Prevalence of alfalfa crown and root diseases in the Peace River Region of Alberta and British Columbia'

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Following the 1973-74 winter, numerous alfalfa fields showed severe injury in the Peace River Region of Alberta and British Columbia. A survey of root and crown diseases was conducted in 40 2nd-year or older alfalfa *(Medicago sativa)* fields. The root/crown rot complex was divided into four principal types of symptoms: root rot, internal crown rot, external crown rot, and winter crown rot. Moderate or severe root rot occurred in *68%* of the fields observed in the northern part of the region in Alberta, whereas in the remaining area only 24% of the fields had just a trace amount of root rot. Internal crown rot was prevalent throughout the survey area. External crown rot and winter crown rot were of minor significance. Twelve percent of the fields observed had no disease symptoms, 55% had only one type of symptom, and 33% had more than one.

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Un grand nombre de champs de luzerne de la region de la rivière de la Paix, en Alberta et en Colombie-Britannique, ont gravement souffert de l'hiver 1973-1974. On a conduit un releve des types de pourridiés dans 40 luzernières *(Medicago sativa)* de deux ans ou plus. On a ainsi pu définir quatre types de pourridie selon les symptômes notes: le pourridie des racines, le pourridie interne du collet, le pourridie externe du collet et le pourridie hivernal du collet. Dans le nord de la region, en Alberta, *68%* des champs examines etaient gravement ou moyennement atteints du pourridié des racines alors que 24% des champs restants seulement ne manifestaient qu'un taux d'infestation negligeable. Le type le plus frequent de pourridie dans toute la region est le pourridie interne du collet. Le pourridie externe du collet et le pourridie hivernal sont relativement rares. Sur les champs examines, 12% n'en presentaient pas de symptômes, 55% n'en presentaient qu'un cas et 33%. plus d'un.

Extensive damage to perennial grasses and legumes occurred during the 1973-74 winter in the Peace River Region of Albert and British Columbia. This winter was characterized by unusually deep and prolonged snow cover. Severe injury has also been reported following the winters of 1955-56 (8), 1926-27 (2) and 1922-23 (1).

With the recent opening of five dehydration plants in this region, alfalfa (*Medicago sativa* L.) production has gained increasing importance. However, yields have been less than 1 ton per acre in some areas and an unsatisfactory level of winter survival has created additional difficulties for manly growers. Hence a project was initiated to assess the extent and causes of poor winter survival and low yields in this region.

Diseases and injuries affecting the overwintering of alfalfa have been recently reviewed by Graham et al. (11), Jung and Larson (17), Kehr et al. (18), Leath et al. (19), Bolton (4), and Heinrichs (15). It has become increasingly apparent that crown rot and root deterioration is a product of an interaction of multiple factors of both the physical and biological environments. Knowledge of the pathogens and environmental factors involved is far from complete and symptoms produced by different causes overlap (19). Moreover, this problem has not been previously investigated in this region and very seldom north of the 55th parallel (25). We therefore decided to assess and describe the types of symptoms, to determine the causal factors involved, and finally to arrive at solutions to minimize occurrence. This paper documents the first phase of this project, to identify the major types of damage occurring on alfalfa in the Peace River Region, as found in surveys of 40 2nd-year or older fields in 1974.

An attempt was made to determine major regional differences in frequency of symptom types. A strictly quantitative survey was not attempted. Twenty-eight alfalfa fields were surveyed throughout the region between June 16 and June 23, 1974. Seven fields were surveyed in the Beaverlodge area on May 23, and 5 fields in the Dawson Creek and Fort St. John area on August 15. Sampling was started 8-15 m (25-50 feet) from the edge of each field, and several plants were dug at each of 5 to 10 locations throughout the field. Except in the case of small patches of winter crown rot, above-ground conditions were not factors in choosing location. Roots and crowns were sliced vertically to show the type and severity of injury. Each field was rated as nil, trace, moderate, or severe for each disease symptom. The index was a qualitative evaluation of the total field sample. Fields tended to fall into one of four clear-cut groups with very little intergradation. Nil indicated that symptoms were not present. Trace indicated that early symptoms were present. Moderate indicated that some symptoms were well developed but either occurred

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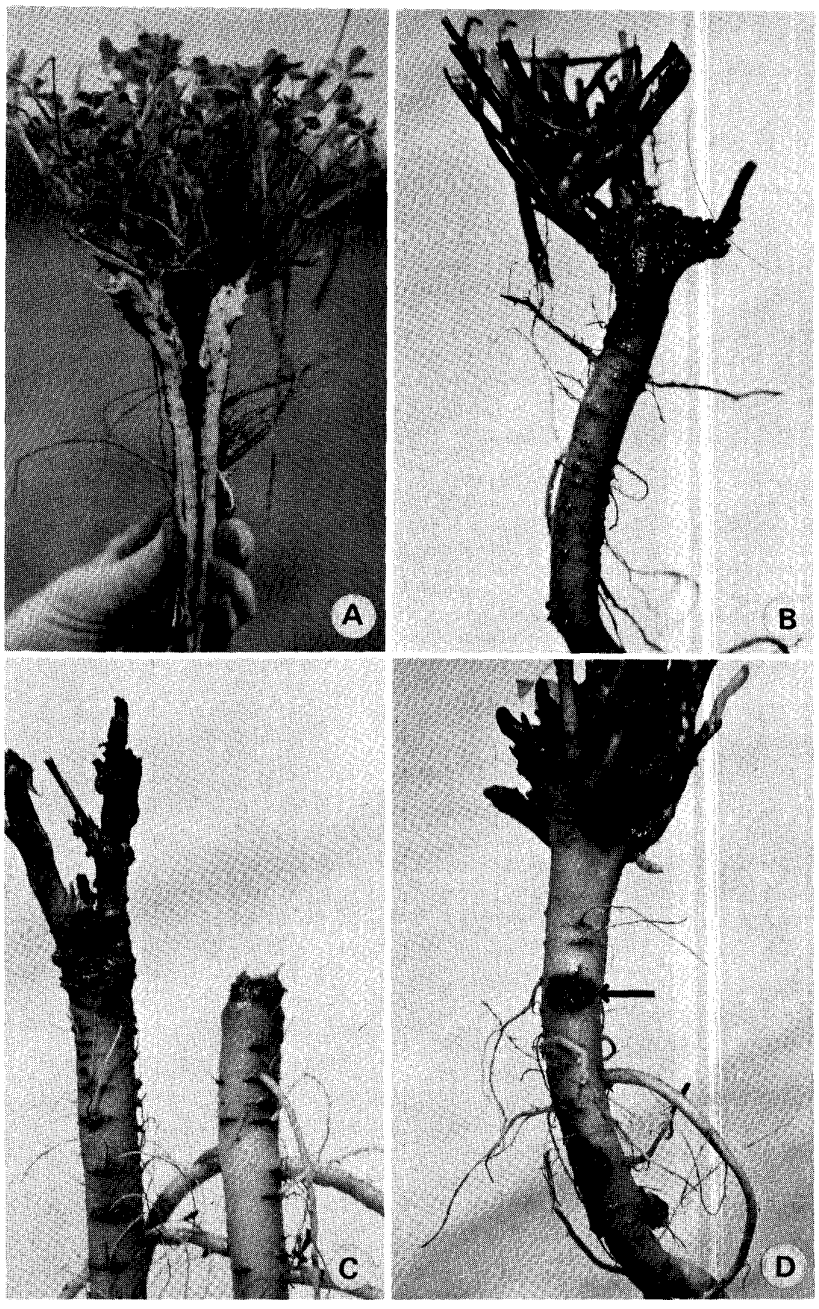

Figure 1. The four main types of crown and root disorders found in the Peace River Region in 1974.

A) Internal crown rot symptoms, indicating advanced stage where central stele of root is damaged.

B) External crown rot, showing necrosis of the root-crown cortex.

C) Winter crown rot indicating disintegration of the crown tissue.

D) Root rot (arrow) showing site of initiation where lateral roots emerge.

sporadically or appeared to cause no serious deterioration of the stand. Severe indicated that symptoms were well developed throughout the field and caused obvious deterioration of the stand.

Results

Description of symptoms

Four main types of injury occurring singly or in various combinations were distinguished.

Internal crown rot occurs frequently in older stands. Dark brown necrotic areas are iniated in the crown at the site of cut stems or in axils. The necrosis proceeds into the crown to form a wedge-shaped decayed area. This eventually progresses into the central stele of the taproot (Fig. 1A). The vigor of plants is reduced because fewer shoots originate from the reduced crown surface. Normally crown buds originate in the fall then develop rapidly in early spring, but in severely affected crowns new shoots arise only from the lower part of the crown in late spring.

External crown rot injury is characterized by necrosis in the transition zone of the crown and root cortex. It appears to begin as an external lesion which expands and results in partial girdling and partial killing of the crown and crown buds (Fig. 1B). After 2 or more seasons, girdling is complete, resulting in death of most of the crown. A marked increase in the extent of external crown rot has recently been observed in patches in one intensively monitored alfalfa field in the fall, prior to freeze-up.

Winter crown rot is a characteristic of both old and young stands. It occurs primarily in patches within a field. Crown tissues become soft and brownish yellow in appearance, then disintegrate until the whole crown is rotted off (Fig. 1C). The rot is not selective of tissues within the crown, and taproots usually are not damaged. It appears to be more common in low, wet areas and completely kills the crown, apparently in a single winter. It is associated with snow mold.

Root rot injury is characterized by blackish-brown lesions appearing on root surfaces, usually expanding from where a lateral root emerges from a taproot (Fig. 1D) or a main root. These lesions progress until they completely rot through the root.

Survey

Figure 2 outlines the Peace River Region of Alberta and British Columbia. The region is divided into two areas on the basis of where root rot appeared to be of major significance. Area 1 includes the region around Manning, Alberta, north to the Fort Vermilion, High Level districts. Area 2 includes the remaining portion of the Peace River Region in Alberta and British Columbia.

The results of the 1974 survey are given in Table 1. Root rot occurred in 68% of the fields surveyed in Area 1 and in most of those fields damage was either moderate or severe. In Area 2 only 24% of the fields had just a trace amount of root rot. Internal crown rot was slightly more prevalent in Area 2 than in Area 1 (Fig. 2). Fifty-seven percent of the 19 fields examined in Area 1 and 67% of the 21 fields in Area 2 had internal crown rot. External crown rot occurred more frequently in Area 1, while winter crown rot was more frequent in Area 2. Both external crown rot and winter crown rot were of minor occurrence in 1974. Twelve percent of the fields observed had no disease symptoms, 55% had only one type of symptom, and 33% had more than one.

A comparison of the fall samples with the spring samples is valid for all symptoms except winter crown rot. Since winter crown rot was of only minor occurrence throughout the survey, data from the fall sampling were included in the analysis.

Discussion

The four types of symptoms distinguished here do not indicate causal agents or the season in which initiation or development occurs. They resemble symptoms previously observed, and are attributed to various causes at various seasons.

Symptoms illustrated and described elsewhere that are similar to our internal crown rot type have been termed heart rot (27, 28), crown rot, or crown and root rot (4, 6, 19, 24). They have been variously attributed to environmental conditions (27), ***Rhizoctonia solani*** Kuhn (4, 24), ***Fusarium*** spp. (6, 19), ***Stagonospora meliloti*** (Lasch) Petr. ***(9,*** 16); similar symptoms have also been produced by artifical freezing (28). The later stages of crown bud rot, which has been attributed to a complex including ***R. solani, Fusarium roseum*** Link sensu Snyder and Hansen ***[F. avenaceum*** (Fr.) Sacc., ***F. acuminatum*** (Ell. and Ev.) Wr.], and ***Ascochyta imperfecta*** Peck ***(Phoma medicaginis*** Malbr. & Roum.), are also similar (12, 13, 14).

External crown rot types of symptom have been termed collar rot (27), phloem injury (28), and winter crown rot in its earlier or partial stages (7). They were attributed to environmental conditions (27) and the low-temperature basidiomycete (7) and also were produced by artificial freezing (28). The greatest increase in external crown rot that we have observed, however, occurred in the fall prior to freezing or snow cover.

Winter crown rot (4, 5, 7), also termed snow mold (20). and the low-temperature basidiomycete disease (11), has *so* far been attributed exclusively to the low-temperature basidiomycete. Isolates of this organism are quite variable in morphology and physiology (20, 26) and may prove to be a complex of basidiomycetes. This type of symptom has also been produced by artificial freezing (28).

Similar root rot symptoms have been variously termed brown root rot attributed to ***Plenodomus meliloti*** Dearness and Sanford (22, 25); root or root and crown rot due to ***R. solani*** (11, 24), ***Fusarium*** spp. (6, 19), or ***Phytophthora megasperma*** Drechs. ***(P. cryptogea*** Pethy. and Laff.) (10, 21), although dissimilar symptoms were also described and shown for ***P. megasperma*** (11); and root canker due to ***R. solani*** (3, 4, 9, 23).

We have, therefore, been careful to separate symptoms from causes, and in this report the attempt has been made to distinguish the main types of symptoms that

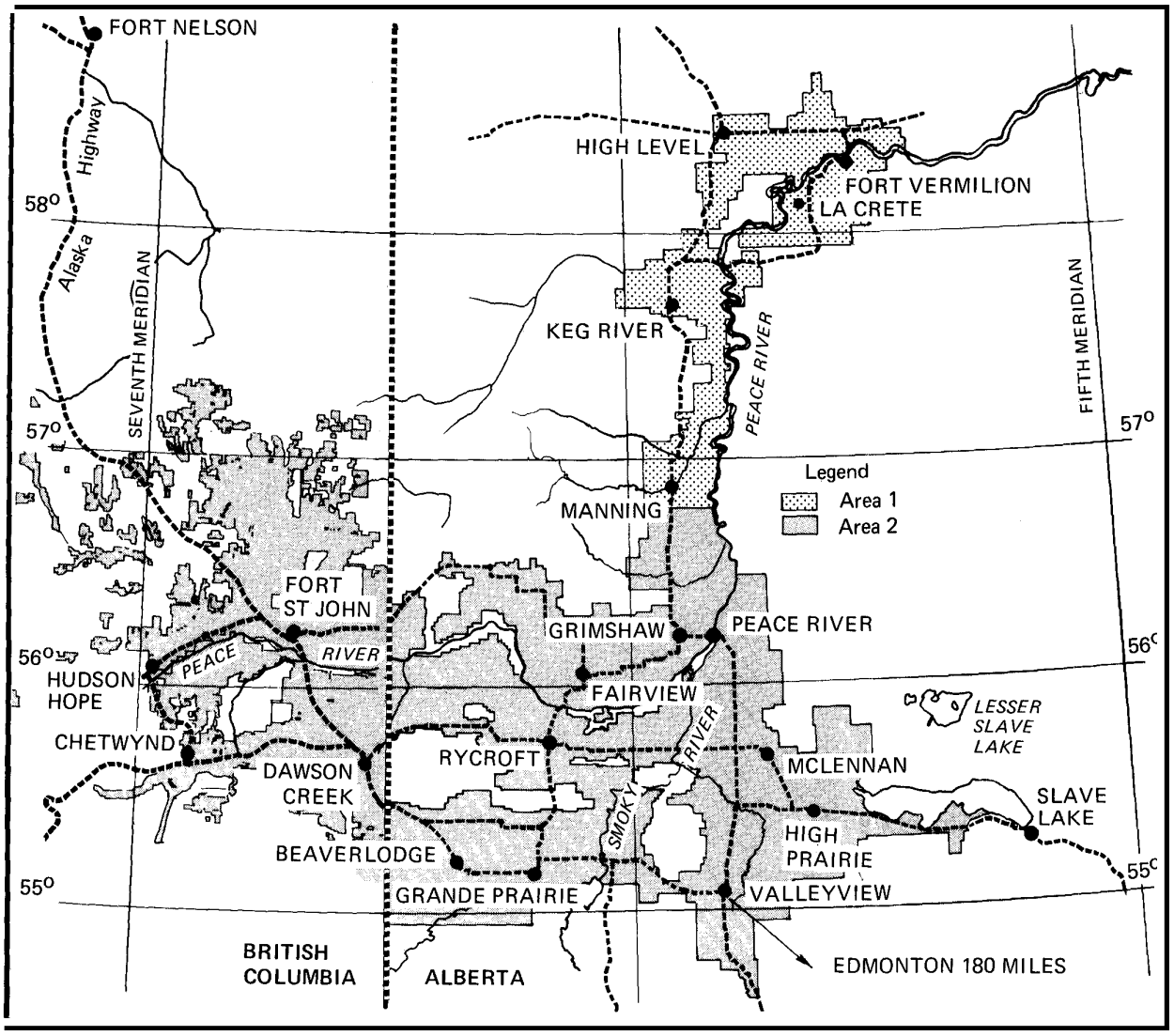

Figure 2 The agricultural area of the Peace River Region in Alberta and British Columbia. Area 1 extends from 10 miles south of Manning, Alberta, north to the High Level and Fort Vermilion area. Area 2 consists of the remaining parts of the Peace River Region.

occur in the Peace River Region before investigating causes and interactions. Descriptions of the symptoms of crown and root disorders of alfalfa and their relative distribution in the region were developed from the results of the survey for one season. The cultivars Beaver, Grimm, Rambler, and Roamer predominate in the region, but no attempt was made to identify cultivars or to specify the particular soil type in which a disorder was found. The prevalence of root rot in Area 1 and its minor significance in Area 2 may be important in understanding the disease and environmental relationships in these areas. Studies are continuing to identify the causes of these symptoms, the organisms involved, and to assess management practices that may reduce severity.

Acknowledgments

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Table 1. Percentage of alfalfa fields observed to have disease symptoms? in two areas of the Peace River Region of Alberta and British Columbia in 1974

Area'	No. fields observed	Internal crown rot			External crown rot			Winter crown rot			Root rot		
		T	M	S	T	M	S	T	M	S	T	M	S
1	19	32	15	10	11	5	0	0	5	0	0	53	15
2	21	33	24	10	5	0	0	5	5	0	24	0	0

* See Figure 2.

† T = trace; M = moderate; S = severe.

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