USDA FOREST SERVICE

RESEARCH NOTE NC-146

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE
Folwell Avenue, St. Paul, Minnesota 55101

SEGREGATION OF FOLIAGE FROM CHIPPED TREE TOPS AND LIMBS

ABSTRACT. — An increase in forest utilization can be brought about by chipping logging residues or whole trees in the woods and removing the bark and foliage later. Because portable whole-tree chippers are now commercially available, methods must be developed for segregating bark and foliage from the chips. This paper discusses foliage removal results obtained from testing two methods of directing an airflow transverse to chips, bark, and foliage. The species tested were aspen, sugar maple, jack pine, red pine, balsam fir, and loblolly pine. Removing leaves was more successful than removing needles. Best results were obtained with sugar maple (88-percent foliage removal and 87-percent wood fiber recovery). More research is necessary to develop methods that will give a higher wood recovery.

OXFORD: 825.71:861. KEY WORDS: utilization, whole-tree, pulpwood, residue, harvesting.

A number of tree species are used for pulping in the Lake States; with each, a large quantity of wood in the form of tops and limbs is left in the forest after harvest because this material is difficult to debark and too awkward to handle and transport. A considerable increase in utilization would result if this waste wood were chipped in the woods and the bark and foliage removed after chipping.

The availability of new equipment capable of chipping whole trees makes it necessary to find methods of segregating leaves, needles, and other light impurities from the chips. In the study described here, two methods of directing a transverse airflow to chips, bark, and foliage were tested. The chips were produced from tree tops and limbs normally considered unmerchantable.

METHODS AND EQUIPMENT

Two experimental setups were tested. The first consisted of directing an airflow transverse to the direction of the chips as they fell freely from the chipper screen into the chip blower (fig. 1). The second consisted of directing an airflow transverse to the chips as they were blown from the chipper into a receiving truck (fig. 2).

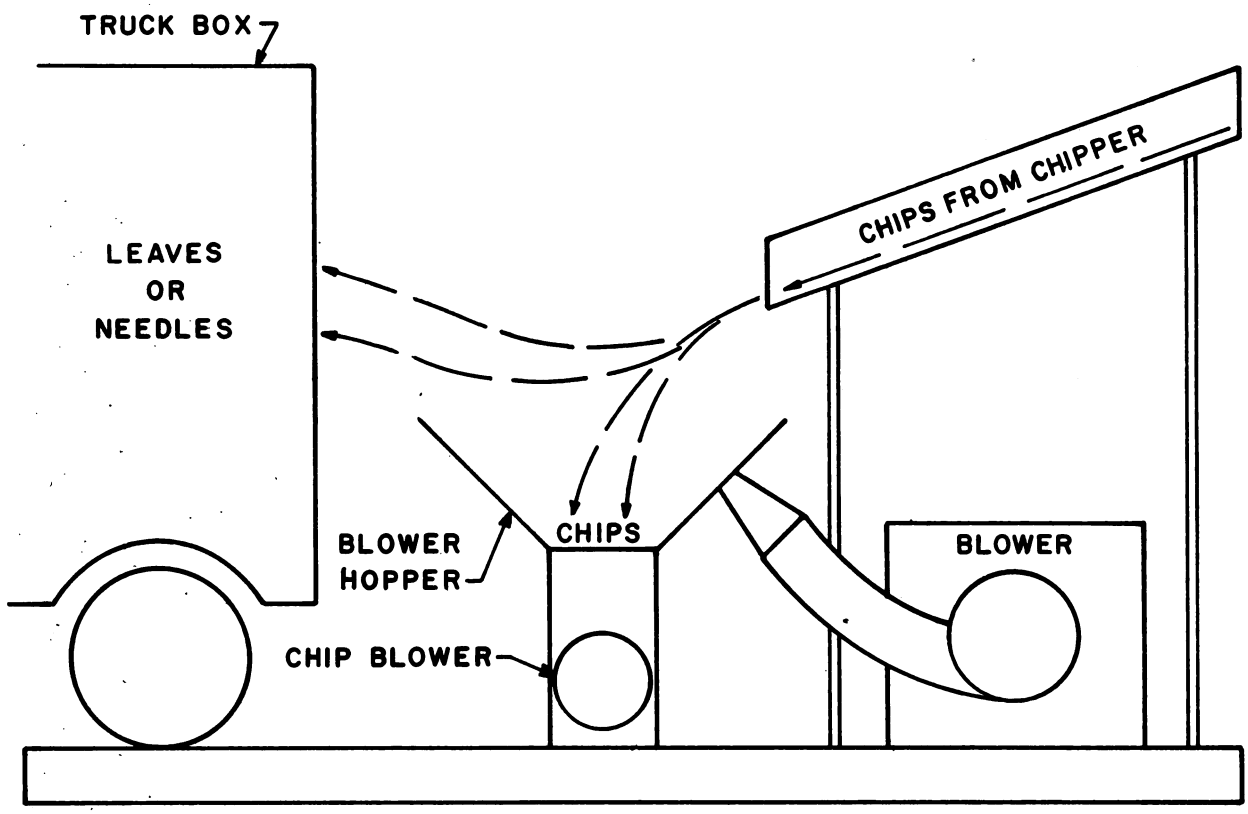

Figure 1. — *A vertical view of the experimental setup for foliage removal as the material was in free fall.*

A Morbark Chip-pac unit[1] with a 48-inch disc and three knives was used. The transverse airflow was produced by a blower unit consisting of a 2-horsepower induction motor and a 16-inch-diameter by 4-inch-wide squirrel cage fan that operated at 1,730 r.p.m. The blower had a hand-operated shutter on the inlet to vary the output air velocity. Tests were run at three different transverse air velocities that differed by setup and species.

The species tested were aspen, sugar maple, jack pine, red pine, balsam fir, and loblolly pine. All tops and limbs from three trees of each species except loblolly pine were chipped and tested for each test run. The loblolly pine was chipped prior to being shipped to the Forest Engineering Laboratory. Replications were made at each transverse air velocity for both setups. In the first, one truck was used to collect the foliage and another to collect the chips. The hopper and foliage truck box were covered by plastic sheeting to contain the air-blown leaves or needles. An air escape with a screen was provided at the front of the truck box. In the second, a semivan trailer was divided in half lengthwise to collect the two products. Here again a screen and air escape were used.

Samples of the chip and foliage products were classified on the Sweco classifier into five nominal sizes as follows: less than 3/16, 3/16 to 3/8, 3/8 to 5/8, 5/8 to 1-1/8, and more than 1-1/8. Each size class was analyzed to determine the percent wood, bark, leaves or needles, and twigs. Random samples from chip

[1] *Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

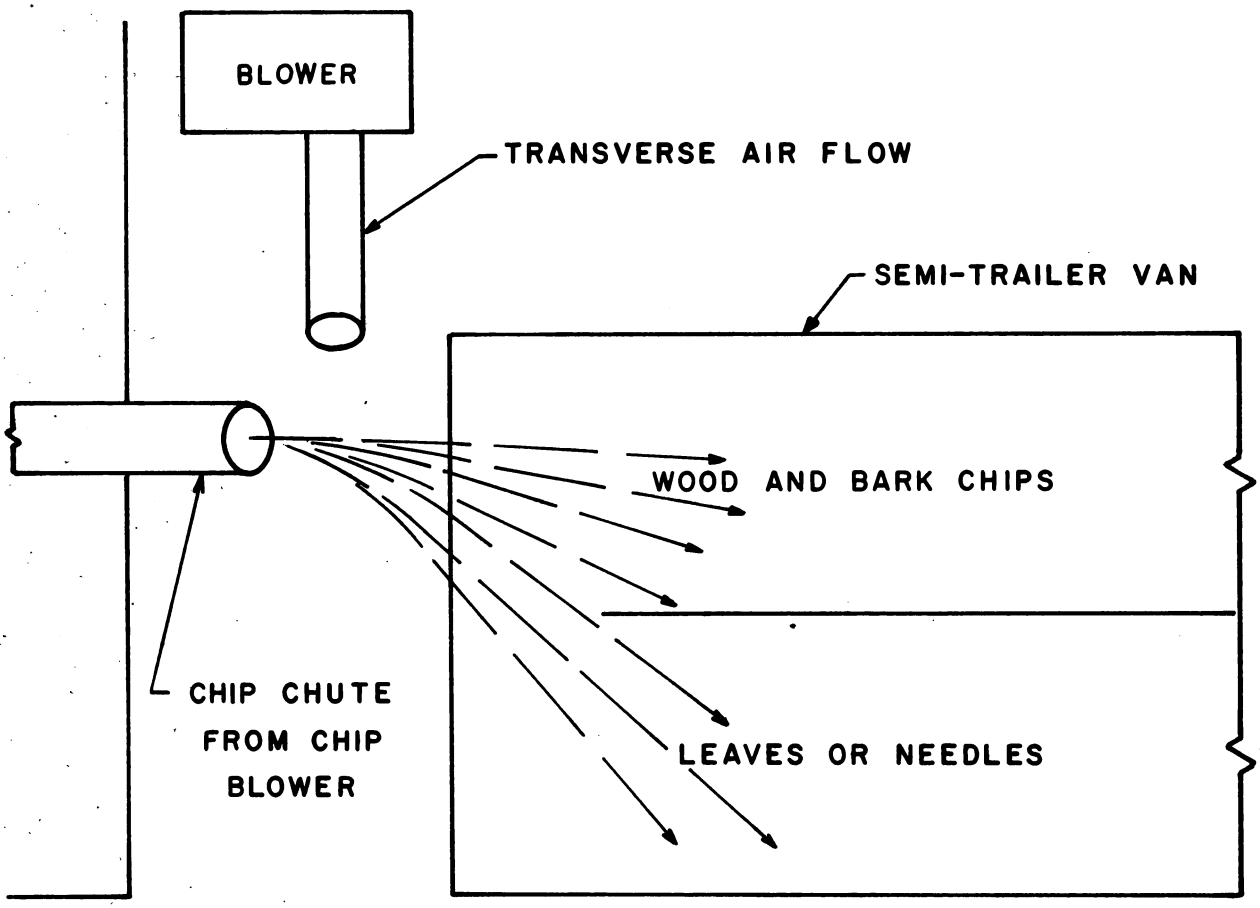

Figure 2. — *A plan view of the experimental setup for foliage removal as the material was being blown into a van.*

products were taken to determine moisture content.

A Dwyer microtector manometer was used to measure the transverse air velocities in the first setup. A Meriam inclined manometer was used for the second setup due to the higher air velocities. The pitot tube positions used for determining the average air velocities were based on recommendations by the fan test code (ASHAU).

RESULTS AND DISCUSSION

The amount of foliage removal obtained with the two methods is shown in tables 1 and 2. In both methods, leaves were more easily removed than needles, and the best results

Table 1. — *Foliage removal results for various transverse air velocities with the chips in free fall*[1]

Species	Transverse air velocity	Foliage content		Foliage segregated	Wood recovered
		Input	Output		
	Ft./sec.	Percent	Percent	Percent	Percent
Aspen	49	10.7	6.0	49.7	92.6
Do.	59	12.1	5.6	62.7	84.8
Do.	66	16.1	5.9	75.0	74.5
Sugar maple	49	10.9	5.5	53.4	97.6
Do.	59	12.3	4.9	66.3	91.8
Do.	66	10.6	3.4	74.7	84.0
Jack pine	59	24.0	19.3	27.8	96.4
Do.	66	24.0	16.9	41.5	91.9
Do.	73	19.2	11.8	51.0	88.3
Loblolly pine	49	16.1	13.1	24.1	97.3
Do.	59	10.8	7.6	39.9	89.1
Do.	66	7.4	5.3	41.6	85.4
Red pine[2]	59	17.1	12.6	36.4	91.0
Do.	66	18.6	12.3	45.4	90.5
Do.	73	17.0	10.8	53.8	78.4
Balsam fir[2]	66	9.5	5.4	52.7	87.3
Do.	73	15.0	7.1	64.1	82.1
Do.	75	15.4	5.5	73.7	80.3

1/ Each percentage value is the mean from three test runs except as noted elsewhere.
2/ Results from single test run at each air setting.

Table 2. — *Foliage removal results for various transverse air velocities with the chips moving at 53 ft./sec.*[1]

Species	Transverse air velocity	Foliage content		Foliage segregated	Wood recovered
		Input	Output		
	Ft./sec.	Percent	Percent	Percent	Percent
Sugar maple	62	6.1	1.4	80.0	88.9
Do.	81	9.2	1.7	85.5	83.3
Do.	85	7.0	1.1	87.6	86.8
Loblolly pine	62	6.9	4.0	47.6	93.7
Do.	81	7.4	3.4	60.4	90.3
Do.	85	6.3	2.3	70.1	84.8
Jack pine	85	20.2	12.9	47.8	90.1

1/ Each percentage value is the mean from three test runs.

were obtained with maple. This is probably due to the fact that a greater difference in density exists between foliage and chips in maple than in the other species. The results from the two setups show that better foliage removal and wood recovery can be obtained while the chips are being blown than while in free fall.

Due to the high amount of wood lost in obtaining 75-percent foliage removal, more research is necessary — particularly to find a better way of removing the short needles of the northern conifers. The problem of needle segregation has two aspects — the removal of single needles and needle clusters. Thus, a two-step process might be necessary.

It is a common belief that the majority of deciduous leaves would fall off prior to chipping if the felled tree or tops and limbs were left in the woods to dry for a period of time. The amount that would come off due to drying alone or drying and skidding is unknown. A limited investigation showed that even after 5 weeks of drying (from the first week in August to the middle of September) the maple and aspen leaves were still on. Maple leaves came off much easier than the aspen when pulled off by hand. Thus, skidding would probably remove more maple leaves than aspen leaves.

JOHN A. STUROS
Mechanical Engineer
Forest Engineering Laboratory
Houghton, Michigan (Laboratory maintained in cooperation with Michigan Technological University)

1973

☆U.S. GOVERNMENT PRINTING OFFICE: 1973--761421/20