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ENTOMOLOGY

Distribution of *Monochamus* Larval Entrance Holes on Lodgepole Pine Logs.—The distribution of larval entrance holes of *Monochamus scutellatus* (Say) on the surface of lodgepole pine logs [*Pinus contorta* Dougl. var. *latifolia* Engelm.] was determined for three different ecological situations: logs scattered on the forest floor; small-diameter decked logs; and large-diameter decked logs. This distribution was a prerequisite for the development of a sampling system for *Monochamus* (Safranyik and Raske, J. Econ. Entomol. 63: 1903-1906, 1970).

Decks of small-diameter logs and logs scattered on the forest floor were located 40 km S.W. of Strachan, Alta., and decks of large-diameter logs near Faust, Alta. All logs had been cut during the winter of 1964–65. Logs were decked before spring and were not disturbed until sampled in the summer of 1967. Ninety-eight decked and 41 scattered logs were sampled near Strachan, and 30 decked logs were sampled near Faust. Small-diameter decked logs were sampled from the deck surface, because only these were infested. Large-diameter decked logs were taken from the surface, middle, and bottom of the deck, because infested logs occurred throughout it. Every third scattered log along a transect was chosen for sampling.

A sample consisted of a log section 122 cm long, located at random on each log, but at least 15 cm from each end. The log diameter was recorded at the mid-point of the sample. Each sample was divided into 12 equal longitudinal units corresponding to numbers on a clock dial: 12–1 o'clock was the first unit at the top, etc. The 3 o'clock side was the warmest, either south- or west-facing. The number of *Monochamus* larval entrance holes on the log surface was recorded for each unit, and expressed as number per dm^2 of log surface before collating and analyses. A χ^2 test was used to test whether the distribution around the log was uniform, and a two-tailed Kolmogorov-Smirnov two-sample test (Siegel, Non-parametric statistics for the behavioral sciences, McGraw-Hill, 1956) to test for differences in density among units.

The average diameter of samples was 20.8 cm for small-diameter decked logs, 19.5 cm for scattered logs, and 38.6 cm for large-diameter decked logs. The χ^2 test showed that the distribution of larval entrance holes around the log surface differed significantly ($p \leqslant .01$) from a uniform distribution for all three log categories. In all small-diameter decked logs fewer entrance holes occurred at the top and bottom of the log than on the sides (Fig. 1). Also no significant differences ($p \leqslant .05$) existed between the sunny and shady side, or between the top and bottom of the log. The bottom of these logs is usually not accessible for oviposition and the top unsuitable for oviposition (Rose, Can. Entomol. 89:547-553, 1957) and sometimes too dry for larval feeding. The distribution of entrance holes on large-diameter decked logs was different from

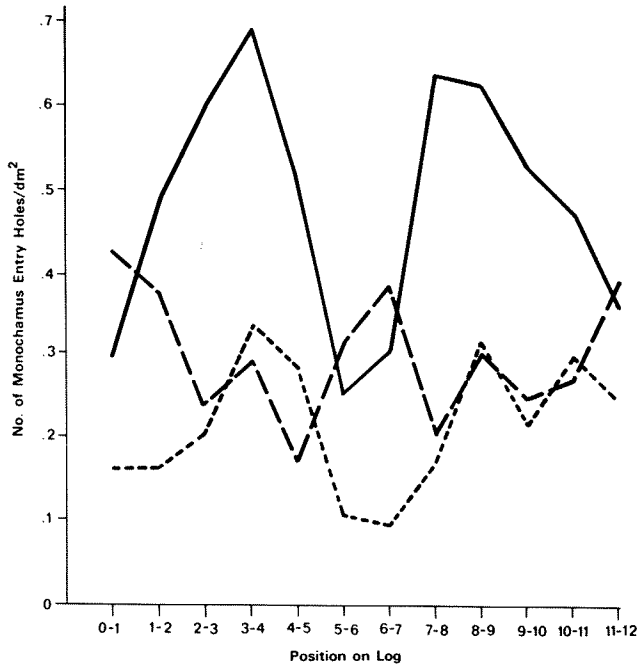

Figure 1. Distribution of *Monochamus* larvae around the log circumference lodgepole pine logs in Alberta.
12 = top, 6 = bottom, 3 = sunny side, 9 = shady side.
Solid line = scattered logs on forest floor (n = 41); short broken line = small diameter decked logs (n = 98); long broken line = large-diameter decked logs (n = 30).

that on small-diameter logs (Fig. 1). More entrance holes occurred at the top and bottom of the log than at the sides. The top and bottom of the large-diameter logs were often not in contact with adjacent logs, which may have allowed greater use of these areas for oviposition and larval feeding.

The density of entrance holes on scattered logs was about twice that of the adjacent decked logs. Similar differences in density between decked and undecked logs were observed in other areas. The cause of this is unknown. The average density of entrance holes per dm^2 of log surface was 0.22, 0.47, and 0.31 for small-diameter decked logs, scattered logs, and large-diameter decked logs respectively. For all three categories the average density of entrance holes was approximated by the number occurring in the 1–2 or 2–3 and again at the 9–10 or 10–11 o'clock units.

The distribution of entrance holes approximates the distribution of the larvae because most larvae enter the log within or adjacent to their feeding areas. The determination of the distribution pattern has made sampling estimates for larvae and their damage more efficient.—A. G. Raske, Northern Forest Research Centre, Edmonton, Alta. (Present address: Newfoundland Forest Research Centre, St. John's, Newfoundland.)

Persistence of a Virus of the White-marked Tussock Moth on Balsam Fir Foliage.—Valuable Christmas tree stands in Nova Scotia have been periodically attacked and heavily damaged by the white-marked tussock moth, *Orgyia leucostigma* (J. E. Smith). The infestations were eventually terminated by a polyhedrosis virus but not until severe damage had been done. Because under natural conditions the virus takes several years to reach epidemic levels, it was postulated that the early artificial introduction of the virus could act as

an important factor in biological control of the tussock moth. As part of the control program, the study sought to determine if virus residues of the white-marked tussock moth persist over winter, and if artificially increasing the virus population enhances carry-over from one generation to the next. The relation between strength of suspension and virus persistence to exposure was also studied.

In the spring of 1972, balsam fir [*Abies balsamea* (L.) Mill.] foliage was collected at West River Station, N.S., where an infestation of tussock moth had collapsed in 1971 because of a virus disease, and near Bridgewater, N.S., in an active outbreak area, where trees had been sprayed in June 1971 with a suspension of a nuclear polyhedrosis virus (18×10^6 polyhedra/ml). Each branch was collected from a different tree and transferred aseptically to the laboratory. Foliage collected in a virus-free area in Fredericton served as control. One healthy first-instar tussock moth larva was placed on each sprig of foliage.

To test the effect of exposure or weathering on the persistence of varying concentrations of the virus, branches of partially exposed and markedly exposed balsam fir trees in a virus-free area were sprayed in the fall of 1973 with one of two virus suspensions (36×10^6 or 360×10^6 polyhedra/ml). The partially exposed branches were protected from rain, snow, and sunlight by overlapping branches of adjacent trees. Foliage of the markedly exposed trees was unprotected. An unsprayed tree was used for control. In the spring of 1974, 10 sprigs of foliage were collected aseptically from each tree, separated to prevent cross contaimination, and placed in sterile rearing vials. One healthy first-instar tussock moth larva was placed on each sprig. All larvae in each experiment were reared at 22 ± 2 C and $50 \pm 5\%$ relative humidity. Dead larvae were smeared and examined for polyhedrosis.

The results suggest that the virus, deposited on the foliage (naturally or artificially) in the summer, retains sufficient activity throughout the winter to kill at least some larvae, and that spraying, even when done the previous year, increases larval mortality (Table 1). Larvae fed foliage from partially exposed trees had higher mortality and died earlier than larvae fed foliage from markedly exposed trees (Table 2). Moreover, higher mortality occurred earlier on partially exposed sprigs sprayed with the weaker suspension than on the markedly exposed sprigs sprayed with the stronger suspension. The virus in the weaker suspension lost its activity when exposed but retained its infectivity when protected. Larvae fed partially exposed foliage sprayed with the suspension of 360×10^6 polyhedra/ml and larvae fed foliage sprayed with the same suspension in the laboratory died in 10 days. In contrast, larvae fed foliage sprayed with this suspension but exposed to weathering died in 17 days.

As trees in both markedly exposed and partially exposed locations were subject to essentially the same temperatures, it appears that the lower incidence of mortality in larvae fed foliage from markedly exposed trees resulted from the inactivation of the virus by precipitation and/or sunlight. The results indicate that strong suspensions of the nuclear polyhedrosis virus of the white-marked tussock moth as well as virus deposits from natural epizootics remain viable on balsam fir foliage over winter. The rate of inactivation depends on the degree of exposure of the branches to weathering and the period to inactivation depends on both the strength of the suspension applied and the degree of exposure of the branches to weathering.—E. Elgee, Maritimes Forest Research Centre, Fredericton, N.B.

TABLE 1
Degree of persistence of nuclear polyhedrosis virus of the white-marked tussock moth expressed as mortality of first-instar larvae reared on balsam fir foliage subjected to weathering overwinter

Treatment	Trees tested, number	Larval mortality %
Artificial virus introduction (Bridgewater)	24	29.2
Natural virus presence (West River Station)	26	7.7
Control – no virus (Fredericton)	33	0

TABLE 2
Mortality of first-instar tussock moth larvae reared on virus-contaminated foliage

Source of foliage	Strength of suspension (polyhedra/ml)	Larvae Number reared	Died of disease %	Days to Death Avg	Range
Unexposed branches	360×10^6	10	40	10.0	9–12
	36×10^6	10	40	13.6	9–19
Exposed branches	360×10^6	10	30	16.6	16–17
	36×10^6	10	0	—	—
Laboratory (sprayed branches)	360×10^6	10	100	10.0	6–11
	36×10^6	10	100	10.0	6–11
Control	–	10	0	—	—

PATHOLOGY

***Cylindrocladium floridanum* in an Ontario Forest Nursery.** —*C. floridanum* Sob. & Seymour was first described in 1967 (Sobers and Seymour. Phytopathology 57:389-393, 1967). Morrison and French (Mycologia 61: 957-966, 1966) compared *C. scoparium* Morg. with *C. floridanum* and concluded that the species were distinct, with *C. floridanum* being the cause of an important root rot in Minnesota forest nurseries. *C. floridanum* is also the fungus responsible for root rot problems reported in Wisconsin, previously attributed to *C. scoparium* (Berbee, J. G., personal communication).

During the fall of 1974, mortality was noticed in a compartment of 2–0 black spruce [*Picea mariana* (Mill.) B.S.P.] in the Provincial Forest Nursery at Midhurst, Ont. Seedlings submitted for diagnosis to the Great Lakes Forest Research Centre, Sault Ste. Marie, Ont., indicated that a root pathogen was involved. Isolations were made from the roots onto PDA and 2% V-8 juice agar plates using routine culture techniques. *C. floridanum* was the only known pathogenic fungus isolated.

Other compartments of the Midhurst nursery were examined in November for seedlings exhibiting symptoms similar to those shown by the affected black spruce. Seedlings suspected of being infected included red pine [*Pinus resinosa* Ait.], jack pine [*Pinus banksiana* Lamb.], and white spruce [*Picea glauca* (Moench) Voss]. *C. floridanum* was isolated from the roots of all three species and results indicated that the fungus is distributed throughout much of the nursery.

Previously, *C. scoparium* Morg. was described as the cause of a damping-off problem in a forest nursery in Quebec (Sutherland and Keable. Bi-mon. Prog. Rep. 22(1):2, 1966). Isolates from that study have recently been examined by Dr. S. J. Hughes, Biosystematics Research Institute, Research Branch, Agriculture Canada, and he has identified them as *C. floridanum* rather than *C. scoparium*. The Midhurst record is the first authenticated report of a nursery disease problem caused by *C. floridanum* in Ontario. Other forest nurseries in Ontario will be examined for this fungus in the near future.—D. T. Myren, H. L. Gross and E. B. Dorworth, Great Lakes Forest Research Centre, Sault Ste. Marie, Ont.

ADDENDUM

Fungitoxic Effects of Fatty Acids Salts. — Due to limitations on space, the photograph of cultures was not published in Vol. 31, No. 4, pages 26-27 with the text of note by George S. Puritch and D. E. Etheridge. This photograph is published herein at the top of page 35.

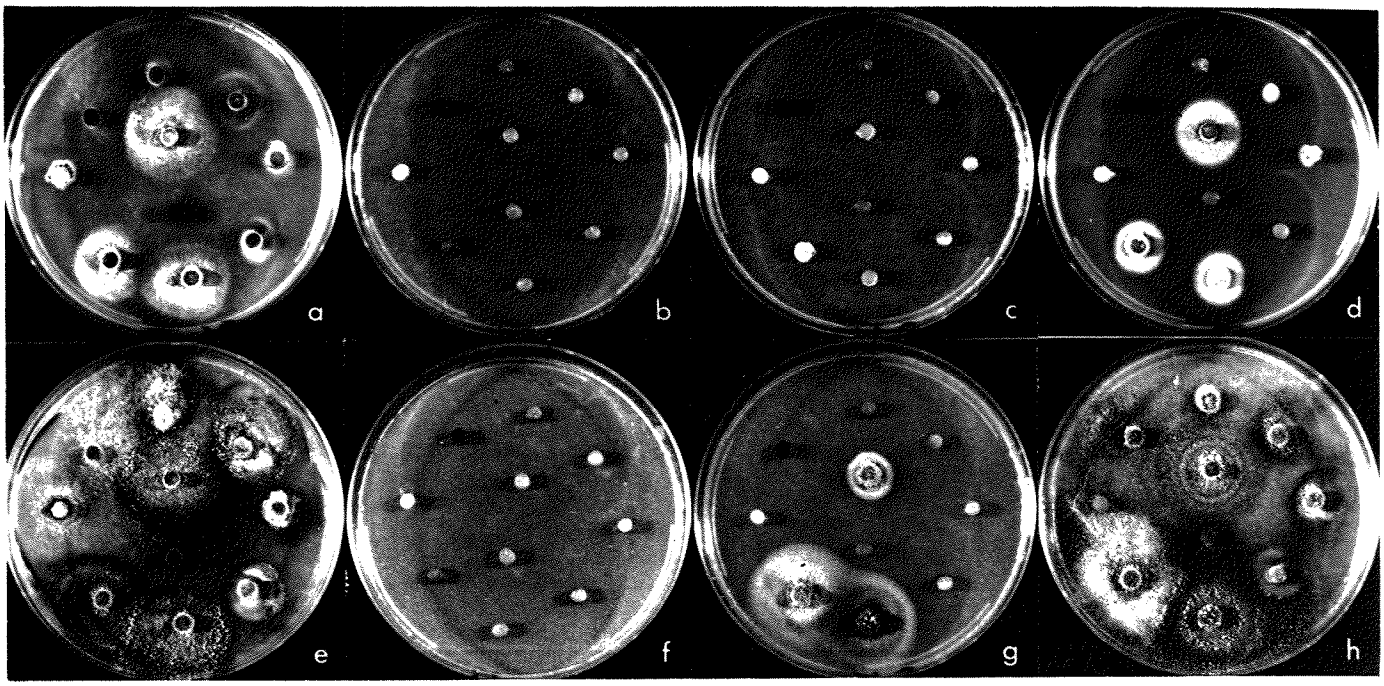

Figure 1. Effect of various concentrations of K caprate on growth of *Ceratocystis picea* (isolates 1-7), *Europhium clavigerum* (isolate 8), and *Ceratocystis* sp. (isolates 9-10) after 5 (A. B. C. D) and 18 (E, F, G, H) days on agar. Isolates are numbered clockwise from the top with No. 9 situated in the upper middle and No. 10 in the lower middle. (Letters A, E = control; B, F = 1% K caprate; G, C = 0.1% K caprate and D, H = 0.01% K caprate).

SILVICULTURE

Use of Gramoxone® to Control Mosses and Liverworts in Greenhouse Pots.—During long-term greenhouse studies with potted tree and alternate host material for rust inoculation experiments, certain nuisance plants such as mosses and liverworts grow over the soil in the pots and require removal from time to time.

In March 1966 the herbicide Gramoxone® was tested for its control of moss and liverwort growth on pots holding transplanted ½ m high lodgepole pine that had been in the greenhouse 20 months. Gramoxone®, a contact paraquat herbicide, which rapidly kills all permeable plant material containing chlorophyll, has been used in forestry practices (Aldhous, For. Comm. Leafl. 51, 2nd ed., 1969; Lacey, J. Agric. Vet. Chem. 6:51-55, 1965). A unique property of the herbicide is its immediate inactivation on contact with the soil, which leaves no danger of toxic residues building up in the soil. Oats planted 9 days after Gramoxone® application were grown to maturity without any residual effects of the herbicide (Winston and Haavisto, Environ., Can., For Serv., Bi-Mon. Res. Notes 30(6):37-38, 1974). Literature supplied by Chipman Chemicals Limited, Winnipeg, in December 1965 indicated no previous experience with its use against mosses or liverworts, although it had been proven effective against grasses, weeds, and algae. Thomson (Agricultural Chemicals, Book 2, Herbicides, Thomson Publ., Indianapolis, Ind. 1975) also does not mention its use against mosses and liverworts. The mosses covering the soil surface of the pots were mostly *Bryum* spp., with some *Didymodon recurvirostris* (Hedw.) Jenn., *Myurella* sp. and *Tortula ruralis* (Hedw.) Gaertn., Meyer & Scherb., and the liverwort *Marchantia polymorpha* L.

Treatments were applied by hand spraying in early March under greenhouse conditions by thoroughly wetting the surface of the mosses and liverworts with Gramoxone® sprays. Care was taken not to expose the foliage of the potted trees to spray. Two concentrations of Gramoxone® were applied: treatment A, 9 ml//, the recommended dosage; and treatment B, 4.5 ml//, both with 1 ml of 'Agral 90'// as a nonionic wetting agent. Ten pots were treated with each concentration, and five pots were used as nontreated controls. All pots had a heavy growth of mosses and/or liverworts almost completely covering the surface of the soil.

Table 1 shows the herbicidal effect of Gramoxone® on moss and liverwort. There was little difference between treatments A and B, both being apparently equally effective. One month after treatment all the liverwort and 85% of the moss plants had been killed, and all the moss and liverwort growth on 35% of the pots had been killed. No separate information was kept on the relative susceptibility of the species of moss.

TABLE 1

Percentage of moss remaining and the percentage of pots free of moss and liverwort on three observation dates after application of Gramoxone®

Months after application	1		7		8	
	% moss remaining	% pots all moss and liverwort killed	% moss remaining	% pots all moss and liverwort killed	% moss remaining	% pots all moss and liverwort killed
Treatment A	15	30	25	30	29	30
Treatment B	14	40	19	40	25	30
Average	14.5	35	22	35	27	30

Seven months later little renewed or fresh growth of the mosses had occurred. During the 8-month test period mosses and liverworts continued to flourish on the control pots and served as a source for spore dispersal to reestablish plants in the treated pots. Gramoxone® therefore seems to be an effective herbicide for controlling nuisance growth of mosses and liverworts under a greenhouse environment.—J. M. Powell, Northern Forest Research Centre, Edmonton, Alta.

ERRATUM

Vol. 31, page 21, col. 1: formula (1) should read $\Delta T:kI^{2/3}/h$.

RECENT PUBLICATIONS — SEPTEMBER-OCTOBER 1975

11 **Arnott, J. T. 1975.** Container production of western hemlock in British Columbia. *Tree Planter's Notes* 26(1):11-14.

11 **Arnott, J. T. 1975.** Field performance of container-grown and bareroot trees in coastal British Columbia. *Can. For. Res.* 5(2):186-194.

3 **Bonnor, G. M. 1975.** A test of cluster sampling in forest inventories. *Can. J. For. Res.* 5(2):269-272.

14 **Carlisle, A. 1975.** Research on tree genetics and breeding at Petawawa Forest Experiment Station, 1971-73. *Proc. 14th Meet. Can. Tree Imp. Ass.*

10 **Carlson, L. W. and L. D. Nairn. 1975.** Pentochlorophenol and captan effects on containerized red and jack pine seedlings.

12 **Chow, S. 1975.** Minimizing wood surface inactivation at high temperatures by boron compounds. *For. Prod. J.* 25(5):41-48.

12 **Cooper, P. A., R. D. Graham and R. T. Lin. 1974.** Factors influencing the movement of chloropicrin vapor in wood to control decay. *Wood Fiber* 6(1): 81-90.

13 **Dokken, M. and V. Godin. 1975.** Instrument for measuring knife pitch angle on veneer lathes. *For. Prod. J.* 25(6):44-45.

9 **Dorworth, C. E. 1975.** *Gremmeniella abietina* collected in Alberta, Canada. *Plant Dis. Reptr.* 59:272-273.

7 **Eidt, D. C. 1975.** The effect of fenitrothion from large-scale forest spraying on benthos in New Brunswick headwaters streams. *Can. Ent.* 107:743-760.

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9 **Ellis, R. C. 1975.** Sampling deciduous broadleaved trees for the determination of leaf weight and foliar elemental concentrations. *Can. J. For. Res.* 5(2): 310-317.

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8 **Frisque, G. and J. T. Arnott. 1975.** How containers affect tubed seedlings 5 years after planting. *Tree Planters' Notes* 26(1):35-37.

11 **Funk, A. and H. Zalasky. 1975.** *Rhytidiella baranyayi* n.sp., associated with cork-bark of aspen. *Can. J. Bot.* 53(8):752-755.

9 **Harvey, G. T. 1975.** Nutritional studies of eastern spruce budworm (Lepidoptera: Tortricidae) II. Starches. *Can. Ent.* 107:717-728.

13 **Hulme, M. A. and J. F. Thomas. 1975.** Stain control in eastern white pine using ammoniacal zinc oxide in mill conditions. *For. Prod. J.* 25(6):36-39.

3 **Gimbarzevsky, P. 1975.** Interpretation for remote sensing imagery in the evaluation of forest land. *For. Soils For. Land Manag.* 527-539. Int. Scholarly Books Serv. Inc. Oregon.

14 **Holst, M. H. 1975.** The introduction and selection of exotic tree species, Petawawa, 1972-73. 97-113. *Proc. 14th Meet. Can. Tree Imp. Ass.*

8 **Jurdant, M., D. S. Lacate, S. C. Zoltai, G. G. Runka and R. Wells. 1975.** Bio-physical land classification in Canada. *For. Soils For. Land Man.* 29:485-495. Int. Scholarly Books Inc. Oregon.

10 **Johnstone, W. D. 1975.** Variable stand-density yields of natural lodgepole pine stands in Alberta. *Mangmt of Lodgepole pine Ecosystems Symposium Proceedings* 185-207. Wash. State Univ. Coop. Extension Serv. Pullman.

3 **Kalensky, Z. 1975.** ERTS thematic map from multidate digital images. *Symp. Proc. of the Comm. VII (Photo Inter. and Remote Sensing of the Intern'l Soc. for Photogram.* Banff, Canada, Oct. 7-11, 1974. 767-785.

12 **Keays, J. L. 1975.** Biomass of forest residuals. *AIChE* 71(146):10-21.

7 **Mahendrappa, M. K. 1975.** Ammonia volatization from some forest floor materials following urea fertilization. *Can. J. For. Res.* 5(2):210-216.

14 **Maini, J. S., C. W. Yeatman and A. H. Teich. 1975.** In situ and ex situ conservation of gene resources of *Pinus banksiana* and *Picea glauca. Pilot study on the methodology of conservation of for. gen. resources* FO. MISC-75(8):27-40. FAO. Rome.

12 **Manville, J. F. 1975.** Juvabione and its analogs. Juvabione and $\Delta^{4'}$-dehydrojuvabione isolated from the whole wood of *Abies balsamea*, have the R,R stereoconfigurations, not the R,S *Can. J. Chem.* 53(11): 1579-1585.

14 **Morgenstern, E. K. 1974.** Open pollinated progeny testing in a black spruce breeding program. *Proc. of Northeastern For. Tree Improvement Conf., Univ. New York, Aug. 7-9, 1974.*

6 **Page, G. 1975.** The impact of balsam woolly aphid damage on balsam fir stands in Newfoundland. *Can. J. For. Res.* 5(2):195-209.

13 **Pnevmaticos, S. M. 1975.** Improving recovery from softwood bucking in eastern Canada. *Can. For. Ind.* (May)

14 **Pollard, D. F. W. and K. T. Logan. 1975.** Growth acceleration and physiological screening of seedlings for a tree-improvement program. 137-141. *Proc. 14th Meet. Can. Tree Imp. Assoc.*

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9 **Rose, A. H., R. H. Silversides and O. H. Lindquist. 1975.** Migration flight by an aphid, *Rhopalosiphum maidis* (Hemiptera: Aphididae), and a noctuid, *Spodoptera frugiperda* (Lepidoptera: Noctuidae). *Can. Ent.* 107:567-576.

11 **Safranyik, L., D. M. Shrimpton and H. S. Whitney. 1975.** An interpretation of the interaction between lodgepole pine, the mountain pine beetle and its associated blue stain fungi in western Canada. *Mangmt of lodgepole pine ecosystems symp. proc.* 406-428. Wash. State Univ. Coop. Extension Serv. Pullman.

13 **Shen, K. C. and D. P. C. Fung. 1975.** New method for improving fire retardancy of plywood. *For. Prod. J.* 25(4):36-38.

9 **Stanek, W. 1975.** Height growth of black spruce and jack pine seedlings in flooded flats. *For. Chron.* 51(2):1-2.

12 **Steiner, P. R. and S. Chow. 1974.** Comparison of modifiers for durability improvement of urea-formaldehyde resin. *Wood Fiber* 6(1):57-65.

13 **Stranks, D. W. and J. Bieniada. 1975.** Effect of phenethyl alcohol and other organic substances on cellulase production. *Mycopathologia* 55(1):57-63.

9 **Sutton, R. F. 1975.** Nutrition and growth of white spruce outplants: enhancement by herbicidal site preparation. *Can. J. For. Res.* 5(2):217-223.

10 **Swanson, R. H. 1975.** Velocity distribution patterns in ascending xylem sap during transpiration. *FLOW* 1:1425-1430.

10 **Swanson, R. H. 1975.** Water use by mature lodgepole pine. *Mangmt of lodgepole pine ecosystems symp. proc.* 263-278. Wash. State Univ. Coop. Extension Serv. Pullman.

13 **Venkateswaran, A. 1975.** How to determine lignin content by measuring pulp permittivity. *Pulp Paper* 107-109. (T108).

14 **Wang, B. S. P. 1975.** Forest tree seed unit, Petawawa, 1971-72. *Proc. 14th Meet. Can. Tree. Impr. Ass. (1973), Part 1,* 147-151.

12 **Warren, W. G. 1975.** Statistical distributions in forestry and forest products research. *A Modern Course on Statistical Distributions in Scientific Work.* 2:369-384. D. Reidel Publ. Co. Boston.

14 **Yeatman, C. W. 1974.** A progeny test of Ottawa valley jack pine — 6-year results. *Proc. 9th Centr. States For. Tree Impr. Conf., Ames, Iowa, Oct. 10-11.* 71-84.

10 **Zalasky, H. 1975.** Cell deformities in bark and sapwood caused by *Rhytidiella moriformis* and *Keissleriella emergens* infections in poplar. *Can. J. Bot.* 53(8):780-783.

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