

Dolman Ridge (Borthwick) Nut Grove Growth Rate Study Report – December 2009

**Eastern Chapter – Society of Ontario Nut Growers (ECSONG)
Ottawa Stewardship Council (OSC)
Ontario Ministry of Natural Resources (OMNR)**



Ministry of Natural Resources
Ministère des Richesses naturelles

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NOTE: Ce rapport scientifique est disponible en anglais seulement.

Acknowledgements

This great work could not have been undertaken without the field work assistance provided by the following individuals:

- Nancy Young, MNR Forester
- Joffre Cote, MNR/OSC Stewardship Coordinator
- Lisa Perkins, OSC Stewardship Assistant Summer Student
- Elicia Prystay, MNR Watershed Stewardship Technician Assistant Summer Student

A special thank you goes out once again to Nancy Young for drafting most of this report, for crunching the numbers and undertaking the literature review; it is greatly appreciated.

Introduction

The Dolman Ridge Nut Grove is a unique area nestled in the forested National Capital Commission Greenbelt surrounding the city of Ottawa, Ontario. This area is found in the vicinity of Anderson Rd. The Central Research Forest assumed management responsibility for these lands in the late sixties and established most of these plantations during their reforestation activities in the early to mid 1970's, making them approximately 35 – 40 years old. Unfortunately, the relatively sandy soils of this site are not necessarily ideal for the species that were planted: red oak, white oak, bur oak, black walnut, and American chestnut.

In 2006, the Eastern Chapter of the Society of Ontario Nut Growers (ECSONG) in partnership with the Ottawa Stewardship Council (OSC), acting as the Dolman (Borthwick) Nut Grove Coordinator, established a measurement trial within these plantations in order to assess the growth of the forest stands and ultimately to develop a management prescription to maintain/improve the health of the forest and boost its seed crop and timber volume as part of an agro-forestry demonstration site. All of the trees measured in the plantations were tagged, numbered, and measured (diameter and height) by Stewardship Rangers in 2006; competing vegetation (buckthorn – *Rhamnus cathartica*) was also removed manually at this time. In late July 2009, the trees were re-measured and the tags removed to prevent growth damage to the trees. The average measurements and graphical comparisons of diameter distributions between the two measurement years are summarized in this report along with a literature review of management options for oak and walnut forests/stands.

Method

- Oak plantations were measured/inventoried and tags were removed as per the following:
 - Entire white oak plantation (93 trees).
 - The north section of the bur oak plantation (143 trees north of Nut Tree trail only).
 - Approx. $\frac{3}{4}$ of the red oak plantation (266 trees; only 223 trees used for the analysis based on area measured).
- All black walnut plantation trees were measured / inventoried and tags were removed (134 trees).
- All American chestnut trees were measured/inventoried and re-tagged but no analysis was undertaken due to sample size (11 trees).

Literature Review

In order to gain a proper understanding of how forests and plantations should be managed, it is crucial to first understand the autecology, or silvics, of the species in question. Provided below are some general silvical details for American chestnut (*Castanea dentate*) and black walnut (*Juglans cinerea*) (also applicable to oak). The complete article is provided in Appendix I.

Selected Silvics of American chestnut

The following American chestnut and shagbark hickory (*Carya ovata*) regeneration requirements were often repeated throughout the research literature reviewed:

- Shade tolerance ranges from intolerant to tolerant; but upon more detailed review it would seem that for both species, young regenerating trees (seedlings to saplings) can tolerate shade, but become more intolerant as they mature.
- “[American chestnut] requires a canopy cover for effective seedling establishment”.
- Mature American chestnut trees prefer moist, deep, acidic soils in full sun.
- Essentially the same requirements were pointed out for shagbark hickory, which are growing immediately adjacent to the Dolman Ridge American chestnut stand – off Anderson Rd, Ottawa, Ontario.

Silvics and tending recommendations for black walnut

The following black walnut thinning requirements were often repeated throughout the research literature review:

- Thinnings are applied as needed according to the average diameter at breast height (DBH) of the trees in the plantation rather than according to their age.
- Black Walnut responds well to thinning.
- For maximum growth, crowns should be 5 feet apart from adjacent trees.
- At maturity, trees should be thinned to approximately 100 trees/acre (250 trees/ha) for timber production or approximately 25 to 30 trees/acre (60-75 trees/ha) for nut production.
- Prefers deep, rich, moist soils for maximum growth; however, will grow in drier, less fertile sites at a slower rate.
- Once crown closure occurs and diameter growth begins to decrease, light thinnings should be made frequently (i.e. every 6-10 years).
- If diameter growth has been averaging .4 inches (1cm) per year and drops to .25 inches (0.6cm) over a 2- or 3-year period, thinning is probably necessary.
- A basal area in the range of 40 to 175 ft²/acre (9 to 40 m²/ha) should be maintained.
- Trees only partially released grew about 50 percent more than unreleased trees.
- To be effective, release must be thorough.

Results

The measurement of the plantation trees comprised height, crown diameter estimation, and diameter at breast height (dbh); these data were used in an equation to determine the basal area for each stand. An average tree height for each stand was measured using a Suunto Clinometer. Average Crown Diameter was visually estimated based on several initial baseline ground measurements correlated to crown width. Average diameter at breast height (dbh) was obtained from 2 perpendicular calliper measurements taken at 1.3m above the ground. The data collected for the 2009 measurement are provided in Appendix II.

Table 1. 2006 Plantation Inventory Results and Analysis.

Plantation (species)	Sample Size (n)	Average Tree Height (m.)	Average Crown Diameter (m.)	Average DBH (cm.)	Total Basal Area (m²/ha.)
Black Walnut	134	13.5	5.89	23.48	24.84
Red Oak	223	8.5	4.14	21.33	32.87
Bur Oak	143	7.7	4.22	16.20	44.93
White Oak	93	6.7	4.31	13.56	12.14
American Chestnut	11	7.5	5.82	21.91	n/a

Table 2. 2009 Plantation Inventory Results and Analysis.

Plantation (species)	Sample Size (n)	Average Crown Diameter (m.)	Average DBH (cm.)	Total Basal Area (m²/ha.)
Black Walnut	134/106*	8.7/8.3	25.3/23.8	28.98/20.09
Red Oak	223	4.75	22.7	44.55
Bur Oak	143	5.54	16.1	45.27
White Oak	93	[4.4]	14.7	14.63
American Chestnut	11	9.0	24.1	n/a

* The black walnut analysis includes data both with and without edge trees as it was thought during sampling that the drastic edge-effect on size would skew the results.

Black Walnut Plantation:

The black walnut (*Juglans cinerea*) plantation sampled (n = 134) had an average DBH of 23.48 cm, in 2006 and 25.3cm in 2009 (a difference of 1.8cm) and a basal area of 28.98m²/ha (20.09m²/ha with the edge trees removed). As it was thought that the extra growth achieved by the trees on the edge of the plantation would skew the data, the data were also analysed with these trees removed. Without the edge trees, the average diameter increased 1.6cm from 2006 (22.2cm) to 2009 (23.8cm).

The crowns (average diameter 8.7m) of most trees in the plantation were touching one another, restricting further lateral growth; the literature reviewed suggests that optimum growth is achieved when adjacent crowns are approximately 5 feet apart. Historical records indicate that a thorough thinning has never been undertaken in this plantation. Approximately 40 trees died of natural causes (i.e. most likely succumbed to shade intolerance / competition from neighbouring trees) and 15 trees were removed by NCC in the early 1990's to accommodate adjacent dwellings (i.e. for excavating a water well and proximity to building).

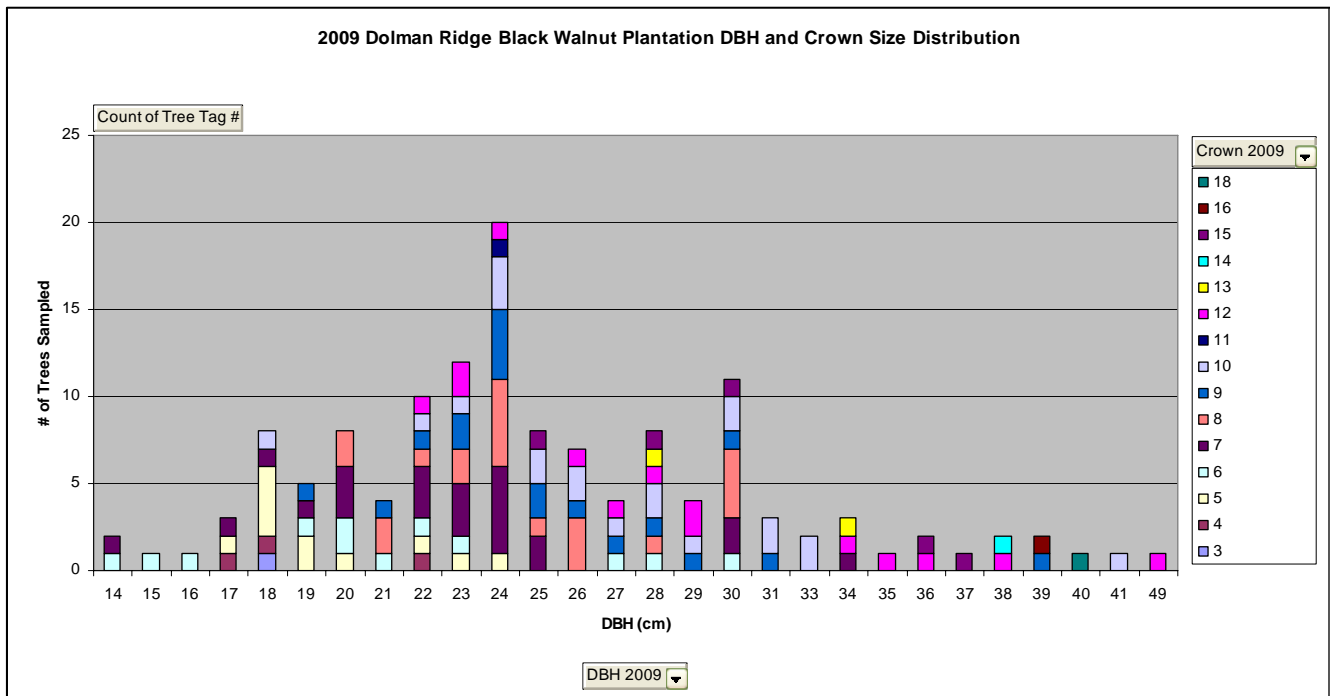


Figure 1. Distribution of trees sampled by diameter at breast height (dbh) showing the relative proportions of crown size.

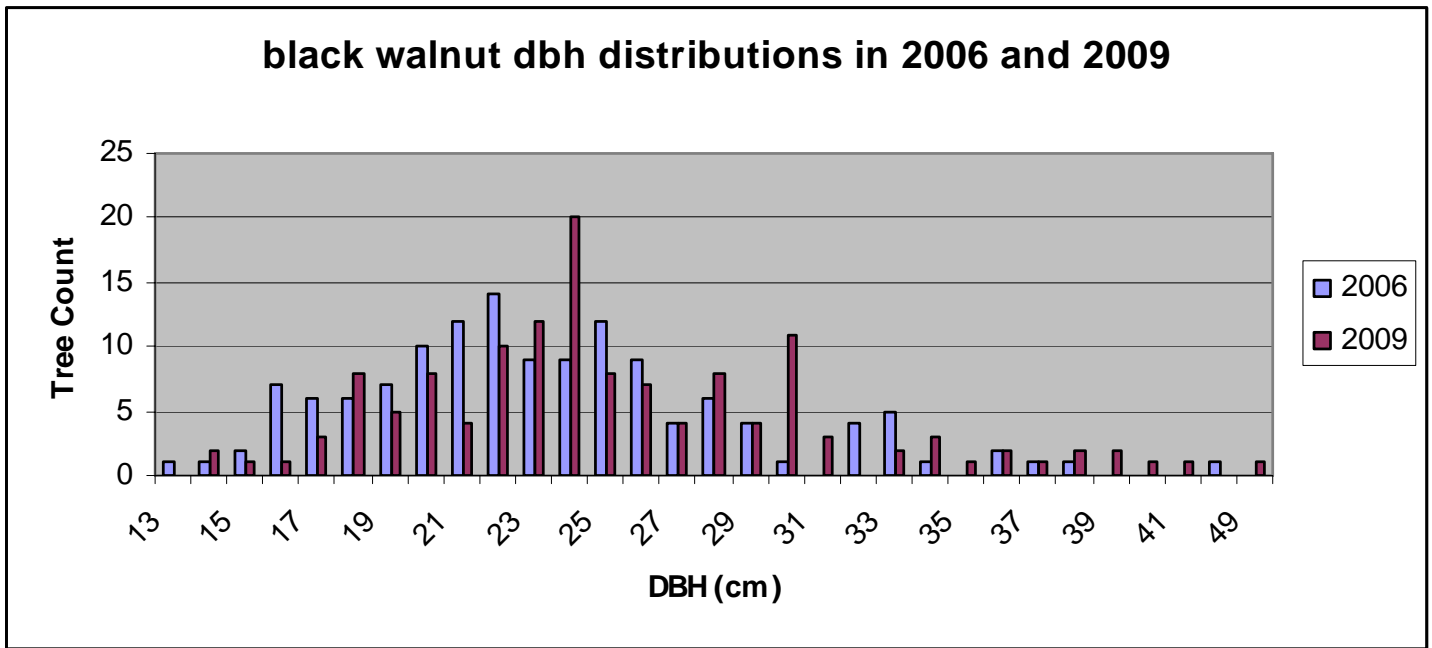


Figure 2. Dolman Ridge Black Walnut Plantation DBH Distributions collected in 2006 and 2009.

Red Oak Plantation:

The section of red oak (*Quercus rubra*) plantation sampled (n = 223) had an average DBH of 22.7cm (a 1.4cm increase in three years). The basal area calculated was 44.55 m²/ha in 2009, as compared to 32.87 m²/ha in 2006. The crowns (with an average diameter of 4.75m) of most trees in the plantation were touching one another, restricting further lateral growth. Historical records indicate that a thorough thinning has never been undertaken in this plantation. A total of 34 trees were removed following the 1998 Ice Storm; Gloucester Hydro removed an entire row of trees adjacent to Anderson Road in the mid-1990's and several others have died of natural causes (i.e. most likely succumbed to shade intolerance / competition from neighbouring trees). From an initial planting of 500 trees in 1973-'74, approximately 300 remain on site today.

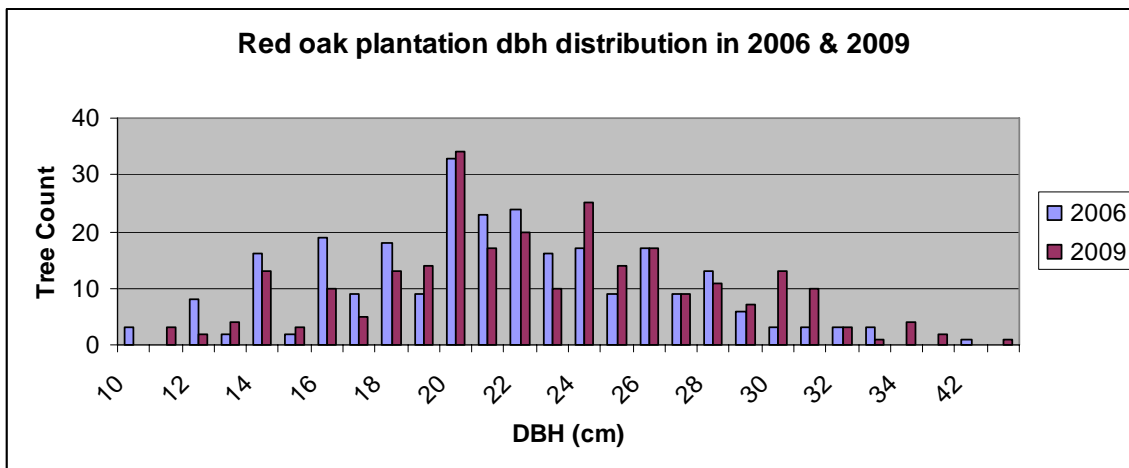


Figure 3. Dolman Ridge red oak plantation DBH distributions in 2006 and 2009.

Bur Oak Plantation:

The bur oak (*Quercus macrocarpa*) plantation sampled (n = 143) north of the Nut Tree trail had an average DBH of 16.1 cm: no change from the previous measurement. The basal area of the bur oak plantation was 45.27 m²/ha. The crowns (averaging 5.54 m in diameter) of most trees in the plantation were touching one another, restricting further lateral growth; optimal crown spacing is 5 feet apart. Historical records indicate that this plantation has never been thinned.

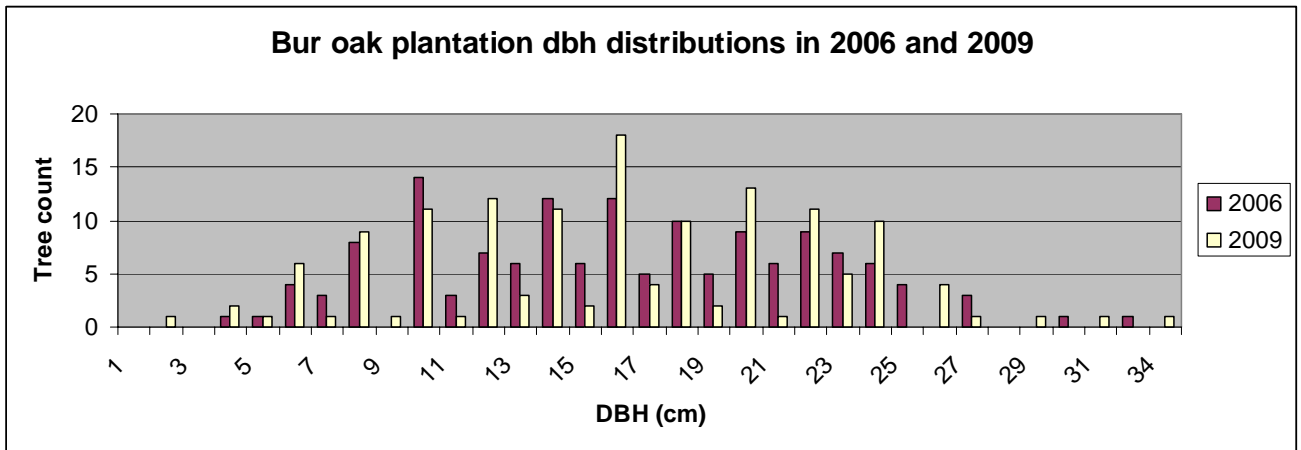


Figure 4. 2006 and 2009 DBH distributions in Dolman Ridge bur oak plantation.

White Oak Plantation:

The white oak (*Quercus alba*) plantation sampled (n = 93) had an average DBH of 14.7 cm and a basal area of 14.63m²/ha. The crowns of most trees in the plantation were far from touching one another and were not restricting further lateral growth. The average Crown Diameter of 4.4 m did not seem to have any specific correlation on the growth of DBH in general within this plantation. This could potentially be attributed to many factors such as seed source, unsuitable geographic growing area / climate, poor soil conditions, etc.

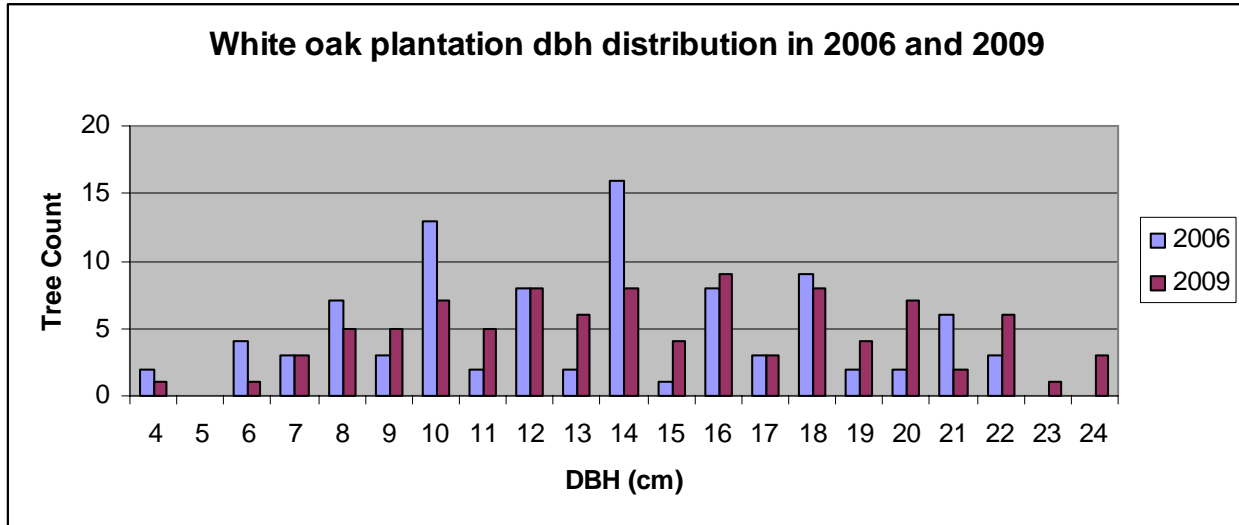


Figure 5. Dolman Ridge White Oak Plantation DBH Distributions collected in 2006 and 2009.

American Chestnut Stand:

The American chestnut (*Castanea dentate*) stand sampled (n = 11) had an average DBH of 24.1cm (an increase of 2.19cm in three years). Due to the very low sample size, no further analysis was conducted. Those trees that are still alive are growing quite well and there is no need for thinning or other management at this point.

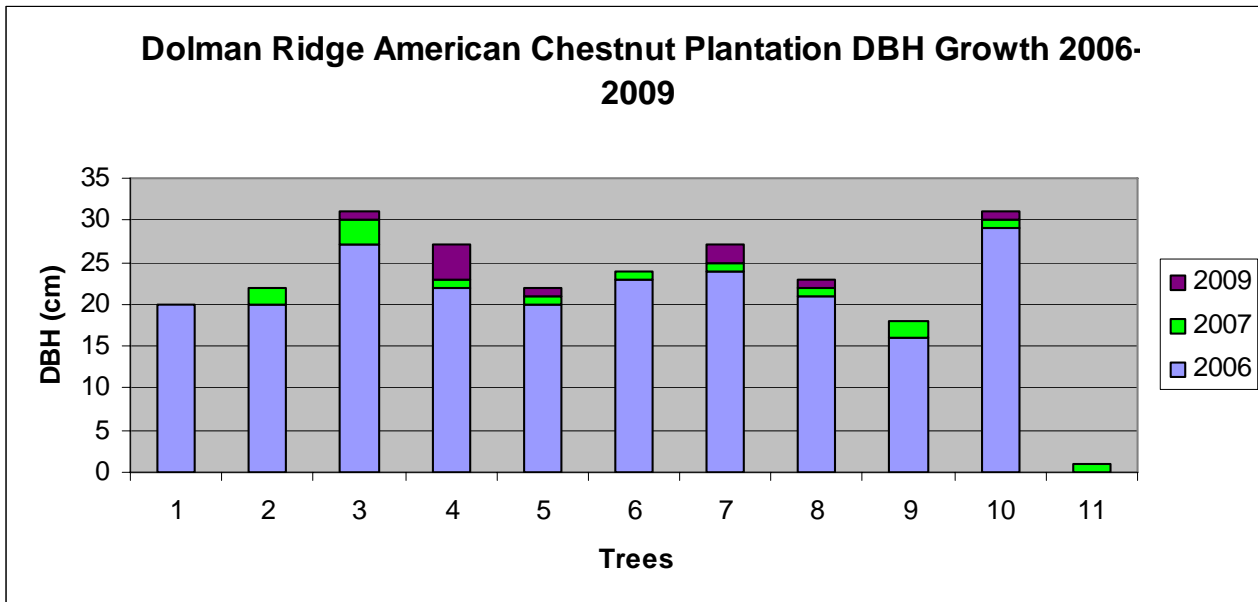


Figure 6. Incremental DBH growth of Dolman Ridge American chestnut trees measured in 2006, 2007, and 2009.

Conclusions

Based on the research literature review conducted, for most hardwood plantations (including black walnut, red, white, and bur oak), a basal area in the range of 9 to 40 m²/ha should be maintained. The black walnut plantation's basal area of 28.98 m²/ha is within these recommended guidelines for basal areas but the annual DBH growth rates are under the optimum level (i.e. from average of .4 inches (1cm) to .25 inches (0.6cm)). The red oak and bur oak plantations had very high basal areas: 44.55 and 45.27 m²/ha, respectively, significantly above the maximum guideline stocking level of 40 m²/ha. The white oak's basal area of 14.63 m²/ha is well within the recommended range.

According to the literature reviewed, for most hardwood plantations the recommended stocking levels for optimum timber or seed production are the following:

- 100 trees/ac (247 trees/ha) for timber production
- 25 – 30 trees/ac (62 – 74 trees/ha) for seed production.

It is hoped that these plantations will eventually be managed as an Agro-Forestry Demonstration Site, to represent a silvicultural system that optimizes both seed and timber production. To achieve this, these plantations (at maturity) should contain approximately 65 trees/ac (160 trees/ha), which essentially translates into leaving approximately 40 black walnut trees (.616ac/.248ha), 41 red oak (.637 ac/ 0.258 ha), 12 bur oak (0.183 ac/ 0.074 ha) and 20 white oak (in 0.304 ac/ 0.123 ha).

Another quantitative and visual way to determine the need for and the level to which a stand should be thinned is to plot the basal area and number of trees per hectare on a stocking diagram (Appendix III, OMNR 2000). These diagrams help to assess the amount of growing space that is occupied by trees (i.e. fully, under, or over-stocked) and the amount that it should be stocked for optimum growth. To use red oak as an example, with a basal area of 44.55m²/ha and approximately 865 trees/ha [223trees/.258ha]: these values are both so high that they are outside the bounds of the stocking diagram, meaning that the red oak stand is very over-stocked and in need of thinning. Bur oak has a similar stocking level; therefore it is recommended that both the red and bur oak stands be thinned. However, the removal of this significant amount of trees in one operation would greatly increase the trees' susceptibility to windthrow or other natural damages due to overexposure after their neighbouring trees are removed. It is recommended that any thinning be done gradually over a number of years to give the trees time to adapt and build strength. A good practice to follow is to remove less than 1/3 of the stems at any one time. Figure 7 shows the response of red oak at different ages to a specific type of thinning, called 'crop tree release' as compared to stands that have not been thinned.

Although the literature recommends leaving only 20 trees in the white oak stand, the narrow shape of the plantation could likely accommodate more. Given this species' typically low growth rates, this plantation is not expected to achieve its full potential for several decades at least. In order to help it achieve its potential in a shorter amount of time, a light thinning could be undertaken.

As well, the black walnut, red, and bur oak plantations have attained crown closure, to the point at which all of the crowns are touching, preventing lateral growth and therefore limiting future diameter growth. As these tree species are generally fairly elastic in response to thinning (at least while they are young), it would be prudent to give the canopies more space to grow within the next few years. According to the literature, the optimum crown spacing between adjacent trees is 5 feet.

Future Management / Activity Recommendations:

1. Undertake thorough thinning operations to effectively release the black walnut, red oak and bur oak plantations; based on a Registered Professional Forester's thinning operation prescription, with the trees marked by a Certified Tree Marker, harvest up to one third of the existing trees within the plantations being mindful of the need for some protection for wind-firmness.
2. Monitor growth rates (i.e. DBH, Height and Crown Diameter) every 3 – 5 years.
3. Undertake subsequent thinning operations as required – not status quo.
4. Continue Buckthorn control, monitoring and maintenance in all plantations, if applicable, including in the American Chestnut / Shagbark Hickory stand.
5. Allow natural regeneration (by native species) to populate the understory, if this addresses the plantations' goals.
6. Monitor for diseases and parasites, often common in monocultures.
7. No thinning of any American Chestnut, Shagbark Hickory or competing mature trees should be undertaken in or adjacent to the American Chestnut / Shagbark Hickory stand to allow for species regeneration which are relatively tolerant to shade.
8. Collect seed from these plantations during good production years to maintain the local population of nut trees.

Sources:

OMNR. 2000. A Silvicultural Guide to Managing Southern Ontario Forests. Version 1.1. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. 648 p.

Miller, Stringer, and Merker. 2007. Technical Guide to Crop Tree Release in Hardwood Forests. US Cooperative Extension Service. www.sref.info/publications/online_pubs.

Ottawa Stewardship Council. 2006. Dolman Ridge (Borthwick) Nut Grove Activities Report. 13p.

Ottawa Stewardship Council. 2006. Dolman Ridge (Borthwick) Nut Grove Activities Report. 18p.

Appendices

Appendix I



CropTreeRelease.pdf

Appendix II



DolmanRidge-Plantations2009.xls

Appendix III



Silviculture_RedOak.pdf