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Loblolly Tree Seed Collection System

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A net retrieval tree seed collection system for loblolly pine (Pinus taeda L.) *has been designed and built by Missoula Technology and Development Center (*MTDC*) engineers. The system combines polypropylene netting that covers the orchard floor to collect seeds, a self-powered retrieval mechanism that rolls and unrolls the netting, and a conveyor that delivers the seed to a separator where it is separated from pine straw and other material. The system can produce seed at a reduced cost while enhancing workers' safety.* Tree Planters' Notes 44(3):101-104;1993.

Engineers at the Missoula Technology and Development Center (MTDC) in Missoula, Montana; the Georgia Forestry Commission in Macon, Georgia; and the USDA Forest Service's Southern Region, headquartered in Atlanta, Georgia, designed a mechanized net retrieval and seed collection system for loblolly pine seed orchards that has made seed harvesting safe and simple. The system consists of a net, a self-powered retrieval system, a conveyor, and a seed separator. The system has been used successfully in southern seed orchards to gather loblolly pine seed for more than 10 years. However, the results of the project are being reported here for the first time. A complete set of drawings for assembling the system and specifications for purchasing the appropriate netting and associated support products have recently been completed and are now available.

Background

Harvesting seed in orchards has traditionally been done by hand. Mature unopened cones are picked from the trees by workers and processed to extract the seed. Because most cones are in the top half of a tree's crown, manually removing these pine cones requires ladders, power platforms, or aerial lifts. Typically, pickers work 30 to 40 feet (9.1 to 12.2 m) above the ground, and the specialized equipment necessary for this operation is utilized for only 4 to 6 weeks a year.

Of the six economically important pine species in the southern United States, loblolly pine *(Pinus taeda* (L.)) has become a popular choice for reforestation throughout the Southeast. Its cones are the most difficult to harvest because they firmly anchor themselves to the tree branch and are particularly hard to dislodge by hand. Manual collection methods cannot keep up with the demand for superior loblolly seed. In addition, workers collecting mature cones frequently break off immature first-year conelets, which reduces the seed crop in the following year. Tree shakers have been tried for dislodging mature loblolly cones, but they also can damage trees.

GFC Netting System

In the early 1970's, the Georgia Forestry Commission began work on a system to harvest loblolly seeds more effectively. They completely covered the orchard floor with polypropylene netting material that caught fallen seed, "pine straw," and debris coming from the trees. Their system allowed the cones to mature naturally on the trees, so that cones could open fully and drop their seeds naturally onto the net spread on the orchard floor. A tree shaker then shook all the remaining seeds from the cones onto the netting. The shaking process deposited tons of pine straw on the netting.

Netting was initially placed between the tree rows, overlapped, and stapled. When retrieving seeds, the stapled edges of the netting were released, and the netting was lifted to separate the grass that had grown through it. This process pushed the material toward the center of the net. Using a tractor, the netting material was folded back on itself and pulled until the debris, seed, and pine straw were all deposited at the end of the row. The process was repeated for each roll of netting.

The netting was then spread out and re-rolled for storage. A modified peanut combine was moved into place to separate the seed from the pine straw and other unwanted material. This semi-clean seed was then transported to a seed processing facility where it was conventionally cleaned and prepared for storage. This collection operation usually required a crew of four, a tractor, and a tree shaker.

MTDC Retrieval/Collection System

Working with this concept, MTDC engineers designed a prototype net system for collecting and retrieving tree seed. This system combines the original Georgia Forestry Commission netting concept

with a self-powered retrieval mechanism and a seed separator that simplifies the collection process.

With MTDC's system, the net retrieval/seed separator units are positioned at the end of a netting row (figure 1). The edges of the netting are released from the adjacent nets and lifted to free the material from any grass growing up through the fabric. The netting is attached to the aluminum core on the retrieval unit and is reeled in under power (figure 2). The speed of retrieval can be varied based on the amount of material on the net.

Figure 1-The MTDC's net retrieval-seed separator system positioned at the end of a netting row.

Figure 2—*Reeling in the netting under power.*

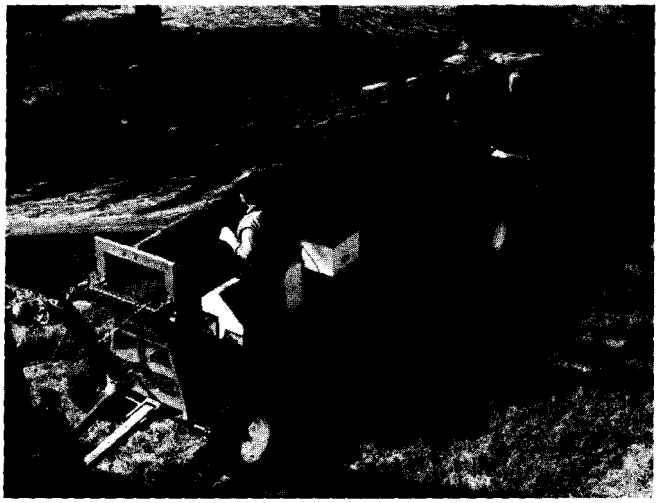

Figure 3-Close-up of the seed separator sorting the seeds and needles.

As the net is being reeled in, the seed and other material pass over a reversing roll and drop onto the conveyor. The conveyor transports the material to the seed separator. The seed separator cleans the seed and prepares it for extractory processing (figure 3).

The large amount of clean pine straw that is produced is an added benefit. Orchard pine straw is a prime-quality mulch that does not contain the weed seed and other debris normally found in straw bales; there is a ready market for this product.

Field Tests

The system was extensively tested at three sites: the Francis Marion Orchard in South Carolina; the Erambert Orchard in Mississippi; and the Stuart Orchard in Louisiana. Approximately 4,529 pounds (2054.4 kg) of loblolly pine seed were collected from 216 acres (87.4 ha) at the three locations with the net retrieval system. In 1984, James L. McConnell and Jerry L. Edwards of the Southern Region produced an economic study of the system. Their report included the following information on equipment and costs:

Net: Polypropylene plastic; 16.5 feet (5 m) wide by a variable length (600 feet or 183 m average); weave count = 6 x 8 per square inch; expected life = 10 years. Netting should be purchased according to Forest Service specifications.
Cost: $316,214 (1982 price) for three orchards (350 acres or 141.7 ha).

Core: Aluminum alloy 6063-T6; 4-inch outside dimension (10 cm) by 17 feet, 4 inches long (5.3 m); expected life = 20 years.
Net retrieval equipment: Net retrieval seed collection machine, netting transport trailer with crane, and tractor-mounted tree shaker; expected life = 20 years. The retrieval seed collection machine must be constructed according to the specifications of Forest Service drawings. The transport trailer, crane, and tractor-mounted tree shaker are available commercially.

Amortized annual fixed costs:

Item	Expected life	Annual cost
Netting	10 years	$31,621
Cores	20 years	$ 702
Retrieval equipment	20 years	$ 7,224
Annual fixed cost		$39,547

Variable costs:
$48,575 (labor, general equipment usage)

Total cost of net collection in 1984:

Category	Total cost (216 acres)	Cost per acre
Variable costs	$48,575	$225
Fixed costs	$39,547	$183
Total cost	$88,122	$408

Cone Collection

Seed production was spotty. Atlantic Coast collections were light; Gulf Coast collections were good to heavy. Loblolly yield was 1.43 pounds (0.7 kg) of seed per bushel of cones. The netting system collected 4,529 pounds (2054.4 kg) of clean seed. This is equivalent to the seed yield from 3,167 bushels of cones.

The collection of 3,167 bushels of cones by contract or force account (using Forest Service workers) would have cost $33 per bushel. The total cost would have been $104,511.

Cost breakdown:

Collection	$30
Drying and extraction	$ 2
Transport to extractory	$ 1
Total Cost	$33

Comparison of costs:

	Total costs	Cost per pound of seed
Cone collection (hand)	$104,511	$23.07
Net collection	$ 88,122	$19.45
Cost Saving	$ 16,389	$ 3.62

Results

The cost of the net seed collection system will be greatly affected by the volume of seed available. Because of high initial equipment costs, a small or young low-yield orchard will not find the net retrieval system an economical alternative to cone collection. In a large-volume, mature seed orchard, however, the net retrieval tree seed collection system can produce seed at a reduced cost while enhancing worker safety and eliminating the need for expensive power platforms or bucket trucks (figure 4). Seven systems are currently in use: two in private orchards; four in southeastern U.S. Federal and State orchards, and one in a European orchard.

Figure 4 - *Workers putting away the net retrieval-seed separator system. They find it easy to use and safe.*

Drawings

During development and testing, the towed prototype system was modified and refined by MTDC engineers working with material manufacturers and Southern Region personnel. A self-propelled model was developed. MTDC has recently completed fabrication drawings for the self-propelled net retrieval tree seed collection system. Ask for *Orchard Seed Harvester, MTDC Drawing 709.*

Netting Specification

MTDC, in cooperation with the Southern Region, has also produced a standard specification for netting material. Currently, Amoco Fabrics and Fiber Company is the only company with a loom wide enough to produce the needed material. Contact them at:

Amoco Fabrics and Fiber Company
A Division of American Oil Company
900 Circle 75 Parkway, Suite 550
Atlanta, GA 30339
Calvin Burgess (404) 956-9025

The netting material is commonly referred to as "carpet backing." The polypropylene plastic is also available in both a weave and fused net. Netting material must fully meet the following specifications:

1. Basic material. The retrieval netting fabric shall be manufactured from polypropylene plastic in continuous length. Splices, welds, or sewn together pieces shall not be permitted.

2. Dimensions. Retrieval netting fabric shall be delivered in rolls measuring 1,000 feet (304.6 m) long by 16.5 feet (5.0 m) wide.

3. Color. Color shall be black.

4. Amoco calls its product "Seed Catcher Net," item 8805. Weave count is 6 x 10. Yarns per inch shall be six in the warp direction and ten in the filling direction.

5. Weight. Weight shall be 2.1 ounces/square yard minimum and 3.0 ounces/square yard maximim.

6. Tensile strength. Tensile strength shall be 60 pounds minimum in the warp direction and 60 pounds minimum in the filling direction when tested in accordance with ASTM D 1682, Grab tensile test.

7. Burst strength. Burst strength shall be 175 pounds minimum per square inch when tested in accordance with ASTM D 751.

8. Yarn stability. Yarn stability shall be 250 g minimum when tested in the following manner:

Test apparatus: 500-g capacity pull spring scale graduated in 25-g increments.

Test method:

A. Spread sample netting on table.
B. Take the pull spring balance and hook a double end about 15 inches (38.1 cm) from the top and bottom selvage edges of the netting.
C. Pull the double end until it breaks its bond and touches the adjacent end. At this point the balance should be read to the nearest 25 g.
D. Take three readings from each side of the fabric, spacing each reading according to the lengths of the sample.
E. Average and record readings.

9. Cores. All cores shall be continuous in 17 feet, 4 inch (5.3 m) lengths. Cores shall have a 4-inch (10.1 cm) minimum inside diameter.

10. Outdoors wearing. The plastic fabric netting shall exhibit a minimum of 70% retention of properties after 400 hours in a weatherometer when tested in accordance with Federal Standard 191A, Method 5804.

11. Selvage edge. Selvage shall be a rninimun of 1/4 inch (0.6 cm) for each edge.

For further information on the loblolly tree seed collection system, contact:

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