bi-monthly research notes

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NOTES FOR AUTHORS

Content: *Bi-monthly Research Notes* is translated to French under the title *Revue Bimestrielle de Recherches,* the same notes being published in both languages under one volume number, but not necessarily within the same issue number. These notes are addressed to the scientific and technical reader and must be concise. New information, techniques, apparatus or significant adaptations of them may be reported but such information must not have been published elsewhere; bare observational data are not acceptable. Only essential information should be included and reported in the most appropriate form (text, table, graph or photograph) but only in one form.

Manuscript: Manuscripts may be submitted in either English or French. They should be typed, double spaced with 1½ inch margins and be presented in the following order: text, tables (one per page), captions for graphs and pictures (all on one page), illustrative material. The original and two copies are required. Manuscripts lacking approval of the Establishment director are not accepted. Use of manuscript paper (FD-5 and FD-6) and the manuscript routing form (FR-28) greatly assist in the review and editing process. Manuscripts are reviewed by the Program Coordinator concerned and/or referees chosen by him.

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Style: Titles are to be typed as "run-in" heads after normal indentation for a paragraph. Titles are followed by a period and a dash. References are "in text" and include author's surname, abbreviated name of publication, volume, pages, and year, e.g. (Lewis, Can. J. Bot. 48:127-140, 1968) or Lewis (Can. J. Bot. 48:127-140, 1968). Information Reports may be cited in the form of other published material, but not Internal Reports or other interagency material. In French texts, titles of periodicals should be underlined and genus names of taxa written with initial capitals. A note is concluded by a period followed by a dash, author's initials and name, unit, city, and province, e.g.—A.J. Lewis, Forest Products Laboratory, Ottawa, Ont.

Webster's Third New International Dictionary is used for both spelling and meaning and the *NCPTWA Word Abbreviation List,* 1971 Edition of the American National Standards Institute, Standards Committee Z39, is used for abbreviations of serial titles. *Measure for Measure,* Can. For. Serv. Pub. 1195 (English) or 1195F (French) is a suitable guide for conversion of English or metric units. When applicable, *Terminology of Forest Science, Technology, Practice and Products* will be used, as will the *CBE Style Manual,* American Institute of Biological Sciences, Washington, D.C., 1972.

Titles should be short, text should be jargon free and concise, and footnotes avoided.

Figures: Figures are printed as either line (graphs, maps) or half-tone (photographs). They should be prepared for reduction to 3¼ inches (one column) or 6¾ inches (two columns) in width. The 3¼-inch width is preferred. Figures are acceptable only if they are essential to the exposition.

Tables: Tables that are one column in width (48 spaces including all punctuation, spaces between words, etc.) are preferred. Consideration should be given to incorporating short tables into the text; this also applies to rows or columns of a table that contain only "nil" results. Normally it is necessary to give only the results of calculations or summary tabulations; if complete calculations or tabular data are needed by the reader, he may obtain them from the author.

FOREST PRODUCTS

A Method of Detecting High-Temperature-Dried Lumber Based on Color Intensity Differences.—Lumber dried under high-temperature conditions has certain physical characteristics which makes it different from lumber dried under more conventional conditions. For example, it attains a lower equilibrium moisture content (EMC). At 65% relative humidity, the true EMC is 0.3 to 1.4% MC lower than that attained by wood dried under milder conditions. Under ambient atmospheric conditions, fluctuating moisture content may be as much as 6% lower in high-temperature-dried material (Salamon, unpublished). Therefore, it is sometimes desirable to distinguish wood dried at high temperatures from that dried conventionally. Since the action of heat on wood causes the development of surface coloration (Kollmann, Holztechnologie Vol. 2, 1955; Christensen and Kelsey, Australian J. Appl. Sci. 9-10:265-282, 1958-59; Killmann and Fengel, Holz als Roh und Werkst. 23 (12):461-467, 1965; Polcin and Rapson, Pulp Pap. Mag. Can. 72(10):T324-330, 1971). This suggests that a measure of color intensity might be useful in detecting the drying history of lumber.

When wood without colored heartwood, such as white spruce [*Picea glauca* (Moench) Voss], is dried under increasingly severe schedules, no apparent color differences are visible to the naked eye. However, reflectance meters, such as those commonly used in pulp and paper testing laboratories for brightness measurements, are able to detect color differences not visible to the eyes. Such a meter (Eirepho, Carl Zeiss) was used to assess the feasibility of detecting color intensity changes in wood dried under different temperature conditions. This note reports the results of the study.

End-matched nominal 2x6-inch, 3-foot long pieces were cut from white spruce lumber. The resulting four sets of 33 specimens each were randomly assigned to one of the following treatments: air drying under dry-shed conditions, conventional kiln drying employing moderate temperatures (max 180 F, time 137 hr – Millett, Can. Dep. Forest., Tech. Note No. 21, 1961); high-temperature kiln drying as recommended by the Eastern Forest Products Laboratory (max 240 F, time 42 hr – Cech and Huffman, Forest Prod. J. 21(10):55-60, 1971); high-temperature kiln drying developed by the Western Forest Products Laboratory (max 240 F, time 37 hr). After drying, all boards were surfaced to 1⅝-inch thickness and a 2-inch long piece was cut from the end of each. Each piece was tested at two locations on the same face according to Tappi Standard T452os-58, with a brightness instrument with an effective wavelength of 457 nm. Sixty-six brightness measurements were made for each seasoning treatment.

Mean brightness values and standard errors of the four treatments are presented in Table 1. A Duncan multiple range test was performed to identify those drying schedules which had resulted in significantly lower brightness values for wood.

As shown in the table, the mean brightness values of the two sets of high-temperature-dried samples were not significantly different from each other, but they were significantly different

TABLE 1
Mean brightness values and standard errors

Drying treatment	Air dry	Conventional kiln drying	Western FPI high temp.	Eastern FPL high temp.
Mean	49.2	45.1	33.7*	32.6*
Std. E_e	2.26	3.25	3.16	3.27

* Not significantly different at the 5% level.

from either air dried or conventionally dried samples. Significant differences were also apparent between the latter two sets of samples. The results suggest that a reflectance meter is a useful tool for segregating lumber dried under various temperature regimes.—M. Salamon, Western Forest Products Laboratory, Vancouver, B.C.

MENSURATION

Tree-height Measurements on Large-scale Aerial Photographs: an Evaluation of Interpreter and Instrument Errors.—Tree-height measurements on large-scale aerial photographs are used in place of heights measured from the ground, for inventories and other purposes. The ability to make such measurements quickly and precisely is fundamental to the efficiency of such work. For this reason, a test was made of the necessity of having each tree measured by two interpreters, and which of two available instruments yields the more precise measurements.

The word "instrument" denotes the hardware used to interpret tree heights: Instrument W is the Wild Stereo-comparator with 6X enlarged contact prints; Instrument A is the Abrams parallax bar with a 2-power stereoscope and 2X enlarged prints. Panchromatic film, exposed at a scale of 1:3,600 during late fall in Western Quebec, was used in the test. Sixty softwood trees were selected at random on the photographs, and two experienced interpreters measured each tree with both of the instruments.

The 240 photo measurements were obtained before the actual tree heights became available, and a two-way experiment was made to determine if significant differences existed between interpreters or between instruments. Analysis of variance showed the difference between interpreters was non-significant, indicating that the precision of tree-height measurements is not improved by using two interpreters; the difference between instruments was highly significant.

Actual tree heights were used to explore the difference between the instruments and to determine which instrument could be expected to yield the more precise height estimates. Data for each instrument were used in a t-test, to determine if the population mean of instrument-measured heights differed from the population mean of actual heights. For both instruments, the null hypothesis proved to be true: The differences between population means was non-significant. The reason for these seemingly contradictory results can be deduced from Table 1: Over-estimates of the actual mean height by 3.26 feet were obtained with Instrument W, while under-estimates of 2.20 feet were obtained with Instrument A. Thus, the difference between instruments (5.46 feet) is highly significant, while the differences between each instrument and the true value (3.26 and 2.20 feet) are non-significant.

TABLE 1
Mean tree heights in feet

Actual tree height	Interpreter I	Interpreter II	Instrument W	Instrument A
52.46	53.42	52.57	55.72	50.26

Due to the small size of the sample, the results are indicative rather than conclusive. Thus, the test suggests that the use of more than one experienced photo interpreter to measure the same trees is unnecessary and inefficient. This result is not unexpected since, in comparison with small-scale aerial photos, the measurements are less subject to personal interpretation and therefore more consistent. The bias of the instruments may be caused by the instrument itself or, more likely, by improper enlargement and printing of the photographs. Considering that Instrument A is less expensive and yielded a somewhat smaller bias, its use in inventory work may be preferable to Instrument W.—G.M. Bonnor, Forest Management Institute, Canadian Forestry Service, Ottawa.

Erratum

Vol. 28, No. 5, page 33. Units for X and Y coordinates should read (8-inch units).

PATHOLOGY

Mortality of Spruce in Ontario Caused by *Polyporus tomentosus* Root Rot.—*Polyporus tomentosus* Fr. is destructive in spruce stands in the Prairie Provinces (Whitney, Can. J. Bot. 40: 1631-1658, 1962). Faull (*in* Rep. Minister Lands Forest., Ont., 259-266, 1922) reported root rot by this fungus in several Ontario conifers and survey reports have indicated its widespread occurrence in Ontario but the only mortality heretofore reported in this province was in planted shelter-belts (Ann. Rep. Forest Ins. Dis. Surv., Can. Forest. Serv., p. 72, 1968) or in experimental white spruce [*Picea glauca* (Moench) Voss] plantations at Petawawa (Stiell, Dep. Forest. Pub. 1258, 1970).

During 1970 and 1971, mortality in natural stands of black spruce [*Picea mariana* (Mill.) B.S.P.] and white spruce, caused by root rot (*P. tomentosus*), was observed in several localities in northern Ontario. Stump ages of killed trees ranged from 75 to 170 years. Dominant and codominant trees with this root rot were dead singly, in groups of two to three trees, or in large numbers forming conspicuous openings in the stand.

Large irregular stand-openings extending over several acres were found in 90-year-old black spruce, approximately 40 miles west of Black Sturgeon Lake in northwestern Ontario. Almost all of the black spruce on a strip varying from 50 to 100 feet wide, running over hillocks and side hills for about 600 yards, were affected. On lower ground, at the swampy bottom of the slope, the spruce were much less severely attacked. In the affected area, dead trees (Fig. 1) surrounded by unhealthy diseased trees with stunted leaders and dying crowns occurred over large areas similar to stand-openings described in white and black spruce in Saskatchewan and Manitoba (Whitney, Can. J. Bot. 40: 1631-1658, 1962). Dead trees were uprooted, broken at ground level, or standing. Green needles on windfalls indicated that the root rot had frequently so weakened the trees that they were no longer windfirm, though still living.

Roots of dead and diseased trees were heavily rotted with white pocket decay and dark reddish brown and greyish brown stains from which *P. tomentosus* was isolated. The fungus had probably been killing roots and trees for many years and very little useable material could be salvaged from the remaining living trees in the affected stand.

Figure 1. Stand-opening in 90-year-old black spruce near Black Sturgeon Lake, Ontario. The windfalls and adjacent standing trees have heavy root rot caused by *Polyporus tomentosus*.

Associated root wounding by root weevils (*Hylobius* sp.), which tunnel in living bark and increase tree susceptibility to root rot (Warren and Whitney, Bi-Mon. Progr. Rep. 7(4): 2-3, 1951), was present on both living and dead trees. The interspersed jack pine [*Pinus banksiana* Lamb.], which is less susceptible to *P. tomentosus* than spruces (Whitney, Bi-Mon. Progr. Rep. 20(5): 3, 1964), were apparently not attacked.

Because there are no known direct controls, stands having this disease should be harvested before losses become serious. Badly affected stands in Saskatchewan were found to have negligible or negative growth over a 10-year period. As there is a considerable period of reduced growth before tree death, losses of net increment can accrue before any mortality; and nonvigorous dominant and codominant trees on otherwise good sites should be examined for root rot even before mortality begins in a stand. If root rot is found in vital tissues, the trees should be removed as soon as practicable and less susceptible species such as pines or hardwoods favored in the next rotation.—R.D. Whitney, Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario.

Practical Size for Sampling Area for Rusts on Stems and Branches of Jack Pine.—An objective of the forest disease survey in Quebec is the improvement of sampling to evaluate satisfactorily the impact of pathogens. Establishing the required size of an observation area is, therefore, important. The pathogen sampled, the forest composition, and the exact evaluation required must be considered, and the disease severity easily and rapidly determined. In many forest disease surveys, the required size of an observation area has yet to be established. For this reason a specific study was made in an observation area, required for a detection survey on jack pine (*Pinus divaricata* Ait.) infected by globose gall rust (*Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka) or fusiform canker rust (*Cronartium coleosporioides* Arth. var. *stalactiforme* Arth.).

The study was carried out at Forestville, Labrieville, and Ilets Caribou in Saguenay County, Quebec, where the percentage of diseased trees among 500 jack pine in each station was calculated. Sampling was performed in pure young stands (average d.b.h., 2.8 – 4.1 inches, 7.1 – 10.4 cm), naturally regenerated after fires which occurred between 1935 and 1955, on a 10 ft (3.048 m) wide strip; length of the strip varied according to stand density (Table 1). The location of diseased trees among healthy trees was plotted on a map, each strip divided into 10 x 50, 10 x 100, and 10 x 200 ft (3.048 x 15.240, – x 30.480, – x 60.96 m) units, and the percentage of infected trees determined. For example, when sampling for *E. harknessii* at Forestville, the total sampling was made on a 1,350 ft (411.48 m) long strip 10 ft wide; the length was necessary to include all 500 trees (Table 1) and was divided into 27 units, 50 ft long. The percentage of infected trees in a unit was calculated and comparison made with the infection percentage of the total strip.

In this type of survey, variation to 1/3 of the average percentage of the total sample is considered acceptable. Considering this, Table 1 shows that when an observer is located in an infected area, by evaluating the frequency of the disease in a unit of 10 x 100 ft, where the number of jack pine varies between 30 and 60, the observer will reach a percentage corresponding to the infection level based on 500 trees (sample in each station). An alternative, suggested by the Biometrics and Computer Branch, would be the use of standard deviation among observed unit percentages to determine which unit-size is suitable (Table 2). Standard deviation corroborates most results in Table 1.

Compared with the 500 tree-sampling, the 10 x 100 ft unit represents a reduction factor between 12 and 16 when dealing with the length of the strip, or a reduction factor between 9 and 16 considering the number of trees to be examined, without appreciably affecting the exact evaluation of the disease.

TABLE 1

Number of units in the total strip where the percentage of infected trees corresponds to the total sampling (variation $\pm$ 1/3 of the average) for the two diseases in each of the three stations

Station	total sample size	total sample diseased trees %	unit size 10 x 50 m 3.048 x 15.240	unit size 10 x 100 – x 30.480	unit size 10 x 200 ft – x 60.960m
	E. harknessii				
Forestville	10 x 1350 ft 3.048 x 411.48 m	6.4	11 (17*)	9 (11)	4 (5)
Labrieville	10 x 1600 ft 3.048 x 487.68 m	39.0	18 (32)	10 (16)	7 (8)
Ilets Caribou	10 x 1200 ft 3.048 x 365.56 m	3.2	6 (11)	7 (8)	3 (4)
	C. coleosporioides var. *stalactiforme*				
Forestville	10 x 1350	3.0	8 (12)	8 (9)	3 (4)
Labrieville	10 x 1600	5.0	7 (18)	9 (14)	4 (7)
Ilets Caribou	10 x 1200	12.2	5 (20)	8 (11)	3 (6)

* Bracketed numerals show number of units where disease was observed.

TABLE 2

Standard deviation of the percentages of infected trees in the various units

Station	total sample diseased trees %	unit size (ft) 10 x 50 3.048 x 15.240	unit size (ft) 10 x 100 – x 30.480	unit size (ft) 10 x 200 ft – x 60.960 m
	E. harknessii			
Forestville	6.4	4.4	3.6	3.5
Labrieville	39.0	14.3	14.0	8.8
Ilets Caribou	3.2	5.7	2.6	2.4
	C. coleosporioides var. *stalactiforme*			
Forestville	3.0	5.8	2.7	1.8
Labrieville	5.0	5.0	3.1	2.0
Ilets Caribou	12.2	9.1	6.8	6.1

This example of a practical size sampling area permits examination and counting of infected trees in a reasonable time, and can lead to results sufficient to determine whether damage by rusts on jack pine trunks and branches is low, moderate, or high.—André Lavallée, Laurentian Forest Research Centre, Ste. Foy, Quebec.

SILVICULTURE

Variation in Rooting Ability of Stem Cuttings from Clones of a Superior White Spruce Provenance.—In a study of 25 provenances of white spruce [*Picea glauca* (Moench) Voss] from the Great Lakes and St. Lawrence Forest Region, a provenance from Peterborough, Ont. (44°18′N, 78°18′W) proved superior in growth height and resistance to winter dessication when established in Quebec (Corriveau and Boudoux, Can. Forest. Serv. Inf. Rep. Q-F-X-15, 1971, 38 pp.). The same provenance also grew well in Ontario under different climatic conditions (Teich, Proc. Twelfth Meeting Comm. Forest Tree Breeding Can. pp 95-100, 1970). Because the Peterborough stand no longer exists, vegetative propagation of fast growing trees from the provenance established in Quebec was undertaken to perpetuate the stock.

During autumn of 1970, 423 trees of the Peterborough provenance were measured for growth height in three Quebec plantations. The mean height after 11 years growth was 5.2 ft (158.496 cm), and mean height, plus one standard deviation from the mean, 6.7 ft (204.422 cm). Fifty of the tallest trees, varying from 7 – 10.2 ft (213.360 – 310.896 cm) were selected for propagation study.

TABLE 1

Rooting percentage of stem cuttings taken from trees of the Peterborough provenance that are superior in growth height

Tree or clone number*	Rooting percentage	Tree or clone number*	Rooting percentage	
13	95.2a**	1	43.3	defghijkl
46	95.2a	3	43.0	efghijkl
5	93.3a	10	40.5	fghijklm
9	93.3a	23	40.0	fghijklm
11	83.3ab	37	36.7	ghijklmn
36	83.3ab	50	36.7	ghijklmn
40	80.9abc	39	33.3	hijklmno
28	79.5abc	38	33.1	hijklmno
21	79.4abc	18	32.1	hijklmno
45	74.6abcd	19	29.4	hijklmno
17	73.3abcde	33	27.8	ijklmno
24	72.4abcde	15	25.7	ijklmno
41	70.5abcdef	32	25.4	ijklmno
29	66.7abcdefg	34	25.4	ijklmno
25	60.0 bcdefgh	30	24.9	ijklmno
6	56.7 bcdefghi	20	20.0	jklmno
7	56.7 bcdefghi	16	17.8	klmno
14	56.7 bcdefghi	4	14.3	lmno
26	56.7 bcdefghi	22	13.3	lmno
27	56.7 bcdefghi	44	11.1	mno
8	54.7 bcdefghi	31	10.3	mno
43	50.0 cdefghij	42	10.0	mno
35	47.8 defghijk	49	4.8	no
12	45.2 defghijkl	2	3.3	o
47	45.2 defghijkl	mean	47.5	

* Tree number 48 was omitted because of mechanical injuries.

** Mean values followed by at least one letter in common are not significantly different from each other at the 5% level by Duncan's Multiple Range Test.

Plain cuttings, averaging 3 inches (7.620 cm), were made in early May 1971 by shearing lateral shoots of the previous growing season a short distance above the base. In a randomized experiment each tree was represented by three blocks of cuttings, 10 in each. The cuttings were inserted in perlite, 100 to a wooden flat (23×15×4 inches; 58.42×38.10 ×10.6 cm) and placed on benches in a greenhouse with an overhead intermittent mist system operating 10 sec every 10 min between 08:00 and 17:00 hr. Air temperature ranged between 90 F during the day and 60 F at night, and averaged 75 F. Relative humidity ranged from 95% during the day to 65% at night, and averaged 80%. The cuttings were examined for rooting performance at 3-week intervals during 9 months.

Under the conditions of this experiment variation in rooting capacity of the cuttings was affected by clonal differences (Table 1). At least four of the best clones exceeded the experimental mean by 46%, and almost half of the clones propagated reasonably well, the rest were less successful.

The outcome of this experiment shows a greater number of trees than those used in this study are required if at least 50 clones, easy to root from cuttings, are to be available for the establishment of clonal seed orchards. It is suggested, therefore, that before such work begins on a large scale, clonal banks in hedge-form should be established to preserve the juvenile nature of the propagation material, and to provide cuttings in quantity. —R.M. Girouard, Laurentian Forest Research Centre, Quebec, P.Q.

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recent publications

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