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A SIMPLE TECHNIQUE FOR PLACING CAMBIUM TEMPERATURE SENSORS AND FOR DETERMINING TISSUE MORTALITY IN YOUNG TREES

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CAMBIUM TEMPERATURE SENSORS

The use of prescribed fire as a silvicultural tool requires an increased knowledge of the physiological effects of varying fire intensities on forest trees. The point where the temperature of the cambium becomes lethal to a tree is one important consideration.

Temperature sensing devices, such as thermocouples, usually are placed in contact with the cambium layer in a tree through a slit in the bark on the side of the tree facing the heat source. This practice is undesirable, because inaccurate temperature readings will result due to external heating of the exposed thermocouple leads (Hare, 1961), and physical damage also will be done to the vital tissue.

These difficulties can be overcome by inserting the thermocouple from the side of the tree opposite the heat source. Using this method, cambium temperature and cambium condition in ponderosa pine trees subjected to an artificial heat source were determined successfully in the following manner:

(1) A one-inch thick wooden reference plate 4" x 8" with a hole in the center was fastened to the back of the tree directly opposite to the spot where cambium temperature reading was to be taken.

(2) The total diameter was measured with tree calipers, including the thickness of the reference plate.

(3) The average bark thickness was determined with a bark gauge.

(4) The bark thickness was subtracted from the total diameter giving the exact distance from the reference plate plane to the cambium.

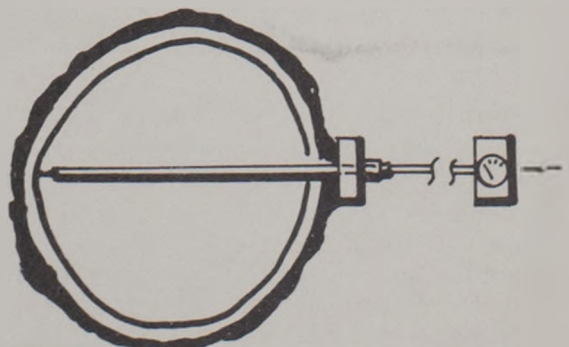
(5) This distance was measured on the barrel of an increment borer and marked with masking tape.

(6) The increment borer was drilled into the tree through the center hole in the reference plate until the tape line was exactly even with the plane of the reference plate. This produced a hole ending precisely at the cambium.

(7) The hole distance (reference plate to cambium) was marked on the one-fourth inch copper tube of a 30 gauge Iron vs. Constantine thermocouple in the same manner as on the increment borer.

(8) The thermocouple was then inserted into the hole until the tape line exactly coincided with the plane of the reference plate. This positioned the thermocouple on the cambium layer (Breuer, 1965).

This method of positioning the thermocouple was successful and involved only the ordinary tools used by foresters. In 20 tests, the thermocouple was placed properly more than 75 percent of the time. In every test, the thermocouple junction came within 2 millimeters of the cambium.



TOP VIEW

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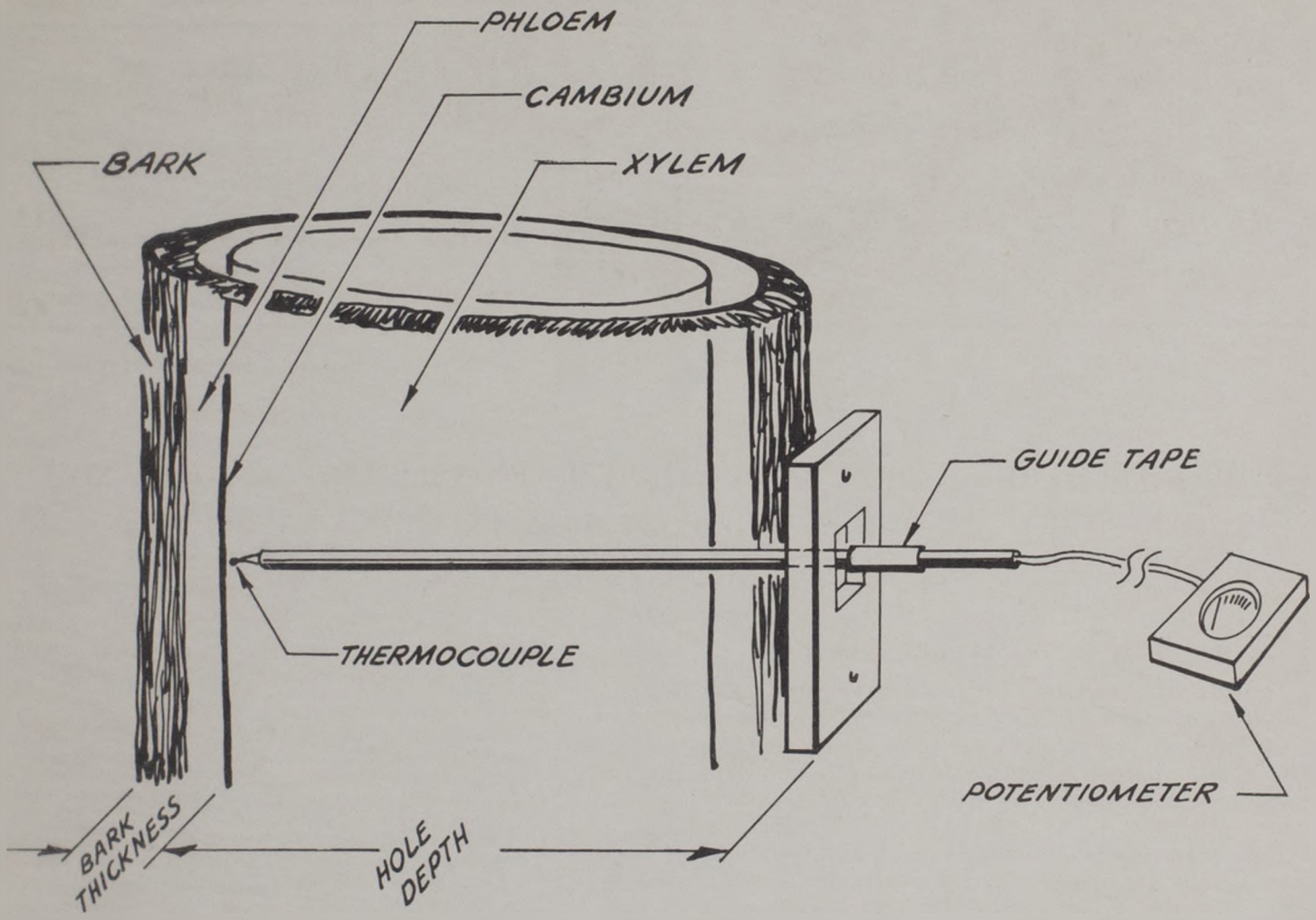

TISSUE MORTALITY TEST

Two vital stains were tested as indicators of tissue mortality after the application of heat from a propane torch to the tree. These were gum guaiac and orthotolidine. These are enzymatic indicators that change color when they are deprived of two hydrogen ions. They must be used with hydrogen peroxide or in solution with urea peroxide. The following reaction takes place when either of these chemicals are sprayed on live tissue:

$$(\text{indicator } H^{++}) + H_2O_2 \rightarrow (\text{Blue indicator}) + 2H_2O$$

The catalyst in this reaction is the enzyme peroxidase. Therefore, when the enzymes have been heat deactivated, causing mortality of the vital tissues, the reaction will not occur.

Orthotolidine is used in a one percent solution of methanol. The hydrogen peroxide is used in a three percent water solution. The indicator on live tissue turns bright blue immediately and changes to deep purple in 30 seconds. The indicator remains unchanged when applied to dead tissue.

Gum guaiac (resin) is used in a two percent solution of ethanol with the three percent hydrogen peroxide in water solution. The indicator on live tissue turns bright blue immediately. The indicator remains unchanged when applied to dead tissue.

These indicators are useful in determining heat deactivation of enzymes and consequent mortality. The orthotolidine solution produces the most vivid colors and is easier to see on days when lighting is poor. Gum guaiac is also useful, except that the change from blue to deep purple does not occur.

Tetrazolium chloride can also be used as an indicator of mortality (Kayll, 1963), but the reaction takes from 12 to 16 hours, and the color change is not as vivid as it is with orthotolidine or gum guaiac.

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