SERIOUS DAMAGE CAUSED BY STALACTIFORM BLISTER RUST AND WESTERN GALL RUST TO A LODGEPOLE PINE PLANTATION IN CENTRAL ALBERTA

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Abstract

Two pine stem rusts, stalactiform blister rust (Cronartium coleosporioides Arth.) and western gall rust (Endocronartium harknessii (J. P. Moore) Y. Hiratsuka), caused severe damage to lodgepole pine (Pinus contorta Doug. var. latifolia Engelm.) grown for Christmas trees and ornamental trees in a tree farm in central Alberta. Stalactiform blister rust killed over 80% of the young trees in the nursery area and a third of the transplanted stock in one area. Numerous new galls of western gall rust appeared in the fall of 1972, having originated from 1971 infections. A survey showed that 63% of the 6- to 12-year-old lodgepole pine were infected, with an average of 28 galls per infected tree. Because of the damage caused by the two pine stem rusts, the operator of the tree farm suffered severe financial loss.

Résumé

Les deux Rouilles-tumeurs Cronartium coleosporioides Arth. et Endocronartium harknessii (J. P. Moore) Y. Hiratsuka causèrent de sérieux dommages au Pin lodgepole (Pinus contorta Dougl. var. latifolia Engelm.) cultivé pour les arbres de Noel et ornementaux dans une ferme forestière en Alberta central. La première tua plus de 80% des jeunes arbres de la pépinière et un tiers des plants dans un certain secteur de la ferme. De nombreuses tumeurs de la deuxième apparurent à l'automne de 1972, résultats d'infections survenues en 1971. D'après un inventaire, 63% des Pins lodgepoles âgés de 6 à 12 ans furent infectés (moyenne de 28 tumeurs par arbre infecté). Tous ces dommages causèrent de sérieuses pertes financières à l'exploitant.

Introduction

During recent years, there have been several reports of significant localized damage by pine stem rusts in Canada and especially by the western gall rust, Endocronartium harknessii (J. P. Moore) Y. Hiratsuka (Carlson 1969, Forbes et al. 1970, 1972, V. Hildahl 1972 personal communication, Ives et al. 1969, 1971, Molnar et al. 1970). Up to 70% to 100% of the trees were reported to be infected in some localities in the Prairies (Ives et al. 1969, 1971, V. Hildahl 1972 personal communication), and a Scotch pine Christmas tree plantation in New Brunswick was abandoned because of the frequency and intensity of the western gall rust (Forbes et al. 1972).

In the summer of 1972, the attention of the Canadian Forestry Service was drawn to a pine stem rust problem on a tree farm, after several infected trees were noted among stock for distribution to the public in Edmonton. The tree farm, near Mackay, Alberta, covers 80 acres and is planted with nearly 100,000 trees. Over 30,000 of these trees are pines, mainly lodgepole pine, Pinus contorta Dougl. var. latifolia Engelm., with smaller plantings of Scotch pine, P. sylvestris L. The trees were grown for Christmas tree production, but in recent years an increased portion has been sold for the ornamental tree market mainly in the city of Edmonton. The trees, up to about 20 years in age, had been planted on agricultural land, surrounded by stands of native forest trees. To investigate and assess the situation, four visits were made to the tree farm by personnel of the Canadian Forestry Service.

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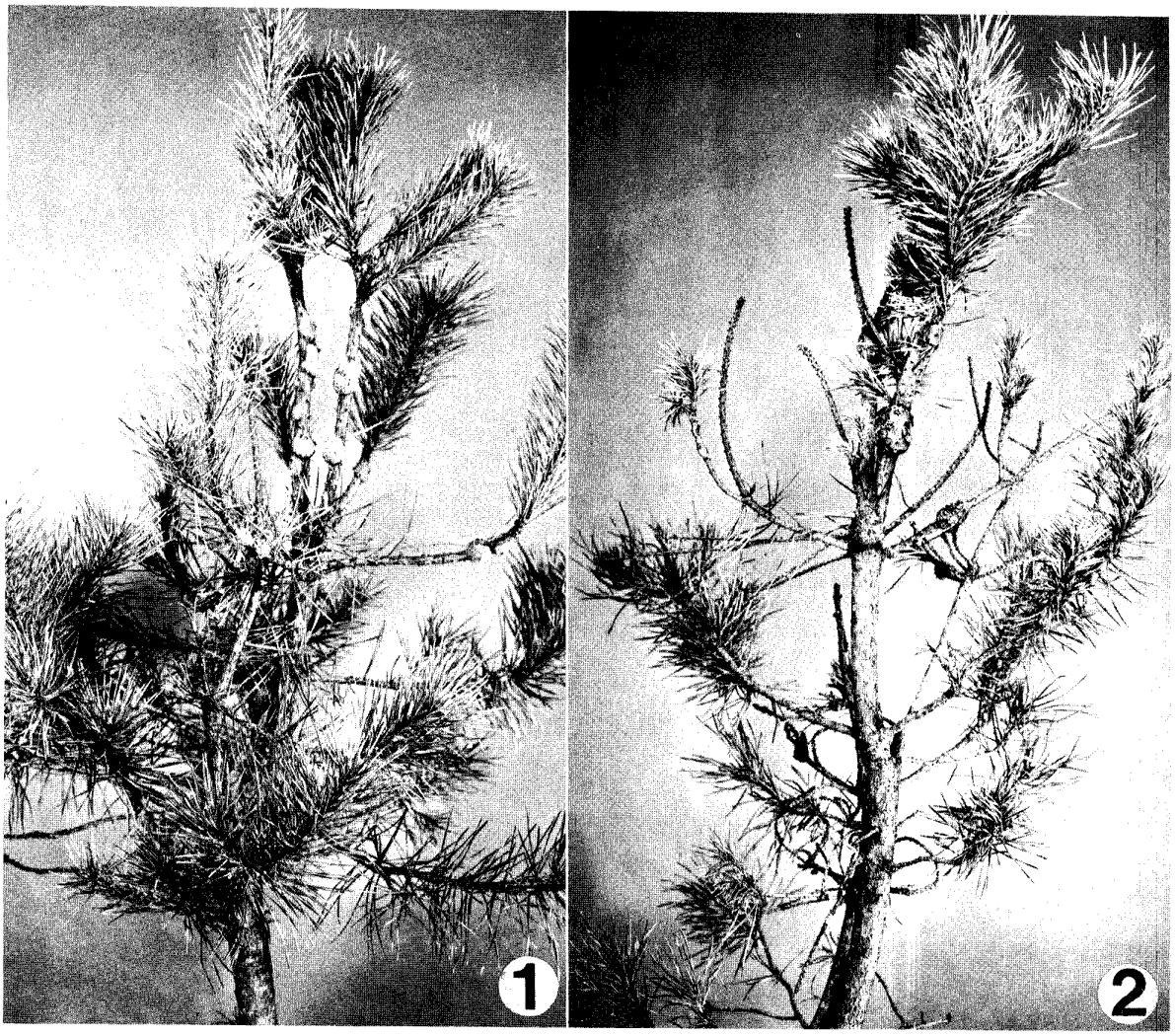


Figures 1 & 2. Top portions of 8-year-old lodgepole pine trees with 1) many multiple galls on 2nd-year shoots; 2) four 5-year-old galls that have caused some branch mortality and reduction of growth; a few new galls are also present.

Observations and discussion

During the two early summer visits, a small percentage of the older lodgepole pine was found to be infected by the western gall rust, and a small area of the younger lodgepole pine was heavily infected by the stalactiform blister rust, Cronartium coleosporioides Arth. The remaining trees in the adjacent nursery area from which the younger, 5- to 7-year-old stock had been transplanted were also heavily infected by stalactiform rust. It was recommended that the nursery area be cleared out and that all planted trees with stalactiform blister rust cankers should be removed, and further suggested that chemical control should be carried out on the surrounding healthy trees in August to prevent reinfection from the alternate host, Indian paintbrush, Castilleja spp., which was abundant and heavily infected in the plantation area. It was also recommended that the trees with western gall rust galls on the main stem be cut out, and branches with galls be pruned.

A re-examination on September 21 and again on October 20, of areas where stalactiform blister rust infected trees had been. showed that many infected trees remained despite the removal of over 1,000

Figure 3. Top portion of an 8-year-old tree with one 6-year-old main stem gall which has caused major reduction in growth and some branch mortality. Note new multiple galls on several of the branches.

trees, or nearly a third of the original plantings in this block of the plantation. Most of the infections occurred near the base of the tree. It was established through aging the cankers on ten infected trees that most of the infections had occurred in 1967 before transplanting. A visual check of the small remaining area in the nursery showed over 80% of the trees were already dead, and more than half of the remaining living trees had signs of active stalactiform blister rust cankers.

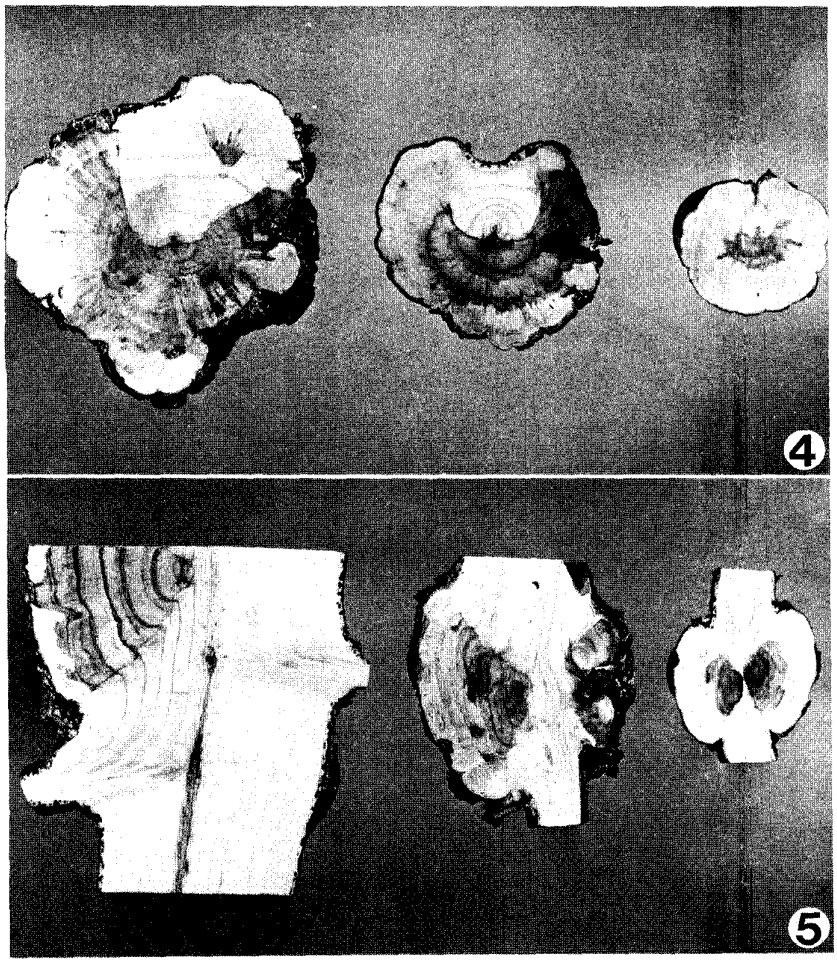
Over the summer there had been a spectacular change in the status of infections by the western gall rust, although some pruning had been carried out. Where before there were only a few infected trees in the 10- to 15-year-old and virtually none in the 8-year-old lodgepole pines, the rust was now very much in evidence with new galls developing on the main stems and branches (Figs. 1 to 3). On some leaders or branches up to ten galls were developing in a row on 1-year-old tissue. Attempts were therefore made on October 20, and subsequently in the laboratory, to obtain some quantitative data of the incidence and intensity of the rust and to find out the ages of infections.

The incidence of the rust was surveyed in two age groups of lodgepole pine (6-8 and 10-15-year-old) by tallying a total of one hundred trees in random rows from each planting block. To determine intensity and to find out the possible year of infection all galls that could be found on each tree were counted and aged. The number of galls occurring on the main stem were recorded separately. The age of the galls was assumed to equal the ages of the host tissues and was estimated by counting branch whorls as suggested by Peterson (1971), who found that in almost all cases infection occurs on the current-year shoots. The rust condition of these surveyed blocks appeared to be typical of the lodgepole pine blocks, although in some older blocks more older galls were in evidence, and the younger blocks planted near the edge of the plantation had less infection.

Percentages of trees infected in the older and younger age class were 57 and 69 respectively. In the older age class there was an average of 37 galls per infected tree and in the younger age class 20 galls (Table 1). On one tree 322 galls were counted and several others in the older age class had

Table 1. Number of lodgepole pine trees infected by western gall rust in two age classes and the number of galls in each age class surveyed in the field

Age class of trees	Number of trees sampled	Number of infected trees	Number and percentage of galls in each estimated year of infection									Total number of galls
			1971	1970	1969	1968	1967	1966	1965	1964	1963	
10-15 years	100	57	2037	7	7	8	18	1	2	2	1	2083
6-8 years	100	69	1391	0	0	1	1	1	0			1394
Total	200	126	3428	7	7	9	19	2	2	2	1	3477
%		63	98.6	0.2	0.2	0.3	0.6	<0.1	<0.1	<0.1	<0.1	



Figures 4 and 5. Sections of three galls with stained and deformed tissues used to determine the year of infection; 4) transverse sections; 5) longitudinal sections.

over 100 galls per tree. The percentage of galls occurring on the main stem was 2.7% in the older age class and 7.2% in the younger class. Of the total number of galls in the two age classes, 98.6% of the galls originated in 1971, percentages in other years were very small with the highest occuring in 1967 (0.5%) (Table 1).

To evaluate the field survey results, 599 galls were collected from the infected blocks for aging in the laboratory. This collection of galls was not a wholly random sample since increased emphasis was given to collecting older galls to help establish whether earlier "wave years" of infection had occurred. The galls were cut transversely (Fig. 4), or longitudinally (Fig. 5), for counting of the annual xylem rings to establish the first year of infection. Of the sample galls, 86.1% originated in 1971, 4.8% and 4.7% respectively in 1970 and 1967, and only 1% or less in the other years.

The two methods of sampling indicate that a wave year of infection occurred in 1971, some infection occurred in each of the other years with a slightly higher incidence in 1967. Peterson (1971) showed that wave years of infection occurred with western gall rust, although his data did not show such a marked year of infection as reported above. In his study the peak year of infection accounted for only 25% to 70% of the total infections.

Although the western gall rust had not yet killed the infected trees, the rust drastically restricted growth, causing the trees to become stunted and malformed (Fig. 3). Consequentely most of the heavily infected trees had lost their commercial value as ornamentals or Christmas trees. It was recommended that the owner should try to eliminate all trees with multiple galls or main stem galls and prune trees with only a few branch galls if the shape of the tree is not drastically altered. Some of these trees may be satisfactory for the Christmas tree market and thus will enable the operator to obtain some return on his investment. At last report the operator had cut or pulled out 3,500 of the trees heavily infected with western gall rust and estimated approximately the same number remained to be cut.

Conclusion

The two stem rusts were responsible for severe damage to lodgepole pine on a tree farm in central Alberta and caused substantial financial loss to the operator. Both stalactiform blister rust and western gall rust should be considered as dangerous biological agents capable of threatening the successful intensive cultivation of lodgepole pine in Alberta, especially in areas close to native stands.

Nursery stock showing a few rust infected seedlings should be destroyed and the remaining stock checked carefully for several years after being planted out, as incipient infections are probably present in a number of seedlings not showing signs of infection. Pruning of branch cankers and galls should be considered when trees in a plantation are of special value.

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