# Harvesting Taproots Of Southern Pines May Boost Yield By 20 Percent

By Dr. Peter Koch
and
S. J. "Sam" Coughran

Currently depressed lumber and plywood prices and bulging chip piles painfully focus manufacturer's attention on surpluses in the market. In the opinion of many raw material managers, however, these surpluses are transitory and will eventually be replaced by shortages arising from increased product demands.

A major objective of wood scientists, who customarily take a long view of supply and demand situations, has been to forestall these anticipated shortages by devising processes which increase the degree of utilization of each tree.

A giant step toward better utilization was recently developed equipment which rapidly and economically harvests pines by pulling them from the ground like giant carrots.

Where the terrain is suitable for mechanized harvesting, the new process promises to increase by 20 percent the tonnage of wood utilized from southern pine plantations.

The concept is simple. Southern pines typically have a shallow system of lateral roots and a thick, tapered, deeply penetrating taproot. Experiments indicated that if the shallow lateral roots were first severed from the taproot, the complete tree could easily be lifted from the soil with the taproot still attached to the stem.

The main advantages of the concept seem to be: an increase of about 20 percent of pulpable tonnage per acre of plantation; site preparation costs for subsequent planting will be substantially reduced; and hazards from black turpentine beetle should be significantly reduced by removal of stump-taproots from harvested sites.

It is speculated, but not demonstrated, that infection and spread of *Fomes annosus* may be inhibited in plantations from which stump-taproots are removed. Breeding of pine reproduction weevils may also be curtailed.

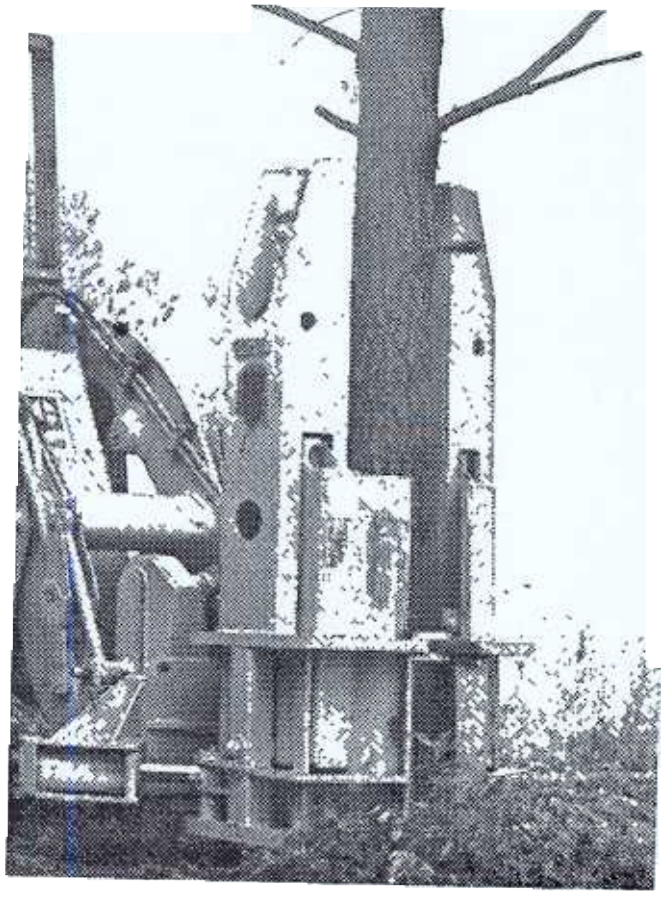
In cooperation with the Southern Forest Experiment Station, Rome Industries of Cedartown, Ga., developed an experimental commercial model of a puller-buncher exploiting this concept. The puller-buncher can be mounted on most wheeled, articulated prime movers.

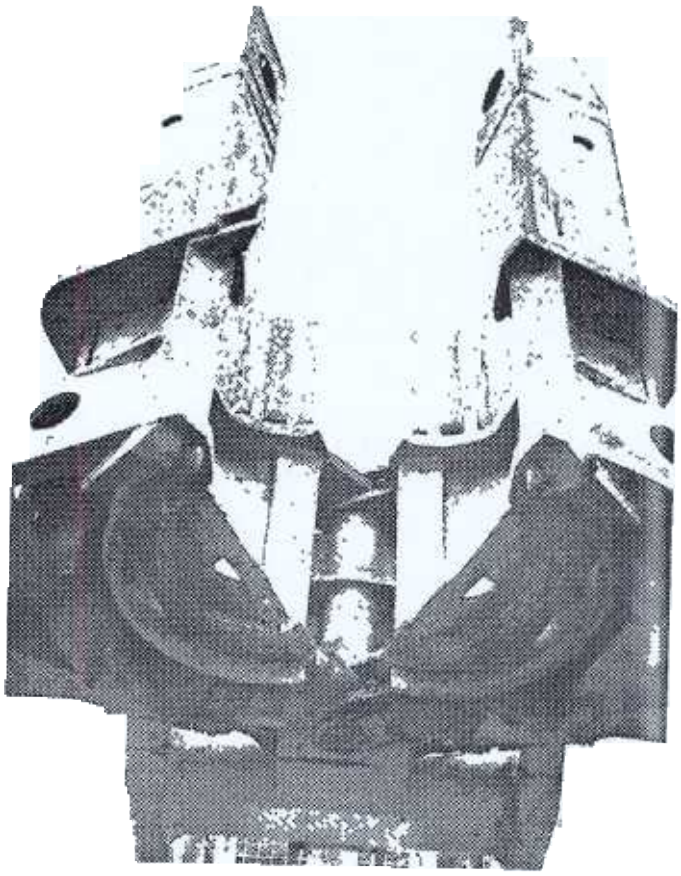
Two elements are central to the design of the puller-buncher. First it is a scissor-type grip achieved with a pair of stout horizontal knife blades that close at ground level around the stem of the tree and bite several inches into it from opposite sides.

With this grip as an anchor, the second element in the design comes into play. It is a clamshell-hinged tubular shear, 22 inches in diameter and sharpened on the lower edge. It is forced vertically into the ground to a depth of 11 inches, se-

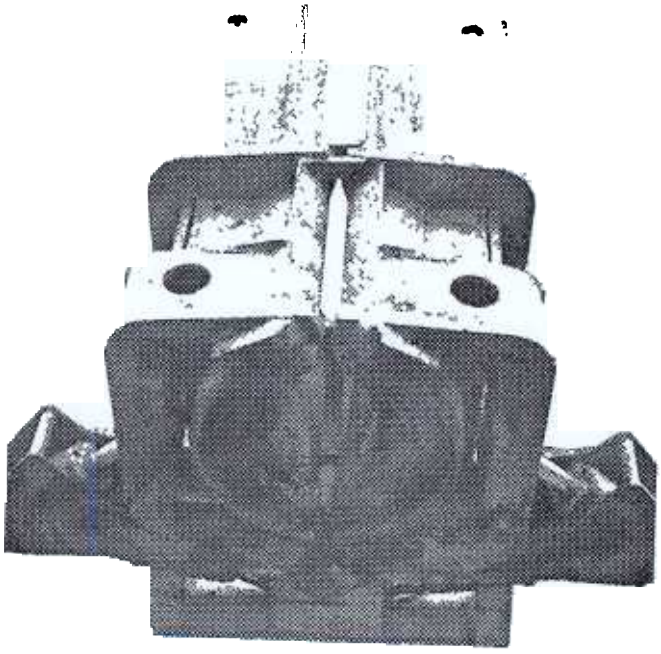
*Sam J Coughran is director of product development for Rome Industries of Cedartown, Ga Dr Peter Koch is the chief wood scientist with the USDA Forest Service Southern Forest Experiment Station at Pineville, La Koch is also the subject of Faces of Forestry in this issue of FORESTS & PEOPLE*

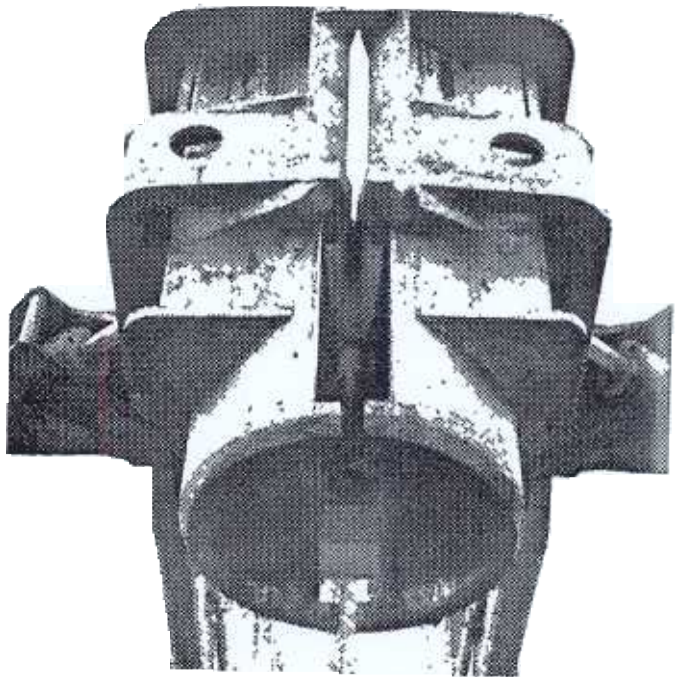
A complete loblolly pine, measuring 10 inches in diameter at breast height, is lifted from the soil with tap root attached





Top left, the lateral root shear with hinged grip closed around a tree with shear retracted Bottom left, grip closed, shear still retracted Top right, grip in open position Bottom right, grip closed with shear fully extended





vering lateral roots all around the tree. At this point, broad steps on opposite sides of the shear strike the ground and prevent further penetration. An additional stroke of the hydraulic cylinder raises the grip 9 inches while the steps remain stationary, pressed against the soil surface.

The effect is to jack the stem upward and break it free from the ground. Finally, the complete tree is lifted into the air and bunched for skidding. Since actuation of the shear takes only a few seconds, a tree can be harvested and bunched in less than a minute.

Field trials of the commercial model were held at Cedartown, Ga., with the puller-buncher mounted on a JD 544B prime mover. Two series of trials were held in a 16-year-old loblolly pine plantation. The soils were loamy clays. More than 1,000 trees of 5 to 10 inches in diameter at breast height were harvested and bunched at a rate well over 60 trees per hour.

The first of these trials was started on June 25, 1974, under rain-moistened soil conditions. The second series began July 13 under extremely dry soil conditions.

Both the amount of force required to shear lateral roots and the force required to lift the trees was greater in dry soil than in moist soil. In no case, however, did severance force (including the force required to penetrate the soil) exceed 75,000 pounds. Lifting force never exceeded 65,000 pounds. The two hydraulic cylinders which activate the lateral-root shear can exert a total force of 180,000 pounds, which should be ample power for trees of up to 16 inches in diameter at ground level, the maximum size the grip will accept.

During the trials, soil tended to cling to stumps and taproots. Much of it was shaken free when the tree was bunched but some remained. Holes left in the ground after the trees were pulled varied from shallow depressions up to cavities 22 inches across and a foot deep. Skidding partially filled most of the holes during the course of the operation.

Ten of the pines uprooted at Cedartown were analyzed for weight and dimensions. The work was done under the supervision of Bernard Davis of the Wood and Woodlands Division of Georgia Kraft Company at Rome, Ga. The trees ranged from 6 to 8 inches in diameter at breast height and had other average dimensions as follows:

After extraction of all trees, the logging site was relatively clean. Skidder action filled in most of the stump holes.

| | Average |
|---|---|
| Diameter, inches | |
| ground level | 10.8 |
| stump level | 8.9 |
| breast height | 7.1 |
| Length, feet | |
| entire tree above 2-inch-high stump | 44.2 |
| merchantable stem | 31.3 |
| top | 12.8 |
| stump-taproot | 4.9 |

Trees with an average 8-inch diameter at breast height had somewhat greater merchantable length (35 feet) than those of 6 to 6.5 inches diameter at breast height (30 feet). Stump-taproot length increased somewhat with tree diameter. Trees with a breast-high diameter of greater than 6.5 inches had stump-taproot lengths of about 5 feet. Trees with breast-high diameters of 6 to 6.5 inches had stump-taproot lengths about 3.5 feet long.

Stump level diameters were about 1.8 inches greater than diameters at breast height and ground level diameters were about 3.7 inches greater than at breast height.

(continued on page 38)

The taproot of the longleaf pine is heavier than that of the loblolly pine, the tree is only nine inches in diameter at breast height but the root measures 22 inches in diameter at its largest diameter

## Harvesting Taproots

(continued from page 11)

Weight analysis of the trees yielded the following information:

| Portion | Green Weight pounds |
|---|---|
| Merchantable pulpwood in stem | 2,990 |
| Stump-taproot, including dirt | 880 |
| Stump-taproot after washing | 560 |
| Dirt washed from stump-taproot | 320 |
| Limbs and tops (estimated) | 658 |

From this information on the loblolly pines from Cedartown, it appears that harvesting of the stump-taproot would increase the amount of fiber available for utilization by 18 percent (from 2,990 pounds to 3,550 pounds) over conventional harvesting methods.

In this trial no evaluation of harvesting costs was attempted. It was recognized that dirt adhering to the stump-taproot is a serious obstacle.

After Cedartown, the harvesting attachment was moved to slash and longleaf pine plantations on International Paper Company land just north of Panama City, Fla., where A. Wimpenny Jr. and his associates conducted trials for more than ten operating days during August 1974.

Several thousand trees were harvested in a corridor thinning operation of every third plantation row. The soil was sandy, less dirt adhered to the stump-taproot than in Georgia. Moreover, the stump-taproot comprised a substantially greater portion of the tree weight. For essentially all of the trees harvested, stump-taproots averaged 22 percent of the weight of the mer-

chantable stems to a 2 inch top on a green-weight basis.

With the company's operators, the equipment extracted and bunched 1.9 trees per minute in stands with trees of up to 10 inches in diameter. In stands with trees up to 13 inches in diameter, the production rate was 1.1 trees per minute. (These are average figures for all shifts.)

Some of the trees (yielding about one full van of chips) were chipped with the taproots attached. Some accelerated knife dulling was noted. The balance of the trees were topped, skidded, bunched for loading and trucked to the mill. Because of the knob-like structure of the taproots, somewhat less payload than usual could be handled per truck. The long taproots on some stems would have caused the truck to exceed the maximum permissible length of 75 feet but these stems can be reduced in length before loading.

To avoid undue conveyor problems at the mill, stub laterals on the taproots were closely trimmed in the field. Stems, with taproots attached, were then sent through the mill's drum debarker and chipped in the normal fashion. When these chips were pulped in mixture with regular chips no immediate problems were detected.

After the Panama tests, Rome industries and the experiment station staged a field explanation and demonstration at Cedartown. An audience of about 80 persons, mostly forest managers and procurement men plus a few papermakers, attended. Resulting from the demonstration, additional field trials throughout the South were scheduled for late 1974 and early 1975.

Based on these various trials, the concept and the hardware, with minor modifications, seems to prove usable throughout much of the southern pine range.

Substantial work will be necessary to devise total harvesting systems able to cope with the problems of complete-tree skidding, transport, bucking, dirt removal and chipper maintenance. In spite of these problems, it is likely the industry will eventually adopt the concept.