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SHORT COMMUNICATION

POSITION EFFECTS IN THE QUANTITATIVE DETERMINATION OF HEARTWOOD PHENOLS OF *PINUS SYLVESTRIS*

BART A. THIELGES*

Yale School of Forestry, New Haven, Connecticut, U.S.A.

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Abstract—Total heartwood phenol content of *Pinus sylvestris* L. was influenced by vertical and horizontal position in the stem. Variation in phenol content between trees was found.

INTRODUCTION

THE PHENOLIC substances in the heartwood of pines, particularly pinosylvin and its monomethyl ether, have been found to inhibit staining and decaying fungi.[1,2] Pinosylvin is responsible for the difficulty of sulfite digestion of heartwood pulp.[3] Qualitative phenolic content of pine heartwood has been used as a taxonomic criterion at the subgeneric and specific levels[4] and quantitative intraspecific variation may be useful to further delimit varieties or races within species. The selection of individuals or races with high or low heartwood phenolic contents could be used in tree-breeding programs to develop lines with increased disease resistance or superior timber or pulping qualities.

An investigation of the pattern of within-tree quantitative variation in heartwood phenols of *Pinus sylvestris* L. has now been made to determine the sampling procedure for subsequent studies of intraspecific variation.

RESULTS AND DISCUSSION

Analysis of samples from 1- and 5-ft levels indicated significant differences between trees and between position (height) within trees (Table 1). Regression analysis showed a highly significant (0·1 per cent level) linear relationship ($r^2 = 0{\cdot}963$) indicating a close correspondence in heartwood phenolic content between the sampling levels within trees (Fig. 1).

The phenolic content is higher at the periphery of the heartwood than at the center,[5,6] and the reduction in heartwood diameter at the 5-ft level is accompanied by a decrease in the ratio of heartwood area/circumference. In the samples of total heartwood analyzed in this study, the relative increase in phenolic content at the 5-ft level was due to this factor. This relationship held for all of the nine trees examined (Fig. 1).

* Presently Instructor, Dept. of Forestry, Ohio Agricultural Research and Development Center, Wooster Ohio.

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[5] H. ERDTMAN, A. FRANK and G. LINSTEDT, *Svensk Papp. Tidn.* **54**, 275 (1951).
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TABLE 1. DIFFERENCES IN TOTAL PHENOLS BETWEEN TREES AND SAMPLING POSITION. ANALYSIS OF VARIANCE*

Source of variation	D F.	S.S.	M.S.	V.R.	P
Trees	8	3237·28	404·66	83·44	Significant at 0 1%
Position	1	63·84	63 84	13·16	Significant at 5·0%
Error	8	38·80	4·85	—	

* Where D.F. = Degrees of freedom; S.S. = Sum of squares; M.S. = Mean square (S.S./D.F.); V.R. = Variance ratio; P = Probability.

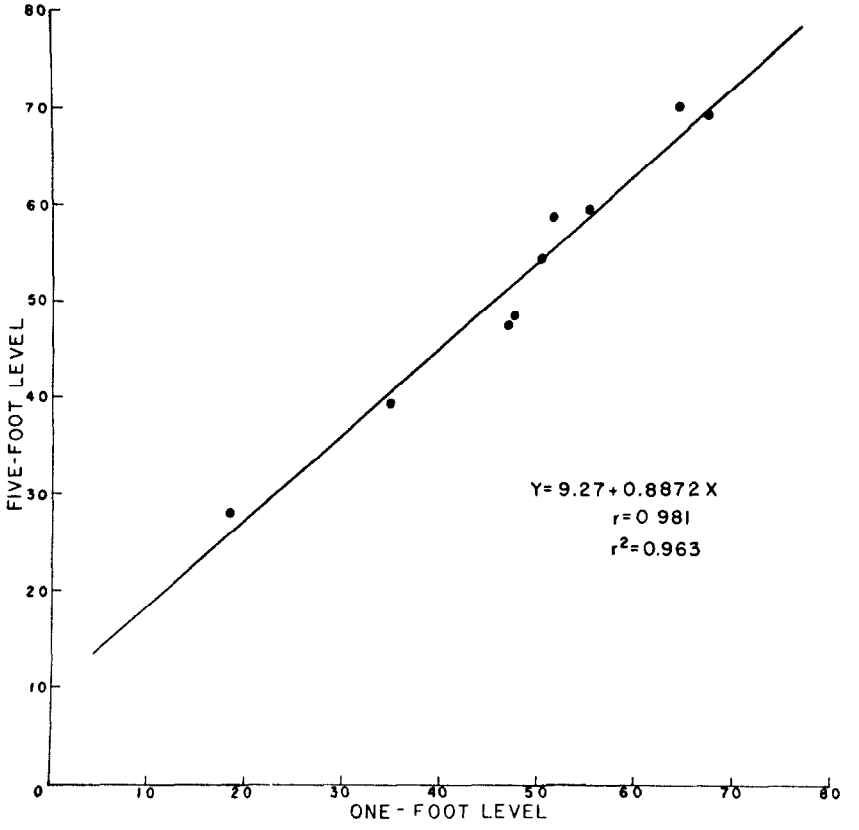

FIG. 1. CORRELATION OF TOTAL HEARTWOOD PHENOL CONTENT OF NINE *Pinus sylvestris* TREES AT ONE—AND FIVE—FOOT SAMPLING LEVELS IN UNITS OF PERCENT ABSORBANCE (ANGULAR TRANSFORMATION).

These results indicate that both vertical and horizontal position in the stem are important sampling considerations for quantitative determination of heartwood phenols. Samples of heartwood taken from any point in the stem involve an interaction of these factors as a function of taper. Although the relative differences between trees were maintained in comparisons

of samples at both heights, between-tree comparison of total heartwood phenols of samples from different heights would not be valid unless the data were adjusted to compensate for variation in the ratio of heartwood area/circumference due to stem taper. The significant difference between trees (Table 1) indicates the possibility of selecting pines for heartwood phenol content.

EXPERIMENTAL

Nine trees, grown in the IUFRO Scotch pine provenance test at Hillsboro, New Hampshire, were felled and knot-free disks were cut from the stem at levels of one foot and five feet above the soil line. Heartwood was ground in a Wiley mill (20 mesh) and dried in a forced draft oven at 40° for 72 hr. The acetone extracts were evaporated to dryness and re-dissolved in 30 ml of acetone. The method of Jorgenson[7] was used for the quantitative determination of heartwood phenols.

[7] E. Jorgenson, *Can. J. Botany* **39**, 1765 (1961).