VASCULAR CAMBIAL INITIALS IN EASTERN COTTONWOOD IN RELATION TO MATURE WOOD CELLS DERIVED FROM THEM

MARGARET KAEISER
Southern Illinois University, Carbondale

ABSTRACT.—Lengths of fusiform cambial initials of eastern cottonwood show variations depending upon their position with respect to side and amount of lean of trunk. Their average lengths increase with increase in lean on both upper and lower sides of the tree trunk. In relation to side of trunk, both vessel cell and fiber lengths increase with lean; within the trees the vessel cells are greater in length on the upper side of lean, whereas the fibers are longer on the upper side in moderate lean but in severe lean their lengths become considerably greater on the lower side of lean.

This study was undertaken to determine the relationship between cambial initial length and mature wood fiber and vessel cell lengths in nearly vertical and severely leaning trees of eastern cottonwood (*Populus deltoides* Marsh.). Fiber-length variations are known to occur in this species (Kaeiser, 1956), and the lengths of these cells are greater on the lower side, in trees with severe lean from the vertical, than in cells on the upper side of the trunks. Bailey (1920) has reported that the cambial initial lengths in an unidentified species of *Populus* are only slightly less than in the mature vessel segment (cell), whereas the averages for fiber cells were almost twice that length. No record was given for leaning trees.

MATERIALS AND METHODS

In April of 1962 two young (10-11 year old) trees growing by a temporarily abandoned stream bank on Southern Illinois University campus were felled. One tree had a 3-4 degree lean from vertical, and the other more than a 12 degree lean from vertical at 4½ feet above ground level. Measurements of lean were made with a plumb bob device made for the author at the U. S. Forest Products Laboratory. Complete discs about one-half inch thick were sawed from each trunk after labelling upper and lower sides of leans of trunks. The discs were wrapped in plastic and refrigerated until the outer sections of the discs could be cut. An electric hand saw was used in the laboratory to remove three outer contiguous sections of the discs in the region of upper and lower sides of each disc, enough to include the outermost three rings of wood. The sections were sawed to include approximately three-fourths inch of cambium. The outer bark was cut off with a razor blade, leaving the inner bark, the cambium and the outermost three rings of wood. Slices approximately 10 microns in thickness were cut from these portions of the discs, after the samples had been strapped on the holder of a Super Histo-Freeze with a gum mastic solution and frozen for at least 20 minutes. The slices for observation were taken in such manner as to show precisely tangential views of the cambial initials, the vessel cells and the fibers. Parenchyma of the rays was not used in this study, nor was the phloem. Approximately a dozen slices were selected from among some 25-50 preparations for the measurements made on cell lengths. The slices were killed and fixed in the usual manner with FAA and were prepared with the tannic acid-iron chloride stain. All measurements were made from camera lucida projections. Averages of 25-30 cambial initial lengths were obtained. Because of their fusiform shape, care was taken to include measurements only of those cells showing the typical fusiform appearance.

After the slices were procured, the rings of wood were removed from the portion of each section remaining, cut lengthwise along the grain of wood into match-stick size and macerated in the usual manner with Jeffrey's solution. The macerated wood, after washing, was tinted slightly with Safranin O and stored in 70% ethyl alcohol. From a suspended mixture of each macerated sample a random sample was removed with a tube of 4 mm bore, placed on a clean dry microscope slide and covered with an oversize coverglass. The first 100 whole fibers and vessel cells were measured, as indicated in Table 1.

TABLE 1.—Lengths of Fusiform Initials, Vessel Cells and Fibers from Areas of Upper and Lower Sides of 10-11 Year Old Eastern Cottonwood Trees With 3-4 Degree and Greater Than 12 Degree Lean. Sampled at 4½' From Ground in Two Trees in April, 1962. Vessels Cells and Fibers were Measured From Macerations of Outer 3 Combined Rings (9th-11th Rings) From Pith.

Side of Lean	Average Length of		Cell Lengths from Tree of: 3-4° Lean	Greater Than 12° Lean
Upper	Fusiform Initials from Tangential Sections		0.556 mm.	0.659 mm.
	1st 100 Whole Vessel Cells	Total length	0.598	0.669
		Mid-Perforation length	0.405	0.453
	1st 100 Whole Fibers		0.865	0.883
Lower	Fusiform Initials from Tangential Sections		0.521	0.609
	1st 100 Whole Vessel Cells	Total length	0.563	0.658
		Mid-Perforation length	0.394	0.450
	1st 100 Whole Fibers		0.783	0.955

RESULTS AND DISCUSSION

The upper side of leaning tree trunks of angiosperms contains the reaction or tension wood. The figures assembled in Table 1 show that in a tree with severe lean the fibers tend to be longer on the lower side. This agrees with previous findings by the author (Kaeiser, 1956). In the tree with greater than 12 degree lean the fusiform cambial initials were longer, on the average, on both its upper and lower sides than in the tree with 3-4 degree lean. However, both trees had longer fusiform initials on their upper sides. This suggests that the further elongation of fibers on the lower sides of trunks with severe lean would be independent of cambial initial lengths.

Total lengths of vessel cells are greater, on both sides, in the tree with severe lean. Within each tree the average increase in total length of vessel cells when compared to average lengths of fusiform initials, was the same on both sides in tree of slight lean (0.042mm); in the tree with severe lean the vessel cell lengths increased over fusiform initial lengths more on the lower side. However, in the tree with severe lean, the cambial initials were shorter, on the average, on the lower than on the upper side, and the vessel cells also were of shorter average length on the lower side. This is the reverse of the observations made of the fibers.

Extension of the study to include samples from trees derived from a single clone growing under different mineral conditions, and also samples taken during different periods of the growing season, is now under way.

LITERATURE CITED

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