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Costs and Returns in Christmas Tree Plantations



Costs and Returns in Christmas Tree Plantations¹

By V. J. RUDOLPH²

INTRODUCTION

IN CHOOSING A SPECIES to be planted for Christmas trees, the grower considers growth characteristics, suitability for available soils, response to cultural treatments and the current and expected market preferences and prices. From among the several species that are generally considered suitable for Christmas trees, he may decide to plant a rapidly growing species such as Scotch pine, which may sell for about \$2 per tree on the stump in about 7 years, or a slower growing species, such as Douglas fir, which may sell for about \$4 per tree on the stump, but takes 12 to 16 years to grow. Since his objective is to make a profit, he must consider the costs and returns associated with Christmas tree production from each suitable species. What are the economic aspects of growing various species for Christmas trees which require widely different growth periods, different levels of costs and sell for greatly differing prices?

PROCEDURE

In this report, costs and returns are analyzed for Scotch pine, white spruce, Douglas fir and blue spruce — four species for which production periods, costs and selling prices span a considerable range. Basic data on the rotation, planting stock, spacing, survival, weed control, fertilization, shearing, insect control and stumpage prices are not specifically for any one Christmas tree growing enterprise, but are taken from numerous sources to reflect the most reliable current

information and general practices in the Michigan Christmas tree industry.

Obviously, there are growers whose tree production practices differ from those outlined in this analysis, whose costs are either higher or lower and who sell their trees at prices either higher or lower than those used here. If an individual grower's data differ considerably from those used here, he can insert his own specific information into the procedure to analyze his own current operation. Proposed Christmas tree growing ventures may be analyzed in the same way.

To make the results applicable to any size operation, all data are for 1 acre of land. Because marketing procedures are variable — some growers sell their trees retail, others sell them cut and piled along the roadside, etc. — this analysis assumes stumpage sale of 7 foot trees.

RESULTS

In the following tabulations, the basis for each step in the production process is given. Also, each cost incurred or return received is listed, and capitalized at 6 percent compound interest to the end of the crop period. The interest factors used are available in any compound interest table.

TABLE 1 — Basic data for four Christmas tree plantation species

Item	Scotch pine	White spruce	Douglas fir	Blue spruce
Rotation, incl. 2 yrs. fallow time	9 years	12 years	18 years	22 years
Spacing	6 x 6 feet (1,210 trees per acre)	5 x 5 feet (1,740 trees per acre)	5 x 5 feet (1,740 trees per acre)	5 x 5 feet (1,740 trees per acre)
Area in roads and lanes	10%	10%	10%	10%
Net trees/Acre	90% of 1,210 = 1,090 trees	90% of 1,740 = 1,570 trees	90% of 1,740 = 1,570 trees	90% of 1,740 = 1,570 trees
Survival	85% of 1,090 = 926 trees	85% of 1,570 = 1,334 trees	85% of 1,570 = 1,334 trees	85% of 1,570 = 1,334 trees
Planting stock	2-0	2-2	2-2	2-2
Fertilizing and shearing labor	\$2/hour	\$2/hour	\$2/hour	\$2/hour
Interest rate	6%	6%	6%	6%
Stumpage price per 7 ft. tree	\$2.10	\$2.00	\$4.00	\$3.50
Surviving trees sold	80% of 926 = 741 trees	80% of 1,334 = 1,068 trees	80% of 1,334 = 1,068 trees	80% of 1,334 = 1,068 trees

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TABLE 2—Costs and returns for Scotch pine Christmas trees on a 9 year production period

Item	Basis	Interest factor	Capitalized to the end of 9 yrs.
Annual overhead & taxes	\$25 each year	11.4913	\$ 287.28
Interest on \$60 land value	Annual	.6895	41.37
Cost of stock	\$22.50 per M x 1,090 = \$24.52	1.6895	41.43
Stock shipping cost	\$3.00	1.6895	5.07
Planting cost	\$14 per M x 1,090 = \$15.26	1.6895	25.78
Weed control—planting	\$10	1.6895	16.90
Later weed control	2nd year, \$10	1.5036	15.04
Mowing between rows	1st year, \$6	1.5938	9.56
Fertilizer materials & labor	None		
Spraying—insect control	Annually, \$10	9.8975	98.98
Shearing	3rd yr., 1¢/tree x 926 = \$ 9.26 4th yr., 1¢/tree x 926 = \$ 9.26 5th yr., 2¢/tree x 926 = \$18.52 6th yr., 2¢/tree x 926 = \$18.52 7th yr., 3¢/tree x 679 = \$20.37	1.4185 1.3382 1.2625 1.1910 1.1236	13.14 12.39 23.38 22.06 22.89
Cleanup for next crop	8th yr., \$12	1.0600	12.72
Trees sold & returns received	6th yr., 1/3 = 247 x \$2.10 = \$ 518.70 7th yr., 2/3 = 494 x \$2.10 = \$1,037.40	1.1910 1.1236	617.77 1,165.62
Total accumulated returns			1,783.39
Total accumulated costs			647.99
Net income for one crop	In 9 years		1,135.40

TABLE 3—Costs and returns for white spruce Christmas trees on a 12 year production period

Item	Basis	Interest factor	Capitalized to the end of 12 yrs.
Annual overhead & taxes	\$25 each year	16.8699	\$ 421.75
Interest on \$60 land value	Annual	1.0122	60.73
Cost of stock	\$50 per M x 1,570 = \$78.50	2.0122	157.96
Stock shipping cost	\$5	2.0122	10.06
Planting cost	\$14 per M x 1,570 = \$21.98	2.0122	44.23
Weed control—planting	\$12	2.0122	24.15
Later weed control	2nd year, \$10 4th year, \$10	1.7906 1.5938	17.91 15.94
Mowing between rows	1st year, \$7 2nd year, \$7 4th year, \$7	1.8983 1.7906 1.5938	13.29 12.53 11.16
Fertilizer materials & labor (4 oz./tree @ 4¢/lb.)	2nd yr., 150 trees/hr. = \$31.16 4th yr., 100 trees/hr. = \$39.96	1.7906 1.5938	55.80 63.69
Spraying—insect control	Annually \$6	14.9716	89.83
Shearing	4th yr., 1¢/tree x 1,334 = \$13.34 6th yr., 2¢/tree x 1,334 = \$26.68 8th yr., 2¢/tree x 978 = \$19.56	1.5938 1.4185 1.2625	21.26 37.85 24.69
Cleanup for next crop	11th yr., \$12	1.0600	12.72
Trees sold & returns received	8th yr., 1/3 = 356 x \$2 = \$712.00 9th yr., 1/3 = 356 x \$2 = \$712.00 10th yr., 1/3 = 356 x \$2 = \$712.00	1.2625 1.1910 1.1236	898.90 847.99 800.00
Total accumulated returns			2,546.89
Total accumulated costs			1,095.55
Net income for one crop	In 12 years		\$1,451.34

TABLE 4—Costs and returns for Douglas fir Christmas trees on an 18 year production period

Item	Basis	Interest factor	Capitalized to the end of 18 yrs.
Annual overhead & taxes	\$25 each year	30.9057	\$ 772.64
Interest on \$60 land value	Annual	1.8543	111.26
Cost of stock	\$90 per M x 1,570 = \$141.30	2.8543	403.31
Stock shipping cost	\$5	2.8543	14.27
Planting cost	\$14 per M x 1,570 = \$21.98	2.8543	62.74
Weed control—planting	\$12	2.8543	34.25
Later weed control	2nd year, \$10 5th year, \$10	2.5404 2.1329	25.40 21.33
Mowing between rows	1st year, \$7 2nd year, \$7 4th year, \$7	2.6928 2.5404 2.2609	18.85 17.78 15.83
Fertilizer materials & labor (4 oz./tree @ 4¢/lb.)	6th yr., 100 trees/hr. = \$39.96 10th yr., 90 trees/hr. = \$42.96	2.0122 1.5938	80.41 68.47
Spraying—insect control	Annually \$6	28.2129	169.28
Shearing	5th yr., 1¢/tree x 1,334 = \$13.34 7th yr., 2¢/tree x 1,334 = \$26.68 10th yr., 2¢/tree x 1,334 = \$26.68	2.1329 1.8983 1.5938	28.45 50.65 42.52
Cleanup for next crop	17th yr., \$12	1.0600	12.72
Trees sold & returns received	12th yr., 1/6 = 178 x \$4 = \$ 712.00 13th yr., 1/5 = 214 x \$4 = \$ 856.00 14th yr., 1/4 = 267 x \$4 = \$1,068.00 15th yr., 1/4 = 267 x \$4 = \$1,068.00 16th yr., 1/7 = 142 x \$4 = \$ 568.00	1.4185 1.3382 1.2625 1.1910 1.1236	1,009.97 1,145.50 1,348.35 1,271.99 638.00
Total accumulated returns			5,414.01
Total accumulated costs			1,953.16
Net income for one crop	In 18 years		3,460.85

TABLE 5—Costs and returns for blue spruce Christmas trees on a 22 year production period

Item	Basis	Interest factor	Capitalized to the end of 22 yrs.
Annual overhead & taxes	\$25 each year	43.3923	\$1,084.81
Interest on \$60 land value	Annual	2.6035	156.21
Cost of stock	\$70 per M x 1,570 = \$109.90	3.6035	396.02
Stock shipping cost	\$5	3.6035	18.02
Planting cost	\$14 per M x 1,570 = \$21.98	3.6035	79.20
Weed control—planting	\$12	3.6035	43.24
Later weed control	2nd year, \$10 6th year, \$10	3.2071 2.5404	32.07 25.40
Mowing between rows	1st year, \$7 2nd year, \$7 5th year, \$7	3.3996 3.2071 2.6928	23.80 22.45 18.85
Fertilizer materials & labor (4 oz./tree @ 4¢/lb.)	5th yr., 150 trees/hr. = \$31.16 10th yr., 100 trees/hr. = \$39.96 14th yr., 90 trees/hr. = \$42.96	2.6928 2.0122 1.5938	83.91 80.41 68.47
Spraying—insect control	Annually \$6	39.9927	239.96
Shearing	5th yr., 1¢/tree x 1,334 = \$13.34 7th yr., 2¢/tree x 1,334 = \$26.68 10th yr., 2¢/tree x 1,334 = \$26.68 12th yr., 2¢/tree x 1,334 = \$26.68	2.6928 2.3996 2.0122 1.7906	35.92 63.94 53.69 47.77

TABLE 5—Continued

Item	21st year, \$12	1.0600	12.72
Trees sold & returns received	15th yr., 1/7 = 152 x \$3.50 = \$532.00 16th yr., 1/6 = 178 x \$3.50 = \$623.00 17th yr., 1/5 = 214 x \$3.50 = \$749.00 18th yr., 1/5 = 214 x \$3.50 = \$749.00 19th yr., 1/6 = 178 x \$3.50 = \$623.00 20th yr., 1/8 = 132 x \$3.50 = \$462.00	1.5036 1.4185 1.3382 1.2625 1.1910 1.1236	709.92 883.73 1,002.91 945.61 741.99 519.10
Total accumulated returns			4,892.06
Total accumulated costs			2,586.86
Net income for one crop	In 22 years		2,305.80

TABLE 6—Summary of costs, returns, and net income at the end of the crop period for four Christmas tree species (summary Tables 2, 3, 4, 5)

Species	Total crop period, years	Per acre			Per tree		
		Total accum. costs	Total accum. returns	Net inc. for period	Accum. costs	Accum. returns	Net inc. for period
Scotch pine	9	\$ 647.99	\$1,783.39	\$1,135.40	\$0.87	\$2.41	\$1.53
White spruce	12	1,095.55	2,546.89	1,451.34	1.03	2.38	1.36
Douglas fir	18	1,953.16	5,414.01	3,460.85	1.83	5.07	3.24
Blue spruce	22	2,586.86	4,892.06	2,305.80	2.42	4.58	2.16

AVERAGE ANNUAL INCOME

These results show that all four species are expected to return a net income or profit at the end of the crop period, over and above the 6 percent compound interest on all money invested in the costs. The net incomes at the end of each crop period listed in Table 6 cannot be compared directly with each other to determine which species is the most profitable to grow because differing amounts of investment and differing time periods are required to obtain them.

If these incomes are put on an average annual basis they can then be compared to show which species will yield the highest average income per year. To do this, the average annual net income for each species is computed. For Scotch pine, for example, it is necessary to know what amount of net annual income received at the end of each year will accumulate to \$1,135.40 in 9 years if invested at 6 percent compound interest. The following formula is used:

$$V_n = \frac{a[(1 + p)^n - 1]}{p}$$

in which V_n = the accumulated value in 9 years, = \$1,135.40;

n = the number of annual incomes, = 9;

p = the interest rate, = 6 percent;

a = the unknown annual income.

$$\$1,135.40 = \frac{a[(1 + .06)^9 - 1]}{.06}$$

$$\$1,135.40 = a(11.4913)$$

$$a = \frac{\$1,135.40}{11.4913}$$

$$a = \$98.80.$$

The same computations were made for white spruce, Douglas fir and blue spruce with the results summarized in Table 7.

TABLE 7—Average net income per year for four Christmas tree species

Species	Total crop period, years	Net income at end of crop period	Average net income per year
Scotch pine	9	\$1,135.40	\$ 98.80
White spruce	12	1,451.34	86.03
Douglas fir	18	3,460.85	111.98
Blue spruce	22	2,305.80	53.14

The values in Table 7 show that the income ranking for the four species is Douglas fir, Scotch pine, white spruce and blue spruce, in that order. This ranking is valid to compare the average net incomes per year, but does not tell us the true profitability of each species in terms of the *actual interest rate earned* on the investment required over the time period needed to grow each species.

INTERNAL RATE EARNED

In all computations to this point, 6 percent compound interest has been used, and the results show that net income (or profit over and above 6 percent) can be expected in varying amounts for each species, or that the interest rate earned is greater than 6 percent. The *actual* or *internal rate earned* on the required investment for each period for each species is computed by the method of *successive approximation*. In this method, a higher and higher interest rate is used in accumulating the costs and returns for each species, until the accumulated costs exactly equal accumulated returns. The interest rate at which costs balance returns defines the actual internal rate *earned* by the investment required for each species in the time period needed to produce the crop. These repetitive computations are so lengthy that they are best made on an electronic computer. However, to illustrate the procedure, the balancing computations for Scotch pine, which occurred at a 33 percent interest rate, are presented in Table 8. The small difference between the total accumulated returns and total accumulated costs is not significant.

The same computations were made for the other

TABLE 8—The final computation of the internal rate earned for Scotch pine, by the method of successive approximation (33 percent rate)

Item	Basis	Interest factor	Capitalized to the end of 9 yrs.
Annual overhead & taxes	\$25 each year	39.4593	\$ 986.48
Interest on \$60 land value	Annual	13.0216	721.30
Cost of stock	\$22.50 per M x 1,090 = \$24.52	13.0216	319.29
Stock shipping cost	\$3.00	13.0216	39.06
Planting cost	\$14 per M x 1,090 = \$15.26	13.0216	198.71
Weed control—planting	\$10	13.0216	130.22
Later weed control	2nd year, \$10	7.3614	73.61
Mowing between rows	1st year, \$6	9.7907	58.74
Fertilizer materials & labor	None		
Spraying—insect control	Annually, \$10	39.4593	394.59
Shearing			
	3rd yr., 1¢/tree x 926 = \$ 9.26	5.5349	51.25
	4th yr., 1¢/tree x 926 = \$ 9.26	4.1616	38.54
	5th yr., 2¢/tree x 926 = \$18.52	3.1290	57.95
	6th yr., 2¢/tree x 926 = \$18.52	2.3526	43.57
	7th yr., 3¢/tree x 679 = \$20.37	1.7689	36.03
	8th yr., \$12	1.3300	15.96
Cleanup for next crop			
	6th yr., 1/3 = 247 x \$2.10 = \$ 518.70	2.3526	1,220.29
	7th yr., 2/3 = 494 x \$2.10 = \$1,037.40	1.7689	1,835.06
Total accumulated returns			3,055.35
Total accumulated costs			3,059.25

three species, and the actual interest rate earned by each species is as follows:

- Scotch pine, 33.0 percent;
- White spruce, 21.0 percent;
- Douglas fir, 17.0 percent;
- Blue spruce, 11.6 percent.

This ranking is different from that shown by the average net income per year in Table 7, where Douglas fir shows the highest annual income. The rate earned by Douglas fir is lower than that earned by Scotch pine, for example, even though the average net income per year is greater for Douglas fir, because a greater investment is required for Douglas fir, and it must be carried for a longer period of time. A greater return on the investment is obtained from that species which can be grown on the shorter rotations and with lower investments, even though total net income per year is higher for a species with a longer rotation and larger required investments.

SUMMARY

For the cultural practices, costs and prices used in this analysis, based on both the amount of investment and time needed to grow a crop of each species, they rank as follows: Scotch pine, white spruce, Douglas fir, and blue spruce. These results can be used as aids in the selection of a species for a proposed Christmas tree plantation endeavor. However, market demands, soil conditions, the grower's personal species preferences, amount of available capital for investment, the need for early or frequent incomes and other factors must also be considered in species selection.

These procedures can also be used to analyze the profitability of a current Christmas tree growing operation. Growers whose practices, costs, prices and rotations differ appreciably from those used here should insert their own actual data into this format to compute the rate of return they can expect from their particular enterprise.