PROPOSED PLANTING STOCK GRADES FOR HARDWOODS PLANTED IN ONTARIO

by

F. W. von Aithen

FOREST RESEARCH LABORATORY

ONTARIO REGION

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Director, Ontario Region,
Canada Department of Fisheries
and Forestry,
Box 490,
Sault Ste. Marie, Ontario.

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THE PROBLEM

The importance of planting stock quality for the successful establishment of forest plantations is well recognized. However, little information is currently available on the suitability of hardwood seedlings produced by the Ontario Department of Lands and Forests for afforestation in southern Ontario. Although culling rules have been applied since 1960 to coniferous planting stock, no grading rules are currently applied to hardwood seedlings.

This report presents the findings of a study that was initiated in 1963 and that tested the suitability for afforestation of the following hardwood species which are most commonly planted in Ontario: silver maple (*Acer saccharinum* L.), basswood (*Tilia americana* L.), red oak (*Quercus rubra* L.), and white ash (*Fraxinus americana* L.). Grade classes are proposed and the adoption of grading rules is recommended.

METHOD

The study was carried out on several acres of fully cultivated agricultural land in Grey County, Ontario. The topography of the planting site was slightly undulating with 5 to 15 per cent slopes. The soil was a deep, well-drained, rather stoney Pike Lake Loam (Ontario 1954).

Three size classes of planting stock of silver maple, basswood, and red oak, in each of two age classes, and white ash, in one age class, were planted in a factorial, randomized block arrangement which was replicated three times. The total study was further replicated by planting in three successive years. Each block was subdivided into 21 plots, each containing 25 spade-planted trees of one species, age, and size class. Spacing between trees was 4 x 2 feet. Complete weed control was maintained for the first 3 years after planting by rotatilling and manual hoeing. In the spring of the fourth year, 5 pounds of simazine (active chemical) were applied with a backpack power sprayer. Each autumn all hardwood seedlings were sprayed with the rabbit repellent Arasan 42S. Where deemed necessary, trees were pruned in early spring to rectify forking or other defects that could have influenced the evaluation of height growth.

All seedlings were obtained from the Ontario Provincial Nurseries. Except for the 1 + 0 seedlings, all trees tested represented the normal planting stock used in Ontario. Upon receipt of the planting stock, all trees were graded into three size classes on the basis of root collar diameter and stem length. Damaged, abnormal, or defective trees were discarded. Since no grading standards are applied to hardwood planting stock shipped from the nurseries, the size limits for the various classes, which were set according to the available stock, varied somewhat from year to year. The replication of the experiment during three successive years was confounded by

the unavailability of certain age classes of planting stock. White ash, for example, was only available as 2 + 0 stock in 1963, as 3 + 0 stock in 1964 and as 1 + 0 stock in 1965. Basswood was also only available as 1 + 0 stock in 1965.

Survival and height growth of all trees were recorded each spring and autumn. Upon completion of the study all data were analysed by analysis of variance.

RESULTS

Replication of the study in three successive years resulted in the collection of three sets of data which, although very similar, could not be analysed as true replications because weather conditions varied as did the size and quality of the planting stock. The weather data of Table 1 show that the precipitation during the growing seasons of 1963 and 1966 was below average whereas 1967 was an exceptionally wet year. June frosts occurred in 1964 and 1966 and caused some loss of white ash and basswood foliage.

Mortality of all species was restricted to the first year after planting with 80 per cent of the losses occurring within the first 2 months.

The application of 10 pounds of Simazine 50W in the spring of the fourth year after planting provided 90 per cent effective weed control during the last 2 years of the study with no herbicide damage to any trees. Clean cultivation prevented all mouse damage and the annual application of Arasan 42S completely protected all trees from browsing damage by snowshoe rabbits which were common in the surrounding woodlots.

Survival and height growth data for the individual species are shown in Tables 2 to 5.

Table 1 Temperature and precipitation records of the experimental area for the growing seasons of 1963 to 1967

Year	Month	Mean daily temperature F	No. of days with freezing temperatures	Total precipitation in	No. of days with 0.1 in or more precipitation
1963	April	41.8	21	3.02	10
	May	49.3	7	3.19	13
	June	61.8	0	1.32	7
	July	66.5	0	2.67	8
	Aug.	61.4	0	2.33	10
	Sept.	54.8	4	3.19	8
	Total		32	15.72	56
1964	April	42.2	14	2.64	9
	May	56.2	4	2.70	9
	June	61.1	3	2.56	8
	July	68.1	0	3.79	9
	Aug.	59.7	0	5.24	13
	Sept.	57.0	3	1.74	11
	Total		24	18.67	59
1965	April	36.2	22	3.38	10
	May	55.9	4	3.11	7
	June	59.0	0	2.26	6
	July	60.2	0	2.15	6
	Aug.	61.5	1	5.79	13
	Sept.	59.3	1	5.14	12
	Total		28	21.83	54
1966	April	38.2	22	2.71	14
	May	46.8	8	2.15	8
	June	63.0	2	2.88	5
	July	68.5	0	1.45	2
	Aug.	63.9	0	3.65	12
	Sept.	54.9	2	3.93	10
	Total		34	16.77	51
1967	April	41.7	15	4.01	10
	May	46.0	10	1.03	8
	June	66.0	0	8.93	20
	July	64.4	0	2.88	7
	Aug.	61.1	0	4.24	10
	Sept.	55.2	4	2.92	8
	Total		29	24.01	63

Table 2 Survival and height growth of silver maple seedlings by age, size class, and year of planting

Year of planting	Planting stock			Survival	Height growth						Height growth weighed by survival
	Age class	Height in	Caliper in	%	First year in	Second year in	Third year in	Fourth year in	Fifth year in	Total growth in	in
1963	1 + 0	5	1/20	80	4	17	19	21	37	98	78
		6	2/20	72	5	20	23	24	45	117	84
		7	3/20	98	8	25	24	24	46	127	124
	2 + 0	7	3/20	84	6	25	19	23	37	110	92
		9	4/20	95	7	26	20	23	40	116	110
		10	6/20	88	8	30	24	26	48	136	120
1964	1 + 0	6	2/20	96	12	27	14	40	-	93	89
		8	4/20	100	16	22	11	45	-	94	94
		9	5/20	100	18	26	14	39	-	97	97
	2 + 0	12	4/20	100	11	20	21	43	-	95	95
		17	7/20	99	13	23	21	44	-	101	100
		22	9/20	100	13	27	21	47	-	108	108
1965	1 + 0	8	2/20	83	12	16	31	-	-	59	49
		8	3/20	85	13	19	37	-	-	69	59
		9	5/20	97	13	18	35	-	-	66	64
	2 + 0	21	6/20	96	15	13	34	-	-	62	60
		25	9/20	96	18	20	41	-	-	79	76
		28	10/20	99	20	13	38	-	-	71	70

Note: Lines connect results which differ significantly at the 5 per cent level. Values are means of 75 trees each.

Table 3 Survival and height growth of basswood seedlings by age, size class, and year of planting

Year of planting	Planting stock			Survival	Height growth						Height growth weighed by survival
	Age class	Height in	Caliper in	%	First year in	Second year in	Third year in	Fourth year in	Fifth year in	Total growth in	in
1963	1 + 0	3	2/20	83	4	11	9	15	23	62	51
		5	4/20	68	7	11	13	19	30	80	54
		6	5/20	83	5	13	10	16	31	75	62
	2 + 0	10	6/20	72	5	15	12	19	28	79	57
		10	8/20	96	5	16	14	20	34	89	85
		10	10/20	88	7	12	11	20	36	86	76
1964	1 + 0	5	3/20	93	3	10	10	30	-	53	49
		6	4/20	93	3	10	11	34	-	58	54
		7	5/20	95	4	12	16	37	-	69	66
	2 + 0	6	5/20	91	4	11	12	32	-	59	54
		7	7/20	95	3	10	14	37	-	64	61
		8	10/20	99	4	13	16	29	-	62	61
1965	1 + 0A	3	2/20	96	6	10	19	-	-	35	34
		4	4/20	96	7	10	21	-	-	38	36
		5	5/20	99	8	12	25	-	-	45	45
	1 + 0B	4	3/20	95	6	13	21	-	-	40	38
		4	4/20	89	6	16	20	-	-	42	37
		5	5/20	95	6	14	18	-	-	38	36

Note: Lines connect results which differ significantly at the 5 per cent level. Values are means of 75 trees each.

Table 4 Survival and height growth of red oak seedlings by age, size class, and year of planting

Year of planting	Planting stock			Survival	Height growth						Height growth weighed by survival
	Age class	Height in	Caliper in	%	First year in	Second year in	Third year in	Fourth year in	Fifth year in	Total growth in	in
1963	1 + 0	5	2/20	55	0	1	1	1	5	8	4
		6	3/20	45	0	2	1	3	10	16	7
		6	4/20	69	1	3	3	3	6	14	10
	2 + 0	6	4/20	67	1	2	1	2	7	13	9
		8	5/20	92	1	7	6	8	19	41	38
		8	6/20	83	2	7	3	13	21	46	38
1964	1 + 0	5	3/20	93	3	2	4	14	-	23	21
		5	4/20	97	2	2	3	4	-	11	11
		6	5/20	97	4	6	8	20	-	38	37
	2 + 0	7	4/20	79	0	1	1	4	-	6	5
		8	5/20	95	1	1	2	7	-	11	10
		10	6/20	99	1	1	1	8	-	11	11
1965	1 + 0	5	2/20	75	1	1	3	-	-	5	4
		7	3/20	81	1	2	6	-	-	9	7
		8	4/20	95	2	3	11	-	-	16	15
	2 + 0	10	4/20	77	0	1	3	-	-	4	3
		12	6/20	83	0	1	4	-	-	5	4
		13	8/20	81	1	1	3	-	-	5	4

Note: Lines connect results which differ significantly at the 5 per cent level. Values are means of 75 trees each.

Table 5 Survival and height growth of white ash seedlings by age, size class, and year of planting

Year of planting	Planting stock			Survival	Height growth						Height growth weighed by survival
	Age class	Height in	Caliper in	%	First year in	Second year in	Third year in	Fourth year in	Fifth year in	Total growth in	in
1963	2 + 0	7	3/20	91	2	7	9	10	25	53	48
		8	4/20	84	2	11	11	20	32	76	64
		8	5/20	88	2	10	11	18	25	66	58
1964	3 + 0	6	3/20	99	2	5	11	19	-	37	37
		7	4/20	97	2	6	15	24	-	47	46
		9	5/20	100	2	9	17	29	-	58	58
1965 A	1 + 0	5	3/20	97	2	10	22	-	-	34	33
		5	4/20	93	3	9	20	-	-	32	30
		6	5/20	99	4	10	20	-	-	34	34
B	1 + 0	4	3/20	53	4	10	17	-	-	31	16
		4	4/20	72	4	12	21	-	-	37	27
		4	5/20	81	5	12	20	-	-	37	30

Note: Lines connect results which differ significantly at the 5 per cent level. Values are means of 75 trees each.

DISCUSSION OF RESULTS

Plowing and tilling before planting and mechanical cultivation for the first 3 years after planting provided excellent growing conditions for all trees and thereby greatly influenced the results of this study. Intensive site preparation was necessary to eliminate established weeds and to equalize microsite conditions. All trees were cultivated to maintain these conditions and to provide a favourable environment for the establishment and early growth of the demanding hardwood species. Site preparation and tending of the trees, however, provided such perfect site conditions that even the weakest seedlings could survive and grow. Weather conditions during the growing seasons of 1963 to 1967 also had a pronounced effect on tree survival and growth. The severe drought during the early summer of 1963 killed many trees and reduced the growth of others, whereas the exceptionally warm and wet summer of 1967 greatly increased the height growth of nearly all trees.

Evaluation of the individual effects of age and size of the planting stock showed that seedling size was much more important than seedling age. Not only did the largest trees in both age classes nearly always grow better than the smaller trees but the 1-year-old seedlings with large root-collar diameters generally survived and grew as well as or better than 2-year-old seedlings of equal size. The results also indicate that the size of the planting stock as defined by root collar diameter and stem length is a good indicator of seedling quality.

Since the largest seedlings of 1 + 0 stock survived and grew as well as 2 + 0 seedlings of equal size, production costs of planting stock could probably be substantially lowered through the production of large 1 + 0 stock instead of the usual medium-sized seedlings of 2 + 0 stock.

RECOMMENDATIONS

Table 6 shows the recommended planting stock grades for the four hardwood species tested in this study plus black walnut for which information was obtained from other planting experiments carried out by the author. The recommended grades are, however, not to be construed as the best planting stock sizes for all planting sites, but rather as the minimum standards for average sites as well as site preparation and cultivation methods. Successful afforestation or reforestation of special or more difficult planting sites will still require the use of special stock best suited for the prevailing conditions.

Table 6 Recommended planting stock grades for hardwoods planted in Ontario

Species	Length of stem		Root collar diameter	
	Minimum in	Preferred in	Minimum in	Preferred in
Silver Maple	6	8	4/20	5/20
Basswood	5	7	4/20	5/20
Red Oak	6	8	4/20	5/20
White Ash	5	7	4/20	5/20
Black Walnut*	8	12	5/20	7/20

* Data obtained from other experiments carried out by the author.