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DWARF MISTLETOE SURVEY IN THE ATHABASCA FOREST, ALBERTA: GROUND CHECK OF INFESTATION.

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INTRODUCTION

We report here the results of a brief ground survey of dwarf mistletoe in selected jack pine stands northeast of Fort Mackay, Alberta. The survey is part of a project undertaken in co-operation with the Alberta Forest Service to determine the status of dwarf mistletoe in selected management units of the Athabasca forest. A preliminary reconnaissance of the forest was reported by Lowe (2) and Blauel (1) and methods developed for an extensive aerial survey of dwarf mistletoe infestation were described by Robins (4). Here we examined selected jack pine stands designated mistletoe-free or mistletoe-infested on the basis of the previous observations (4) from low-level aircraft flight. Our objectives were to determine occurrence, spread and impact of dwarf mistletoe and fire history of selected infested trees.

METHODS

Trees in areas designated as infested and non-infested by aerial detection of brooms were inspected Sept. 12-14, 1972 from the ground and from low level flights by helicopter. Tree dimensions and ages were determined in several localities. Some gross effects of dwarf mistletoe infection were documented by photography. The extent of dwarf mistletoe spread from residual source trees into adjacent young trees was measured. Residual infected trees were felled and sections cut at the stem base to determine age of fire scars.

Recent aerial photographs, transportation into and within the survey area, accommodation and personnel to assist the survey were provided by the Alberta Forest Service whose help we gratefully acknowledge.

RESULTS

1. Detection of dwarf mistletoe infestation

Our observations confirm that the occurrence of dwarf mistletoe is highly correlated with the occurrence of large witches brooms which are readily observed from the air. Infested trees age 100 or more were heavily broomed particularly those at boundaries and openings in stands. Although only small brooms not visible from the air were formed on infested trees age 40 or less, young infected trees were situated within 100 ft distance of old heavily-broomed residual trees. Generally old infested trees occurred in groups of 10 or more with large brooms on trees near the centre of the patch. Dwarf mistletoe seems to cause considerable mortality thus thinning out infested stands and apparently stimulates growth of large brooms on remaining trees. In only one instance on the 16-mile flightline we found broomed residuals that were not detected. These apparently were situated directly underneath the flight path and were not seen by the observers who looked out of side windows of the aircraft.

2. Detection of infestation by aerial photographs

We discovered that dwarf mistletoe infestation could be determined on vertical aerial photographs (at scales of 1:15,840; 1:21,120; and 1:31,680) in a stand of trees 110 years age and 80

ft height. Infestation caused circular openings 200-500 ft diameter (Photo 1) which we examined from the ground and from low-level flights by helicopter. In the centres were old dead, broomed trees standing and fallen; in the open areas, stunted infested and occasionally young non-infested pines, and white spruce 6-12 ft height; and at the circumferences of the openings, trees heavily-broomed and frequently dead (Photo 1 and 2). Approximately 50 openings observed from the air were infested with dwarf mistletoe, and no comparable openings were found without dwarf mistletoe or around non-infested residuals.

Comparison of aerial photographs taken in 1952 and 1972 (Photo 3 and 4) showed that most of the openings developed recently. Close examination showed that most openings visible in 1972 were also present but much smaller in diameter on 1952 photographs. Extensive mortality of infested trees occurred between 1952 and 1972. Apparently the dwarf mistletoe spreads relatively slowly but is very damaging. The amount of damage caused by mistletoe is clearly evident by the area of the openings shown.

3. Occurrence of infestation

Trees age 9 to about 200 years were visibly infested by dwarf mistletoe. Some young trees near old infested residuals had witches brooms at 1-2 ft height (Photo 8) which indicated they were infected at an early age. Infestation was found both on presumably dry sites as indicated by lichen ground cover and on moist sites as indicated by mosses, grasses, shrubs and understory white spruce. The pattern of infestation varied with site and fire history as described below.

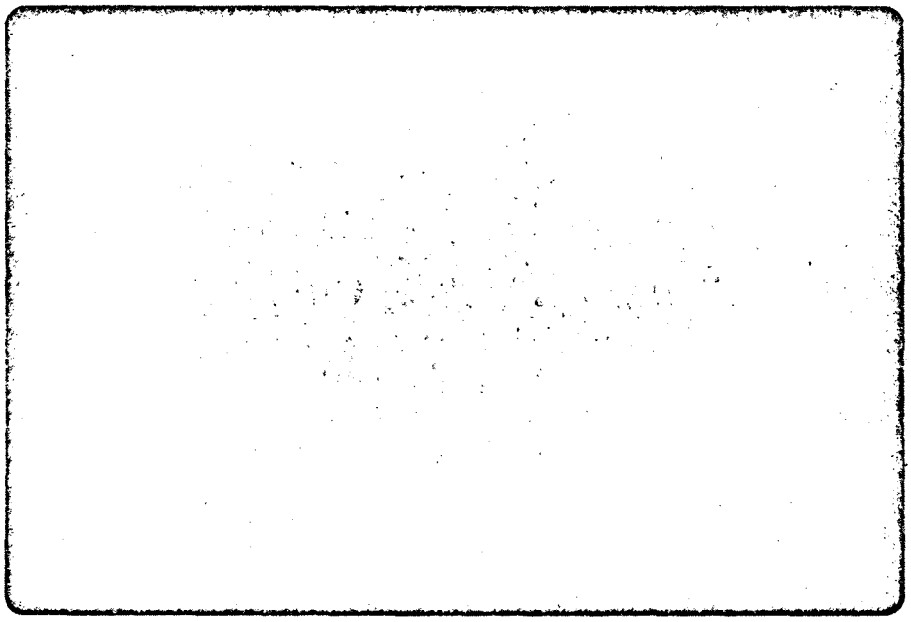

Photo 1. Dwarf mistletoe infection centre in jack pine. Broomed and dead trees (80 ft height) in and at the periphery of the opening.

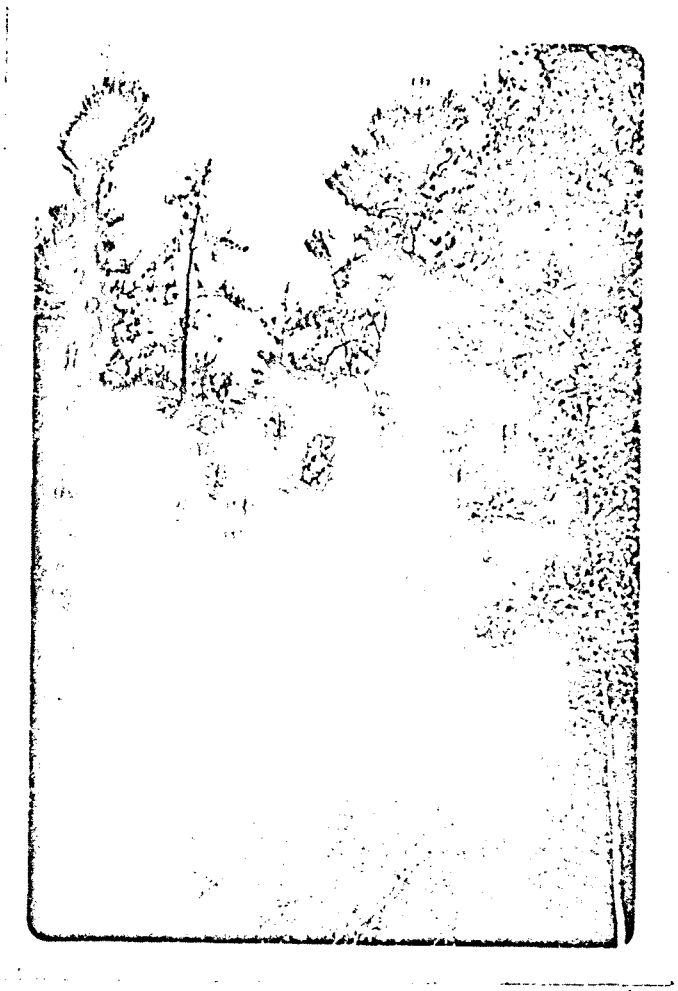

Photo 2. Infested jack pine trees (80-90 ft height) at periphery of dwarf mistletoe infection centre. Photo taken from centre of opening. Note dwarf mistletoe brooms and top-killing on trees.

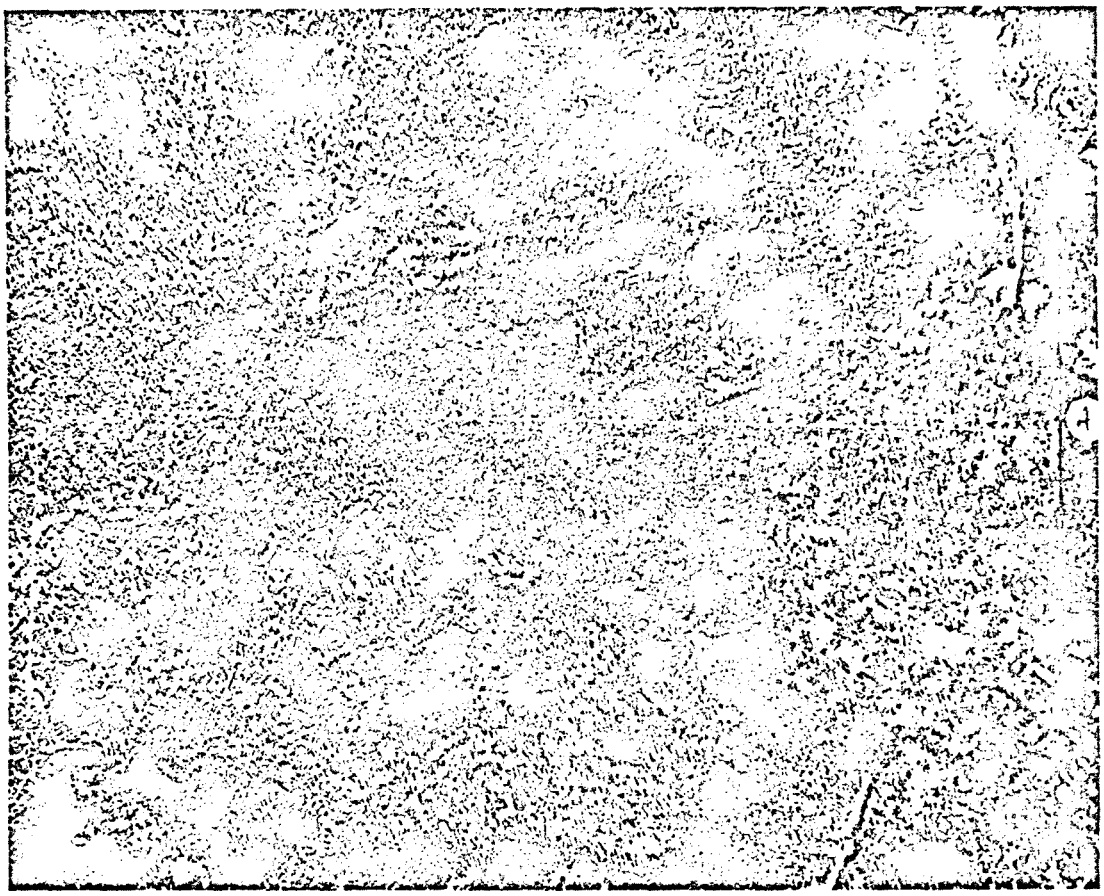

Photo 3. Vertical aerial photograph of a 100-year jack pine stand taken 1952 (scale 1:18,230) showing the circular openings (centre of photo) which are dwarf mistletoe infection centres.

Photo 4. Aerial photo of same stand as shown in Photo 3 taken 1972 (scale 1:18,230). Note the numerous infection centres which developed since 1952.

No relationship was found between infestation and topography because of the low relief in the survey area.

4. Fire history and infestation

Examination of maps and photographs prepared by the Alberta Forest Service and stands of trees in the survey area showed the frequent occurrence of wild fires. They resulted in areas of 150-5800 acres of even-aged 10, 25, 40, and 120-year stands of trees. We found the youngest trees on dry (lichen-covered) sites suggesting that they were burned over repeatedly and frequently. Generally on dry sites large areas were burned and few residual trees were left. Those remaining frequently were grouped in patches of 1-5 acres (Photo 5) or in narrow strips 200 yd. wide by 1-5 miles long (Photo 6). Mistletoe-infested residuals occurred singly, in patches, or within long narrow strips. We found stands of older trees, age 120 years, on moist sites (and on dry sites surrounded and thus protected by moist sites) over large areas. Apparently conditions favouring extensive burning occurred less frequently here. Generally single infested and non-infested residuals occurred frequently but were scattered.

Determination of the age of fire scars on selected infested residuals revealed that the trees were exposed to and survived numerous fires (Photo 7). For example on four trees age 115 to 177 years in a patch of infested residuals situated near the edge of a large stand of 30-year trees (Photo 5), we found fire scars corresponding approximately to dates 1963, 1952, 1941, 1930, 1920, 1890, 1860, 1840, and 1820. The variation in fire scar ages and numbers per tree

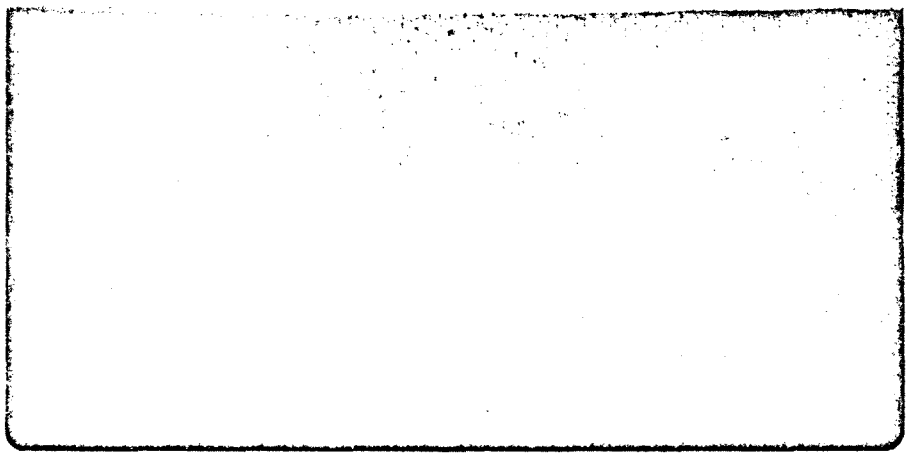

Photo 5. Patch of dwarf mistletoe-infested residuals (100-200 years age) in a young (30 years) stand.

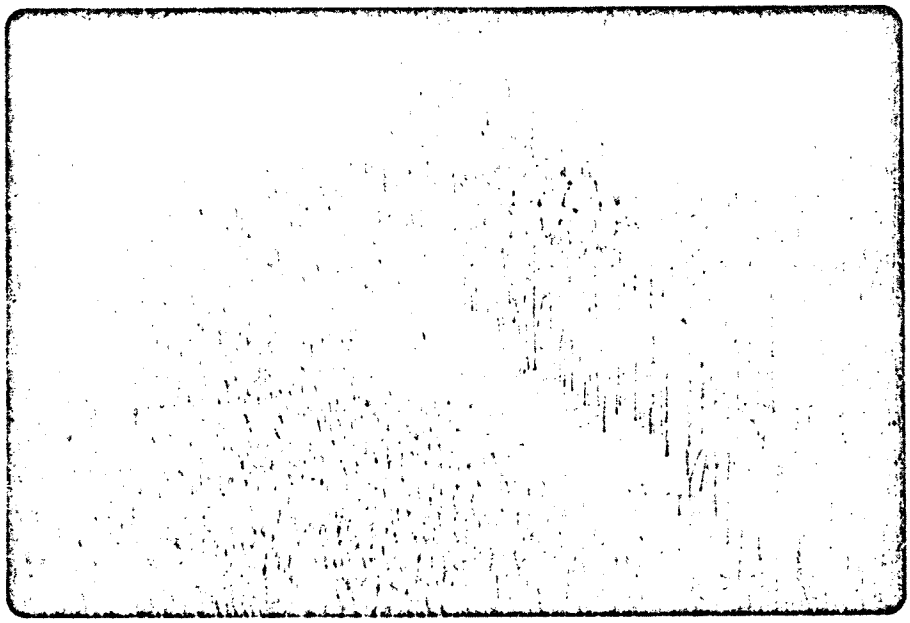

Photo 6. Mistletoe-infested residuals (note brooms and dead trees) in a narrow strip of residuals.

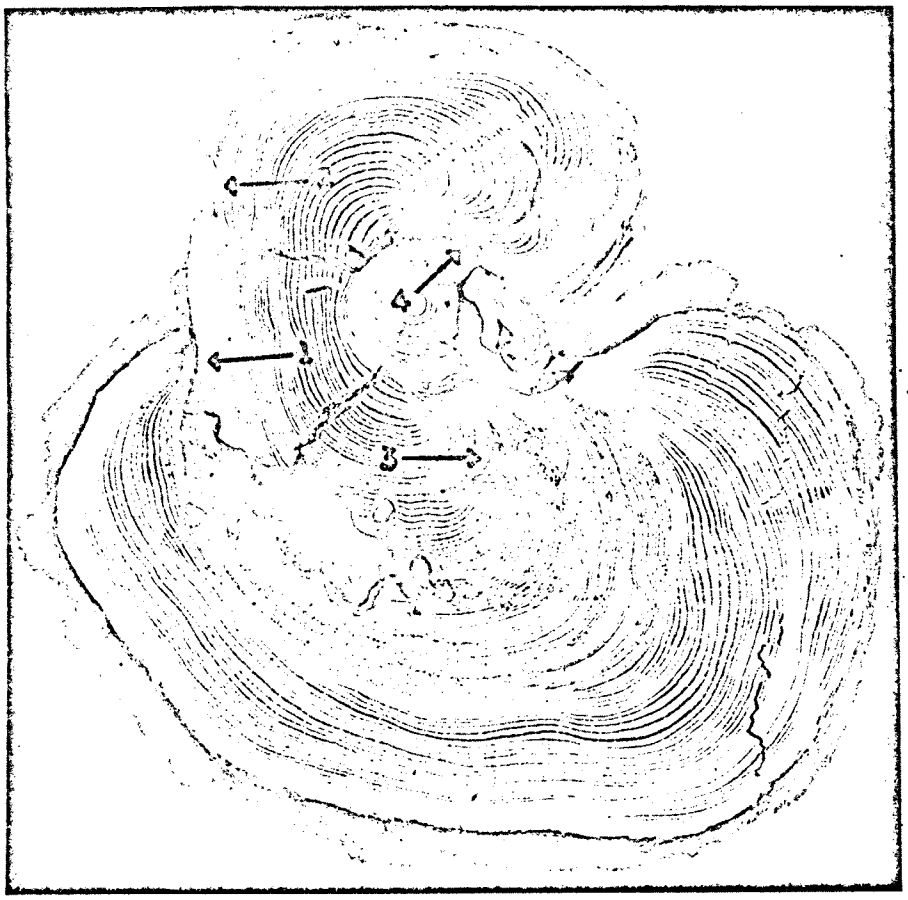

Photo 7. Fire scars (nos. 1 to 4) on basal section of dwarf mistletoe-infested residual (selected at stand shown in Photo 5). Magnification 2/3 full size.

suggests the occurrence of many fires which often miss or do not burn sufficiently to cause scars on all residuals. Fire suppression was initiated in the region in 1960 and we were unable to examine recent burns in nearby forests.

5. Infestation of young trees

Our ground observations confirm that several large areas of young trees rated free of infestation by aerial observation were not infested. The only exception was the occurrence of infestation adjacent to a broomed residual tree which was not detected presumably because of its position underneath the flight path.

Spread of dwarf mistletoe from infested residuals into adjacent trees 10-30 years age was 50-60 ft. Occasionally we found considerably less spread than expected but were unable to determine the causes of the variation. For example, in a few instances we found that none or only 1-2 young trees were infested. The adjacent residual trees had dwarf mistletoe reproductive shoots on the brooms which implied that seeds were being produced, but we did not find any small recently developed infections on the young trees.

A distinct pattern of infestation of young trees was generally evident. Many trees situated underneath or within 20 ft distance of the infested trees had a small broom at 1-2 ft height and were stunted (Photo 8). Here many of the broomed trees were dead. At 20-30 ft distance an occasional tree had 1 or 2 brooms at 4-6 ft height. At greater distances infections were scattered and not situated at a particular height. Occasionally in areas where only a few young trees

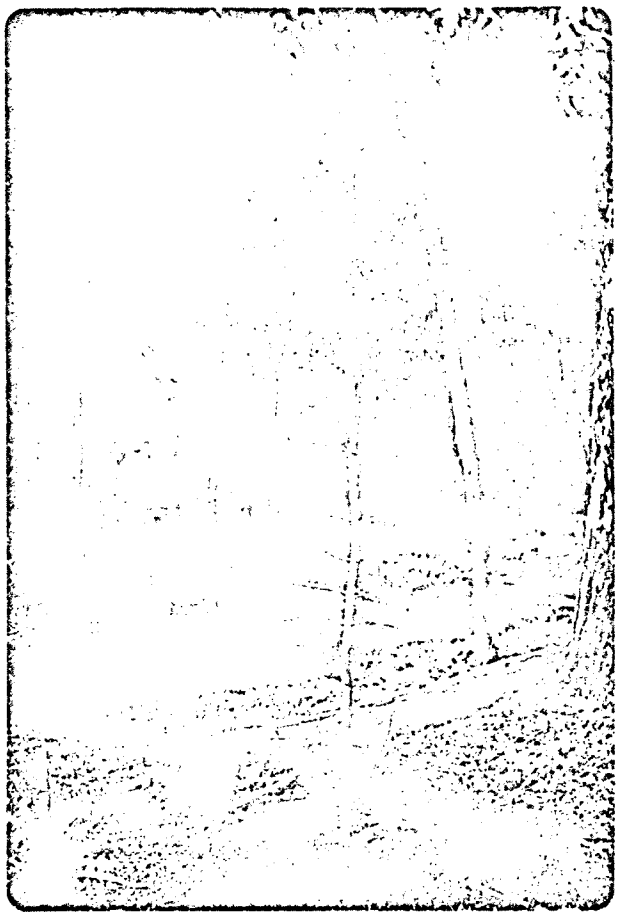

Photo 8. Young (30 year) trees near infested residual (part of stem on right). Seven-foot tree without mistletoe and 1 ft tree to left with mistletoe witches broom.

were infested the infections were found more frequently at 20-30 ft than at distances closer to the residual trees.

6. Effects of dwarf mistletoe infection and infestation

We observed the following phenomena which are associated with or caused by the dwarf mistletoe:

a. pronounced swelling and brooming of infected tree tissues which presumably reduce stem growth (Photo 9);

b. increased diameter growth of branches supporting brooms which might hamper mechanical harvesting;

c. on trees with large brooms, sparse foliage on non-infected branches and top-killing indicative of declining tree growth (Photo 10);

d. frequent infestation of young trees near broomed residuals which resulted in stunting and mortality; and

e. pronounced mortality of older infested trees leading to large openings in stands.

The dwarf mistletoe causes significant damage to the jack pine forests. Infection centres develop slowly but cause severe damage in trees 80-100 years age or more. Young trees become established in the openings but are soon infected by the mistletoe. Although small trees may grow appreciably after infection, we believe they will rarely, if ever, grow to mature size. Large trees with heavy brooming probably were infected relatively recently - most growth occurring before infection took place.

Photo 9. Dwarf mistletoe infection on young (30 year) tree. Note swollen branch with dwarf mistletoe shoots, and upright branches growing from the swelling which are systemically infested and probably will form a witches broom.

Photo 10. Dwarf mistletoe-infested residual showing witches brooms and sparse foliage on non-infected branches. (Tree selected from patch shown in Photo 5 and shown in Photo 7.)

DISCUSSION AND CONCLUSIONS

Our results although based on a limited survey warranted extensive description and discussion mainly because little is known about the dwarf mistletoe on jack pine in general or in the survey area in particular. They also will form a basis for forest management decisions and future research. The results indicate that dwarf mistletoe behaves somewhat differently in the survey area than previously reported perhaps because of the local topography. Accordingly the results may only pertain here and should be extrapolated with caution to other areas.

We confirm that low-level aerial observation is adequate for determining infestation by dwarf mistletoe. Witches brooms are constantly associated with infestation and can be distinguished from occasional brooms caused by other agents. Although witches brooms are not seen from the air on trees up to 30 years age, those trees within 50-60 ft of broomed residuals can be expected to be infested.

Conventional aerial photography appears very promising for detection and inventory of dwarf mistletoe infestation particularly in older (80-120+ years) stands of jack pine. Because of its potential usefulness, aerial photography should be examined further and other refinements considered such as large-scale colour photography or infra-red photography which was used to detect infection centres of the eastern dwarf mistletoe on black spruce (3).

Our results indicate that dwarf mistletoe-infested trees

either survive or are eliminated by wildfires apparently depending on fire behaviour as influenced by weather, site and forest characteristics. Fire behaviour seems highly variable resulting in diverse patterns of infestation. Recent burns should be examined to determine what and where infested trees survive. Possibly some characteristics of dwarf mistletoe infestation such as the development of stand openings at infection centres increase the chances of survival of infested trees.

Patches or strips of infested trees remaining after an extensive fire seem immune to subsequent fires as evidenced by fire scars. This hypothesis, although requiring further testing, implies that prescribed burning to sanitize infested stands may be of limited usefulness unless methods are developed to increase the flammability of infested trees.

Our results indicate that eradication of dwarf mistletoe-infested trees surviving a fire would eliminate infestation of young trees. Spread of dwarf mistletoe into 20-30 year trees was limited to 50-60 ft distance of residual infested trees, and we did not see any evidence of recent long distance spread by birds or animals. The occurrence of dwarf mistletoe brooms on small trees near infested residuals indicates that young trees can be infested quite soon.

We suggest that after a fire in an infested forest is contained some fire suppression crewmen could be directed to eradicate residual infested trees.

REFERENCES

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November 1972