LOSSES FROM FOLIAGE DISEASES OF FORAGE CROPS IN CENTRAL AND NORTHERN ALBERTA IN 1970

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Abstract

An extensive survey of foliar diseases of forage crops was carried out in central and northern Alberta in 1970. Methods were devised to estinate the severity of each disease of each species, and these were used to estimate losses. A loss of 5.651 or $4.7 million was found.

Introduction

Although it is known that diseases reduee the potential yield of forage crops, there is very little published information on the extent of this reduction or its value. There is likewise a dearth of information on methods of estimating losses. This paper outlines a method for determining losses and reports estimates of losses caused by foliage diseases of forage crops based on an extensive survey of central and northern Alberta in 1970, as a part of the National Crop Disease Loss Assessment Program.

Winter crown rot and other root and crown diseases of legumes were not surveyed due to the short period during which symptoms appear, but losses from these diseases may approach or surpass those caused by foliar diseases. Insufficient information was available on root diseases of grasses to allow a meaningful survey. One would suspect that variation in severity of various diseases would occur from year to year and attempts will be made to compare prevalence and severity over several years.

Materials and methods

One percent of the farms qrowing forage crops (2) in seven of the Alberta Census Divisions (CD) 8–15 (Figure 1) were surveyed during the period June 29 to September 8. CD 9 was not included because of a sparsity of farms. Leaf and stem samples from 5,150 forage plants were collected from 305 fields and examined for disease symptoms. The fields selected were at least 2 miles apart and in each the percentage contribution of those plant species comprising at least 5% of the forage mixture was estimated. Ten shoots of each of these species were collected at 2-pace intervals starting at a point 20 paces from the edge of the field and following a line approximately 45 degrees from the edge. The plants were examined in the field or were kept for short periods in labelled plastic bags. Pastures and recently cut fields in which legumes were in a pre–bud stage or grasses in a pre–boot stage were not sampled. For each field the date of sampling, approximate location, Census Division, percentage of each forage species, presence of the various diseases and average severity of each disease were recorded.

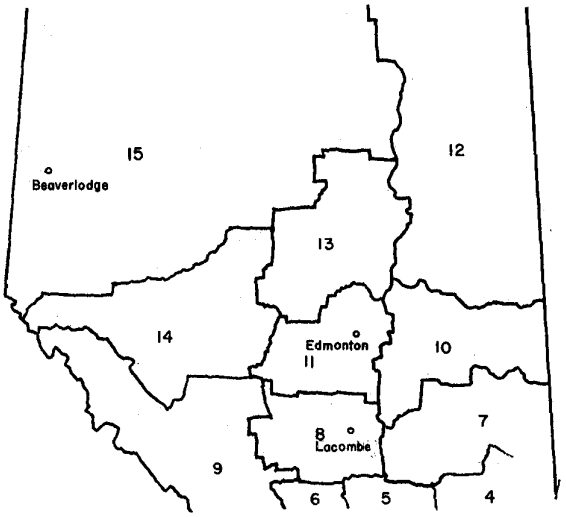

Figure 1. Map of central and northern Alberta showing Census Divisions.

A disease index based on severity was determined for each disease. Yellow leaf blotch and common leaf spot of alfalfa were assessed using the key in Figure 2.

For other foliage diseases, indices were based on the % leaves affected or on the % leaf area affected. Percentage of leaves affected was used as the basis for assessing brown stripe of creeping red fescue and stagonospora leaf spot, pepper spot, downy mildew, rust, sooty blotch, northern anthracnose, powdery mildew, and black–stem leaf spot of alfalfa and clovers. Percentage leaf area affected was used for drechslera leaf streak of timothy, using a key described by James et al. (5) and applying it to all

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the leaves present on each shoot. The leaf area affected by heterosporium leaf spot of timothy was determined by estimating the number of spots per leaf and multiplying by 0.15, the ratio of lesion-to-leaf area.

Disease Index	Symptoms
0.1	Symptoms present in field.
1.0	Symptoms on more than 2 leaves per shoot but fewer than 7. Almost all plants show symptoms.
5.0	Symptoms generally restricted to the lowest quarter of shoot.
10.0	Very little defoliation. Leaves on the upper half of shoot nearly free of symptoms.
25.0	Leaf symptoms severe on the lower half of shoots. Upper leaves showing moderate symptoms but with green growing tips.
50.0	Severe leaf symptoms up to three-quarters length of shoot. Lowest quarter defoliated.
75.0	Severe symptoms on three-quarters of all leaves, only growing tips green. Up to half of stem defoliated.

Figure 2. Key to severity of yellow leof blotch and common leaf spot of alfalfa.

The percentage of stem area affected was determined for black stem of alfalfa and clovers and for stem eyespot of creeping red fescue.

Horsfall (4) has shown that for each percentage of diseased leaves the loss is 0.25% due to stemphylium leaf spot on red clover. This factor was applied to other crops and their diseases. He also stated that severe powdery mildew apparently reduced the crop 25-33%. Davies et al. (1) reported that spraying ryegrass affected by powdery mildew and rhynchosporium leaf blotch with a fungicide gave a yield increase of up to 25% depending on the level of infection, which was presumably near 100%. Therefore, the disease index, corresponding to percent area affected, was multiplied by 0.25 to obtain percent loss for all legumes and grasses surveyed. The validity of this factor should be verified for each disease by field tests.

The disease index for each field was calculated by multiplying the total disease index for all diseases of each species by the proportion of that species in the field and adding the indices of other species present. The average disease index for each Census Division was multiplied by 0.25 to give percent loss. Potential production is actual production plus yield loss. No adjustment was made for loss in quality (6). Acreage, yield, and actual production were derived from the survey, with assistance and data from the Alberta Marketing and Statistics Branch, (H.H. Bryce, personal communication).

Results and discussion

Alfalfa was the species most frequently used in forage mixtures in the area surveyed (Table 1), comprising 45.5% of the total cultivated forage. These figures are somewhat biased in favor of legumes, since they recover more rapidly than grasses after cutting and make up a greater percentage of hay in second and subsequent cuttings. No allowance for seed or pasture production was made and all acreage was considered as producing hay. Since the survey was carried out over a period of 72 days, disease severity in fields sampled early in the survey was actually less than in the later samplings, but no attempt was made to adjust for this. This feature would tend to underestimate losses. Incidence and severity ratings of forage crop diseases in each Census Division are shown in Table 1.

Census figures do not report species and mixtures cultivated for forage but report all as "tame hay". Thus in estimating losses, the species and diseases were combined. Table 2 shows acreage, yield, and loss by Census Division, and totals or averages for the northern half of Alberta. The low loss in CD 14 was partially due to the common use of wheatgrass, on which disease was not estimated.

The legumes were found to be more seriously affected by diseases than grasses and were infected by a larger number of different diseases. Red clover sustained the greatest percentage loss, 7.28%, composed mostly of powdery mildew, 3.04%; stagonospora, 2.17%; and northern anthracnose, 1.11%. Alsike clover had a total loss of 7.035, composed chiefly of powdery mildew, 3.54% and staqonospora, 2.83%. Alfalfa, the most common forage crop, sustained a disease loss of 5.8136, most of it caused by yellow leaf blotch, 2.87; black stem, 1.45%; and common leaf spot, 1.3%. Harding (3) reported a similar relationship in Saskatchewan in 1967. Only one major disease was found on brome, drechslera leaf blotch causinq 2.56% loss, and on timothy, drechslera leaf streak, causing 1.46% loss.

As suggested, the loss figures of $4.6 million or 5.65% could be an underestimate. As this loss is from leaf and stem diseases only, it is obvious that when root and crown disease losses are added the loss of potential forage yield due to disease is very substantial.

Table 1. Incidence and severity of foliage diseases of forage crops in central and northern Alberta, 1970

1. ALFALFA (Medicago sativa L.)

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed* Yellow leaf blotch	Black stem	Stagonospora	Pepper spot	Downy mildew	Common leaf spot
8	148.0	29	21/ 9.87**	22/8.22	10/0.04	0/0	6/0.02	11/ 0.92
10	142.1	47	43/11.44	46/5.46	19/0.15	12/0.06	5/0.26	39/ 4.52
11	177.2	36	33/14.11	31/3.37	16/0.20	5/0.40	0/0	32/ 6.23
12	147.7	21	7/ 0.58	20/5.02	9/2.34	1/1.43	2/0.01	19/10.68
13	175.4	31	26/10.33	26/8.89	11/0.64	0/0	1/0	17/ 5.17
14	0.5	1	0/0	0/0	1/0.10	0/0	0/0	1/ 0.10
15	186.7	18	18/24.40	13/3.48	1/0.01	0/0	1/0.01	8/ 5.88
Total	977.6	183	148/11.49	158/5.79	67/0.46	18/0.26	15/0.07	127/ 5.21

* Causal fungi: Yellow leaf blotch, Leptotrochila *medicaginis* (Fckl.) Schuepp; black stem, Ascochyta *imperfecta* Pk.; stagonospora, Leptosphaeria pratensis Sacc. and Briard; pepper spot, Pseudoplea trifolii (Rostr.) Petr.; downy mildew, Peronospora trifoliorum de Bary; common leaf spot, *Pseudopeziza* trifolii f. Sp. *medicaginis-sativae* Schmiedeknecht.

** Number of fields affected/disease index.

2. RED CLOVER (Trifolium pratense L.)

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed* Powdery mildew	Northern anthracnose	Black stem	Black-stem leaf spot	Stagonospora
8	46.0	8	2/ 2.51	6/3.97	3/0.51	0/0	5/19.14
10	4.0	4	2/11.75	1/9.50	1/0.25	0/0	0/0
11	86.6	22	11/14.23	9/8.65	11/2.35	0/0	4/ 5.16
12	6.1	2	1/ 6.00	0/0	0/0	0/0	0/0
13	91.2	17	12/15.97	5/3.01	8/6.00	1/0.06	10/ 6.79
14	1.3	2	0/0	1/1.00	0/0	0/0	0/0
15	185.3	18	8/12.43	7/0.61	8/1.59	6/5.19	14/14.03
Total	420.5	73	36/12.16	29/4.44	31/2.57	7/1.29	33/ 8.69

* Causal fungi: Powdery mildew, Erysiphe polygoni DC. ex Mérat; northern anthracnose, Kabatiella *caulivora* (Kirchn.) Karak.; black stem, Ascochyta meliloti (Trel.) Davis; stagonospora, Stagonospora recedens (O. Massal.) Jones and Weimer.

3. ALSIKE CLOVER (Trifolium hybridum L.)

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed* Powdery mildew	Black stem	Stagonospora	pepper spot	Rust	sooty blotch
8	46.8	11	6/10.39	3/0.84	6/ 8.12	0/0	0/0	0/0
10	12.4	6	4/35.17	0/0	3/ 7.02	0/0	0/0	1/0.02
11	42.5	16	4/ 8.01	3/0.07	11/10.09	4/0.76	0/0	0/0
12		0						
13	24.0	6	4/21.70	1/4.67	6/20.55	0/0	0/0	1/6.33
14	2.6	3	0/0	0/0	0/0	0/0	0/0	0/0
15	85.6	10	4/15.31	2/0.02	10/17.20	0/0	1/5.00	0/0
Total	213.9	52	22/14.17	9/0.74	36/11.31	4/0.23	1/0.96	2/0.73

* Causal fungi: Powdery mildew, Erysiphe polygoni DC. ex Mérat; black stem, Ascochyta *meliloti* (Trel.) Davis; stagonospora, Leptosphaeria pratensis Sacc. and Briard; pepper spot, Pseudoplea trifolii (Rostr.) Petr.; rust, *Uromyces* trifolii (Hedw. f. ex DC.) Lév.; sooty blotch, *Cymadothea* trifolii (Pers. ex Fr.) Wolf.

Table 1 (Cont'd.)

4. SWEET CLOVER (*Melilotus alba* Desr. and M. officinalis (L.) Lam.) *

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed: Black stem	Downy mildew	Stagon-ospora
8	7.7	1	0/0	1/0.10	0/0
10	4.0	1	0/0	1/0.10	1/0.10
11	8.0	3	0/0	0/0	1/0.03
12	8.5	1	1/13.40	0/0	1/2.70
13	1.3	1	0/0	0/0	1/0.10
14	1.1	1	0/0	0/0	1/0.10
15	46.3	4	0/0	0/0	0/0
Total	82.9	12	1/ 1.12	2/0.02	5/0.26

*

Causal fungi: Black stem, Ascochyta *meliloti* (Trel.) Davis; downy mildew, Peronospora *trifoliorum* de Bary; stagonospora, Leptosphaeria pratensis Sacc. and Briard.

5. WHITE CLOVER (*Trifolium repens* L.) *

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed: Pepper spot	Stagon-ospora	Rust
8	3.3	2	0/0	2/0.10	1/0.05
10		0			
11	1.2	1	0/0	0/0	1/0.10
12		0			
13		0			
14	0.5	1	0/0	0/0	0/0
15		0			
Total	5.0	4	0/0	2/0.05	2/0.05

*

Causal fungi: Pepper spot, Pseudoplea trifolii (Rostr.) Petr.; stagonospora, Leptosphaeria pratensis Sacc. and Briard; rust, Uromyces trifolii (Hedw. f. ex DC.) Lév.

6. BROME (*Bromus* inermis Leyss.) *

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed: Brown leaf spot	Selen-ophoma	Scald
8	30.3	10	9/ 5.87	2/0.07	0/0
10	51.3	24	24/ 8.57	10/0.12	4/0.05
11	30.9	13	13/ 7.36	2/0.13	1/0.16
12	9.8	4	4/10.90	1/0.02	0/0
13	36.7	8	8/23.01	1/0.01	1/0.27
14	3.1	2	2/ 7.00	0/0	0/0
15	65.3	8	7/13.27	5/0.06	1/0.01
Total	227.4	69	67/10.26	21/0.09	7/0.08

*

Causal fungi: Brown leaf spot, Drechslera bromi (Died.) Shoem.; selenophoma, Selenophoma bromiqena (Sacc.) Sprague and Johnson; scald, Rhynchosporium *secalis* (Oud.) J.J. Davis.

7. TIMOTHY (*Phleum* prafense L.) *

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed: Eyespot	Leaf streak
8	71.3	26	25/0.39	25/ 6.11
10	4.7	4	4/0.35	4/ 4.17
11	48.9	24	22/0.40	20/ 5.40
12	10.4	4	3/0.14	3/ 7.30
13	47.9	13	12/0.98	12/ 3.47
14	11.3	3	3/0.02	2/ 0.67
15	27.4	5	2/0.07	5/15.82
Total	221.9	79	71/0.44	71/ 5.83

*

Causal fungi: Eyespot, Heterosporium phlei Gregory; leaf streak, Drechslera phlei (Graham) Shoem.

8. FESCUE (Festuca rubra L.) *

Census Division	Acres grown ('000)	No. fields sampled	Diseases assessed: Brown stripe	Stem eyespot
8	3.3'	1	0/0	0/0
10		0		
11		0		
12	2.1	1	1/10.00	0/0
13		0		
14		0		
15	103.9	9	5/ 0.06	5/4.44
Total	109.3	11	6/ 0.95	5/3.64

*

Causal fungi: Brown stripe, Passalora *graminis* (Fckl.) Höhn; stem eyespot, Phleospora idahoensis Sprague.

*

Note: For each disease assessed incidence and severity ratings show no. fields affected/disease index.

Table 2. Losses from foliage diseases of forage crops in Alberta Census Divisions 8 to 15

Census Division	No. of fields sampled	Acreage of forage crops ('000)	Yield (tons/acre)	Loss (%)	Actual production ('000 tons)	Potential production ('000 tons)	LOSS ('000 tons)	LOSS* ($'000)
8	47	365.4	2.03	4.03	741.8	772.93	31.13	560.34
10	56	222.0	1.71	4.82	379.6	398.81	19.21	347.78
11	60	400.8	2.03	5.99	813.6	865.40	51.80	932.40
12	22	189.4	1.81	4.47	342.8	358.82	16.02	288.36
13	53	386.3	1.81	7.15	699.2	753.08	53.88	969.84
14	6	61.8	1.81	0.16	111.9	112.07	0.17	3.06
15	61	702.0	1.75	6.55	1228.5	1314.60	86.10	1549.80
Total	305	2327.7	1.85	5.65	4317.4	4575.71	258.31	4651.58

* Based on a farm value of $18 per ton of forage.

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