forestry report

Environment Canada Environnement Canada

CANADIAN FORESTRY SERVICE • NORTHERN FOREST RESEARCH CENTRE

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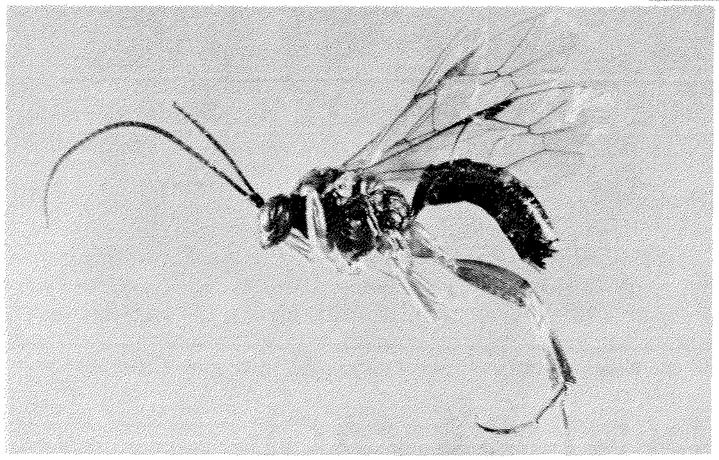
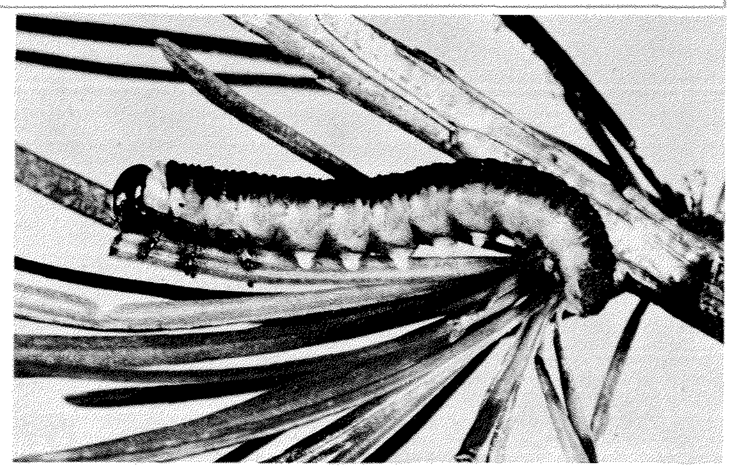
FOREST INSECTS AND DISEASE



Olesicampe benefactor adult.



Larch sawfly larva.

LARCH SAWFLY

A Biological Control Success Story

Biological control is the attempt to use parasites, predators and disease organisms to reduce the numbers of a pest species to non-damaging levels. It has great advantages over the use of pesticides in that it is safe, permanent and economical. In some cases the gain on investment has been enormous, as high as 25,000 percent. The disadvantages of the method are that there is no certainty of success. Results may not be achieved until several years after initiating a project and then only in a restricted area, and considerable preliminary study must often be done on natural enemies before they can be successfully utilized.

Biological control has been most successful against pests that have accidently invaded a new environment leaving their complement of natural enemies behind. The larch sawfly is such a pest and because of this a biological control program was initiated in 1957. The first releases of parasites from Europe were made in 1961 and between then and 1965, six different species of exotic parasites were released. Only two of these became successfully established but the performance of one of them, the wasp-like *Olesicampe benefactor*, has been outstanding both in terms of numbers of sawflies attacked and rate of dispersal. The map on the next page shows that although the parasite had only spread two miles by 1967 (five years after release) during the next five years it spread an additional 275 miles, with an average rate of spread in the last three years of about 80 miles per year. Dispersal from the other release points has not been monitored as thoroughly as for the Pine Falls release but limited data indicate it has followed a similar pattern: more information on this will be collected during the current summer.

The larch sawfly is now very difficult to collect within a mile of the Pine Falls release point, only four colonies being collected in a three-hour search in 1972. In this same area in 1967 sufficient larch sawfly larvae were collected to provide over 9,000 cocoons. *O. benefactor* adults from these cocoons were released in the Maritime Provinces in 1968.

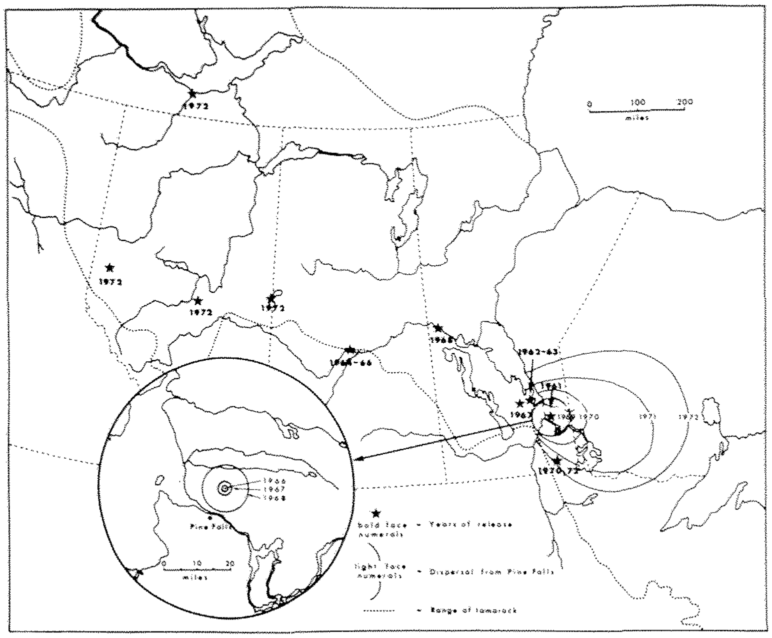
There is now a very noticeable reduction in damage to tamarack due to the larch sawfly over a wide area surroundiing the Pine Falls release point and this undoubtedly is due to the progressive decrease in larch sawfly density brought about by the high rate of kill caused by *O. benefactor* since 1965 as shown in the following table.

Year	Cocoons Per Acre	Parasitism By O. Benefactor
1964	507,000	8%
1965	311,000	61%
1966	334,000	93%
1967	137,000	97%
1968	122,000	95%
1969	132,000	94%
1970	35,000	91%
1971	4,356	85%
1972	871	50%

These high rates of attack have occurred in spite of *O. benefactor* itself being heavily attacked by another wasp-like parasite of its own (a hyperparasite) called *Mesochorus dimidiatus*. The reduction in rate of attack by *O. benefactor* since 1969 from 94% to 50%) is probably due to both the effect of this hyperparasite and the scarcity of larch sawflies but it appears that the state of balance that is being reached in the ecosystem is one in which the larch sawfly will remain at non-damaging levels of abundance.

The hyperparasite may actually be performing a useful role by decreasing the rate of parasitism by *O. benefactor* at low sawfly densities, thus preventing the local extermination of both its host and, as a consequence, itself. The danger of such local extinctions is that re-invasion of an area by the sawfly only may occur and outbreaks develop before *O. benefactor* can re-invade and bring the sawfly under control.

In a number of other biological control programs, introduced parasites have shown promise for three or four years but failed to live up to expectations. *O. benefactor*, however, still appears promising twelve years after its introduction. Only time will tell whether it is able to maintain control over a long period of time. Also, tamarack covers a vast range in North America and it may be that *O. benefactor* will not provide good control over the whole range. In 1972 releases were made in Alberta and the North West Territories at four widely-separated locations (see map) in an attempt to obtain more rapid control over the whole range. Consideration is now being given to releasing the parasite in the stands of western larch in British Columbia and in the larch plantations of southern Ontario.



INSECT AND RODENT DAMAGE ASSOCIATED WITH REGENERATION

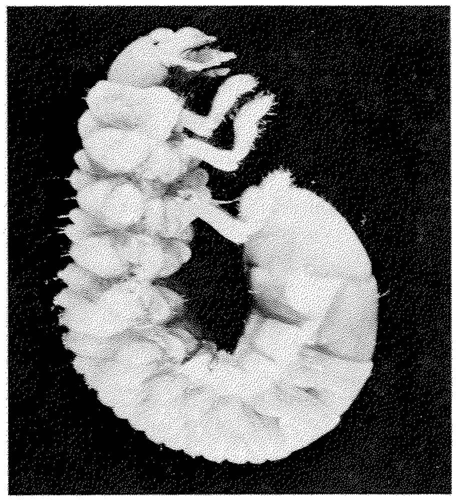
In recent years, several organisms causing growth losses, deformed stems and mortality to conifer seedlings and small trees have become increasingly evident in natural stands and plantations in the Prairie Provinces. Prominent among the animal damaging agents are root-collar weevils, white grubs and the snowshoe hare.

Two species of root-collar weevils, *Hylobius radicis* and *H. warreni*, feed as larvae in the root-collar zone of healthy trees, killing some by girdling. Partially girdled stems suffer growth losses, are weakened structurally and made prone to windthrow. The life habits and damage of both species are similar.

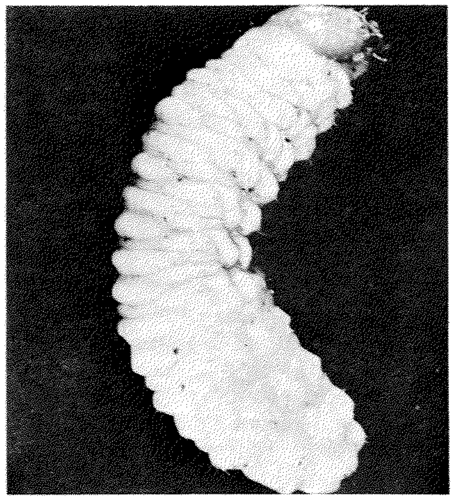
An outbreak of *H. radicis* occurred in Scots and lodgepole pine plantations, 7-18 years old, on about 100 areas in the Sandilands Forest Reserve in Manitoba. Five years later, an average of 50% tree mortality occurred and some plantings were a complete loss. Red pine plantations in the same vicinity remained relatively immune to attack. Thus far, this weevil has not been found beyond a 10-mile radius of the initial plantation infestations, and is believed to have originated from an endemic population surviving in the surrounding native stands of jack pine.

H. warreni is present in low numbers in most spruce and pine forests in the Prairie Provinces and southern Northwest Territories, but has been found abundant on lodgepole pine in high productivity sites along the Alberta foothills and on white spruce and jack pine in moist sites in central Saskatchewan and western Manitoba. Invasion into natural regeneration and plantations begins when trees are less than 10 years old; thereafter weevil populations may persist and attack the trees repeatedly to maturity. Mortality from girdling is confined mostly to trees under 30 years of age and rarely exceeds 5% in natural regeneration. In recent years, higher percentage kills have become evident in some pine regeneration on sites previously clearcut. The main reasons for this seems due to the reservoir weevil populations in residual trees bordering clearcuts, which are available for early invasion of young stands; the relatively wide spacing of young planted trees which favors fast dispersal and host selection; and the fact that a single larva can girdle one tree stem an inch or less in diameter. Some recommendations for control of this weevil in lodgepole pine have been formulated using clearcutting and some modifications in silvicultural management. Studies of its behavior, damage and control are being continued in areas under intensive management.

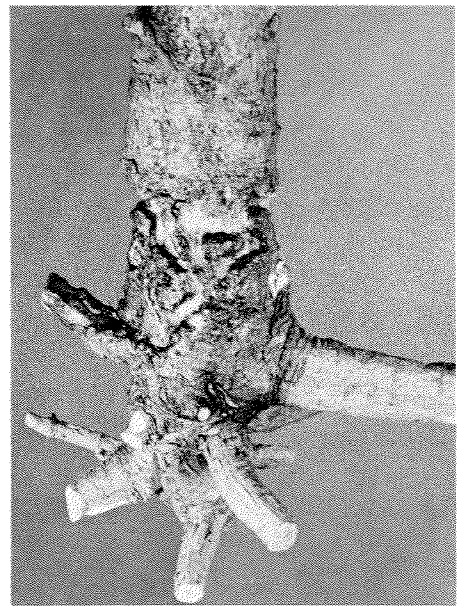
White grubs of the genera *Phyllophaga* and *Serica* species have caused serious damage (up to 80% loss) to



White grub.



Root collar weevil larva.



Root collar weevil damage.

jack, Scotch and red pine transplants in southeastern Manitoba and Spruce Woods Forest where a reforestation program was initiated to regenerate cut-over, burnt-over and reclaimed pasture lands. Typical white grub sites are those with a grassy or heavy sod layer and light sandy soil. The grubs spend at least three years in the soil and feed on the root systems of the pine seedlings during their late feeding stages. Because of the severity of the problem, sampling techniques were developed to classify levels of infestation and to evaluate the need for pre-planting control measures. Breaking up and removing the sod layer prior to planting has proved partially successful in reducing grub populations, and some preliminary trials were made toward chemical control. Damage may also be reduced if plantings coincide with adult flight years. Pre-planting surveys have been carried out since 1966 to determine wh ther planting should be delayed until grub populations are at a safe level. This has proved successful in Manitoba at the operational level. While reclamation of pasture lands has posed the greatest problem, most of the white grub sites are now planted.

Severe damage by the snowshoe hare (*Lepus americanus*) to coniferous and deciduous (aspen, birch) regeneration has been reported generally throughout the central and northern regions of the Prairie Provinces and in the Yukon and Northwest Territories during 1960 - 62 and again in 1970 - 72. These periods coincide with peak abundance of rabbits which have recurred, on the average, about every 10 years since 1855 - 56.

During the years between peaks, rabbits become relatively scarce and cause very little tree damage. The population highs generally coincide over large areas with one or more years variation and are thus fairly predictable: the next major peak throughout the Prairie provinces can be expected during 1980 - 82. Populations along the Alberta foothills and in the mountains have tended to remain lower than at lower elevations and farther north. Damage during rabbit peaks occurs mostly between late fall and early spring when tree stems up to an inch in diameter may be girdled and chewed - off, and branches and leaders severely pruned. Larger trees may also be girdled. Pine, larch and spruce regeneration are favored food in addition to most deciduous species.

Reports of tree damage and mortality in central and northern areas suggest that those years coinciding with rabbit peaks are the most hazardous for reforestation programs and seedling transplant trials. However, the full magnitude of the problem of rabbit populations in relation to forest regeneration in the Prairie provinces has not been fully assessed.

SEPTORIA CANKER AND LEAF SPOT

Septoria canker has been considered to be a serious threat to hybrid poplars for many years. However, recent experimental work has shown that this is not necessarily the case.

Studies of the infection pattern and distribution, using natural and artificial infection of a dozen clones of hybrid poplar in each of three areas where the fungus was considered to be a problem (Oliver Tree Nursery, Edmonton, Alberta; Birds Hill, Manitoba; and Indian Head, Saskatchewan), have shown that susceptibility to leaf spot varied between clones. A few clones were highly susceptible to leaf spot, but many were not. No stem infections were found in the study plots.

Greenhouse experiments used several thousand balsam poplar seedlings grown from seed collected from 15 source trees in each of six geographic areas. These seedlings were artificially inoculated with spores of the fungus from five sources: four strains of one species and one of another. Susceptibility to the disease varied between the trees providing the seed source and the inoculum used. Seedlings from some sources were completely free from infection, many others had leaf infections only and those from a relatively few seed sources had both leaf and stem infections. Those cankers that did occur were relatively small.

There are a number of reasons why septoria canker is not as serious a disease as once thought because it s ldom reaches its full potential. Leaf spots first appear in late June after the leaves complete their development, corresponding roughly to a period of maximum dispersal of air borne spores, June 15 to July 15, and often to the beginning of a rainy season. Their appearance signals the production of secondary inoculum and re-infection, which spreads from the inner crown and from the bases of

Septoria canker.

the shoots. However, the period during which secondary infection can occur in July is usually brief, because two weeks of warm weather are required for leaf spots to produce spores. Cool nights do not permit production of secondary spore inoculum throughout August. Heavy rain reduces the effectiveness of the fungus because it dilutes the inoculum and often washes it off before the spores germinate. Cool temperatures that often accompany wet weather, especially in August and September, stimulate the production of spermatia, which are important in the production of the overwintering state, but not in reinfection. Prolonged periods of wet weather also increase mold activity which causes decomposition of leaf litter and destruction of the fungus. This factor is particularly important in forested areas, but may also be important in parkland and plains areas. Conversely, warm dry weather in the fall increases spore production and prolongs their viability. The disease is therefore most likely to be a

Close-up of Septoria leaf spot.

problem in nursery stooling beds used in the production of whips when a warm dry fall is followed by a warm dry spring.

DISEASES IN THINNED STANDS OF REGENERATION PINE

The young lodgepole pine trees in the spacing trials in stands of regeneration pine south of Hinton in the Rocky Mountain foothills of Alberta have suffered considerable damages and losses from a pine stem rust (western gall rust, Endocronartium harknessii) and a root rot complex (involving Armillaria mellea). These disease agencies are common in regenerating pine stands throughout the Rocky Mountain foothills area where they usually act as natural thinning agents in the dense stockings which are prevalent in the area.

However, these diseases have resulted in considerable losses (as high as 23% on some plots) among the spaced trees in the study. The mortality has all occurred within the eight years since the spacing trial was established (1964-1972) with losses increasing in more recent years. In some of the plots many of the remaining living trees (e.g. over 60%) are infected with western gall rust.

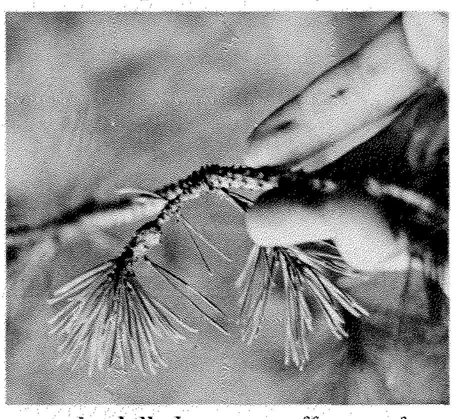
Western gall rust is readily identified by the spherical galls which form either on the main stem or the branches of the pine (fig. #1, #2). Recent infections produce very small galls which can be difficult to spot (fig. #3).

Main stem rust infections caused a stunting of height growth, a marked decrease in diameter growth above the rust gall, and sometimes caused the breakage of the main stem or killed the tree by girdling it; incomplete girdling often caused crooked stems. The galls also caused resinosis and shorter wood fibres were formed in the cankers.

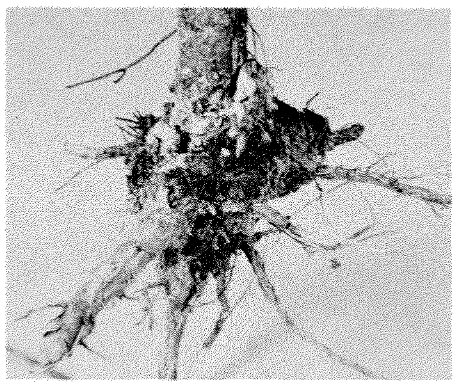
In general, the effects of branch infections on the trees were not as obvious. Some branches were killed by the gall rust, but the impact on the growth was not readily discernible, and no information is currently available on growth impacts of branch infections. No main stem deformations or other main stem abnormalities were observed for branch infections, however the presence of many branch galls did create a bushy tree. This would have significance in ornamental or Christmas tree crops.

Examinations in the spacing trial revealed that many of the old dead and recently killed trees had been infected with the root rot complex involving *Armillaria mellea.* Further examination revealed that many of the unhealthy trees were also infected by the fungus. Root rot infections are identified by root collar (basal) resinosis (fig. #4) and by the presence of white mycelial mats on the root system (fig. #5).

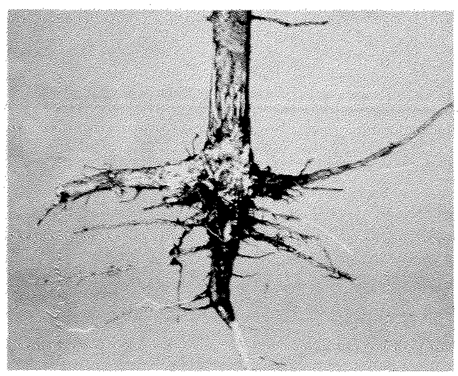
The impact of the root rot on individual infected trees centered around growth loss and tree mortality (fig. #6). Growth losses were obvious near the tops of unhealthy trees and



recently killed trees suffering from root rot infections. The point at which the root infections affected tree growth (the growth impact threshold of the infection) was not determined. No deformations of the main stem or wood fiber quality losses were observed to result from the root rot complex and no deformations of this nature are known to result from this disease agency. Infection patterns observed in the field (fig. #6) indicated that infections resulted from scattered



inoculum sources and spread among the trees over a period of years. In effect, the aggregations of tree deaths caused by the root rot complex have



created many patchy openings in the regular stocking plan in some of the plots. The frequency of the root rot complex infection appears to be related to its rate of spread through the soil. However, the incidence and rate of tree death is most probably regulated by tree predispositions, as "escape" trees were sometimes found in among the dead patches (fig. #6).

The result of this spreading infection is reflected in the pattern of tree deaths, where old dead, recently killed and unhealthy trees are found in sequentially developed groups.

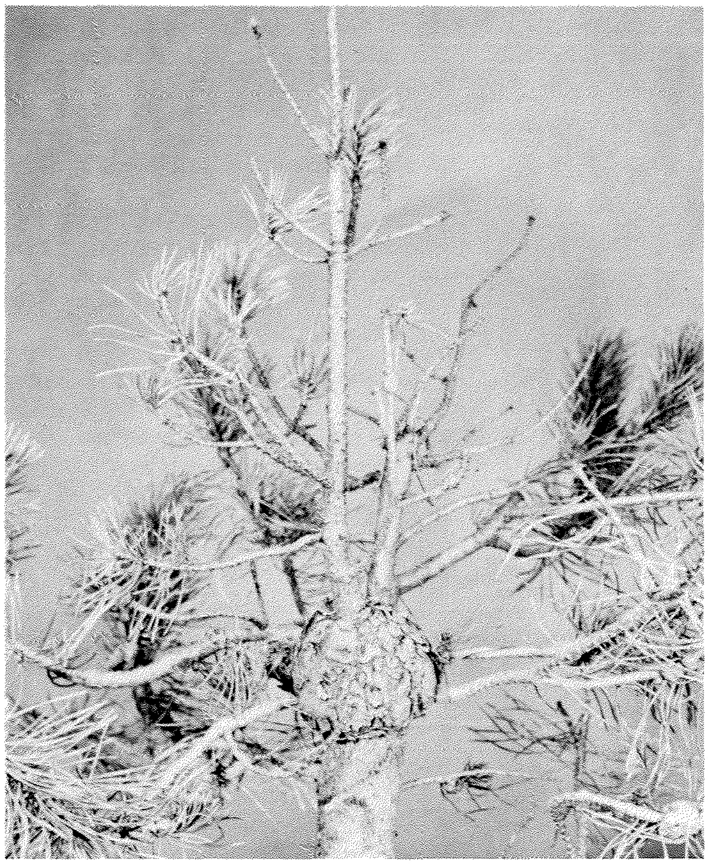
In conclusion, the trial spacing study has brought to light the problem of tree losses and eventual stand

understocking that may result from disease agencies functioning in regenerating areas reduced to ultimate ideal stocking and spacing conditions through management practices. It has also raised the question as to whether the stand manipulation procedures have increased the disease infection rates and impact levels.

STEM RUSTS CAN CAUSE SERIOUS DAMAGE TO PINE PLANTATIONS

Reports of localized damage by pine stem rusts to plantations or native stands have become quite frequent in the Prairie Provinces. Five pine stem rusts occur in the Prairies; four are native while one is introduced. Damage by the introduced white pine blister rust is restricted to the stands of limber and whitebark pine in southwestern Alberta and of eastern white pine in southeastern Manitoba. Three of the rusts, the comandra and stalactiform blister rusts and the western gall rust occur throughout the range of jack and lodgepole pine, but the fourth, sweetfern blister rust, is restricted to the more northern ranges of these pines in the Prairies and Northwest Territories. These native stem rusts are also known to infect introduced species of pine, such as Scotch and mugo pine. All the rusts except the western gall rust require a species of plant other than pine in order to complete their life cycle, although the perennial cankers on pine continue to grow causing damage and mortality to the individually infected trees. Western gall rust requires no other host, and its orange-yellow spores, which are produced in abundance on the globose galls, are capable of re-infecting pine directly if the conditions for infection are suitable.

The stem rusts attack pines of all ages, often the most vigorous; mortality is caused by stem or branch girdling. The germinating rust spores invade pines through the needles or young shoot tissues and evidence of cankers or galls is seen in one or two year-old tissues. Seedlings and saplings are usually killed within two to five years of infection but cankers on older trees may persist for 30 or more years. There is one record of a 277 year-old western gall rust on a lodge-



Western gall rust.

pole pine. Most stem cankers occur in the bottom 10 feet of the tree, but cankers at higher levels can be found in mature stands and produce dead or spike-tops where the rusts have girdled the upper stem. There are instances where hundreds of galls of the western gall rust occur on the branches of a single tree, the majority of the infections having occurred in one favourable 'wave" year. Multiple galls result in malformation and stunting; generally only galls on the main stem eventually girdle and kill the tree.

White pine blister rust threatens to destroy much of the native stands of limber pine. The most recent report indicated that 83% of the trees in the southern area of the range of limber pine had been killed by the rust and all regeneration in the area was heavily infected.

Comandra blister rust has become a problem of young pine plantations in the southeastern United States. As yet there are no reports of heavy damage by this rust in plantations on the Prairies, but 22% of the trees in a jack pine plantation near Thunder Bay, Ontario, were infected. A survey in a 20-year-old natural jack pine stand in the Northwest Territories showed 44% of the trees were infected. In a small lodgepole pine regeneration area in southwestern Alberta, 23% of the trees were infected when surveyed in 1967, and by 1971 only 12% of the infected trees were still alive.

On a tree farm in central Alberta, stalactiform blister rust killed over 80% of the young lodgepole pines in the nursery area and a third of the transplanted stock in one area. Damage from this rust can be expected to reoccur at this location as the alternate host, Indian paint-brush is abundant in the planted and adjacent area. In an area north of Burmis, Alberta, approximately 80% of the lodgepole pine was found infected.

There are recent reports of light to moderate infection by the sweetfern blister rust in natural stands in the Northwest Territories and in areas of northern Saskatchewan.

Plantations in the Whiteshell Provincial Park, Manitoba, have been shown to have at least 75% of the young jack pine infected by the western gall rust, many with main stem and multiple galls, such that mortality losses are expected to exceed 70% over the next few years. The source of this infection is a heavily infected stand of jack pine immediately adjacent to the affected plantation. A 1972 survey on a tree farm in central Alberta found 63% of the 6 to 12 year-old lodgepole pine infected, with an average of 27 galls per tree. Over 98.5% of the infections had occurred in 1971. Some of the older Scotch pine on this tree farm were also heavily infected. Source of infection was again the adjacent native stands. Recently in New Brunswick, a Scotch pine Christmas tree plantation was abandoned because of the high frequency and intensity of western gall rust.

All these rusts should be considered as dangerous biological agents capable of threatening the successful intensive cultivation of native and introduced pines on the Prairies, especially in areas close to infected native stands, or for those rusts requiring an alternate host, in areas supporting the alternate hosts. Planting pines for intensive management in such areas should be avoided whenever possible. No chemical sprays are presently available to help control these rusts. Nursery stock showing rust infections should be destroyed and the remaining stock checked carefully for several years after being planted out as incipient infections may be present. Trees with active cankers or galls on the main stem should be cut. Pruning of branch cankers or galls should be considered when trees in a plantation are of special value. Pruning or cutting should be done prior to the release of fresh rust spores, which occurs from late May through into early August.

A DWARF MISTLETOE SURVEY TECHNIQUE

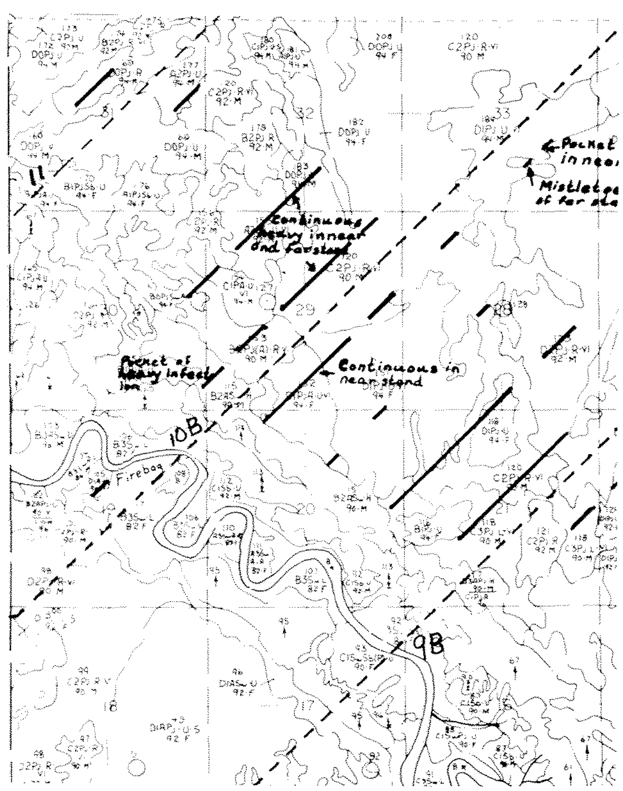
Dwarf mistletoe is a serious pest of jack pine in the Prairie Provinces, causing deformity, loss of increment and mortality. In its concern for the extensive stands of jack pine in north-eastern Alberta, the Alberta Forest Service has been examining the feasibility of wild fire manipulation and post-fire sanitation to reduce losses from this disease. The Forest Insect and Disease Survey was asked to assist in the mapping of the mistletoe infected stands in a 1764 square mile management unit. Cost and access considerations dictated an extensive type of aerial survey using a fixed-wing aircraft.

To assist in the recording, retrieval and interpretation of in-flight observations, an integrated tape — event recorder apparatus was designed and used to advantage. The equipment consisted of a Rustrak, four channel event recorder, a Uher 4000 Report L tape recorder, control boxes and headsets for two observers, a navigator and the pilot and a main control box that supplied regulated power and various audio and control circuits. Each observer controlled two channels of the event recorder, the navigator had control of all four. All crew members had uninterrupted access to intercom and the tape recorder.

Flight lines were set up at 1.5 mile intervals giving each observer two strips, each 3/8 of a mile wide to observe, for 100 percent coverage. A twin-engined Dornier S.T.O.L. fixed winged aircraft was used, flying at 400 to 500 feet above ground at an air speed of 100 M.P.H. The two observers recorded the presence or absence of dwarf mistletoe infections at right angles to their side of the aircraft on appropriate channels of the event recorder and made verbal comments on the tape recorder. The navigator insured proper course, elevation and speed, indicated start and finish of flight lines and intermediate check points on the event recorder, his base map and on the tape recorder.

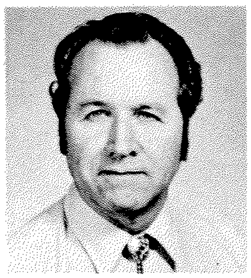
The record of occurrence of dwarf mistletoe was transferred from the event recorder to forest type maps with the aid of a Map-O-Graph adjusted to match the scale of the tape to that of the map. Relevant verbal comments were transferred from the tape recorder to the map.

While planned as an extensive rather than an intensive type of survey, the results were sufficiently accurate for use in adjusting inventories and applying disturbance factors to revised type maps.

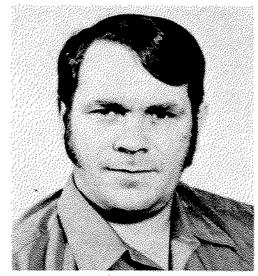


FOREST INSECT AND DISEASE SURVEY AND EXTENSION TECHNICIANS

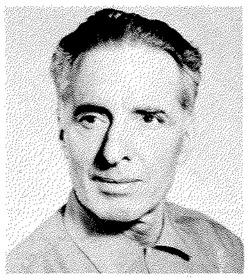
The technicians pictured below conduct detection and damage appraisal surveys, advise on pest problems and collect specimens and data. Work is concentrated i n areas of high wood fibre and recreational areas. The Forest Insect and Disease Survey has a staff of nine field technicians (Figs. 1 to 9) distributed across the Prairies Region from late spring until early fall. They may be contacted through the Canadian Forestry Se·vice offices in Winnipeg phone 269-7379, Prince Albert phone 764-3715 and Edmonton phone 435-7210.



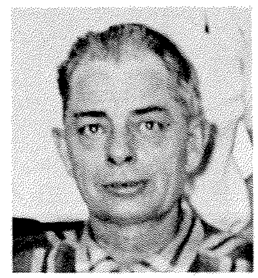
V. D. Patterson
(N.E. Alberta)



G. N. Still
(E. Manitoba)



Gord. Smith
(S. Alberta)



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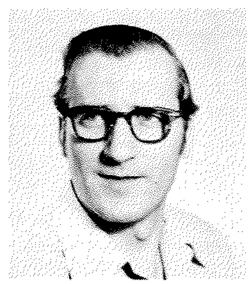
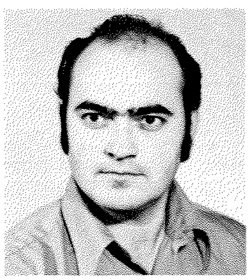
(Edmonton)

J. Petty
(W. Saskatchewan)

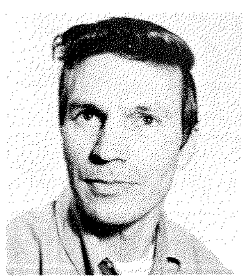


R. C. Tidsbury
(S.E. Saskatchewan)

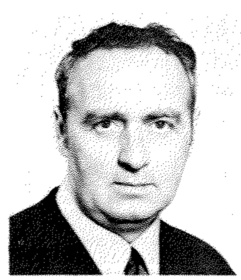


J. P. Susut
(Central Alberta)

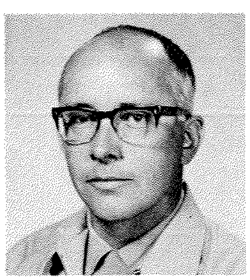
A. E. Campbell
(Winnipeg)



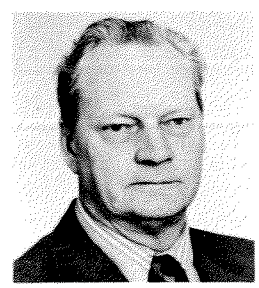
E. J. Gautreau
(N.E. Saskatchewan)



F. J. Emond
(W. Manitoba)



R. M. Caltrell
(N.W. Alberta and N.W.T.)



V. Hildahl
(Winnipeg)

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