

EFFECTS OF DIFFERENT INTENSITIES OF YELLOW BIRCH AND SUGAR MAPLE CROP TREE RELEASE

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1994



*Funding for this report has been provided through the
Northern Ontario Development Agreement's Northern Forestry Program.*

Canadian Cataloguing in Publication Data

The National Library of Canada has catalogued this publication as follows:

Main entry under title:

Effects of different intensities of yellow birch and sugar maple crop trees release
(NODA/NFP technical report ; TR-4)

Includes an abstract in French.

Includes bibliographical references.

ISBN 0-662-21586-9

Cat. no. Fo29-41/4-1994E

1. Forest thinning—Ontario.

2. Yellow birch.

3. Sugar-maple—Ontario.

I. Von Althen, F.W.

II. Great Lakes Forestry Centre.

III. Series.

SD396.5E33 1994

634.9'53

C94-980259-X

©Minister of Supply and Services Canada 1994

Catalogue No. Fo29-41/4-1994E

ISBN 0-662-21586-9

ISSN 1195-2334

Copies of this publication are available at no charge from:

Communications Services

Natural Resources Canada

Canadian Forest Service – Ontario

Great Lakes Forestry Centre

P.O. Box 490

Sault Ste. Marie, Ontario

P6A 5M7

Microfiches of this publication may be purchased from:

Micro Media Inc.

Place du Portage

165, Hotel-de-Ville

Hull, Quebec J8X 3X2

The views, conclusions, and recommendations contained herein are those of the authors and should be construed neither as policy nor endorsement by Natural Resources Canada or the Ontario Ministry of Natural Resources. This report was produced in fulfillment of the requirements for NODA/NFP Project No. 4022 "Yellow birch and sugar maple thinning: effects on diameter and height increment, crown size and stem form".

von Althen, F.W.; Wood, J.E.; Mitchell, E.G.; Hoback, K. 1994. Effects of different intensities of yellow birch and sugar maple crop tree release. Nat. Resour. Can., Canadian Forest Service – Ontario, Sault Ste. Marie, Ont. NODA/NFP Tech. Rep. TR-4. 12 p. + appendix.

ABSTRACT

Twenty-year-old yellow birch (*Betula alleghaniensis* Britton) and sugar maple (*Acer saccharum* Marsh.) saplings were thinned near Thessalon, Ontario by a work crew employed under a Canada Job Development program. Treatments consisted of either a control or the removal of all competing trees at 1, 2, or 3 metres around the boles of sugar maple crop trees or 1, 2, 3, or 4 metres around the boles of yellow birch crop trees. Crop tree release increased the 5-year diameter increment and crown width of both species. The greater the release the larger the increase. Height increment of the yellow birch crop trees decreased with intensity of release while height increment of the sugar maple crop trees was higher in all thinning treatments than in the control. Few epicormic sprouts developed on the stems of both species released at 1 to 3 metres. However, release of yellow birch at 4 metres increased the number of epicormic sprouts and greatly increased their size. Five years after release at 1 and 2 metres the space available for yellow birch crown expansion had nearly filled. Release at 3 metres provided a good balance between diameter increment and stem quality maintenance. Release at 4 metres degraded stem quality. Release at 1 metre was inadequate for crown expansion of sugar maple crop trees while release at 2 and 3 metres increased diameter increment by 114 and 171%, respectively, with adequate space for crown expansion for a further 5 years. The Job Development program improved the participants employment opportunities. Recommendations are made for the release of crop trees in similar stands.

RÉSUMÉ

Près de Thessalon, en Ontario, des bouleaux jaunes (*Betula alleghaniensis* Britton) et des érables à sucre (*Acer saccharum* Marsh.) de 20 ans ont été éclaircis par une équipe de travailleurs engagés dans le cadre du programme canadien de développement de l'emploi. Les traitements ont consisté à éliminer tous les arbres concurrents situés dans un rayon de 1, 2 ou 3 mètres du tronc des érables d'avenir et dans un rayon de 1, 2, 3 ou 4 mètres du tronc des bouleaux d'avenir. Après 5 ans, le dégagement des arbres d'avenir a eu un effet positif sur l'accroissement du diamètre et l'expansion du houppier chez les deux espèces. Cet effet a été d'autant plus élevé que l'étendue dégagée était grande. Chez le bouleau, un effet inverse a été observé en ce qui concerne l'accroissement en hauteur, qui diminuait lorsque le dégagement était plus intense. Dans le cas des érables, l'accroissement en hauteur a été supérieur au témoin pour tous les traitements. Peu de pousses adventives

sont apparues sur les troncs dégagés sur 1 à 3 mètres chez les deux espèces. Toutefois, dans le cas des bouleaux dégagés sur 4 mètres, on a constaté que ces pousses étaient plus nombreuses et beaucoup plus développées. 5 ans après le traitement, l'espace disponible pour l'expansion du houppier des bouleaux dégagés sur 1 et 2 mètres était pratiquement rempli. Un bon équilibre entre l'accroissement du diamètre et le maintien de la qualité du tronc a résulté des dégagements pratiqués sur 3 mètres. Les dégagements sur 4 mètres, par contre, ont eu un effet négatif sur la qualité des troncs. Chez les érables, les dégagements sur 1 mètre n'ont pas assuré un espace suffisant pour l'expansion du houppier; les dégagements sur 2 et 3 mètres ont augmenté de 114 % et de 171 % respectivement l'accroissement en diamètre et assuré un espace suffisant pour 5 autres années d'expansion du houppier. Le programme de développement de l'emploi a amélioré les possibilités d'emploi des participants. Des recommandations sont formulées pour le dégagement des arbres d'avenir dans des peuplement similaires.

TABLE OF CONTENTS

INTRODUCTION	1
IMPORTANCE OF THE SUGAR MAPLE AND YELLOW BIRCH RESOURCE IN ONTARIO	1
LITERATURE REVIEW	1
Timing of Thinning	1
Cleaning	1
Crop Tree Selection	2
Crop Tree Release	2
STUDY AREA	3
THE WORK FORCE	3
METHOD	4
DATA ANALYSIS	5
RESULTS	5
DISCUSSION	9
SUMMARY AND CONCLUSIONS	10
RECOMMENDATIONS	11
ACKNOWLEDGMENTS	11
LITERATURE CITED	11
APPENDIX 1 Gould Township Thinning Trial Tally Sheet	

EFFECTS OF DIFFERENT INTENSITIES OF YELLOW BIRCH AND SUGAR MAPLE CROP TREE RELEASE

INTRODUCTION

Strip clearcutting in the tolerant hardwood stands of the Great Lakes-St. Lawrence Forest Region of Ontario (Rowe 1972) has resulted in excellent natural regeneration of yellow birch (*Betula alleghaniensis* Britton) and sugar maple (*Acer saccharum* Marsh.). But many of these stands are presently overstocked. Research in the province of Nova Scotia, and in the states of Minnesota, Michigan, Ohio, and New York on the effects of thinning hardwood saplings has shown that thinning can increase diameter growth and will thereby shorten rotation length (Drinkwater 1960, Marquis 1969, Heitzman and Nyland 1991).

When the opportunity arose in 1986 to obtain funds under a Canada Job Development program, staff of the Blind River District of the Ontario Ministry of Natural Resources (OMNR) approached the Canadian Forest Service - Great Lakes Forestry Centre to help evaluate the growth response of yellow birch and sugar maple saplings to thinning. The aim of the project was to demonstrate the effects of a thinning in a stand representative of stand conditions in the Tolerant Hardwood Working Group in Ontario (Anderson et al. 1990). This report presents the 5-year results of the crop tree release, compares these results with those of similar thinning operations in eastern Canada and the United States, and makes recommendations for improvement in future crop tree release operations.

IMPORTANCE OF THE SUGAR MAPLE AND YELLOW BIRCH RESOURCE IN ONTARIO

Sugar maple and yellow birch are the main components of the tolerant hardwood forest type in Ontario. There are just over 500 million cubic metres of tolerant hardwoods in the province which account for almost 10% of the total growing stock (OMNR 1986). Sugar maple is by far the most important species in terms of quantity, comprising over 380 million cubic metres or 76% of the total volume of the tolerant hardwood forest. Yellow birch is a more valued tree for quality veneers, but forms only 6.4% of the tolerant hardwood growing stock. Other hardwoods include less abundant species such as northern red oak (*Quercus rubra* L.), white elm (*Ulmus americana* L.), basswood (*Tilia americana* L.), American beech (*Fagus grandifolia* Ehrh.), and black cherry (*Prunus serotina* Ehrh.).

Between 1976 and 1986 the average annual harvest of sugar maple and yellow birch on crown lands in Ontario was 260,409 m³ and 107,790 m³, respectively (Smyth and

Campbell 1987). The value of Ontario lumber exports in 1986 amounted to \$11.7 million for maple and \$4.8 million for birch. In 1986, the value of Ontario veneer and plywood exports amounted to \$5.1 million for maple and \$20.2 million for birch.

LITERATURE REVIEW

One of the main objectives in managing northern hardwoods is the production of high value veneer and sawlogs. Yellow birch and sugar maple respond well to thinning at an early age. Well timed thinnings and improvement cuts, made at regular intervals, will therefore not only improve their quality but will also greatly reduce rotation length. Erdmann (1987) estimated that with well timed treatments it might be possible to produce a 45-cm diameter veneer-grade yellow birch tree in 87 years. Without thinnings and crown release it would probably take 60 years longer.

Timing of Thinning

The tree age at which thinnings should commence depends on stand conditions, species composition, the aims and wishes of the owners or managers, and last but not least the availability of funds and manpower. While some managers prefer to wait until the trees to be removed have reached some commercial value, others prefer to start treatments at a very early age. Lamson and Smith (1987) recommended delaying the treatment until stands are at least 10–15 years old. Stoeckler and Arbogust (1947) reported that by age 11 dominance is expressed well enough in sugar maple, basswood, and white ash to identify desirable crop trees. Godman (1968) suggested that for best results, sugar maple should be thinned before the live crown ratio (live crown/total height x 100) drops below 40%. Marquis et al. (1984) suggested that the first thinning should occur at about the time that height growth begins to slow down. By then most trees will have developed a clear bole on the first log or two, and the smaller trees in the stand that are to be removed will have reached merchantable size, so that thinning may pay for itself. Normally this first thinning will occur when the stand is between 40 and 60 years of age. Erdmann et al. (1975) and Erdmann (1983) recommended that stands not be released until the first commercial thinning in pure sapling or pole stands of sugar maple, but suggests that yellow birch should be released earlier for best responses.

Cleaning

The earliest thinning treatment in naturally regenerated northern hardwood stands is generally referred to as

cleaning (Ford-Robertson 1971). This treatment is carried out at a stand age of less than 15 years and never past the sapling stage. It removes trees of similar age but of less desirable species or form than the crop trees they overtop (Anderson et al. 1990). In some cases, cleaning may be the only way to maintain a desirable species in the stand (Heitzman and Nyland 1991).

Cleaning a 7-year-old, even-aged stand containing 65,000 seedlings per ha of mainly sugar maple and yellow birch near Marquette, Michigan increased annual diameter growth of yellow birch from 0.38 cm in the controls to 0.79 cm in trees released at a radius of 3.7 m (Erdmann et al. 1981). But cleaning at this early age retarded natural stem pruning. Branches on cleaned trees increased in size with wider spacings. Trees growing under the 3.7 m and 4.9 m release developed long crowns and large branches. Forks persisted and the trees appeared shrubby. The best compromise between survival, growth rate, and quality development without corrective pruning was to clean within a 2.4-m radius.

Releasing 8-year-old paper birch (*Betula papyrifera* Marsh.), yellow birch, and sugar maple trees in Vermont at radii of 1.22 m and 2.44 m significantly increased the average diameter growth of the birches but not the maple (Voorhis 1990). Yellow birch diameter increment increased significantly from control to light release and from light to heavy release. Paper birch had a significant increase in diameter from control to light release and from control to heavy release, but not from light to heavy release. Sugar maple did not respond significantly to either treatment. Average height growth of all species was unaffected by treatments. The amount of decline in height to the first major limb was more dramatic for yellow and paper birches than for sugar maple. At age 15, many crop tree stems of yellow birch and sugar maple were more vigorous and of better quality than those chosen as crop trees at age 8. On the basis of these results the author concluded that age 8 was an appropriate time for choosing paper birch crop trees, but was too early for choosing yellow birch and sugar maple crop trees.

Crop Tree Selection

Selection of appropriate crop trees is of vital importance for the success of any crop tree release treatment. Lamson and Smith (1987) recommended the selection of only high-quality, vigorous trees in the dominant and codominant crown position. Intermediate crop trees might be selected if they are relatively shade tolerant species such as the maples. But even so, dominant and codominant trees are still the best bet for all species.

Crop trees should be of good form and capable of producing high quality butt logs. Slight bole crooks or sweep can be

overlooked, since these features tend to become less pronounced as the tree matures. In young stands, crop trees should not have a major fork in the butt log. They should also be relatively free of surface defects such as large knots and should not have excessive epicormic branches.

Stump-sprout origin crop trees may also be selected. Stroempl (1983) found little potential for the development of internal decay spreading from the parent stump.

Good judgement is critical in selecting crop trees. If no trees are present with good potential for saw timber or veneer, do not choose any. Experience indicates that untreated portions of the stand will continue to develop and that some acceptable trees will eventually emerge into an upper crown position through the effects of local competition.

Good judgement is also needed where two excellent crop trees grow close to each other. If crop trees are hard to find nearby, leave both trees. Treat their crowns as one and choose between them at a later date if necessary. However, do not leave more than two crop trees adjacent to each other. Where there is an excess of potential crop trees, some good trees must be removed to promote faster growth of the best ones.

Crop Tree Release

The treatment best suited to start the management of naturally regenerated northern hardwood stands is crop tree release (Voorhis 1986, Heitzman and Nyland 1991). It is applied when stands are 10 to 25 years old. This treatment improves the proportion of preferred species in the stand, improves the quality of the average crop trees being grown to final harvest, and increases the rate of diameter growth and thereby reduces the rotation length. It also improves stand appearance for aesthetics and recreation (Robertson et al. 1991). However, to obtain the desired results it is essential to apply the proper intensity of release.

Drinkwater (1960) crown thinned around 21- to 26-year-old dominant and codominant sugar maple trees in Nova Scotia. He applied either no release or crown spacing treatments of 90–120 cm, 150–180 cm or 240–300 cm around individual crop tree crowns. The heavier 150–180 cm release produced significantly better 5-year diameter and basal area growth responses than did either the control or the 90–120 cm release treatment. Dominant trees responded best. Release had no effect on height growth or epicormic branching, but retarded natural pruning. Crowns closed at the rate of 20 cm per year for the 150–180 cm treatment, and almost 30 cm per year for the 240–300 cm treatment. For best growth and quality development of saplings, Drinkwater (1960) recommended the 150–180 cm release treatment.

Erdmann et al. (1975) applied five intensities of crown release treatments (control, 75 cm, 150 cm, 300 cm, 450 cm) in a 16-year-old stand of yellow birch saplings in northern Michigan. Initial diameters at breast height ranged from 7.7 to 10.1 cm for dominant trees and from 5.5 to 7.4 cm for codominants. Crown release significantly increased diameter growth of all crop trees. Increases averaged about 36% in the first year and 64 and 56% in the second and third years, respectively. There was no significant effect on height growth among release treatments. Crown release delayed natural branch mortality. During the 3-year duration of this study, significantly more live limb-free length was added to the boles of unreleased saplings than to released saplings. There was some increase in the number of epicormic branches on released trees but most branches were small and were not expected to degrade the stem quality. Although the time of observation was too short to make recommendations, releases at 150 and 300 cm were expected to last at least 10 years before additional releases would be necessary.

Lamson and Smith (1987) recommended the crown-touching method to release northern hardwood saplings. With this treatment any tree, except another crop tree, is removed if its crown touches the crown of the adjacent crop tree, or if its crown overlaps above or below the edge of the crop-tree crown. Borderline trees close to the crop tree are also cut. Depending on the number of crop trees selected per hectare, most crop trees will be released on four sides. The actual distance between crowns released by this method should average 180 cm.

Lamson and Smith (1987) recommended the release of 185 to 250 crop trees per hectare, but the cost of releasing trees and the availability of good crop trees strongly influence the number to release. To reduce costs, McCauley and Marquis (1972) recommended the release of not more than 200 crop trees per hectare. Erdmann (1987) indicated that in the Lake States 185 crop trees per ha were sufficient for sugar and red maples, but recommended 250 crop trees per ha for yellow birch to allow for loss from disease and sap sucker damage. Also, since managed even-aged northern hardwood stands generally

have about 125 dominant or codominant trees per ha at maturity (Erdmann 1983), it seems unnecessary to release more than 185 to 250 trees per ha during precommercial operations.

STUDY AREA

The study area (Lat. 46°30'N, Long. 83°25'W) is located in Gould Township in the District of Algoma, approximately 30 km north of the town of Thessalon, Ontario. The soil is a glaciofluvial outwash consisting of silty sand overlying very hard, compacted glacial till at a depth of approximately 55 cm (Table 1). The topography is level. Surface drainage conditions are mixed, and range from dry to wet (van Dine 1980).

The original stand consisted of mature sugar maple and yellow birch with a minor component of red oak and white elm. The stand was highgraded in 1938–39 and again in 1961–63 and is typical of the stands in this area. During the winter of 1965/66, alternate strips, approximately 20 m wide, were clearcut in a north-south direction. Leave strips of the same width were only partially logged to preserve seed trees (Figure 1). Following logging, all remaining trees were felled in the clearcut corridors and the soil was scarified with bulldozer blades to mix the organic and mineral soil horizons to favor the establishment of yellow birch regeneration. Twenty years after logging the clearcut strips are densely regenerated with up to 8,800 stems per ha of mainly yellow birch and sugar maple and a sprinkling of red oak, pin cherry (*Prunus pensylvanica* L.), trembling aspen (*Populus tremuloides* Michx.), ironwood (*Ostrya virginiana* [Mill] Koch.), and white elm (Figure 2).

THE WORK FORCE

The thinning was carried out under a Canada Job Development program. The project was a joint effort by the Algoma Fish and Recreation Association, Canada Employment and Immigration; the OMNR, Blind River District; and the Canadian Forest Service – Great Lakes Forestry Centre. The Algoma Fish and Recreation Association of

Table 1. Analysis of soil sampled in June 1993 in the study area.

Horizon	Sample depth (cm)	pH	Sand (%)	Silt (%)	Clay (%)	N (%)	P (ppm)	K (ppm)	Ca (ppm)	Mg ^a (ppm)
Lfh	3	4.5	–	–	–	0.635	17.61	190.88	1068.40	102.68
Ah	15	4.9	64.0	36.0	0.0	0.285	7.54	89.97	134.66	13.81
Bhf	40	5.0	70.5	22.5	7.0	0.083	10.46	62.78	46.37	4.59
C ₁	56	5.2	72.5	19.5	8.0	0.024	21.79	61.60	38.75	4.72
C ₂	60	5.3	65.5	30.5	4.0	0.017	24.93	60.48	34.19	4.09

^aCa = calcium, K = potassium, Mg = magnesium, N = nitrogen, P = phosphorus.

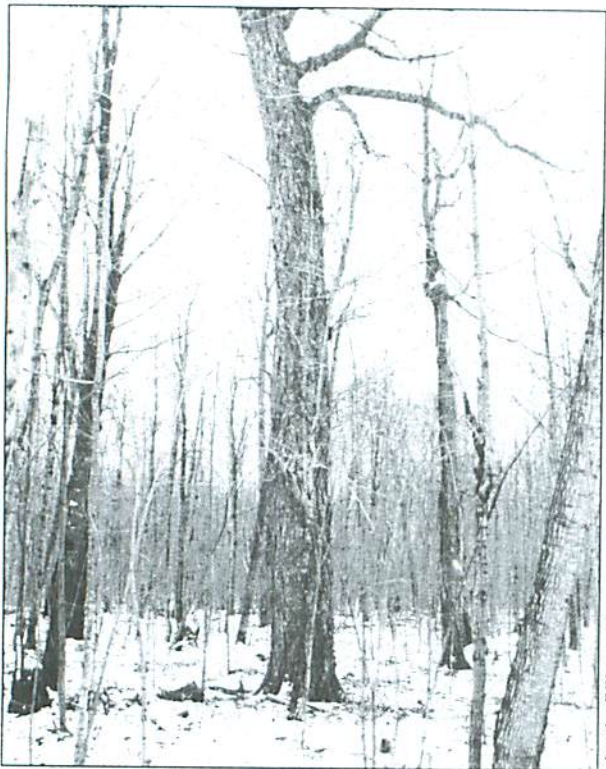


Figure 1. Leave strip with yellow birch and sugar maple seed trees.



Figure 2. Control plot in yellow birch regeneration area.

Thessalon sponsored the application. Canada Employment and Immigration provided the funds, and the OMNR selected the stand, assisted with training the crew in the selection of crop trees and the layout of the treatment blocks, and supervised the operation. The Canadian Forest Service measured the sample trees and evaluated the results. The Northern Ontario Development Agreement (NODA) Northern Forestry Program provided funding for the fifth year remeasurement, data analysis, and preparation of a report of five-year results.

Eight workers were employed from 1 January to 31 March 1987 and six of them continued to the beginning of August 1987. Clerical and administrative support was provided by the Algoma Fish and Recreation Association. The terms of employment included a mandatory training component.

The Algoma Fish and Recreation Association engaged several local agencies to train the eight crew members in each of the following areas:

- Cardiac Pulmonary Resuscitation (CPR)
- First Aid
- Chain saw safety
- Stand tending theory
- Stand improvement techniques
- Dendrology
- Map reading and orientation
- Aerial photo interpretation
- Forest fire suppression
- Money management
- Job preparedness
- Job application skills.

A total of 600 person days were spent in the field to release the crop trees. The average production rate was 0.11 ha per person-day. Cold temperatures and deep snow during the first part of the project reduced productivity.

METHODS

The 67 hectare study site was divided into eight blocks for yellow birch thinning and seven blocks for sugar maple thinning (Figure 3). The yellow birch blocks represented one block each for the control and 40% thinning levels and two blocks each for the 10%, 20%, and 30% thinning levels. The sugar maple blocks represented one block for the control and two blocks each for the 10%, 20%, and 30% thinning levels.

Within the alternate clearcut strips of each block, dominant and codominant crop trees of either yellow birch or sugar maple were identified and marked with paint. The crop trees were selected at a spacing of 6 metres with a preferred variation of not more than 2 metres. If no suitable crop tree of the desired species could be found within the

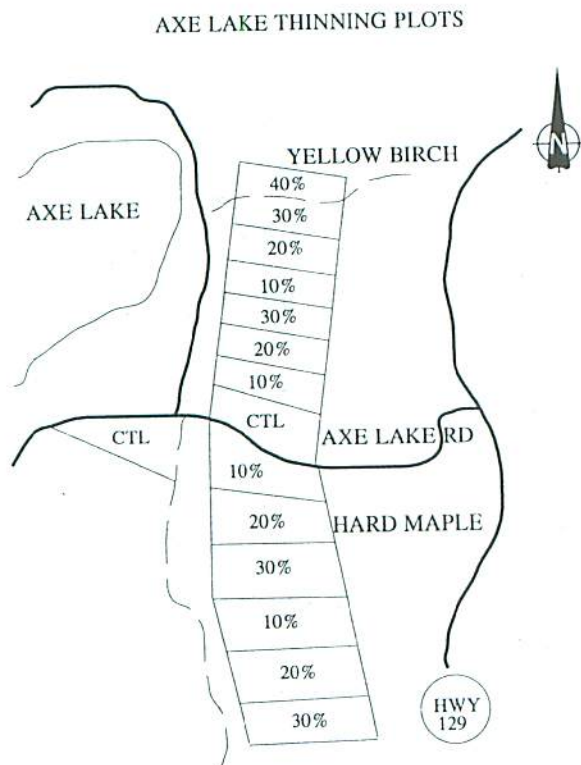


Figure 3. Map of experimental layout.

specified distance, a crop tree of another species could be marked. The ranking in species preference was red oak, because there were so few present in the stand, and either yellow birch or sugar maple depending on the area designation to either yellow birch or sugar maple release.

The criteria for crop tree selection were crown position within the dominant or codominant crown classes, good stem form, freedom from defects, acceptable stem diameter and crown size.

The selected crop trees were released by cutting all competing trees within a radius equal to either 10%, 20%, 30% and, in the case of yellow birch, 40% of the mean height for dominant and codominant trees in the stand. Since this mean height was 10 metres, all trees within either 1, 2, 3, or 4 metres of the bole of the crop tree were felled. To measure the distances for release the cutters were provided with measuring sticks. With one end of the stick touching the bole of the crop tree, all competing trees touched by the appropriate stick in a 360° sweep around a circle of the crop tree were removed.

Following the operational thinning, 30 crop trees were selected in each block for determination of treatment effects. The trees were numbered and marked with paint at breast height for identification and accuracy of remeasurement. The diameter at breast height (DBH) of all crop trees were measured with a diameter tape to the

nearest one-tenth of a centimetre. Total height was measured with an Abney level to the nearest 25 cm. Height to live crown was measured with a measuring pole to the nearest 25 cm and the number and size of epicormic branches were recorded.

The circular area around each crop tree was divided into four pie-shaped sections (Appendix 1). Within each quadrant the stump diameter of all cut trees was measured with a caliper to the nearest one-tenth of a centimetre and recorded by species. Using the crop tree bole as a centre point, the distance to the edge of the crown for each crop tree and the distance to the crown of the nearest competitor were recorded for each of the four cardinal directions as determined by compass.

The crop tree release was carried out between January and August 1987. Yellow birch were released during the winter of 1987 and crop tree measurements were taken in the spring of 1987 and again, after five growing seasons, in the autumn of 1991. The sugar maple crop trees were released during the summer of 1987 and crop tree measurements were recorded in the autumn of 1987 and again, after five growing seasons, in the autumn of 1992.

DATA ANALYSIS

The major aim of this project was to demonstrate the effects of different thinning intensities in 25-year-old stands of yellow birch and sugar maple. To achieve this aim the 67 hectare stand was divided systematically into eight blocks for yellow birch thinning and seven blocks for sugar maple thinning (Appendix 1). No randomization of treatments was attempted because the cutting was carried out by a crew inexperienced in hardwood thinning. Although not suitable for conventional statistical analysis, the 30 crop trees evaluated in each treatment block provided a suitable data base with which to demonstrate treatment effects.

For data compilation, the crop trees in the two blocks of the 10%, 20%, and 30% release treatments of both species were combined for a total evaluation of 60 trees in each of these treatments. In each of the control blocks of both species, and the 40% release of yellow birch crop trees, 30 trees were evaluated.

To compute the area available for expansion of the crop tree crown, the distance between the crop tree crown to that of a competing tree was measured for all four quadrants and the average calculated.

RESULTS

At time of treatment the total number of saplings of all species in the yellow birch release area ranged from 7,859 trees per ha to 8,455 trees per ha (Table 2). Yellow birch

accounted for 78% and sugar maple for 20% of the total number of trees. The remaining 2% consisted mainly of pin cherry, ironwood, trembling aspen, and white elm.

At time of treatment the total number of saplings of all species in the sugar maple release area ranged from 7,682 trees per ha to 8,778 trees per ha (Table 3). Sugar maple accounted for 58% and yellow birch for 38% of the total number of trees. The remaining 4% consisted mainly of pin cherry, black cherry, ironwood, red oak, and trembling aspen.

Tables 4 and 5 show the average number and mean stump diameter of trees cut around individual yellow birch and sugar maple crop trees, respectively. In the 10% release an average of 3.6 trees were cut around each yellow birch crop tree and 4.2 trees around each sugar maple crop tree. The number of trees cut increased to an average of 22.9

and 24.8 trees in the 30% release, around each yellow birch and sugar maple crop tree, respectively (Figure 4). In the 40% release, 29.3 trees were cut around each yellow birch crop tree.

Crop tree mortality during the first 5 years after thinning was low. Four yellow birch crop trees died of unknown causes and one additional yellow birch and sugar maple crop tree, each lost their crowns. Figure 5 shows the diameter and height increments of yellow birch and sugar maple crop trees. Both species responded well to release with a greatly increased diameter increment that was positively correlated with the intensity of release. In contrast, height increment of the yellow birch crop trees decreased with intensity of thinning while height increment of sugar maple crop trees was higher in all thinning treatments than in the control.

Table 2. Number of trees per hectare before thinning in the yellow birch thinning area.

Treatment	Sugar maple number	Yellow birch number	Other spp. number	Total number
Control	2158	6120	177	8455
10%	1344	6756	71	8171
20%	1381	6407	71	7859
30%	1770	6160	177	8107
40%	1440	6426	248	8114

Table 3. Number of trees per hectare before thinning in the sugar maple thinning area.

Treatment	Sugar maple number	Yellow birch number	Other spp. number	Total number
Control	3823	3540	319	7682
10%	4708	2761	389	7858
20%	4496	2761	531	7788
30%	5522	3044	212	8778

Table 4. Mean number and stump diameter of competing trees cut around individual yellow birch crop trees.

Treatment	Sugar maple		Yellow birch		Others		Total number	Mean diameter (cm)
	Number	Diameter (cm)	Number	Diameter (cm)	Number	Diameter (cm)		
Control	—	—	—	—	—	—	—	—
10%	0.5	3.7	3.1	4.1	0	0	3.6	4.0
20%	1.5	4.8	7.4	4.2	0.1	3.3	9.0	4.3
30%	5.0	4.7	17.4	4.6	0.5	6.0	22.9	4.7
40%	5.2	4.1	23.4	4.1	0.7	6.2	29.3	4.1

Table 5. Mean number and stump diameter of competing trees cut around individual sugar maple crop trees.

Treatment	Sugar maple		Yellow birch		Others		Total number	Mean diameter (cm)
	Number	Diameter (cm)	Number	Diameter (cm)	Number	Diameter (cm)		
Control	—	—	—	—	—	—	—	—
10%	3.2	4.4	0.9	5.4	0.1	8.0	4.2	4.7
20%	7.5	4.3	7.8	4.9	1.5	6.6	16.8	4.8
30%	15.6	3.9	8.6	5.0	0.6	7.2	24.8	4.4



Figure 4. Yellow birch crop trees shortly after release at 30% intensity.

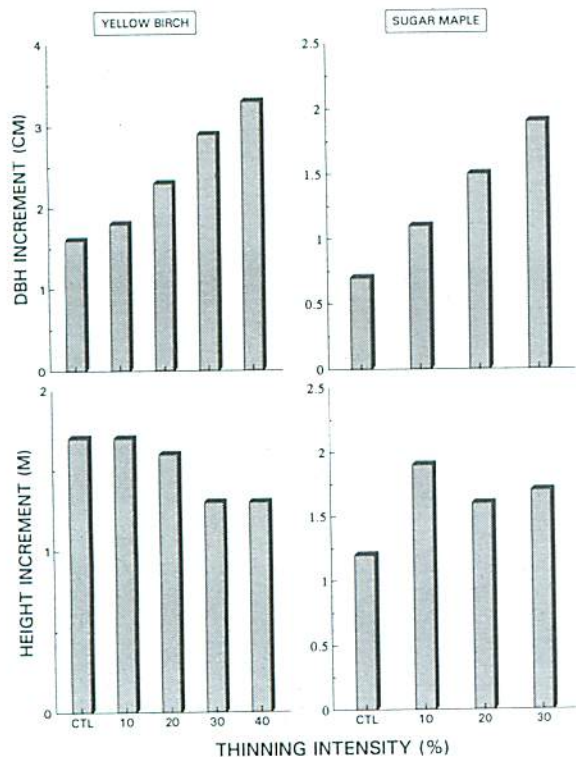


Figure 5. Five-year diameter and height increment of yellow birch and sugar maple crop trees by thinning intensity.

Five-year diameter increment of the crop trees of both species was positively correlated with their DBH at time of release (Figure 6). The larger the initial diameter the larger the diameter increment.

For yellow birch, crown length increment was little affected by releases at 10 to 30% intensities (Figure 7). However, the release at 40% intensity greatly increased crown length. Total height increment was also little affected by release intensities of 10 and 20%. But total height increment was substantially lower for trees released at 30 and 40% intensities. Release at 10 and 20% promoted clear bole length. At 30% the increase was lower than that of the control, while at 40% there was a net loss of clear bole length.

For sugar maple release at all three intensities promoted crown length increment as well as total height increment (Figure 7). Release at 10% intensity had little effect on the increment in clear bole length, but at 20 and 30% release intensities clear bole length increment was lower than that of the control trees.

Crown area of yellow birch and sugar maple crop trees increased greatly with available space following the removal of the crowns of non-crop trees (Figures 8 and 9, respectively). Figures 10 and 11 show the canopy of yellow birch crop trees shortly after release at the 30% intensity and five years after thinning, respectively.

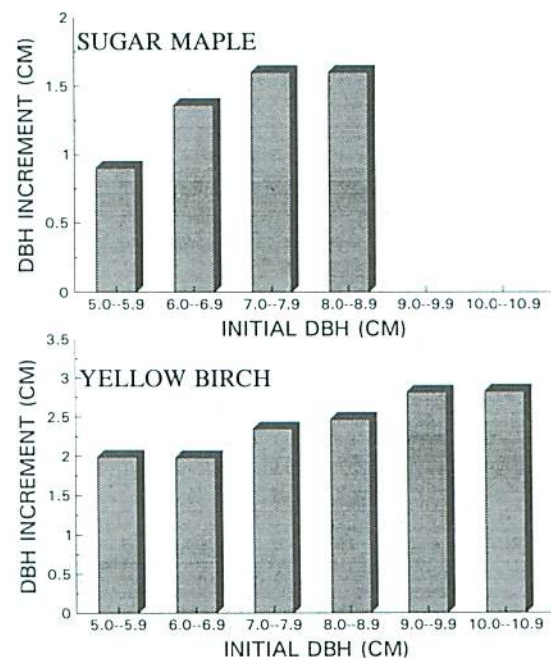


Figure 6. Five-year diameter increment of yellow birch and sugar maple crop trees by diameter at breast height (DBH) at time of release.

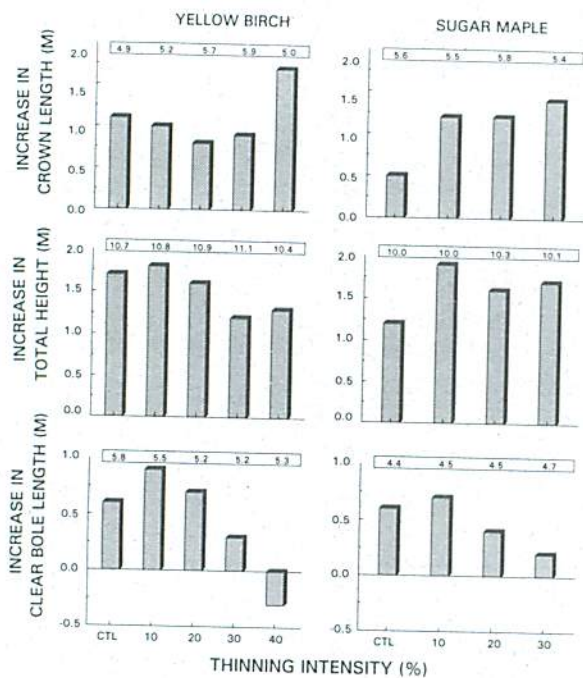


Figure 7. Increment in length of crown, height, and clear bole of yellow birch and sugar maple crop trees by thinning intensity. Boxed values above bars are initial length of crown, height, and clear bole.

The degree of crown expansion was closely correlated with available space. The most dramatic crown width expansion occurred following the 40% release of yellow birch crop trees because crown expansion was largely unrestricted.

Few epicormic sprouts developed following the release of yellow birch crop trees at the 10 to 30% intensities (Table 6). However, at the 40% release half of all trees had developed epicormic sprouts and 20% of the trees had developed branches originating from epicormic buds. The average branch length was 50 cm 5 years after thinning. The branches were healthy with many leaves and are, therefore, expected to persist for many years. As a result, stem quality will likely be degraded.

Nearly all sugar maple crop trees had some epicormic sprouts growing on their stems at the time of treatment (Table 6). Release at 10 and 20% intensity did not greatly change their numbers and sizes. But following release at 30% intensity the number of epicormic sprouts increased from an average of 2.5 to 7.3 per tree. Most of the sprouts had very small diameters, were 10 to 20 cm in length, and had generally only one to two pairs of leaves. Some sprouts had died recently while others appeared to have grown very little during the last two or three years.

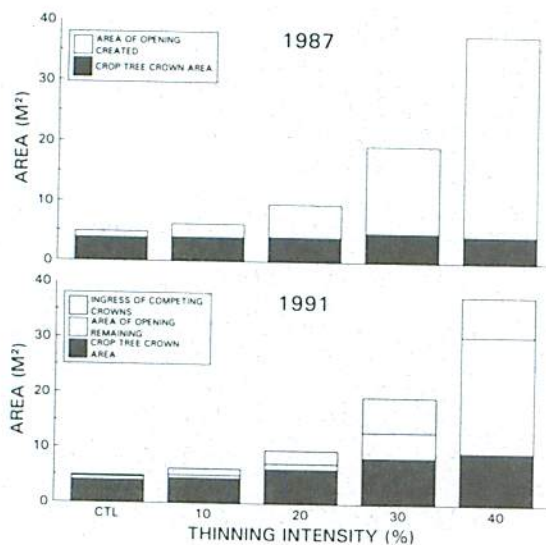


Figure 8. Available area for crown expansion of yellow birch crop trees shortly after thinning and five years later by thinning intensity.

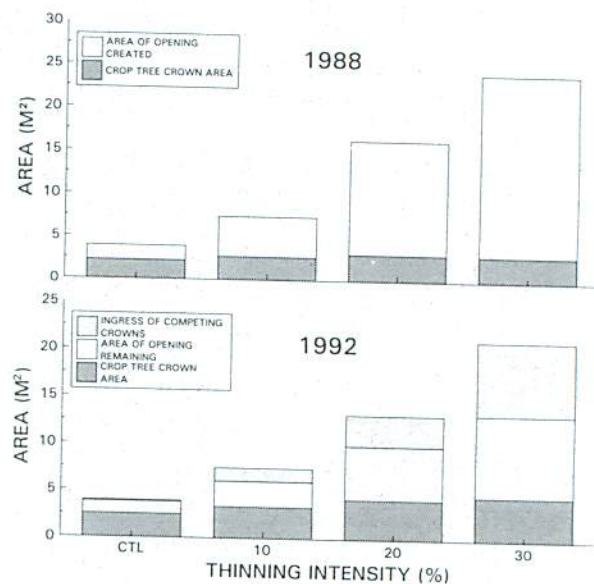


Figure 9. Available area for crown expansion of sugar maple crop trees shortly after thinning and five years later by thinning intensity.

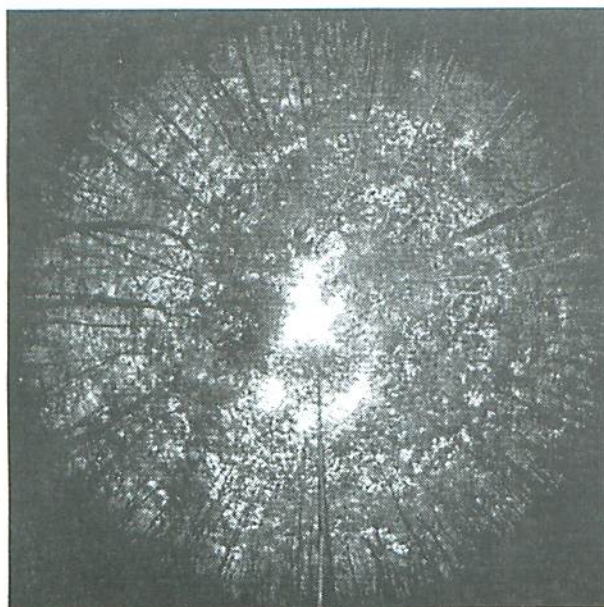


photo by: J.E. Wood

Figure 10. Canopy of yellow birch crop trees shortly after removal of all competing trees within a 3-metre radius (30% thinning intensity) around bole of the crop tree.

Table 6. Average number of epicormic sprouts on yellow birch and sugar maple crop trees by treatment at time of thinning and 5 years later.

Treatments	Yellow birch		Sugar maple	
	1987	1991	1988	1992
Control	0	0	4.9	5.9
10%	0	0.3	4.2	4.0
20%	0	0.1	3.3	4.1
30%	0	0.5	2.5	7.3
40%	0	2.0	—	—

DISCUSSION

In the release treatments described in this report the competing trees were cut according to the distance of their boles from that of the crop tree. This method of thinning was chosen because it sets a standard of release that is not subjective and can therefore be followed by inexperienced fellers. The bole-touching method provided reasonably good results and the majority of crop tree crowns were released on at least two sides. The disadvantage of this method is the failure to remove trees with boles growing outside the cutting distance but leaning toward the crop tree and thereby interfering with crop tree crown expansion. This method also fails to remove overtopping trees with stems located outside the cutting distance. Recommendations are therefore made to use the crown-touching method which avoids the disadvantages of the fixed distance release.

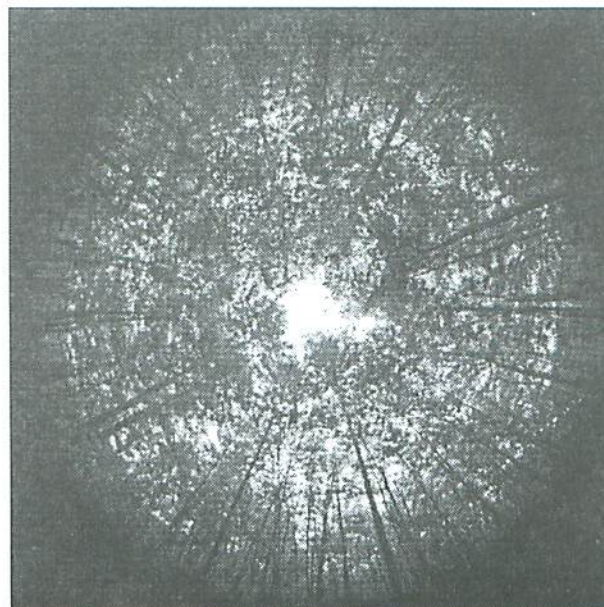


photo by: J.E. Wood

Figure 11. Canopy of a typical yellow birch crop tree five years after removal of all competing trees within a 3-metre radius (30% thinning intensity) around the bole of the crop tree.

In the yellow birch release, cutting all competing trees within a radius of 1 or 2 metres around the bole of the crop tree (i.e., 10 or 20% thinning intensity) provided only temporary relief (Figure 8). Five years after the release the space available for crop tree crown expansion had nearly closed and a second release is required now to prevent a severe decrease in diameter increment as the result of limiting crown expansion.

Release at a 3-metre radius (i.e., 30% thinning intensity) provided a 14.5 m² space for yellow birch crop tree crown expansion. Five years later this space had shrunk to 4.6 m² (Figure 8). To maintain maximum diameter increment a second release will be required soon and certainly not later than 10 years after the first release.

Release of a 4-metre radius (i.e., 40% thinning intensity) removed all trees competing with the yellow birch crop trees. Although diameter increment was highest in this treatment, clear bole length was reduced and stem quality was degraded by the development of epicormic branches (Figure 12 and Table 6). This treatment was also the most expensive because an average of 29 non-crop trees were cut around each crop tree. The drastic opening of the canopy allowed much sunlight to reach the forest floor. As a result, many of the stumps have suckered. This did not occur in the less severe thinning treatments.

Cutting all non-crop trees within radii of 10 and 20% of the mean height of the dominant (i.e., 1 or 2 m around the boles) sugar maple crop trees increased crop tree diameters

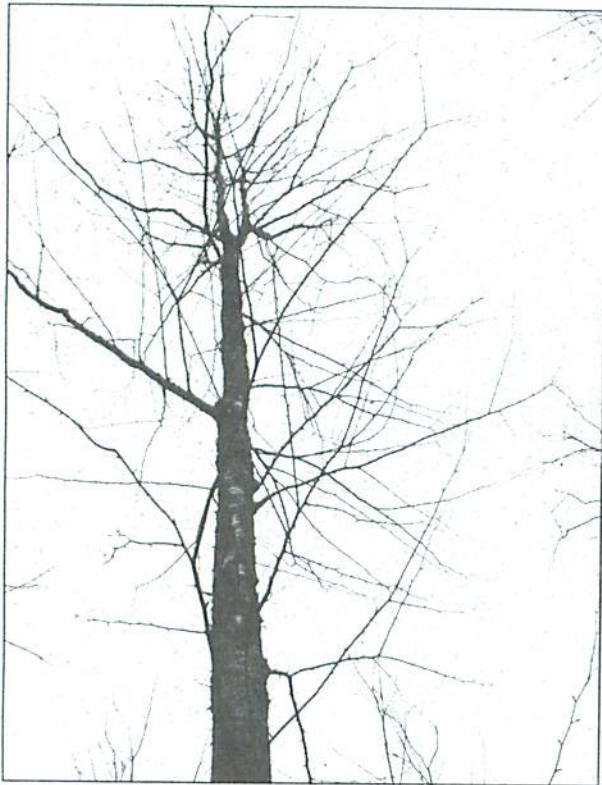


photo by: F.W. von Althen

Figure 12. Epicormic branches on the stem of a yellow birch crop tree released at 40% intensity.

by 57 and 114%, respectively (Figure 5) without any increase in the number of epicormic branches (Table 6). Release at 3 metres increased diameter increment of the crop trees by 171%. But the number of epicormic sprouts also increased.

Crown expansion of sugar maple crop trees was slower than that of yellow birch crop trees (Figures 8 and 9). The 20% (i.e., 2 m) release may therefore be adequate to provide space for sugar maple crown expansion for a few more years. However, release at 30% (i.e., 3 m) is recommended to assure maximum diameter increment during the next 5 years. A second thinning should be carried out at that time.

In the crop tree release described in this report, crop tree selection was carried out by inexperienced forest workers who had received little training. In crop tree selection, overemphasis was placed on stem form and insufficient emphasis on tree size. This resulted in the selection of a number of small, well shaped codominants and intermediates while large dominants of somewhat poorer, but nevertheless acceptable stem form, were ignored. Figure 6 indicates that larger trees, at time of treatment, always grew faster than smaller trees. This is not surprising because in this even-aged stand, trees of larger diameter at time of treatment had outgrown the smaller trees during

the last 22 years. Following release, this superior growth rate was then either maintained or accelerated. Because the selection of the best crop trees is of vital importance to the success of any release, crop trees should only be selected by only well-trained, knowledgeable workers capable of exercising good judgement under variable stand conditions.

SUMMARY AND CONCLUSIONS

Crop tree release increased the 5-year diameter increment of 22-year-old yellow birch and sugar maple saplings. Larger increases were associated with greater release. Width of the crop tree crowns of both species increased greatly with the degree of release and was positively correlated with available space. Release had little effect on total height of either species. Clear bole length of the yellow birch crop trees decreased in the 40% release while clear bole length of the sugar maple crop trees was little affected by intensity of release. Few epicormic sprouts developed following the release of yellow birch crop trees at the 10 to 30% intensity. However, at the 40% intensity, nearly 50% of crop trees developed large epicormic branches which will degrade stem quality. Most sugar maple trees had some epicormic sprouts growing on the stems at the time of treatment. While release at 10 and 20% intensity had no effect on the number or size of epicormic sprouts, the 30% release increased their numbers from 2.5 to 7.3 sprouts per tree. However, most of these were small and are not expected to grow into major branches.

Cutting all competing trees at radii of 1 and 2 metres around the bole of yellow birch crop trees provided release for less than 5 years and a second thinning is now required to maintain their growth potential. Release at a 3-m radius provided good balance between diameter increment and stem quality maintenance. Release at the 4-m radius provided the largest diameter increment but also degraded stem quality by decreasing clear bole length and stimulating the development of large epicormic branches.

Release of sugar maple crop trees at a 1-m radius increased diameter increment by 57%. However, 5 years after release inadequate space remains for further crown expansion. Release at radii of 2 and 3 metres increased diameter increment by 114 and 171%, respectively, with adequate space for crown expansion for a further 5 years.

The release carried out by a work crew hired under a Canada Job Development program had a significant positive impact on the participants. Several crew members proceeded to gain full employment with local and other agencies and one crew leader became project leader and continued to manage other projects.

RECOMMENDATIONS

1. Apply the first crop tree release in sapling stands 15 to 25 years old.
2. Release 200 to 250 yellow birch crop trees or 175 to 200 sugar maple crop trees per hectare.
3. Have crop trees selected by well trained, knowledgeable workers capable of exercising good judgement under variable stand conditions.
4. For yellow birch release, apply the crown-touching method in which all trees are removed that touch the crown of a crop tree, or remove all trees to create an opening 150 to 200 cm wide around the circumference of the crop tree crown.
5. For sugar maple release, apply the crown-touching method or remove all trees to create an opening 120 to 150 cm wide around the circumference of the crop tree crown.
6. Plan to repeat the release at 10-year intervals.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of Brian Fox, Brad Eagleson, Bruce Bennet, and Hank Babbitt in the layout of the crop tree release operation and the hiring and supervision of the crew. Funding for this project has been provided in part through the Northern Ontario Development Agreement, Northern Forestry Program.

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APPENDIX 1

Gould Township Thinning Trial Tally Sheet

PLOT.....

CROP TREE #.....

SPECIES.....

HT 87(m).....

DBH 87(cm).....

HT 91(m).....

DBH 91(cm).....

COMPETITION REMOVED

tree no	dist. to crop tree (cm)	quadrant	species	stump diam (cm)	Plot Notes (form, epicormic br, sun scald)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

1 M.

