Extension Report 71

2001 Canola Disease Survey in Minnesota and North Dakota

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A field survey in Minnesota and North Dakota evaluated the incidence (percent infected stems) of aster yellows, caused by the aster yellows phytoplasma; blackleg, caused by *Leptosphaeria maculans* (*Phoma lingam*); Sclerotinia stem rot, caused by *Sclerotinia sclerotiorum;* and the pod severity (percent infected pod area) of Alternaria black spot, caused by *Alternaria brassicae* and *A. japonica*. Field surveys of canola diseases were conducted previously in North Dakota in 1991 and 1993-2000 (2, 3, 4, 5, 7, 8, 9, 10) in Minnesota in 1996-2000 (5, 7, 8, 9, 10) and in South Dakota in 1996, 1997 and 2000 (5, 7, 8). In previous surveys, blackleg incidence was highest in 1991, when it was 28% in North Dakota (2, 3). The highest incidence of Sclerotinia stem rot over the years was 19% in North Dakota in 1993 (2, 3) and 19% in Minnesota in 1997 (8). Alternaria pod spot severity has been assessed only since 1996 and severity has never been high in either state. Aster yellows was common in some areas of both Minnesota and North Dakota in 1999, and fairly common in 2000, but data were not recorded in the 1999 survey.

The 2001 field survey of canola diseases was conducted in 297 fields in 30 counties of the two states. There were 252 fields in 24 counties of North Dakota and 45 fields in six counties of Minnesota that were surveyed.

Materials and Methods

The survey techniques were adapted from those used by Petrie *et al*. in Saskatchewan (13). The fields were inspected for disease when the crop was in the swath and the stubble was freshly cut. All fields surveyed were Argentine canola, *Brassica napus*. Five stems were sequentially pulled from the soil at each of eight randomly selected locations for a total of 40 stems examined in each field. The lower stems and roots of the plants were visually inspected for symptoms of blackleg and Sclerotinia stem rot. These diseases were easily identified on 6- to 18-inch stubble left in the fields after swathing.

Blackleg was identified by the black girdling lesions at or near the soil surface. Tiny black pycnidia characteristic of the virulent strain of the blackleg fungus often were associated with the lesions. In cases where the cause of the disease was in doubt, the roots of plants were split with a knife and the interior tissues inspected. If they were dark gray to black, rather than white, the root was considered to be positive for blackleg. If blackleg symptoms were only superficial with few or no pycnidia and no internal tissue discoloration, the low virulence strain of *L. maculans* was suspected.

Sclerotinia stem rot was identified by the bleached stems, often accompanied by a shredding of the tissues. The presence of sclerotia inside the bleached tissues was an additional confirmation of Sclerotinia.

At each of eight random sampling locations, the swath was inspected for symptoms of aster yellows. An attempt was made to randomly sample five plants at each stop, but this was not feasible, so counts of aster yellows might better be considered estimates than accurate counts. Aster yellows symptoms used to identify the disease included bladder-like upper pods, a witches' broom or proliferation of tissues on the upper portions of the plant, and a purpling of the upper tissues. Since purpling can also be a characteristic of certain hybrids or of sulfur deficiency, this characteristic was used in conjunction with other symptoms and in comparison with other plants in the swath.

Ten pods were inspected for Alternaria black spot at each of four random locations per field for a total of 40 pods. Pod severity (percent of pod area affected) was assessed using a visual scale of 1%, 5%, 10% and 20% devised by Conn *et al*. (1). Pod severity and incidence in northwestern North Dakota was estimated on the basis of which figure best fit the ten pods being examined, rather than by inspection of individual pods.

Incidences of aster yellows, blackleg and Sclerotinia stem rot were calculated as (number infected / 40) X 100. The average severity of black

spot in each field was calculated by adding the number of pods per category (1%, 5%, 10%, 20%) times the category (1, 5, 10, 20) and dividing by 40 (the total number of pods examined). A sample calculation follows for a field with 15 pods at 1%, 2 at 5% and 1 at 10%: [(15 X 1%) + (2 X 5%) + (1 X 10%)] / 40 = 0.875%.

Counties to be surveyed were determined based on Farm Service Agency records of acreage in 1999 and 2000, with the objective of conducting the survey in the counties with the greatest acreage (Table 1). Acreages from both 1999 and 2000 were used since wet planting conditions reduced acreages of certain counties in some years. An attempt was made to visit at least 10 fields in any county surveyed so there would be an adequate sample size to compare results among counties. Exceptions were made in several counties due to limited canola acreage in 2001. More than 10 fields were surveyed in some counties with large acreages; the objective was to survey one field for each 5,000 acres in the county. This resulted in 30 fields surveyed in Cavalier County, 20 in Bottineau County, 17 in Ward County, 16 in McLean County, 13 in Renville County and 12 in Towner County.

Results

The 2001 survey included all of the Minnesota and North Dakota counties surveyed in 2000 and some additional counties in North Dakota, but did not include the South Dakota counties surveyed in 2000 (Table 1). Counties not previously surveyed included Eddy, McKenzie, Nelson and Pembina counties in North Dakota.

Aster yellows incidence was 2.2% in Minnesota and 1.8% in North Dakota, approximately half the incidence in 2000 for both states (Table 2). The highest incidences were 5% in Roseau county, Minnesota; 4.7% in Benson County, North Dakota; 4.1% in Pennington County, Minnesota; and 3.2% in Rolette County, North Dakota. These figures were approximately half those of the top counties in 2000. No aster yellows was recorded in 11 counties in North Dakota with the majority of those counties located in the western part of the state.

Table 1. Fields surveyed in 2001.

North Dakota County	No. of Fields	Minnesota County	No. of Fields
Benson	9	Kittson	7
Bottineau	20	Marshall	11
Burke	5	Pennington	8
Cavalier	30	Polk	4
Eddy	2	Red Lake	10
Divide	5	Roseau	5
Foster	7	**Minnesota total**	**45**
Hettinger	10		
McHenry	10		
McKenzie	2		
McLean	16		
Mountrail	10		
Nelson	10		
Pembina	4		
Pierce	10		
Ramsey	10		
Renville	13		
Rolette	18		
Sheridan	10		
Stutsman	10		
Towner	12		
Ward	17		
Wells	10		
Williams	2		
N.D. total	**252**		

Table 2. Aster yellows incidence in 2001.

District	Incidence (%)	County	Incidence (%)
Minnesota (NW)	**2.2**	Kittson	0.4
		Marshall	0.2
		Pennington	4.1
		Polk	5
		Red Lake	1.5
		Roseau	5
North Dakota (NE)	4.4	Cavalier	1.4
		Nelson	1.8
		Pembina	0
		Ramsey	11
		Towner	10
North Dakota (C)	0.5	Eddy/Foster	1.3
		Sheridan	0
		Stutsman	0
		Wells	0.8
North Dakota (NC)	1.9	Benson	4.7
		Bottineau	0.8
		McHenry	0
		Pierce	1
		Rolette	3.2
North Dakota (NW)	0.5	Burke	0
		Divide	0
		Mountrail	0
		Renville	1.0
		Ward	0.9
		Williams	0
North Dakota (WC)	0	McKenzie	0
		McLean	0
North Dakota (SW)	0	Hettinger	0
North Dakota (State)	**1.8**		

Blackleg incidence was 1.6% in Minnesota and 1.8% in North Dakota (Table 3). This represents a lower incidence in North Dakota and a higher incidence in Minnesota than in 2000. Incidence in North Dakota varied by county, with the highest averages 6.5% in Towner County, 4.8% in Cavalier County, 3.5% in Pierce County and 3.3% in Benson County. The highest incidence in Minnesota was 3.8% in Pennington County. Blackleg incidence varied by crop reporting district, with the highest incidence in northeast North Dakota with an incidence of 3.7%, followed by central North Dakota with 1.7% and Minnesota with 1.6% (Figure 1). Samples taken in the 2000 survey and tested at Melfort, SK, Canada, were primarily the virulent strain of the blackleg fungus (M. Keri, personal communication).

In 2001, the average Sclerotinia stem rot incidence was 14.1% for both Minnesota and North Dakota (Table 4). This is lower than the 17.0% for North Dakota and 17.8% for Minnesota in 2000. The incidence in North Dakota varied by county and by crop reporting district, with the highest incidences 40% in Wells County, 38% in Sheridan County, and 28% in Stutsman County, all in the central crop reporting district, and 28.8% in Ramsey County, in the northeast crop reporting district (Figure 2). The highest incidence in Minnesota was 25% in Pennington County. The highest incidence for a crop reporting

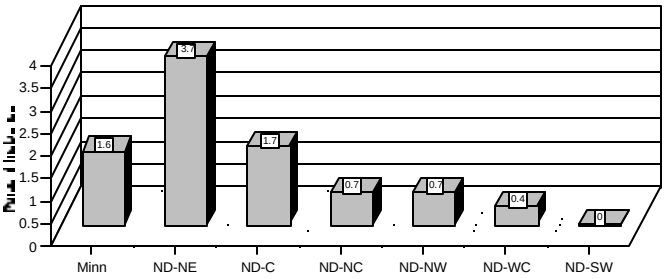

Figure 1. Blackleg by District in 2001.

Table 3. Blackleg Incidence in 2001.

District	Incidence (%)	County	Incidence (%)
Minnesota (NW)	**1.6**	Kittson	0.4
		Marshall	2.0
		Pennington	3.8
		Polk	1.3
		Red Lake	1.3
		Roseau	0
North Dakota (NE)	3.7	Cavalier	4.8
		Nelson	1.8
		Pembina	0
		Ramsey	0
		Towner	6.5
North Dakota (C)	1.7	Eddy/Foster	0.8
		Sheridan	2
		Stutsman	1
		Wells	3
North Dakota (NC)	1.5	Benson	3.3
		Bottineau	0.6
		McHenry	0.5
		Pierce	3.5
		Rolette	0.8
North Dakota (NW)	0.7	Burke	0
		Divide	0
		Mountrail	0.5
		Renville	1.0
		Ward	1.2
		Williams	0
North Dakota (WC)	0.4	McKenzie	0
		McLean	0.5
North Dakota (SW)	0	Hettinger	0
North Dakota (State)	**1.8**		

Table 4. Sclerotinia Stem Rot Incidence in 2001.

District	Incidence (%)	County	Incidence (%)
Minnesota (NW)	**14.1**	Kittson	2.5
		Marshall	18.6
		Pennington	25
		Polk	16.3
		Red Lake	6.3
		Roseau	16.5
North Dakota (NE)	17.0	Cavalier	15.0
		Nelson	13.8
		Pembina	0
		Ramsey	28.8
		Towner	19.5
North Dakota (C)	32.0	Eddy/Foster	21.1
		Sheridan	38
		Stutsman	28
		Wells	40
North Dakota (NC)	11.8	Benson	12.8
		Bottineau	9.4
		McHenry	9.5
		Pierce	14
		Rolette	14
North Dakota (NW)	5.7	Burke	6
		Divide	8
		Mountrail	1
		Renville	10.2
		Ward	5
		Williams	0
North Dakota (WC)	1.0	McKenzie	0
		McLean	1.1
North Dakota (SW)	7.8	Hettinger	7.8
North Dakota (State)	**14.1**		

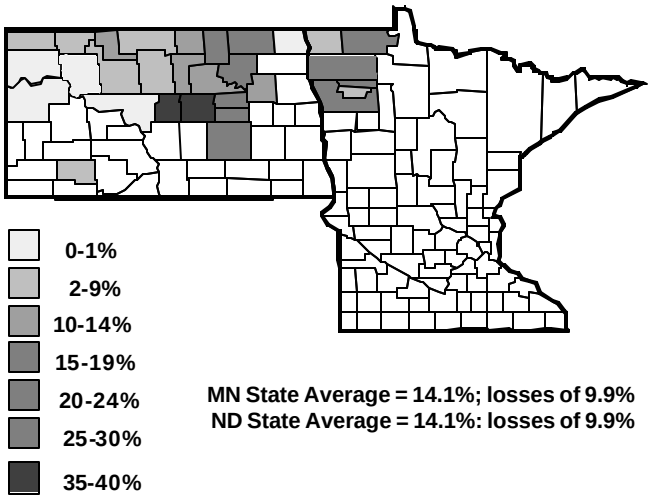

Figure 2. Sclerotinia Stem Rot in 2001.

district was 32% for the central district of North Dakota, followed by 17% for the northeast district of North Dakota (Figure 3).

The survey in Cavalier County was completed at two different times: 20 fields were surveyed on August 15-16 and 10 fields were surveyed on August 28. The fields surveyed on August 28 were late planted fields that had not been swathed on August 15-16. The 20 early fields averaged 20% Sclerotinia incidence; the 10 late fields averaged 6%.

Alternaria black spot severity was 0.37% in Minnesota and 0.66% in North Dakota; these figures are twice those in 2000 for North Dakota and about the same for Minnesota. Severity by county varied from 0.1% in Hettinger County in the southwest to as high as 1.2% in Mountrail and Ward Counties and 1.7% in Renville County in northwest North Dakota. In Minnesota severity ranged from as low as 0.06% in Marshall County to as high as 1.75% in Polk County (Table 5).

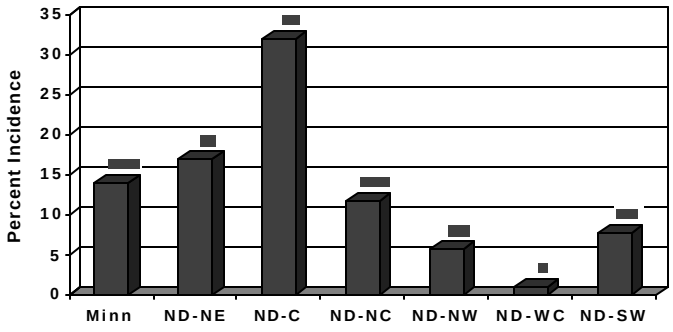

Figure 3. Sclerotinia Stem Rot by District in 2001.

Table 5. Alternaria black spot severity on the pods in 2001.

District	Incidence (%)	County	Incidence (%)
Minnesota (NW)	**0.37**	Kittson	0.19
		Marshall	0.06
		Pennington	0.72
		Polk	1.75
		Red Lake	0.20
		Roseau	0.23
North Dakota (NE)	0.43	Cavalier	0.36
		Nelson	0.18
		Pembina	0.43
		Ramsey	0.31
		Towner	0.89
North Dakota (C)	0.35	Eddy/Foster	0.34
		Sheridan	0.21
		Stutsman	0.38
		Wells	0.41
North Dakota (NC)	0.57	Benson	0.04
		Bottineau	0.9
		McHenry	0.8
		Pierce	0.4
		Rolette	0.44
North Dakota (NW)	1.2	Burke	0.8
		Divide	0.4
		Mountrail	1.2
		Renville	1.7
		Ward	1.2
		Williams	1
North Dakota (WC)	1.17	McKenzie	1
		McLean	1.19
North Dakota (SW)	0.10	Hettinger	0.10
North Dakota (State)	**0.66**		

Discussion

Blackleg, caused by *L. maculans*, was first found in North Dakota in 1991. Some isolates of the blackleg pathogen were identified as the highly virulent pathogenicity group PG-2, which is common in Canada (2, 6). Average incidence in North Dakota was 27.7% in 1991, which was the last year that the highly susceptible cultivar 'Westar' was grown (Figure 4). By 1993 'Westar' had been replaced by moderately susceptible cultivars, and blackleg incidence was 3.4% in 1993, 6.2% in 1994, 6.6% in 1995 and lower thereafter. One reason for the slightly higher incidences in 1994 and 1995 is that a few fields of Polish canola, *Brassica rapa*, were surveyed in those years; all cultivars of *B. rapa* are susceptible. Although there was change in varieties grown, with some moderately resistant and resistant varieties being grown in recent years, differences in environmental conditions

and the use of fungicide seed treatment may also have influenced blackleg incidence.

Major economic incidences of blackleg were found in two North Dakota fields, one in Towner County with 48% blackleg and one in Cavalier County, with 38%. This is similar to 1999 and 2000. Many lesions were girdling the stems. Petrie (12) determined that there is a 0.7% yield loss for each 1% of stems with girdling lesions, so the losses in these fields were estimated at 34% and 27%, respectively. Four other fields in North Dakota had smaller losses; there were two in Cavalier County with 28% and 20%, one in Sheridan County with 20% and one in Pierce County, with 20% incidence. Losses for 28% and 20% incidence are estimated at 20% and 14%, respectively.

Sclerotinia was the most prevalent and serious disease problem in 2001, as it was in all previous years, except 1991. Average Sclerotinia incidence was 14.1% in both Minnesota and North Dakota, compared to 17.8% in Minnesota and 17.0% in North Dakota in 2000. Compared to other years, 2001 was an average year, with a Sclerotinia incidence that was at about the mid-point between the lowest and the highest infection levels in other years (Figure 5).

The highest state-wide incidence of Sclerotinia stem rot in North Dakota was in 1993, with an incidence of 18.7%. July rainfall that year was very high. The lowest incidence of Sclerotinia stem rot in North Dakota was in 1991, with an incidence of 7.1%, a year with low July rainfall. The highest state-wide incidence of Sclerotinia stem rot in Minnesota was in 1997 with an incidence of 18.8%, and the lowest was in 1998, with an incidence of 10.6%.

The Sclerotinia data from Cavalier County indicate that infection levels were higher for earlier planted canola (20%) in that county than that for late planted canola (6%). There was a dry period in early to mid July that might have reduced the Sclerotinia incidence for canola flowering at that time.

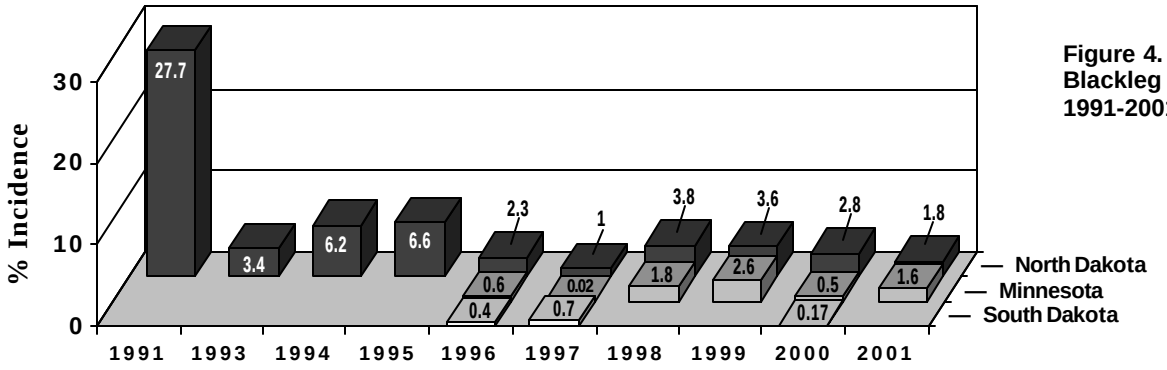

Figure 4. Blackleg Incidence, 1991-2001.

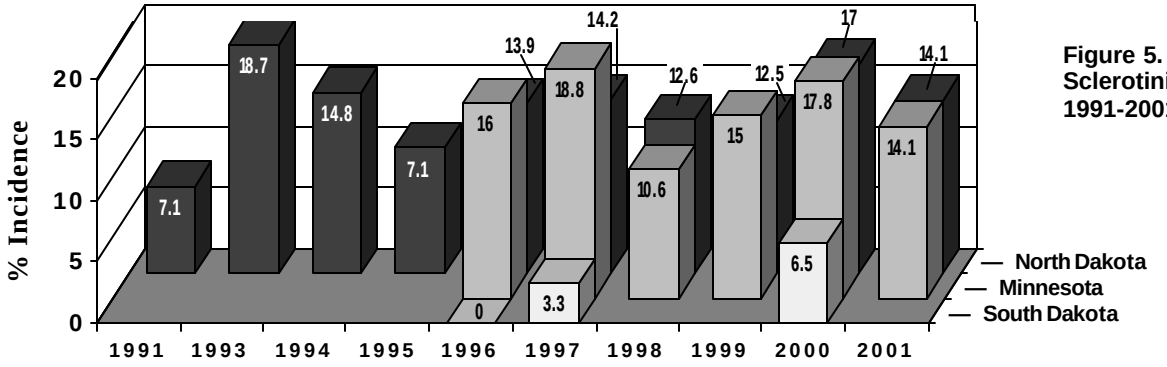

Figure 5. Sclerotinia Incidence, 1991-2001.

Data on Canadian yield trials with Sclerotinia indicate a 0.5 to 0.7% yield loss for each 1% of infected plants (11, 15). Since only plant stubble was inspected and infections farther up the plant could not be assessed, the higher figure of 0.7% was used to estimate yield losses. Thus, incidences of 14.1% in Minnesota and North Dakota represent estimated yield losses of 9.9%. Assuming an average yield potential of 13 cwt / A in North Dakota and an average price of $9.47 / cwt (loan rate used), losses were approximately 1.29 cwt / A or $12.22 / A; losses on 1,293,000 North Dakota acres (Farm Service Agency data) are estimated at $15,800,460, which is $2,330,940 less than the estimated losses in 2000. Assuming a yield potential of 14.5 cwt / A in Minnesota and an average price of $9.12 / A (loan rate), losses were approximately 1.44 cwt / A or $13.13 / A; losses on 73,762 Minnesota acres (Minnesota Agricultural Statistics Service data) are estimated at $968,495, much less than that estimated in 2000. Total losses for the two states are estimated to be $16,768,955, or about 80% of the estimated losses in 2000.

Fields with over 30% Sclerotinia were considered to be fields with an economic loss, since this incidence represents an estimated 21% loss. There were 39 of 289 surveyed fields in North Dakota, or 14%, with an economic loss (Table 6). This is about two thirds the percent of fields with an economic loss in 2000. There were seven of 45 surveyed

Table 6. Percent of fields with an economic loss (>30% incidence) from Sclerotinia stem rot in 2001.

	Fields with Economic Loss			Fields with Economic Loss	
District	No. of Fields	% of Fields	County	No. of Fields	% of Fields
Minn. (NW)	**7/45**	**15.6**	Kittson	0/7	0
			Marshall	3/11	27.3
			Pennington	3/8	37.5
			Polk	1/4	25.0
			Red Lake	0/10	0
			Roseau	0/5	0
N.D. (NE)	14/66	21.2	Cavalier	5/30	16.7
			Nelson	0/10	0
			Pembina	0/4	0
			Ramsey	5/10	50.0
			Towner	4/12	33.3
N.D. (C)	19/39	48.7	Eddy/Foster	2/9	22.2
			Sheridan	6/10	60.0
			Stutsman	5/10	50.0
			Wells	6/10	60.0
N.D. (NC)	6/67	9.0	Benson	0/9	0
			Bottineau	2/20	10.0
			McHenry	1/10	10.0
			Pierce	2/10	20.0
			Rolette	1/18	5.6
N.D. (NW)	0/52	0	Burke	0/5	0
			Divide	0/5	0
			Mountrail	0/10	0
			Renville	0/13	0
			Ward	0/17	0
			Williams	0/2	0
N.D. (WC)	0/18	0	McKenzie	0/2	0
			McLean	0/16	0
N.D. (SW)	0/10	0	Hettinger	0/10	0
N.D. (State)	**39/289**	**13.5**			

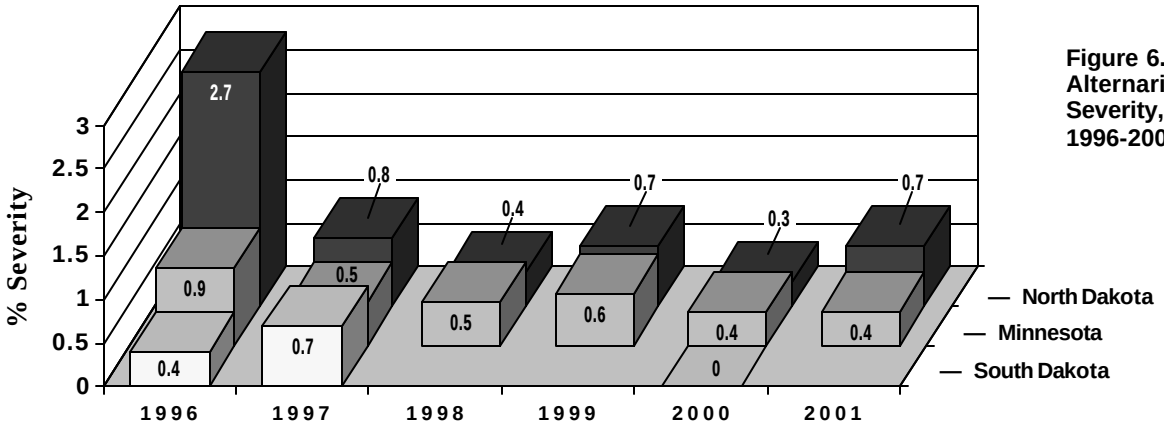

Figure 6. Alternaria Black Spot Severity, 1996-2001.

fields in Minnesota, or 16%, with an economic loss. This is about two thirds of the percent of fields with an economic loss in Minnesota in 2000. Average incidence in the fields with over 30% Sclerotinia was 47.9% for the 39 surveyed fields in North Dakota and 43.8% for the seven surveyed fields in Minnesota. The percent infection for the fields with an economic loss in 2001 was slightly greater than the percentages for Minnesota and North Dakota in 2000.

In Minnesota, Alternaria black spot pod severity in 2001 was similar to 2000, but in North Dakota it was about twice as great in 2001 as in 2000 (Figure 6). Black spot severity was low in all years, except that it was moderately low in North Dakota in 1996. Alternaria black spot may contribute to increased seed shattering and green seed. For each 1% of black spot severity on the pods there is a 1% yield loss (14). However, incidences in northwestern North Dakota cannot be compared with those from other areas since the method of recording data was different (see Materials and Methods). It is possible that assessing 10 pods as a group may lead to assessments that are higher than those where 10 pods were assessed individually.

Relatively low levels of aster yellows occurred in 2001, compared to higher levels in 2000 and in 1999. Apparently there was a smaller influx of the aster leafhopper, vector of the aster yellows phytoplasma, in 2001 as compared to 2000.

Acknowledgments

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