COMPARATIVE TIMBER-YIELDS

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The author has made an interesting comparison of the rates of growth of a number of important American timber trees. The study indicates the richness of our native tree flora in fast-growing conifers, and that these are not confined to any one region or type of climate.

During the last decade the U. S. Forest Service and several of the forest schools have completed rather comprehensive studies of the growth and yield of a number of commercially important native conifers. As the majority of these studies show the volumes obtainable in fully-stocked stands to very similar standards of utilization, they furnish an excellent opportunity to compare the relative rates of growth on a number of important tree species. This is always an interesting subject to many foresters, as indicated by the Woodward-Forbes controversy[1] of some months ago, and consequently the writer has felt it worth while to bring some of the newer data together for purposes of comparison.

In this comparison only normal yield tables, showing the volumes obtainable in fully-stocked stands, have been used throughout. In each instance the cubic-foot volumes include the entire peeled contents of the tree; i. e., stump, stem and tip, but not bark or branches. The board-foot values are, with two exceptions, in the International ⅛-inch rule and show the contents of all trees 7 or 8 inches and up scaled to a 5-inch top diameter. Both exceptions are to reasonably comparable standards. In each case an attempt has been made to choose values for average site, but, as this is not always readily determined from tabular descriptions, minor injustices may have been done individual species. Within these limitations Table 1 gives a fair comparison of the relative rates of growth and yield for a round dozen commercially-important conifers.

Even a casual survey of the timber-yields shown in Table 1 reveals two very interesting features: (1) The richness of our native flora in fast-growing conifers, even in a list by no means complete, for of the species for which data are given six produce gross yields in excess of 20,000 board feet at 40 years and six over 50,000 board feet per acre at 100 years. (2) The fact that valuable fast-growing species are not confined to any one region or type of climate. For example, both the South and the Pacific Coast, with a wide diversity of climate and soils, are represented among the leaders, and white pine (including both *P. strobus* and *P. monticola*) more than holds its own in three widely separated forest regions.

Total timber-yields, the factor emphasized in Table 1, is, however, a rather unsatisfactory measure with which to compare rates of growth, for the numerical rank of species derived in this way varies markedly with the age chosen, and no one age is equally fair to all species alike. For this reason perhaps the best single measure of the wood-producing capacity of a species is maximum average annual growth, a value independent of all elements of personal choice. Table 2 shows in descending order the relative rank of the conifers listed on this basis.

[1]Journal of Forestry, Vol. 26, pp. 5-11 and 500-506. 1928.

In this table a species growing in two distinct forest regions is given separately by regions.

Under this rating, Redwood (*Sequoia sempervirens*) is preeminently the fastest growing native conifer, far surpassing its nearest rival, Douglas fir (*Pseudotsuga taxifolia*), a species that in itself maintains an extraordinarily high rate of growth. These two species head the list on the basis of both cubic-foot and board-foot production, and it is doubtful if any native conifer not yet accounted for will be able to displace them. Slash pine (*Pinus caribea*) and white pine (*Pinus strobus* in New England take the fourth and fifth places in cubic volume production, while white pine in New England and western white pine (*Pinus monticola*) in the Northern Rocky Mountains capture, respectively, similar places from the standpoint of board-foot yields. Four regions and as many types of climate are represented among the first five species listed and five widely diverse regions among the same number of tail-enders. The latter group includes, on the basis of board-foot yields, shortleaf pine (*Pinus echinata*) from the South, ponderosa pine (*Pinus ponderosa*) from both the Northern Rocky Mountain and California regions, red spruce (*Picea rubra*) from New England, and jack pine (*Pinus banksiana*) from the Lake States. The inclusion of other species not listed would, of course, undoubtedly change the general position of some of the species just named.

Relative wood-producing power alone, as expressed in maximum average annual growth, is not, however, a complete expression of the value of tree species as timber producers, as the length of time needed to reach merchantable size is also an important factor. Some species, such as the southern pines, tend to attain merchantable size in short order, whereas such species as the western yellow pine and western white pine tend to reach merchantable size rather slowly. The larger yields finally obtained in some cases by

TABLE 1

RATE OF GROWTH AND YIELD OF TWELVE COMMERCIALLY-IMPORTANT CONIFERS

Region	Tree species	Average site or site index	Maximum average annual growth		Theoretical rotation age[1] for cubic feet · board feet		Total yield										Reference
							At rotation age		At 40 years		At 60 years		At 80 years		At 100 years		
			Cubic feet	Board feet	Years		Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	Cubic feet	Board feet	
South	Loblolly Pine	90	131	750	35	50	4600	37500	5200	28500	6700	43000	7400	50000	......	......	U. S. D. A. Misc. Pub. 50
South	Longleaf Pine	80	101	573	50	75	5050	43000	4000	17000	5950	33500	7350	45500	8300	54000	U. S. D. A. Misc. Pub. 50
South	Shortleaf Pine	70	110	558	40	60	4380	33500	4380	17800	6000	33500	6930	42000	7520	47800	U. S. D. A. Misc. Pub. 50
South	Slash Pine	80	143	567	15	45	2150	25500	4600	22000	5750	32000	......	......	......	......	U. S. D. A. Misc. Pub. 50
New England	White Pine	I	136	828	45	60	6120	49700	5390	27800	7980	49700	......	......	......	......	Harvard Forest Bul. 7
New England	Red Spruce	50	80	310	65	80	5200	24800	1860	1200	4780	13300	6060	24800	6520	28800	U. S. D. A. Tech. Bul. 142
Lake States	White Pine	60	121	739	70	90	8470	66500	4200	10500	7200	36500	9500	59000	11100	72000	U. of Wis. Research Bul. 98
Lake States	Jack Pine	Medium	79	214	35	70	2750	15000	3100	3500	3750	11500	4100	16500	......	......	U. of Wis. Research Bul. 90
N. Rocky Mts.	Ponderosa Pine	Medium	59	298	40	110	2350	32740	2350	5400	3300	14610	3960	22960	4550	29760	U. of Ida., For. Exp. Sta. Bul. 1
N. Rocky Mts.	W. White Pine	60	118	760	100	120	11850	91150	2650	4450	5880	23250	9000	48750	11850	73500	Mimeograph Report, U. S. F. S.
Pacific N. W.	Douglas Fir	160	170	1190	70	80	11900	95200	6160	30500	10200	66200	13360	95200	15600	115100	U. S. D. A. Tech. Bul. 201
California	Douglas Fir	100	180	962	50	70	9000	67300	7200	31700	10500	56900	12750	76200	14300	91000	U. of California, Coll. of Agri., Bul. 491
California	White Fir	60	128	750	70	90	9000	67500	......	......	7400	36500	10000	60000	11500	74000	U. of California, Coll. of Agri., Bul. 407
California	Ponderosa Pine	III	66	350	120	130	7970	45000	......	......	......	......	2600	9300	5400	25700	Jour. Agr. Research 31: 1121-1135
California	Redwood	II	310	1930	45	55	13900	110000	12400	68000	17100	115000		......		......	U. of California, Coll. of Agri., Bul. 361

[1]Year of culmination of average annual growth

the slower-growing species probably do not completely offset the longer time necessary to produce timber large enough to log. Accordingly, some weight should be given to this time factor. Table 3 shows in descending order the relative standing of the conifers listed based on the time needed to produce in fully-stocked stands an average tree 8 inches in diameter, breast high. This standard is arbitrarily chosen chiefly on the grounds that it seems reasonably fair to all species and that in stands with an average diameter of 8 inches about one-half the trees would be above this limit and hence merchantable under close standards of utilization.

Redwood again heads the list, proving itself the species par excellence, with some of the rapid-growing southern pines and Douglas fir making up the remainder of the five leading species. Loblolly (*Pinus taeda*) and slash pine are particularly fast in reaching merchantable size, with longleaf (*Pinus palustris*) close behind and white pine in New England a good rival. It is true that there are certain inconsistencies in the ratings shown in Table 3. White fir (*Abies concolor*), for example, is favored by the fact that only trees 4 inches and up, and not all trees, were used in computing average diameter; while western white pine is handicapped by the mixed nature of the stands in which it grows where many tolerant trees if small size lower the average diameter of the stand without appreciably affecting volume. But on the whole the comparison seems fairly reasonable.

Any ranking on rate of growth, therefore, should probably give due weight to both wood-producing capacity and the time needed to reach merchantable size.[2]

TABLE 2

RELATIVE WOOD-PRODUCING CAPACITY OF TWELVE COMMERCIALLY-IMPORTANT CONIFERS IN TERMS OF MAXIMUM AVERAGE ANNUAL GROWTH

Numerical rating	Maximum average annual growth Cubic feet	Numerical rating	Maximum average annual growth Board feet
1. Redwood	310	1. Redwood	1930
2. Douglas fir (Calif.)	180	2. Douglas fir (N. W.)	1190
3. Douglas fir (N. W.)	170	3. Douglas fir (Calif.)	962
4. Slash pine	143	4. White pine (N. E.)	828
5. White pine (N. E.)	136	5. Western white pine (N. Rocky)	760
6. Loblolly pine	131	6. Loblolly pine	750
7. White fir	128	7. White fir	750
8. White pine (Lake States)	121	8. White pine (Lake States)	739
9. Western white pine (N. Rocky)	118	9. Longleaf pine	573
10. Shortleaf pine	110	10. Slash pine	567
11. Longleaf pine	101	11. Shortleaf pine	558
12. Red spruce	80	12. Ponderosa pine (Calif.)	350
13. Jack pine	79	13. Red spruce	310
14. Ponderosa pine (Calif.)	66	14. Ponderosa pine (N. Rocky)	298
15. Ponderosa pine (N. Rocky)	59	15. Jack pine	214

[2]Had the data been available for each species, an even more interesting and valuable comparison would have been on the basis of grades produced, and, consequently, the dollar value of the product. It is quite probable that, on such a basis, the relative order of the species in the author's tables would be materially altered. *Ed.*

TABLE 3

RELATIVE RATE OF GROWTH BASED ON TIME NEEDED FOR AVERAGE TREE TO REACH 8 INCHES, BREAST HIGH

Numerical rating		Number years needed
1.	Redwood	22
2.	Loblolly pine	29
3.	Douglas fir (Calif.)	33
4.	Slash pine	36
5.	Douglas fir (N. W.)	37
6.	Longleaf pine	44
7.	White pine (N. E.)	45
8.	Shortleaf pine	48
9.	White fir	50
10.	White pine (Lake States)	53
11.	Ponderosa pine (N. Rocky)	55
12.	Ponderosa pine (Calif.)	65
13.	Jack pine	70
14.	Western white pine (N. Rocky)	78
15.	Red spruce	87

On this basis, redwood is undoubtedly the fastest-growing conifer, with Douglas fir and loblolly and slash pines close be hind. These species, together with the northern and western white pines and white fir, form an exceptionally fast-growing group of conifers. It is interesting to note, as previously stated, that this group contains conifer types scattered from the Pacific Coast to New England and from the Lake States to the Gulf of Mexico.

How important are the mineral elements of the soil in regulating tree health and growth? Professor Pierre Delbert (Paris Letter, *Journal of the American Medical Assoc.*, Oct. 11, 1930, and Feb. 7, 1931) reports that in France, fertilizers are employed to restore phosphorus, calcium and potassium to the soil deprived of these substances by continued production of cultivated crops, but that this is seldom done for magnesium. He believes that the high incidence of cancer in parts of France is due to a deficiency of magnesium in the diet. Of 24 rural communes having the most cancer, 23 have no magnesium; of 25 districts with a very low cancer incidence, 24 have a soil high in magnesium content. Soil scientists have presented much evidence for and against the theory of a calcium-magnesium balance governing plant growth. The fact that magnesium is an essential constituent of chlorophyll should lead forest investigators to study the part played by magnesium in tree growth and health.

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