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Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

How Risk and Form Affect Tree Properties of Northern Tolerant Hardwoods

June 2017

Technical Note

Resource Characterization

INTRODUCTION

The Northern Hardwoods Research Institute Inc. (NHRI) has developed a tree classification system for New Brunswick to provide necessary information for predicting (1) product distribution, (2) tree harvesting cost, and (3) timber processing cost (Pelletier et al. 2014). Moreover, this classification is useful for choosing trees of good form (form class, noted F) and high vigour (risk class, noted R) as residual crop trees for the future. In New Brunswick, the tree classification system has been used in forest surveys and research activities since 2012. However, the variation on tree vigour and stem geometry among different risk and form class trees has not been assessed yet. Hence, this paper presents some of the results on how tree height, merchantable bole length, stem taper and diameter growth of some of the northern tolerant hardwood tree species vary among different risk and form class.

HIGHLIGHTS

A healthy (R1) tree of good form (F1):

- **is taller and has a higher diameter growth than other trees of the same given diameter at a site.**
- **has better quality wood and longer merchantable bole since it has less tapered stem.**
- **Provides healthier stands, improving forest regeneration quality.**

METHODOLOGY

Sample trees used in this study were coming from different locations of northwest New Brunswick. Each tree was classified based on tree form and risk class using NHRI tree classification guide (Pelletier et al. 2014). This information was used to assess the effects of tree form and risk class on (1) height-diameter relationship, (2) stem taper, (3) merchantable bole length and (4) diameter growth.

Reviewed: May 2018

1. Height-diameter (HD) relationship:

Height and DBH (diameter at breast height) data of 1167 trees of five different hardwood species (sugar maple, red maple, paper birch, yellow birch and American beech) coming from Gounamitz East, Gounamitz West and Saint-Quentin areas of northwest New Brunswick were used in assessing height-diameter relationship. This data was then used to calibrate an Acadian HD model, as developed by Rijal and Weiskittel (2012).

2. Stem taper and merchantable bole length:

Stem taper and merchantable bole length were assessed for 380 trees of four different species (sugar maple, yellow birch, white birch and red maple) grown in Saint Quentin and Nackawic region of central and northwest New Brunswick. Stem diameters measured at stump height, breast height, and different heights along the main stem (end of log section) were used to calibrate Kozak stem taper function. Merchantable bole length was calculated by adding length of all logs obtained from main stem of the same tree.

3. Diameter growth:

Effects of tree form and risk class on diameter growth was assessed for sugar maple and yellow birch. Average individual tree basal area growth in last five years (cm^2/year) was calculated using increment cores measurement data coming from McCoy brook, Gounamitz and Saint Quentin area of northwest New Brunswick. Site (Biomass Growth Index) and stand level basal area in trees larger than the subject tree variables were used to control the effects of site and competition on tree growth, respectively.

RESULTS

1. Height-diameter (HD) relationship:

Among sugar maple, red maple, white birch, and yellow birch, there was no significant effect of species on tree height for the given DBH. Trees of low risk of losing vigour (R1: No defects) were found significantly taller than the trees of high risk of losing vigour (R2, R3, and R4: trees with defects) (Figure 1A). Similarly, trees of form class 1 (F1: straight) were taller than inclined and forked trees (trees with sweep, inclination and forks) for a given DBH (Figure 1B). Prediction ability of the HD model was improved by 4% when broad categories of tree risk (R1 and other) and form class (F1, F2 and F6, and Other) were included in the existing HD model by Rijal and Weiskittel (2012).

2. Bole length and stem taper:

Since there were not enough observations in each combination of tree form and risk class, the classes were merged into four broad categories (see Table 1): NVF, NVNF, VF, and VNF. Merchantable bole of VNF trees were significantly longer than NVF trees (See Figure 2).

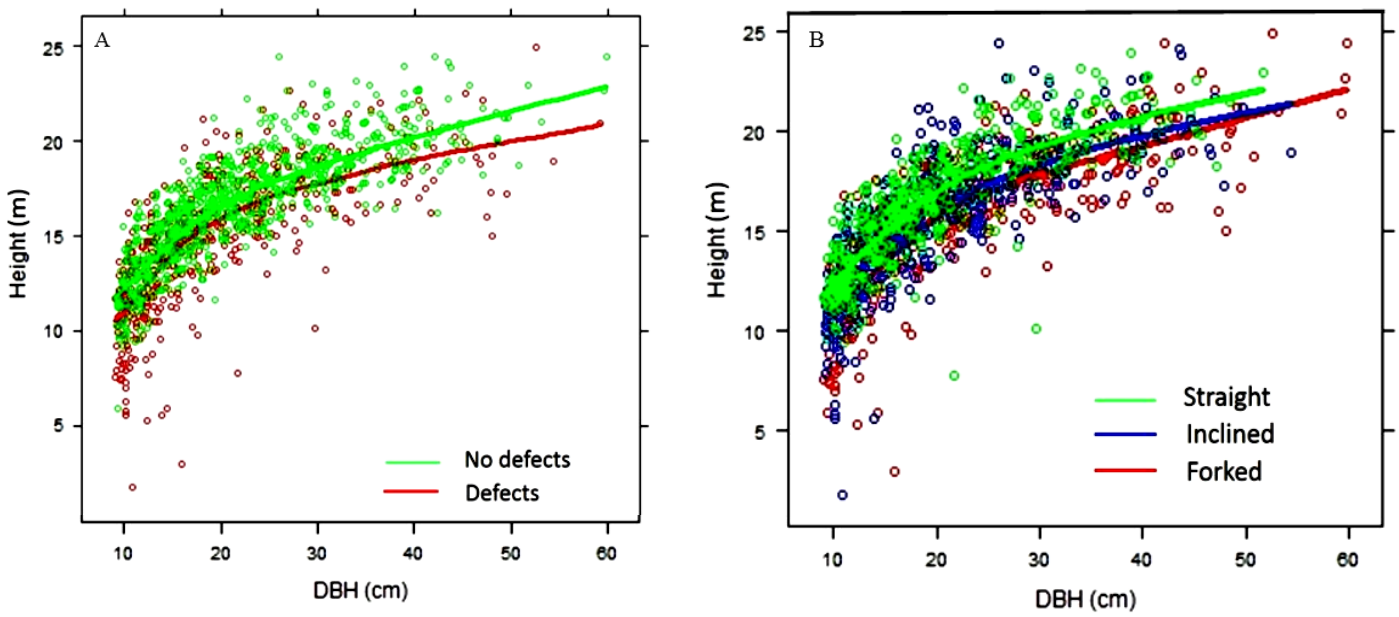

Figure 1: Height-diameter relationship of different risk and form class trees.

Table 1: Categories of combinations of tree forms and risk classes (see the technical note from July 2015 (2015-1-01) for more information about the Tree Classification System).

Category	Name	Tree Risk	Tree form
NVF	Non-vigorous and forked	R2 R3 R4	F3 F4 F5 F7
NVNF	Non-vigorous and non-forked	R2 R3 R4	F1 F2 F6 F8
VF	Vigorous and forked	R1	F3 F4 F5 F7
VNF	Vigorous and non-forked	R1	F1 F2 F6 F8

Shorter merchantable bole length of NVF tree must be due to (1) presence of defects or damages and (2) presence of fork. Merchantability of the log section can be compromised when a serious defect or a large knot (fork) is present. On the other hand, the main stem tapers rapidly above the fork or big branch insertion point. In Figure 3, we can see that relative diameter (stem diameter/ diameter at breast height) tapers more rapidly as relative height increases (height of measurement/tree height) for NVF trees than other category trees. To the contrary, VNF trees have least tapered stems.

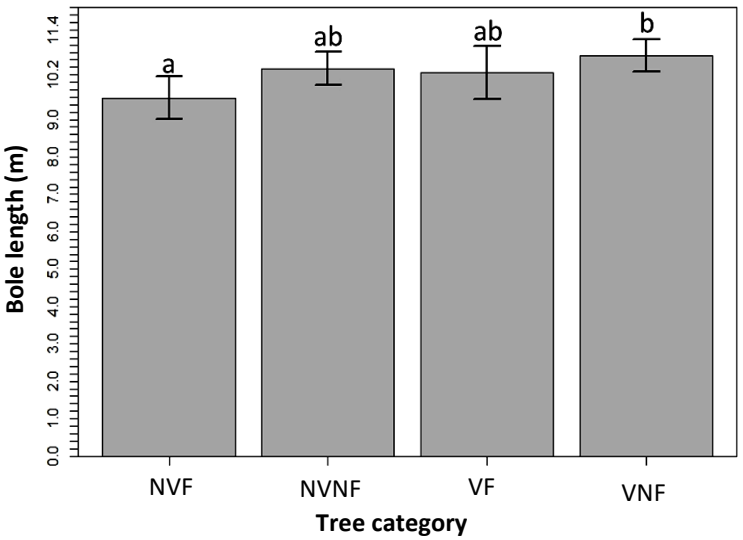

Figure 2: Merchantable bole length of different tree form and risk class trees (Note: The merchantable bole length excludes the length of butt cut).

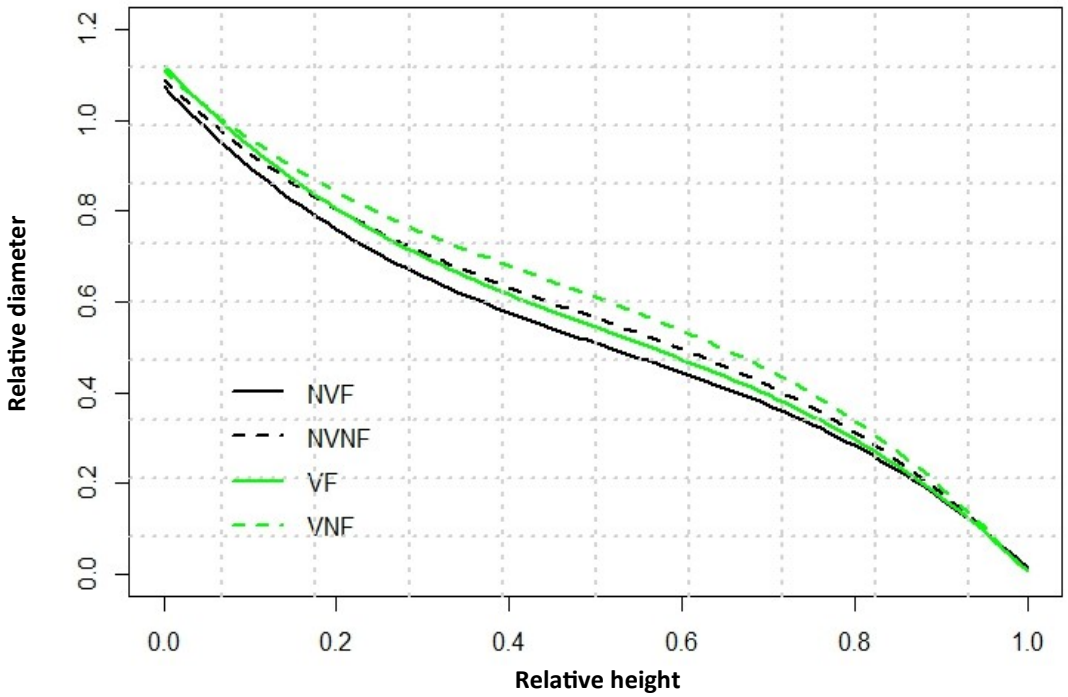

Figure 3: Effects of tree form and risk on stem tapering. Relative diameter = stem diameter / diameter at breast height. Relative height = height of measurement / tree height

3. Effects of risk class on individual tree basal area growth:

In general, yellow birch trees had higher growth than sugar maple. However, trees of higher risk of losing vigour grew poorly for both sugar maple and yellow birch (Figure 4).

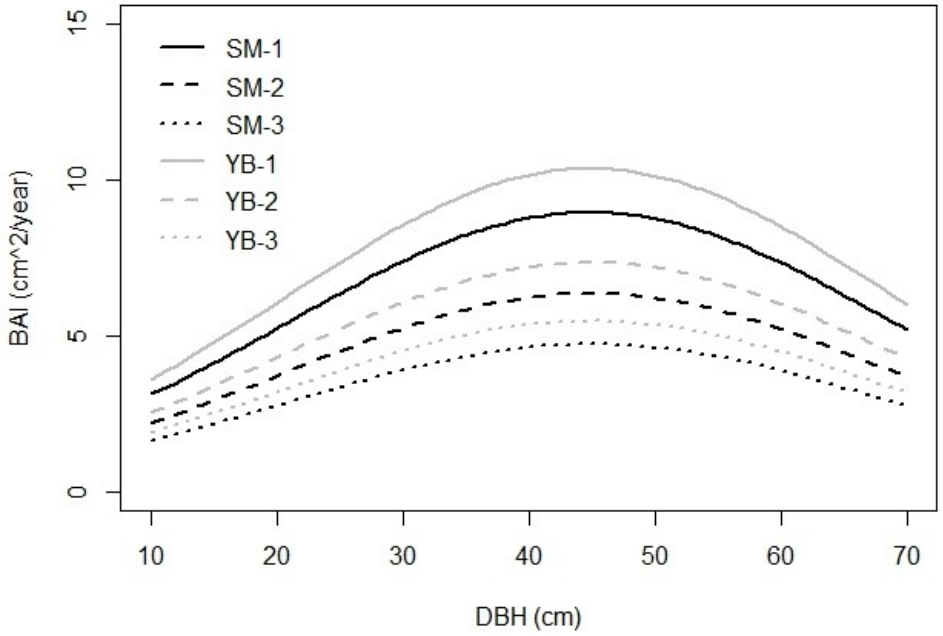

Figure 4: Effects of risk class on individual tree basal area growth. SM = sugar maple, YB = yellow birch, 1 = risk class 1, 2 = risk class 2 ,and 3 = risk class 3. Trees of risk class 4 category were excluded as we did not have enough observations.)

CONCLUSION

The results showed that trees vary significantly on stem geometry and growth based on their form and risk class category. It has two important implications: (1) it is important to maintain higher proportions of tree with low risk of losing vigour and good form (R1F1) for improving stand health and quality, and (2) it is also important to consider tree form and risk class on tree biometry (e.g.: equations to predict tree height, volume, stem taper, etc.) to obtain less biased estimates. However, the results presented here are based on the data coming from different experiments at different times. Thus, it is cautioned that the results have limited geographical scope and are associated with methodological inconsistencies.

REFERENCES

Pelletier, G., Landry, D., Girouard, M., 2014. A Tree Classification System for New Brunswick (Version 1.3). Northern Hardwoods Research Institute Inc., Edmundston, New Brunswick.

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