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ABSTRACT: A new technique for sampling tops of tall Douglas-fir trees by using a special pole pruner from a helicopter has been developed and field-tested. The pole pruner cuts and holds a branchlet. Foliage samples collected will be compared by spectral analysis to show the type of aerial imagery that best differentiates healthy trees from those attacked by root rot.

Sampling Tree Tops by Helicopter . . .

special pole pruner cuts branchlets

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Cutting branch sample from the tops of dominant forest trees can now be done quickly and efficiently by a new sampling technique (fig. 1). A lightweight tree pruner has been designed and field-tested for use from a helicopter.

Foliage samples from tree tops are needed in a study being made by the U.S. Forest Service with the support of the U.S. National Aeronautics and Space Administration. This study is seeking to determine the optimum combination of film and filters for use in identifying tree species and vigor class by means of aerial photography. Photographic tone is an important aid in making such identifications. The tone of a particular tree depends on the amount of light reflected to the camera from the top of the tree within a specific spectral zone.

After tree top samples are collected, laboratory measurements of the light reflectance can be made in each spectral zone. By using this technique, it will be possible to determine the optimum spectral zone, and hence the optimum film-filter combination, for use in obtaining a unique photographic "tone signature" for each kind of tree.

Standard Sampling Methods

The standard tree climbing methods to clip and collect small branchlets from the top and outer portions of a tree crown are laborious and time-consuming. Only a few samples from tall trees can be obtained in a day by an experienced tree climber. Shooting branchlets out of tree tops with a rifle is difficult, time consuming, and uncertain--especially in tall dense stands. Wind movement in the tree top causes an unsteady target, and a severed branchlet may "hang up" in the upper tree crown. In many instances only about 1 rifle-severed branchlet out of 10 reaches the ground in a short time.

In this study, branchlets from the tops of 45 trees were needed for analysis and comparison. The time factor and lack of experienced tree climbers or expert marksmen necessitated a different approach.

In a previous study,[1] an efficient tree marking technique was described

[1] Wear, J. F., and Howard, B. *New tree marking technique improves forest spraying operations.* Pacific NW. Region, U.S. Forest Serv. 8 pp. 1966.

Figure 1.--*Helicopter hovers next to the top of a tall Douglas-fir tree while a branchlet is clipped with the newly developed tree pruner to sample foliage.*

in which a helicopter was used to apply fluorescent paint or weighted streamers to tree tops. This aerial technique suggested using high powered helicopters for tree sampling of dominant trees in the forest canopy. The power and hovering capabilities of either the Hiller 12E or the Bell G3B helicopter[2] are minimum for this type of tree-top sampling. Therefore a highly skilled helicopter pilot with considerable experience in low level cargo handling or forest spraying operations also is required. It is necessary that only trees occupying the highest part of the forest canopy be selected for sampling from the helicopter. Several extra trees should be selected to replace any that the helicopter pilot might reject because of adverse approach or unusual wind conditions.

Special Pole Pruner

The special pole pruner for foliage sampling from a helicopter was designed with two aims: (a) to cut an 8- to 12-inch branchlet rapidly, with minimum hovering time for the helicopter, and (b) to hold the cut branchlet until specifically released by the operator. A scissor-type cutting head (figs. 2,3) was developed by the senior author

[2]Trade names or commercial products or enterprises are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

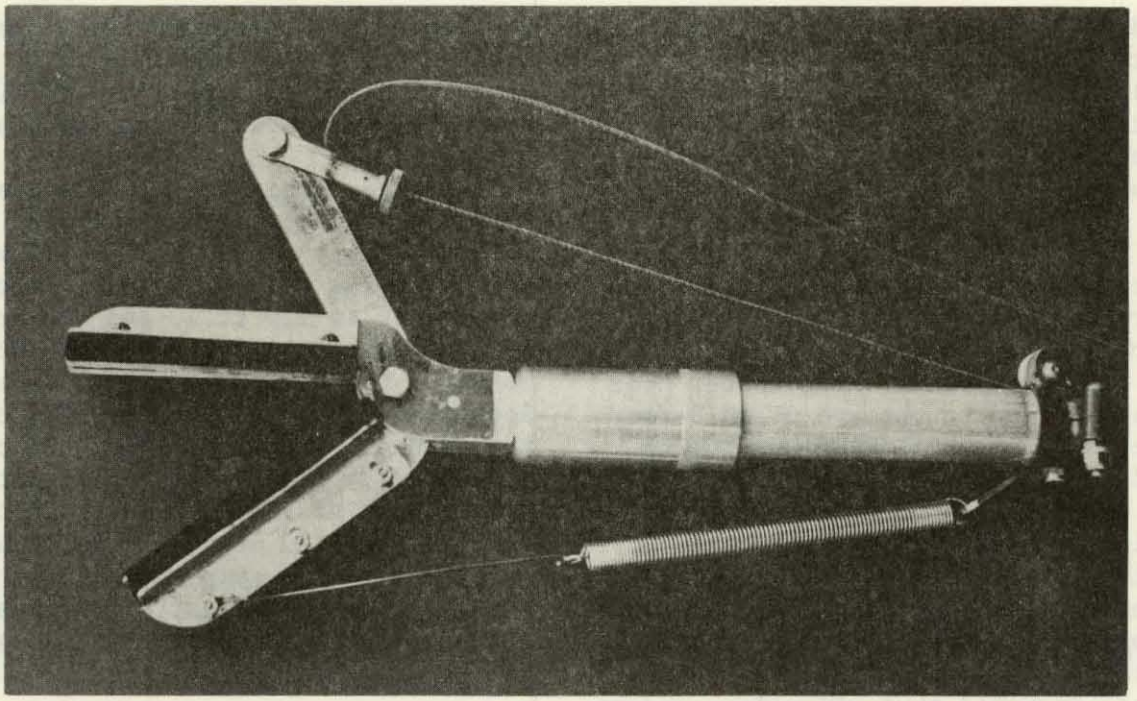

Figure 2.--*The cut branchlet can be held in the pruner head until it is retrieved or released.*

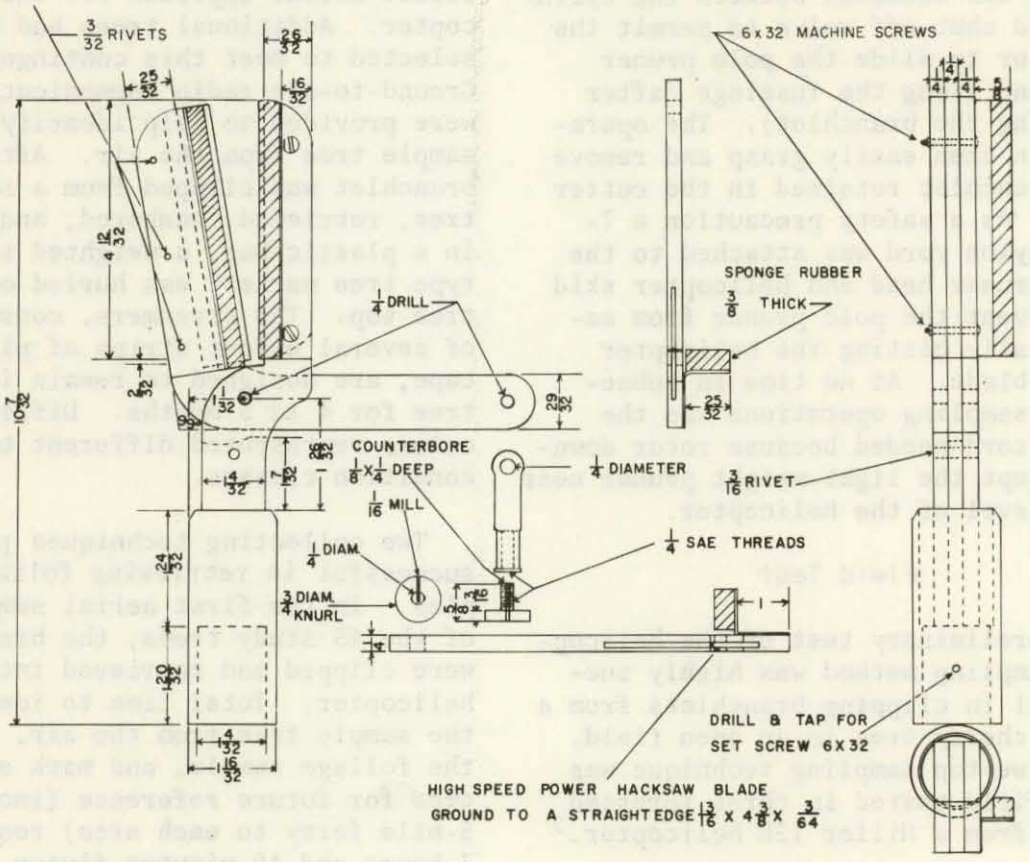

Figure 3.--*Detail shows construction of the scissor-type cutter head.*

and engineering personnel of the U.S. Agricultural Research Service (A.R.S.). Walter Wilson, A.R.S. general machinist, designed and assembled the various components of the pole pruner.

To simplify the actual clipping operation for the operator, we incorporated a cylinder powered by carbon dioxide (CO_2) into the handle of the pole pruner. The cutter head was attached to one end of an 8-foot piece of thin wall aluminum tubing, and a 3-inch stroke two-way cylinder to the other end of the tubing. A 1/16-inch cable was attached to the cutter arm and threaded inside the tubing to the actuator cylinder. Appropriate fittings and tubing were attached to the cylinder, to a two-way lever operated shut-off valve, and to a small 3- by 12-inch CO_2 cylinder (fig. 4). Enough 3/8-inch rubber tubing was attached between the cylinder and shut-off valve to permit the operator to slide the pole pruner back and along the fuselage (after clipping the branchlet). The operator can then easily grasp and remove the branchlet retained in the cutter head. As a safety precaution a 7-foot nylon cord was attached to the pole pruner head and helicopter skid to prevent the pole pruner from accidentally hitting the helicopter rotor blade. At no time in subsequent sampling operations was the nylon cord needed because rotor downwash kept the light-weight pruner near skid level of the helicopter.

Field Test

A preliminary test of the helicopter sampling method was highly successful in clipping branchlets from a small cherry tree in an open field. The tree-top sampling technique was then field tested in three forested areas from a Hiller 12E helicopter.[3]

Fifteen Douglas-fir trees were preselected on the ground in each of three areas of different age class in Wind River drainage near Carson, Washington.

The three areas were in centers of *Poria weirii*, a root rot disease. Sample areas were representative of young growth stands (40 to 80 ft.), second growth (90 to 120 ft.), and old growth (130 to 225 ft.). Five trees that represent a tree condition class were selected in each area and marked from the ground. The three condition classes were (a) healthy, (b) root rot infected with no visible crown symptoms, and (c) infected with visible crown symptoms. Three samplings of the 45 trees were made to test differences in reflectance data at different seasons of the year.

Only two trees selected from the ground were discarded because of difficult aerial approach for the helicopter. Additional trees had been selected to meet this contingency. Ground-to-air radio communications were provided to help identify each sample tree from the air. After a branchlet was clipped from a sample tree, retrieved, numbered, and placed in a plastic bag, a weighted streamer-type tree marker[1] was hurled onto the tree top. The streamers, consisting of several 6-foot strips of plastic tape, are designed to remain in the tree for 4 or 5 months. Different colors represented different tree condition classes.

Two collecting techniques proved successful in retrieving foliage samples. In the first aerial sampling of the 45 study trees, the branchlets were clipped and retrieved into the helicopter. Total time to identify the sample tree from the air, collect the foliage sample, and mark each tree for future reference (including 5-mile ferry to each area) required 3 hours and 10 minutes flying time. The last three trees were sampled and marked in 6-1/2 minutes.

[3]Columbia Helicopters provided pilot Wes Lematta and a Hiller 12E helicopter.

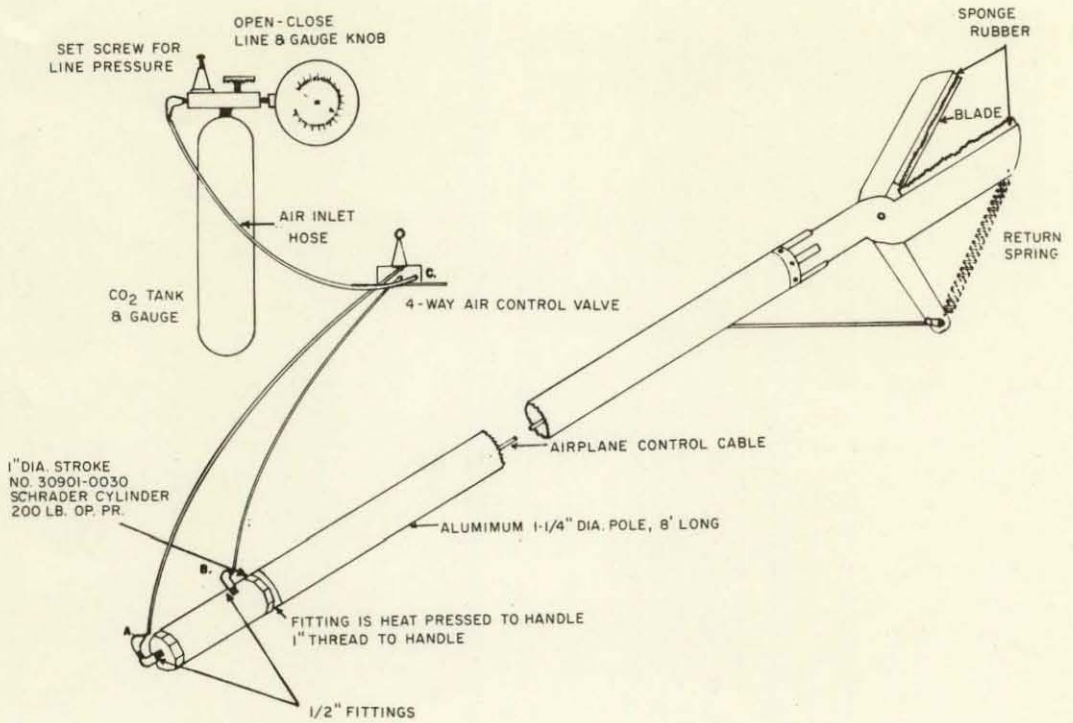

Figure 4.--*Pneumatic-actuating cylinder at one end of the aluminum tubing powers the tree pruner. At the other end of the 8-foot tubing is the cutter head.*

In the second aerial sampling, the technique consisted of clipping the branchlet and dropping it through an opening in the canopy to field men on the ground. Some time was saved because sample trees that had been marked during the first sampling could be identified readily. Total time to complete the second sampling with the second technique was 2 hours and 5 minutes.

The first sampling technique was used for the third sampling period because of limited field men. Total air time for the third sampling was 2 hours and 15 minutes.

The current progress on collecting tree branchlets from the tops of dominant trees with a special pole pruner used from a hovering helicopter indicates a practical and efficient sampling procedure. In a relatively short time many branchlets, cones, or scions can be clipped from the tallest trees in the forest canopy. Care must be given to see that trees to be sampled are properly selected, that the helicopter pilot is skilled in hovering techniques, and that the helicopter meets basic requirements.

The Authors

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