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ATROPELLIS CANKER IN ALBERTA: SILVICULTURAL CONTROL AND ITS BIOLOGICAL BASIS

PROJECT NO. A/T 221

by

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INTRODUCTION

This report summarizes aspects of the biology of Atropellis piniphila (Weir) Lohman and Cash that are pertinent to a control program and presents some suggested applications of the data to practical situations for controlling the disease. Control in this context refers to a reduction of the incidence of the disease in a stand, or to a lessening of a potential hazard, and does not necessarily imply eradication. While the suggested control methods will require field testing to evaluate the extent of their effectiveness, they are expected to provide the basis for reducing the considerable damage presently occurring.

Investigations into the biology of this disease and its causal organism have been carried out almost exclusively in Alberta (2, 3, 4, 5, 6). Apart from taxonomic work (7, 9, 11), and reports on distribution (8, 10) including those of the Forest Insect and Disease Survey, no other important studies of this organism have taken place outside Alberta although the disease is widely distributed throughout western

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PLATE I

Cross section through the center of a 37 year old Atropellis canker with the typical blue-black discolouration and continued ring formation on the unaffected side of the stem.

Surface view of a relatively young infection originating at a branch node on a suppressed tree with typical resinosis.

North America. Accordingly, caution is required in extrapolating the results and suggestions to areas of different climatic conditions, although at least some of the control procedures should be applicable.

Control by antibiotics or other fungicides is not presently feasible and there appears little hope of finding an economically acceptable method of using them for Atropellis canker.

Control programs for forest diseases based on silviculture can rarely, if ever, eradicate a disease completely although the incidence may be lowered to a point where the damage is of little economic value. The fact that the pathogen is present even though at a low population level, and the partial dependence of that level on climate, introduces risk in predicting effects of treatments. Nevertheless, acceptance of some risk, which must be balanced against the risk inherent in inaction, must be made in any disease control program.

BIOLOGY

Damage

Severe resinosis characterizes the disease and causes much of the economic damage (Plate I). This resinosis hinders effective debarking and degrades the pulp. The blue-black stain adds to bleaching costs. The tissues produced by the host in the vicinity of a canker are abnormal and cause further degradation. For example, there is a large increase in the proportion of bark periderm and xylem parenchyma while tracheid production is diminished and the tracheids themselves are abnormally short and thin-walled. Lumber quality is much reduced by the stem malformation in the vicinity of cankers.

In many areas this disease reaches high incidences and multiple stem cankers occur frequently. Complete girdling with consequent death of the tree may occur in trees of low vigor.

Ecology

In the foothills of Alberta, south of the North Saskatchewan River, high incidences of Atropellis canker occur usually in dense, overcrowded stands. Open-grown trees even though close to infected dense stands tend to remain free from infection.

In areas north of the North Saskatchewan River, the disease forms high incidences over large areas even though many of the stands are less dense than those farther south. Inoculum for intensification in these northern stands come mainly from branch infections.

The North Saskatchewan River represents an approximate boundary but the choice is somewhat arbitrary. The explanation for the different infection patterns in the north and south is not known, but is believed to be partly related to fire history, partly to different stand densities, and partly to differences in summer rainfall and evaporation. Several consecutive days of continuously moist summer weather is believed to favor development of new infections. This weather is much more common in the north. In southern areas, despite a generally unfavorable summer climate for the disease, the dense stands provide a microclimate suitable for infection.

Resistance

Resistance to this pathogen occurs in several forms. The most important, from the control standpoint, is that exhibited by young regeneration. Information on this form of resistance has been obtained by examination of regeneration in cut lines subject to heavy spore loads, and from tree ages at the time when infections occurred. It is evident from these examinations that infections do not develop before trees are 10 years old and develop only occasionally before trees are 15 years old. A decrease in resistance usually occurs soon after the trees become 15 years old.

Resistance occurs in a few of the vigorous older trees in some areas (4). In these trees, cankers become over-grown and the fungi are killed. Some trees have suppressed and active cankers.

Resistance in mature trees might become important, from a control standpoint, if further research would indicate that stock from these trees retain the resistance of the parent.

Inoculum Formation

Inoculum capable of establishing new infections consists of ascospores. The ascospores, in apothecia, are formed after widely varying intervals. An interval of 2 to 5 years usually elapses between infection and the onset of inoculum formation on small branches and stems of small, suppressed trees. The interval is often 20 or more years for stem infections on large, vigorous trees. Inoculum production, once it has commenced, continues each year until a few years after death of the host.

Inoculum formation on cankers of slash left after clear-cutting usually ceases within a year, although it can continue for 3 or 4 years on logs in the heavy shade within a stand.

Inoculum Dissemination

Atropellis piniphilia is disseminated by airborne ascospores that are released during wet periods from April to October. Aerial dissemination is a very complex process dependent on many variables. Most fungal spores are deposited near their source, but some may be transported over great distances (1). The greater the distance from an inoculum source the smaller the chance of spore deposition. Examination of infection gradients of Atropellis canker have indicated that dispersal may occur up to 1000 feet from a source (5) although evidence suggests that the maximum distances are often much less than 1000 feet.

CONTROL

The control recommendations are designed to minimize the initial amounts of inoculum and its subsequent rate of formation, thereby greatly reducing the incidence of Atropellis canker.

Young Uninfected Stands Established After Fire

In southern areas the sources of inoculum for subsequent infections have been traced to old fire residual trees that were infected before the fires. Consequently, fire residuals should be felled within approximately 8 years of the appearance of the first regeneration after a fire. Similarly, any large segments of older stands adjacent to young regeneration should be cut before the young trees become susceptible.

Regeneration in patches resulting from small fires within a relatively large stand of infected trees presents a special control problem. It is likely that the regeneration will become infected which in turn will perpetuate the supply of local inoculum after the older trees are harvested. Planting the burned patch with a non-susceptible species, perhaps spruce, would be one remedy. A total clearcut at the time of harvest would be another remedy.

Immature Infected Stands

Control treatments for infected immature stands should minimize the subsequent infection rate so as to prevent a high incidence of multiple stem infections. In southern regions of the province there is evidence that thinning would be effective. Experiments are continuing there to determine to what extent infection rates are reduced by thinning to different densities.

In northern areas the problem of control in immature stands is more complex because high incidences are frequent in stands stocked lightly or moderately. It is not known at present what treatments should be recommended for these stands.

Mature Merchantable Stands

Clearcutting of mature merchantable stands, either in strips or in large blocks, removes local inoculum sources. However, strips or stands that remain standing until adjacent regeneration becomes susceptible will eventually infect the latter. Before cutting commences, the distribution of the disease should be examined to determine if it occurs in pockets or in a comparatively uniform distribution. Pockets should be cut as early as possible. The larger the area cut the better the degree of control likely to be achieved. Consequently, in areas with a high incidence of canker, cutting should be concentrated in one region rather than in smaller areas widely separated from each other. Where strip-cutting is practised it is most important to cut the remaining strips at least one year before the oldest regeneration may become susceptible. Consideration may also be given to arranging a border of non-susceptible species which may filter off much inoculum produced by the infected residual pines.

A potential source of infection in all areas are the few trees which are left because they are too small to be useful. They should be cut as soon as possible. Apparent absence of infection is insufficient reason to leave such trees because often small cankers are not visible from ground level.

Unmerchantable Mature Stands

Controlled burning appears to constitute the best treatment for many of the older infected stands of suppressed lodgepole that are not expected to reach commercial value. Many stands of this type exist in the southern area. Inoculum production is very rapid on stem infections of small suppressed trees, and thus constitutes a potential hazard to nearby stands.

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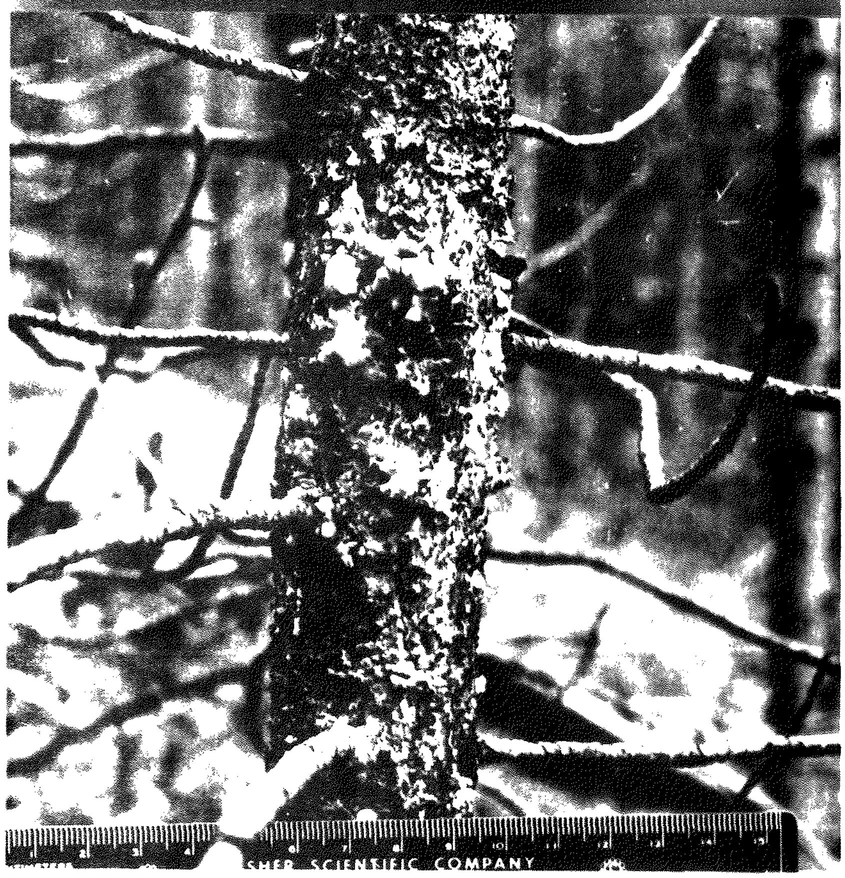
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