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YIELDS FROM SHORT-ROTATION ASPEN SUCKERS[1/]

Ronald A. Person, Alvin R. Hallgren, and John W. Hubbard[2/]

Studies in the South indicate that sycamore promises high yields of wood fiber on a "silage-sycamore" type of very short rotations[3/]. Such a use of sapling-sized rather than the more mature trees as is now the practice for wood fiber production would reduce the interest burden of the long growth period. Also, the possibility of using agricultural-type equipment such as a corn chopper for the harvesting of suckers would open new opportunities for reducing the present relatively high percentage of a wood product's cost attributed to the harvesting process.

If there is a Minnesota species that could be adapted to this departure from the traditional form of wood production, it would have to be aspen (Populus tremuloides Michx.). Aspen has the desirable characteristic for short-rotation management of fully occupying a site with root suckers shortly after a harvest cut. But more information is needed as to just how much fiber is produced by aspen suckers at what is now considered a precommercial age and size. The purpose of this study was to determine the wood fiber yields that could be expected from aspen suckers. The work was done in northern Minnesota in the vicinity of International Falls.

Method

Cutting records of the Dentaybow District of the Boise Cascade Corporation at International Falls were used to locate potential sampling areas. The decision was made to limit the sampling to only the best aspen sucker sites in an area. Sucker stems more than twelve years in age were considered to be too large for potential harvesting with silage-harvesting type of equipment, so twelve years was made the upper limit of the age range. With the exception of one eleven-year-old stand of suckers, only even ages from two through twelve were sampled. Another criteria for an area to be measured was that at least 80 percent of the weight of the measured stems had to be aspen.

The sampled areas were in a belt of aspen that was known to be of fairly uniform and high site quality. The site indices for the selected areas ranged between 70 and 80, and the average for these areas was 75.

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2/ Respectively: Research Assistant and Associate Professor in the College of Forestry and Research Forester, Boise Cascade Corporation.

3/ Herrick, Allyn M. and Claud L. Brown. 1967. A new concept in cellulose production--silage sycamore. Agric. Science Review (5:4) 4th quarter, Coop. State Research Service, USDA: 8-13.

The plots to be measured were placed in those portions of the clear-cut areas that were by observation the most fully occupied with aspen sucker reproduction. Thus, the wood fiber yields, number of stems per acre, and other data calculated from these plot measurements will approach the maximum for sucker reproduction in the areas sampled.

A random line was sighted with a compass through the area to be sampled using a 100-foot tape as a guide. At each of the ten milacre plots located every 20 feet along the tape, all the woody vegetation 12 inches and over in height was cut off at the ground line and weighed with a spring-type dairy scale. (Accuracy of the scale was checked regularly at the laboratory and found to be within two-tenths of one pound accuracy up to 30 pounds.) Stem counts were also recorded for each plot by species.

A sub-sample of aspen was collected randomly within each fifth and tenth plot for the purpose of calculating the dry weights of the twigs and leaves, bark, and the woody stem. After measuring the total weight of the aspen sub-sample in the field, the leaves and twigs were removed from the stem and the stem reweighed alone. The weight of the leaves and twigs was calculated from the difference between the two weighings. In order to reduce moisture loss between the field and the laboratory, the twigs and leaves were stored in plastic bags as were the stems after they had been cut to convenient lengths. In the laboratory the bark was removed from the stem, and the percent moisture content on a dry-weight basis was determined separately for the sucker components.

Results and Discussion

The data calculated from the field and laboratory measurements are summarized in Tables 1, 2, and 3.

Table 1. Percent moisture and dry weight percentages of aspen sucker parts and weight of brush per acre in aspen sucker stands of two through twelve years of age.

AGE (yrs)	AREA No.	AVERAGE PERCENT MOISTURE*			PERCENT DRY WT. OF TREE			BRUSH/AC.	
		T & L**	Stem***	Bark	T & L**	Stem***	Bark	No.	Wt.(lbs.)
2	4	226	110	118	37	39	23	2500	90
4	8	184	135	136	28	46	26	1200	270
4	3	200	124	123	33	42	25	9000	420
6	6	202	102	124	31	48	22	4200	260
6	9	170	123	122	24	51	25	6200	530
6	5	168	110	119	32	47	21	200	30
8	10	160	108	143	28	56	17	7500	230
8	7	190	105	120	21	57	22	8800	450
10	11	168	110	142	25	58	16	19400	2020
11	12	93	110	133	32	53	15	13300	2210
12	13	142	100	141	22	61	17	17200	2220

*Percent moisture is on a dry-weight basis
**T & L = twigs and leaves
***Stem = woody stem

Average site index = 75

Site index range = 70-80

Table 2. Green and dry weight of aspen sucker parts and number of stems per acre in aspen sucker stands of two through twelve years of age.

AGE (yrs)	AREA No.	STEMS/AC. No.	GREEN WT./AC.(lbs.) Stem+Bark	GREEN WT./AC.(lbs.) Total*	DRY WT./AC. (lbs.) T & L**	DRY WT./AC. (lbs.) Stem***	DRY WT./AC. (lbs.) Bark	DRY WT./AC. (lbs.) Total
2	4	42200	1850	3520	510	540	320	1370
4	8	37500	8300	12320	1400	2280	1300	4980
4	3	22700	9450	15390	2080	2670	1580	6330
6	6	15900	15000	24380	3100	4900	2200	10200
6	9	26300	16100	22270	2290	4910	2390	9590
6	5	11100	11000	17730	2450	3560	1610	7620
8	10	16300	31000	45200	5550	10850	3370	19770
8	7	10700	27200	37000	3350	9150	3530	16030
10	11	6700	44200	63500	6800	15760	4360	26920
11	12	10600	50700	72700	11200	18430	5250	34880
12	13	5700	62300	82300	8450	23410	6530	38390

* Total consists of stem, bark, twigs and leaves Average site index = 75
** T & L = twigs and leaves
*** Stem = woody stem Site index range = 70-80

Table 3. Size of aspen stems sampled in each age class by diameter, height and weight.

AGE (yrs)	AREA No.	DIAMETER* (in.) Avg.	DIAMETER* (in.) Range	HEIGHT (ft.) Avg.	HEIGHT (ft.) Range	GREEN WT. (lbs.) Avg.	GREEN WT. (lbs.) Range
2	4	0.2*	0.1-0.4	3	1-5	0.1	-------
4	3	0.6	0.3-1.2	6	3-11	0.6	-------
4	8	0.6	0.3-0.9	6	3-8	0.5	-------
6	6	0.8	0.4-1.1	9	4-14	1.2	0.1-3.3
6	5	0.8	0.3-1.4	8	3-14	1.8	0.1-6.3
6	9	0.7	0.3-1.1	9	3-14	1.0	0.1-3.4
8	7	1.2	0.7-1.7	12	6-16	3.8	1.0-8.4
8	10	1.0	0.7-1.4	11	7-14	2.7	0.3-6.3
10	11	1.6	1.0-2.6	16	12-20	8.8	2.2-22.4
11	12	1.4	0.9-2.1	16	11-25	6.3	0.9-16.0
12	13	2.1	1.2-3.1	24	14-33	14.4	3.2-46.5

*Diameters in Area #4 measured at 12" above ground; all others at ground level.

The weight yields of the dry woody portion of the aspen sucker stems for ages two through twelve are indicated by the curve in Figure 1. In order to estimate the relationship between the dry woody stem weight of aspen and age on the 110 plots sampled for this study, the following model was used:

$$\text{Log (dry weight)} = \text{Log (a)} + \text{Log (age)}$$

The coefficient of determination (R^2) adjusted for degrees of freedom was equal to 0.87.

The present generally accepted rotation age for aspen on a single clear-cut system of harvesting is about 40 years. The curve in Figure 2 represents the total dry woody stem yield that might be harvested from aspen suckers at ages two through twelve over

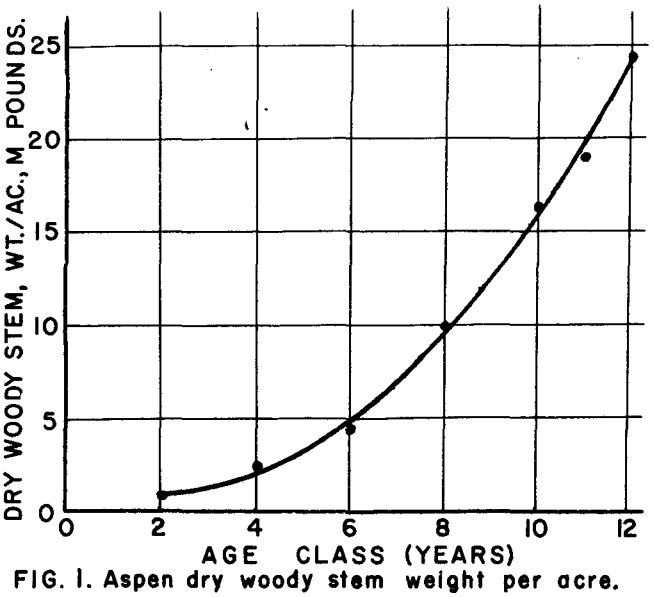

FIG. 1. Aspen dry woody stem weight per acre.

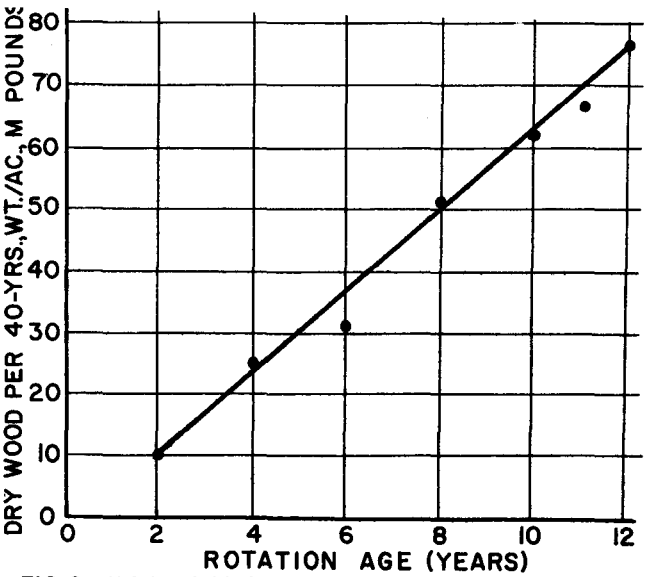

FIG. 2. Weight yield dry wood per acre over 40-yr. period.

a forty-year period. This assumes equal yields for each of the harvest cuts that would occur over the forty years for the particular rotation age selected. For instance, if the suckers were to be harvested on a ten-year rotation, an area would yield four equal harvest cuts during the forty-year period. This also assumes that each tenth-year harvest would yield the amount of wood fiber determined from the field samples used for this study.

The yield for the forty-year period by age classes (Figure 2) increased with age in an approximately straight line. The maximum forty-year yield for aspen suckers had not been reached at a rotation age of twelve years, which was the maximum age measured for this study.

For the area studied 35 cords per acre is considered a good yield from a normal single clear-cut harvest of a forty-year old stand of aspen. Using the generally accepted conversion factor for aspen of 2,000 pounds of dry wood fiber in a cord of wood, the total yield for twelve-year rotations over a forty-year period would be about 39 cords per acre. It should be recognized that these yields for both the sucker and the normal single rotations do not include the wood fiber content of the tops, twigs, and branches. The data indicates that the forty-year wood yield from twelve-year rotations of aspen suckers is four cords greater than that from a single forty-year rotation. Just how sound this cord yield comparison is depends on how good a measure the 2,000 pound conversion figure is of the dry wood content of a cord of aspen wood.

This study indicates that the potential wood yield from heavily stocked stands of aspen suckers on good sites for rotations as short as twelve years accumulated over a forty-year period is at least as good as the wood yield from a single clear-cut harvest of aspen at forty years of age on an equivalent site. This short-cycle concept for the production of wood fiber from aspen (and other species) opens new possibilities for reducing the cost of as well as meeting of present and predicted increased future demands for wood fiber. But there is much more that needs to be learned about aspen suckers. It is not known if an area will continue to produce fiber yields from suckers with repeated cutting. Fertilization, irrigation, and other forms of site preparation may be necessary to achieve continued high yields. Also, high among the problems which would have to be resolved are the economic and technical aspects of harvesting and making wood pulp from small sucker stems.

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