and discussion

The number of samples within a composite ranged from 2 to 430 (Table 1). Less than twenty-two samples were received from Saskatchewan crop districts 2, and 4 and Alberta district 1 because little canola is grown in these areas (DeClercq ***et al.,*** 1989).

Alternaria brassicae and ***A. raphani*** were most frequently isolated from crop districts 1 to 7 in Alberta, 8 and 9 in Saskatchewan, and 5 and 12 in Manitoba (Figures 1 and 2). Both pathogens were recovered more often in 1989 than in 1990, with ***A. brassicae*** being the more common of the two. The abundance of these pathogens on seed from the more northern crop districts may be due not only to weather conditions, but also to the seeding of varieties

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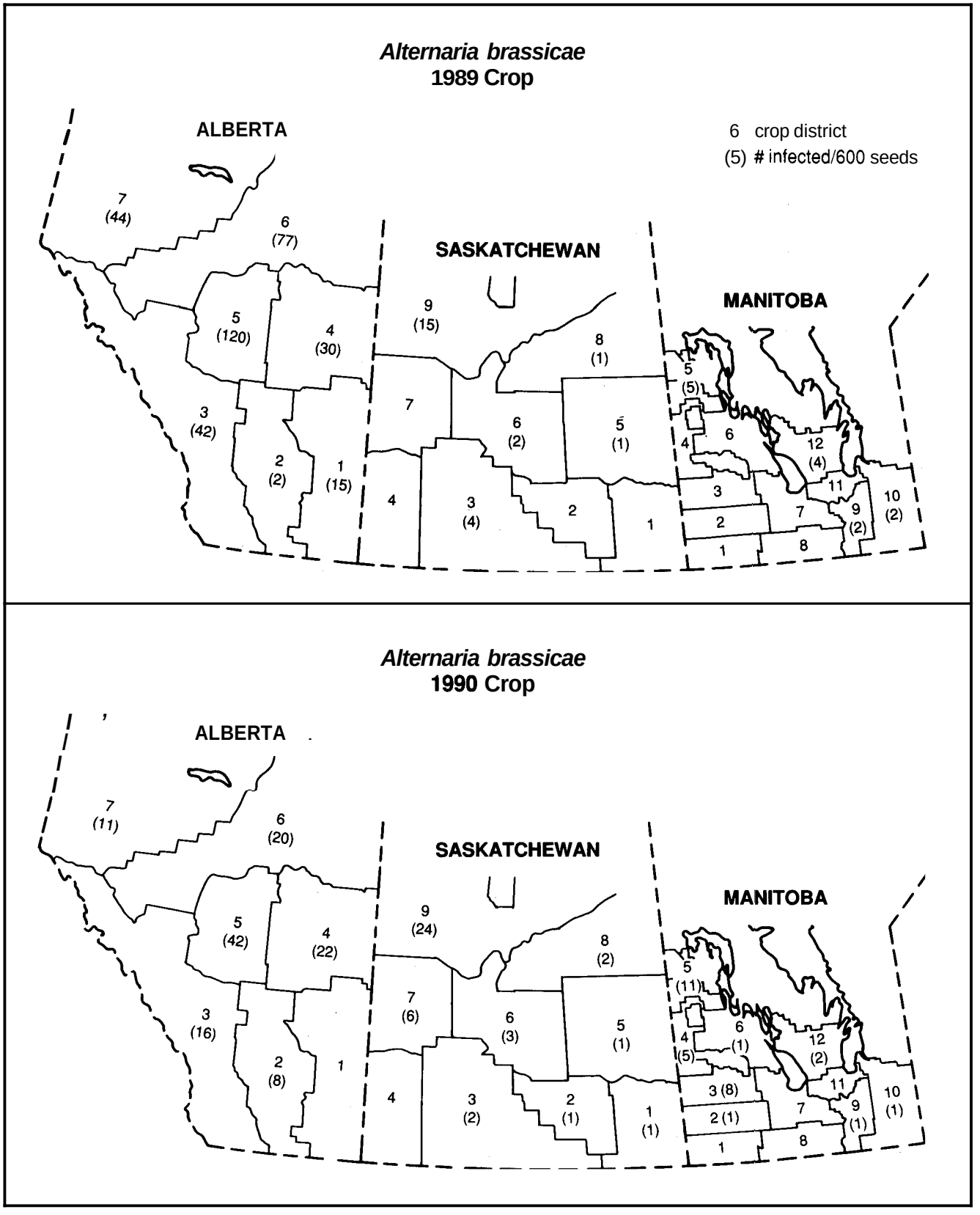
Alternaria brassicae
1989 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
6 crop district
(5) # infected/600 seeds
7 (44)
6 (77)
5 (120)
4 (30)
9 (15)
8 (1)
3 (42)
2 (2)
1 (15)
7
6 (2)
5 (1)
4
3 (4)
2
1
5 (5)
4
6
12 (4)
3
11
2
7
9 (2)
10 (2)
1
8
Alternaria brassicae
1990 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
7 (11)
6 (20)
5 (42)
4 (22)
9 (24)
8 (2)
3 (16)
2 (8)
1
7 (6)
6 (3)
5 (1)
4
3 (2)
2 (1)
1 (1)
5 (11)
4 (5)
6 (1)
12 (2)
3 (8)
11
2 (1)
7
9 (1)
10 (1)
1
8

Fig. 1.

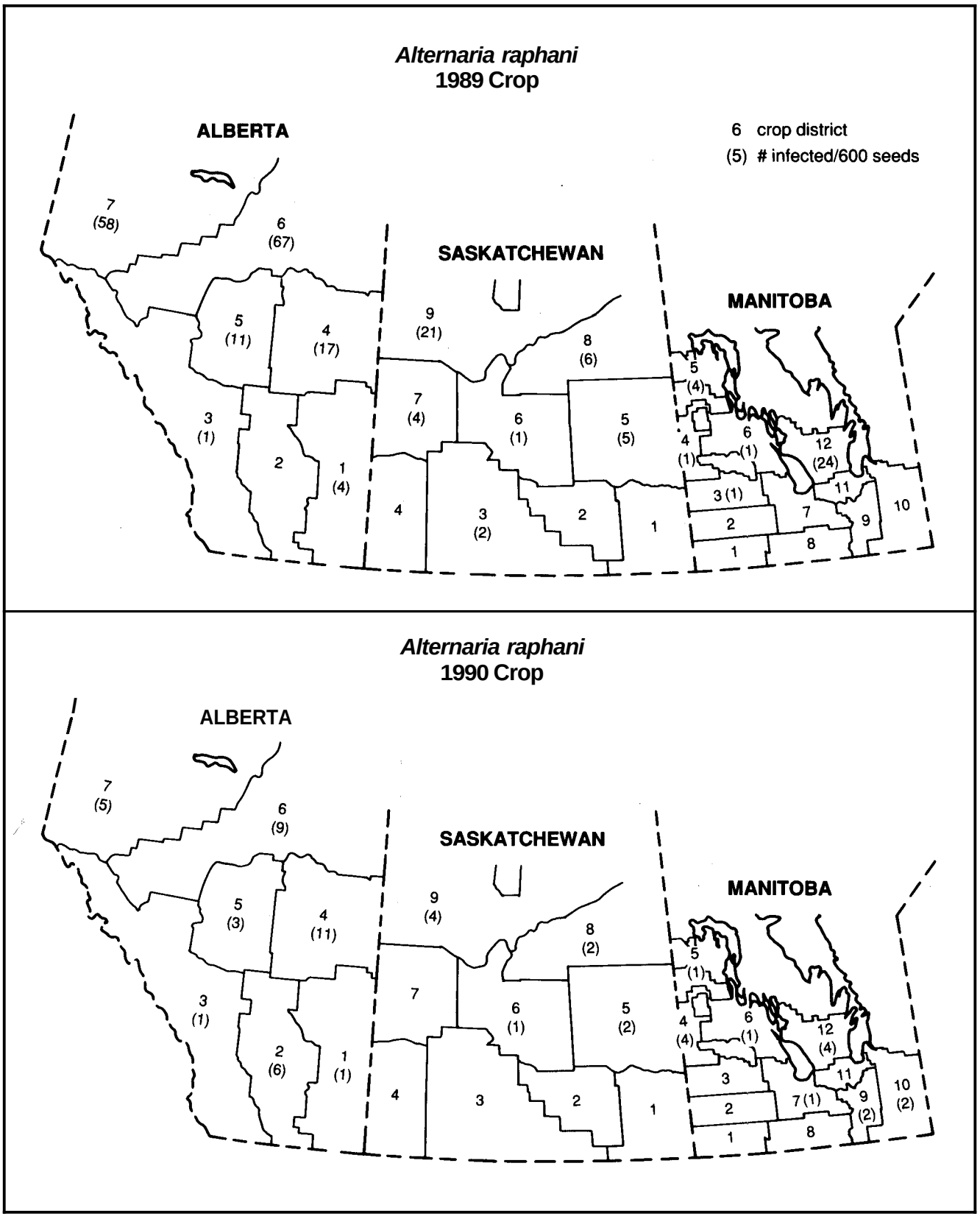
Alternaria raphani
1989 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
6 crop district
(5) # infected/600 seeds
7 (58)
6 (67)
5 (11)
4 (17)
9 (21)
8 (6)
7 (4)
6 (1)
5 (5)
5 (4)
4 (1)
6 (1)
12 (24)
3 (1)
2
1 (4)
4
3 (2)
2
1
3 (1)
2
1
7
9
11
10
8
Alternaria raphani
1990 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
7 (5)
6 (9)
5 (3)
4 (11)
9 (4)
8 (2)
7
6 (1)
5 (2)
5 (1)
4 (4)
6 (1)
12 (4)
3 (1)
2 (6)
1 (1)
4
3
2
1
3
2
1
7 (1)
9 (2)
11
10 (2)
8

Fig. 2.

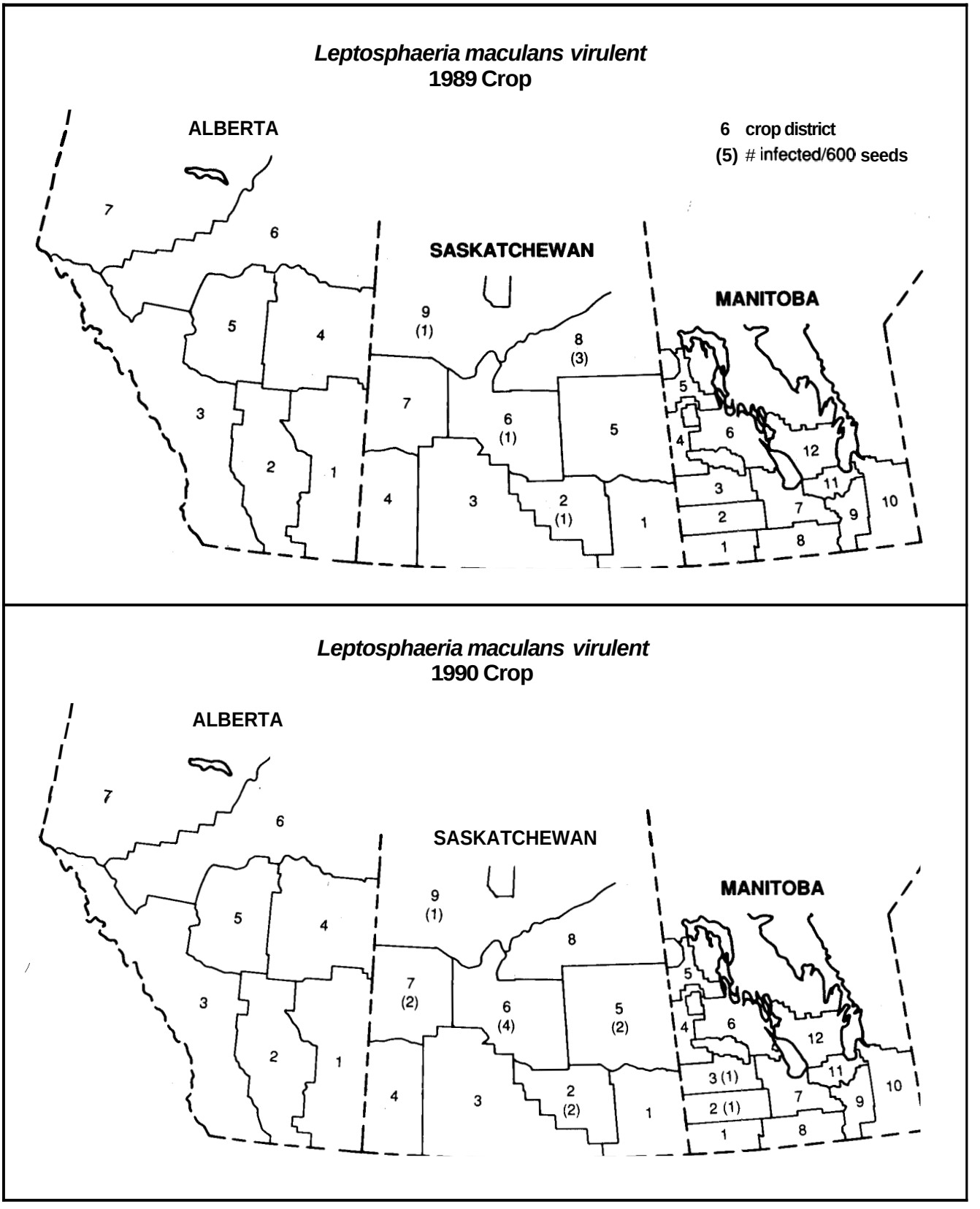
Leptosphaeria maculans virulent
1989 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
6 crop district
(5) # infected/600 seeds
Leptosphaeria maculans virulent
1990 Crop
ALBERTA
SASKATCHEWAN
MANITOBA

Fig. 3.

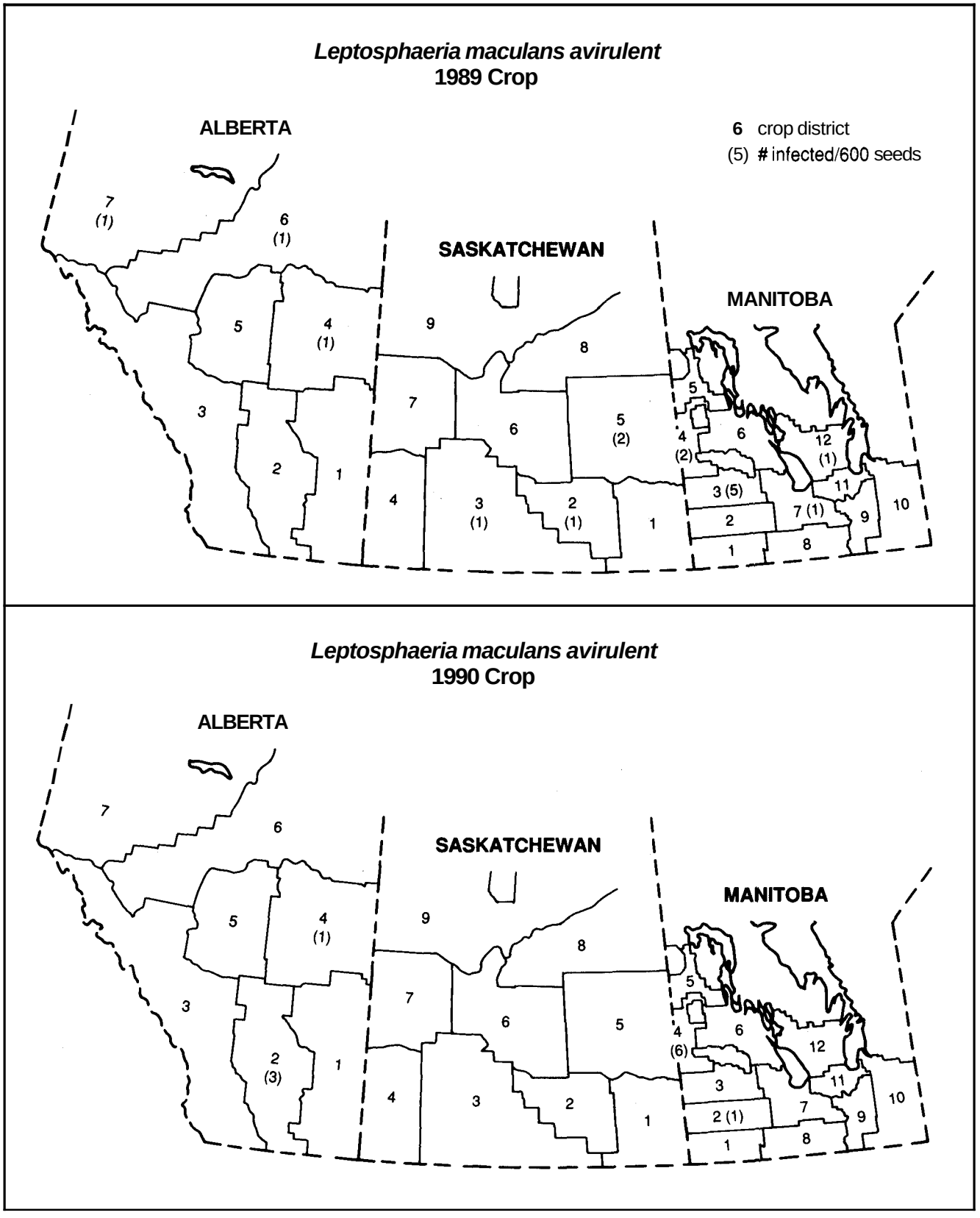
Leptosphaeria maculans avirulent
1989 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
6 crop district
(5) # infected/600 seeds
7 (1)
6 (1)
5
4 (1)
9
8
3
7
6
5 (2)
4 (2)
5
6
12 (1)
2
1
4
3 (1)
2 (1)
1
3 (5)
2
1
11
7 (1)
9
8
10
Leptosphaeria maculans avirulent
1990 Crop
ALBERTA
SASKATCHEWAN
MANITOBA
7
6
5
4 (1)
9
8
3
7
6
5
4 (6)
6
12
2 (3)
1
4
3
2
1
3
2 (1)
1
11
7
9
8
10

Fig. 4.

of the earlier maturing Brassica campesfris L., which are more susceptible to blackspot than are the B. *napus* L. varieties (Skoropad and Tewari, 1977; Conn and Tewari, 1989). In 1989 and 1990, *B.* campesfrisvarieties accounted for 67.9% and 63.8%, respectively, of the canola acreage in Alberta, with only districts 1 and 2 having more acres of B. napusthan B. campestris. In Saskatchewan in 1989, 35% and in 1990, 29.8% of the canola acreage was sown to B. campesfris, notably in districts 7 and 9, and for the same years in Manitoba only 8.7% and 15.4% of the canola acreage was B. campesfris (Anonymous, 1989; Anonymous, 1990). The higher occurrence of the blackspotfungi in the 1989 composite samples coincides with the observation that alternaria blackspot was the most economically important disease of canola in central Alberta in 1989 (Conn and Tewari, 1990). In 1990 in central Alberta, the percent areas of siliqua covered with lesions were much less than in 1989 (Conn and Tewari, 1991). They attributed the difference to the wet weather at the end of July and early August of 1989. However, the Peace River of Alberta was surveyed for blackspot in 1989 (Harrison, 1990) and 1990 (Harrison and Loland, 1991) and they found blackspot to be more common in 1990 than 1989. Perhaps environmental conditions in the Peace River area were more advantageous for seed infection in 1989 than in 1990. Blackspot also was reported at higher levels in northeast Saskatchewan in 1990 than 1989 (Kirkham and Berkenkamp, 1990; Berkenkamp and Kirkham, 1991), whereas this disease was found in more Manitoba fields in 1989 than 1990. The severity in Manitoba was low (Van Den Berg and Platford, 1990; Van Den Berg and Platford, 1991).

Lepfosphaeria maculans is not readily seedborne but it was recovered from some seed samples. Almost all of the seedborne virulent forms were recovered from the Saskatchewan samples, where it was isolated from 0.1% of the seeds, and was more common than the avirulent form (Figures 3 and 4). A few virulent isolates were found in the Manitoba seed samples whereas none were detected in the Alberta samples. Recent reports of the field incidences of the virulent blackleg indicate it is more common in Saskatchewan (Berkenkamp and Kirkham, 1991), than in Manitoba (Van Den Berg and Platford, 1991). There has also been a recent report of the presence at low levels of the virulent blackleg in certain areas of Alberta (Evans *et al.*, 1991). In only one instance did the cultural characteristics and the pathogenicity tests on seedlings fail to agree. An isolate from Saskatchewan appeared to be virulent culturally, but in the seedling test it was avirulent.

The frequency and distribution pattern of these pathogens on seed is in agreement with the field disease survey results in some crop production areas, but they differ slightly from the results in other areas. Differences in the frequency and distribution of these pathogens between growing areas probably involves a number of factors, of which weather is certainly a major one. Spread of the virulent form of *L.* maculans, even when 0.1% of the seed is infected, is a real threat to crop production. Based on estimates by Humpherson-Jones (1985), a seeding rate of 3-4 kg/ha and 0.1% seed infection would result in the sowing of 750 infected seeds/ha. To limit disease spread it is important to ensure that only pathogen-free seed or

Table 1. Number of canola samples in each crop district composite for 1989 and 1990.

	Manitoba		Saskatchewan		Alberta	
Crop District	1989	1990	1989	1990	1989	1990
1	60	54	142	102	16	14
2	60	117	22	16	102	114
3	60	119	106	24	56	55
4	33	53	6	2	135	249
5	51	69	147	328	91	100
6	32	43	171	145	79	67
7	60	105	82	66	136	168
8	60	116	167	346	--	--
9	--	--	128	430	--	--
9 & 10	54	38	--	--	--	--
11	46	37	--	--	--	--
12	21	25	--	--	--	--

fungicide treated seed is used in areas free of the pathogen. Since most districts had detectable levels of the alternaria blackspot pathogens, use of seed free of these pathogens would not imply freedom from the disease during the growing season. However, it would be especially beneficial if resistance to these pathogens was incorporated into varieties agronomically suitable to the areas where alternaria blackspot is most important.

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