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ROLL SPLITTING OF BIOMASS

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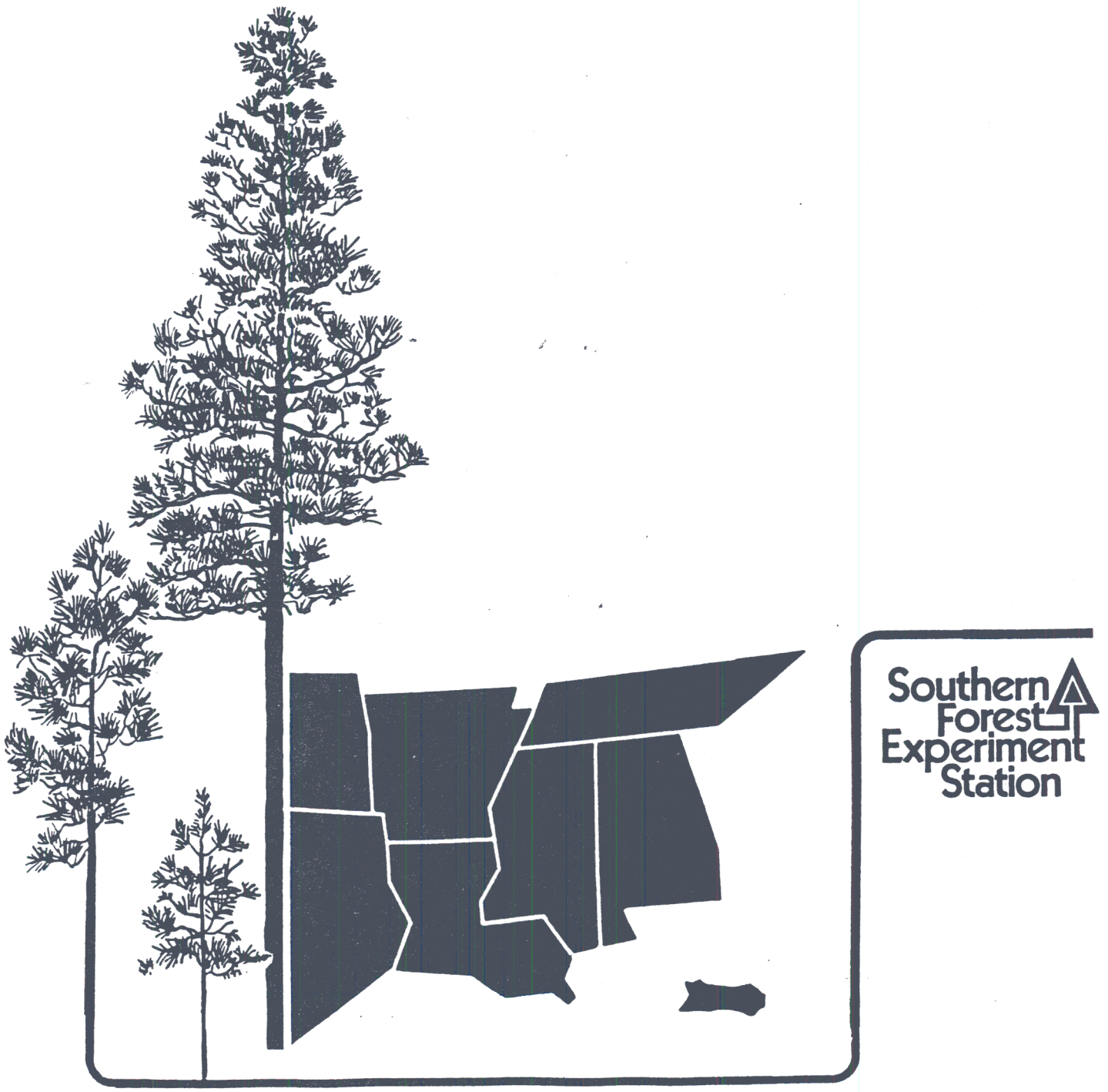

Roll Splitting of Biomass

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This presentation is to make you aware of a biomass harvesting research project just initiated between TVA in Norris, Tennessee and the U.S. Forest Service in Auburn, Alabama, and hopefully, to generate your and your company's input in the form of questions, comments, and concerns, to problems you may have experienced in your rights-of-way (ROW) management program. ROW management is becoming increasingly restrictive through nationwide pressures to limit chemical and herbicide applications and through increasing maintenance costs.

TVA's ROW maintenance concerns led them to investigate methods of crushing or splitting ROW material and baling it for energy uses. FERIC (the Forest Engineering Research Institute of Canada) demonstrated that roll crushing will reduce biomass to a splintered mass suitable for baling, while squeezing a significant amount of water from the green wood. TVA acquired FERIC's roll crushing test machine, and with the help of a DOE grant, got funds to further evaluate the concept of roll crushing ROW type biomass.

Through these funds, the U.S. Forest Service is cooperating with TVA to determine these objectives about biomass harvesting. First, to conduct a literature review of past and on-going research for biomass harvesting systems, especially for small woody biomass of 5 inches and less. Second, to survey and characterize ROW biomass, area, terrain, and road spacing. Third, to develop engineering, production, and cost criteria for determining the feasibility and design of a biomass harvesting system, and finally, to assist TVA with testing the FERIC roll splitter, and design and fabricate improvements into the roll splitter that meet the established criteria for the conditions found in Tennessee and other southern states.

Quickly, let me explain to you a little more about the machine we have acquired from FERIC for further testing. The roll crusher is a mobile test stand with a 175 Hp gasoline engine that supplies hydraulic power to the roller motors and crushing cylinders.

The test stand has 2 lower crushing rollers, one in the front and one in the back, that are mounted in a fixed position. These are the powered rollers that feed the material through. The upper 2 rollers, again one in the front and one in the back, move up and down by means of two hydraulic cylinders and do the crushing and dewatering as the material is fed through.

Note the water that is squeezed from the stem as it is fed through the front rollers. To further aid in drying the material, the rollers do a good job of crushing and splintering the wood and leaving it a suitable produce for baling.

Although it appears that one set of rollers can do all the dewatering and crushing, the second set can be run at a slower rpm to cause buckling and further splitting of the material. The second set is also necessary when there is a significant difference in stem size.

Everyone knows, that the economic utilization of undersirable brush and biomass is highly dependent upon low cost methods of harvesting and handling such material. We feel that a biomass harvester has a large potential for recovering some of the ROW maintenance costs, especially since aerial spraying and ground spraying are becoming so closely regulated. Another advantage of a biomass harvester would be longer rotations between maintenance periods. Through a survey of 20 power companies from Mississippi to West Virginia, we found almost all maintenance of ROW was on a 5 year or less rotation period, with most companies maintaining their ROW's every 3 years. Other results of our survey showed: the average number of ROW miles maintained to be 6134, the average width of the ROW to be 95 feet, the average distance of the ROW from the access point to be 0.5 mile, and the average of the maximum diameter of small trees in the ROW to be 5 inches.

We realize that a ROW harvester would not be appropriate for all ROW conditions, but to get a better idea of how much ROW mileage could feasible be harvested, we characterized slope and vegetation types for the 20 power companies surveyed.

For the percentage of ROW miles in each slope class, we note that: 19.1 percent are on level lands, 42.5 percent are between near level and 15 percent slopes, 29.8 percent are between 15 and 25 percent slopes, and only 8.7 percent are on slopes of 25 percent or greater. We deduce that at least 62 percent of ROW mileages are on acceptable slopes while another 30 percent could be accessable with a low center of gravity machine.

For the percentage of ROW miles grouped by vegetative type, we note that: 22.9 percent are in grasses, 15.3 percent are herbaceous or of the broad leaf weed type, 13.7 percent are in shrubs, and 48.1 percent are trees.

Recall that the maximum average diameter of the tree class was 5 inches. So nearly half of the ROW mileage surveyed could feasible be harvested and baled for biomass.

Another class surveyed was the percentage of ROW miles grouped by maintenance type. Here we see that of the 20 power companies surveyed, 84.3 percent of the ROW miles are mechanically maintained with the other 15.7 percent of the ROW miles being maintained by herbicides and handcutting. This shows that a large majority is open to a mechanical harvester.

For the average cost by maintenance type, we note approximately 350 dollars/acre is spent handcutting, 115 dollars/acre is spent on herbicide application, and 170 dollars/acre is spent on mechanical control. In chemical control, none of the maintenance costs are recoverable, but with mechanical control, there exists that potential to recover some, if not all, of the ROW maintenance costs. That is our goal! We feel that crushing the material and baling after it has dried has 3 distinct advantages.

First, we feel that squeezing out some of the water then leaving crushed material on the ground to dry will significantly decrease drying time between the crushing and baling phases. Second, we can split and bale dry material with less energy than required to chip the material and haul it green, as it is now conventionally done. Third, dry bales of biomass will decrease hauling cost and increasing combustion efficiency at the boiler.

In a relation between the moisture content in stems as a function of stem height, we see a direct comparison between those stems with 4 weeks of drying versus those with no drying. After 4 weeks of drying, the percent moisture content is consistently half of that just cut. By dewatering and crushing the material, we expect this 4 week drying cycle to be reduced. We don't know exact drying times for crushed wood at this time but that is a test objective. FERIC's tests did not answer this question because their's were conducted in the winter using frozen wood. Note the percent moisture content for this species averages 120 percent.

Regarding boiler efficiency, biomass above approximately 68 percent moisture content can not be used, so drying is essential.

I look forward to discussing any of your thoughts on roll crushing of biomass. Our Forest Service lab in Auburn is involved in timber harvesting research but has approached the problem of biomass utilization before. The Nicholson Mobile Chip Harvester was a prototype machine that was developed to retrieve cull trees at the stump and recover logging slash in place instead of trying to utilizing a skidder to skid logging residue to a stationery chipper.

The harvesting costs for a machine this large is still not feasible, but it proved the concept that a biomass harvester can be feasible with a smaller, less expensive machine.

Our engineering unit has had input into the design of a skidder sprayer with Scott Paper Co. for use in site prep activities. The 22 tip manifold nozzle has a 50 foot spray width and carries a 600 gallon tank.

Our lab also had input into the design of this crawler sprayer system for the Georgia Forestry Commission. It also has a 50 foot spray width and is used for Kudzu control.

Again, your input and thoughts on the potential for roll crushing and baling ROW biomass will be most useful in our work. Please feel free to get with me after this session. Thank you and good day.