Foresters care about site productivity and stem quality in Douglas-fir plantations for many reasons. The profitability of forest land and the economic returns on silvicultural investments are directly related to site productivity. Thus, understanding the relationships among Douglas-fir productivity, stem form and site characteristics is important economically. My objective was to identify the specific site characteristics that explained variation in Douglas-fir productivity and stem form throughout western Oregon and Washington by using progeny tests that substantially reduced the confounding effects of genotype by environment interaction. These assessments were undertaken to advance our understanding of near-term climate change effects on Douglas-fir productivity and stem form. The site characteristics I focused on include climate, soils and topography. Measures of site productivity and stem form were explained using correlation, random forest, and linear regression analyses. The results of these analytical methods were summarized as total importance scores. The consistency of important site characteristics identified by the analytical methods and the consistency of important site characteristics for explaining variability in different productivity measures were assessed using Spearman rank correlations. The results of this study provide new direction and insight for future research on understanding and modeling the effects of site characteristics on tree growth and form. It may be reasonable to focus future research on summer drought, cold season temperatures and precipitation interactions with soil properties, particularly available water capacity when examining site productivity. Additionally, examining genotype by environment interactions at the family level may provide insight to the driving site characteristics for stem forking, ramicorn branching and sinuosity.
Identifying Site Characteristics That Explain Variation in Douglas-fir Site Productivity and Stem Form.

by

Lauren E. Magalska

A THESIS

submitted to

Oregon State University

in partial fulfillment of the requirements for the degree of

Master of Science

Presented September 16, 2011
Commencement June 2012
Master of Science thesis of Lauren E. Magalska presented on September 16, 2011.

APPROVED:

Major Professor, representing Forest Science

Head of the Department of Forest Ecosystems and Society

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Lauren E. Magalska, Author
ACKNOWLEDGEMENTS

There are many people that have contributed to the successful completion of my master’s degree and I would like to express my sincerest gratitude to all of them. I would like to thank my major professor, Glenn Howe, for all of his time, insight and guidance. I would like to thank Scott Holub for his advice on working with the soils site characteristics. I would like to thank Robin Rose for agreeing to step in at the last minute. I would also like to thank Jeff Stone, my Graduate Council Representative, for volunteering his time to serve on my committee. I would also like to thank Doug Maguire for all of his support and guidance throughout the writing process, which have been instrumental to my success.

This work could not have been completed without the cooperation and support of the Northwest Tree Improvement Cooperative. Keith Jayawickrama, Denise Cooper, and Terrance Ye were extremely helpful throughout the data analysis phase. Additionally, Jim Smith, Jeff DeBell, Sarah Lipow, Randall Green, Dan Cress and Rich Kelly provided much needed support throughout the test site location phase.

I would like to acknowledge the student workers that have helped on a variety of tasks over the past three years. Annie Simmonds, James Crawford, and Elaine Blampied were all very helpful.

My graduate education and this project were supported by the Center for Advanced Forestry Systems, the Pacific Northwest Tree Improvement Research Cooperative, the Henry and Mildred Fowells Graduate Fellowship, the J.R. Dilworth Memorial Fund, the Richard and Doris Waring Graduate Student Travel Award, the OSU Student Chapter of the Society of American Foresters, the Gordon Carlson Scholarship, the Schutz Family Education Fund, and the Jackie Cain Memorial Scholarship.

Finally, I would like to thank all of my family and friends for their support. I feel very lucky to have spent my time at OSU with some of the most amazing, intelligent, supportive, and fun people that I met in my life. Thanks for all of the distractions!
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1 Introduction

Douglas-fir (*Pseudotsuga menziesii*) is an important species in the Pacific Northwest (PNW) of the United States, dominating approximately 8.3 million hectares of forestland in Oregon and Washington (FIA Program 2008). The volume of Douglas-fir on this land is enormous, with over 2.83 million cubic meters of standing timber (FIA Program 2008).

Foresters care about site productivity and stem quality in Douglas-fir plantations for many reasons. The profitability of owning forest land and the economic returns on silvicultural investments are directly related to site productivity. Thus, understanding the relationships among Douglas-fir productivity, stem form and site characteristics is important economically.

Foresters measure site productivity in a variety of ways. Site index is a common measure of inherent site productivity and represents the height of dominant trees of the selected species at a specific base age (Avery and Burkhart 2002). Maximum potential basal area, stem volume increment and net primary productivity (NPP) have also been applied as measures of site productivity. Shoot growth, cambial growth, injury and mortality all influence site productivity.

After volume growth, stem quality is the most important factor determining tree value. Stem quality is determined by the presence or absence of stem attributes and growth defects that can reduce the value of a tree. The two most important growth defects in Douglas-fir are stem forks and ramicorn branches. These defects can reduce the value of a tree in two ways: 1) a portion of the stem may be unmerchantable; and 2) large knots can cause a reduction in log or product grade (Howe et al. 2006). Stem forks and ramicorn branches are positively associated with the frequency of second flushing (Schermann et al. 1997), which is the growth of late season shoots. In addition to predisposing trees to stem forks and ramicorn branching, second flushing can negatively impact stem form by increasing susceptibility to damage from late season drought and early fall frost (Adams and Bastien 1994). Stem forks and ramicorn branches can be difficult to visually distinguish from one another. Nevertheless, it is important to distinguish the growth mechanisms that lead to
these defects. Howe et al. (2006) observed that “forked stems are often formed if the terminal leader is damaged or killed, and two branches subsequently assume equal dominance.” Ramicorns are large, high angled branches (Helms 1998) that occur when the terminal shoot loses apical dominance to a lateral branch (Schermann et al. 1997). Loss of apical dominance seems to be promoted by decapitation or defoliation of the terminal shoot (Cline and Harrington 2007). Loss of apical dominance is also enhanced by fertilization, supporting the mineral nutrient-deprivation hypothesis, i.e., that lower branch growth is repressed because nutrients are diverted to the upper dominating branch or shoot (Cline et al. 2009).

A third important stem defect is sinuosity. Stem sinuosity is defined as crookedness that occurs entirely within an interwhorl (Campbell 1965). A decrease in grade can occur in extremely sinuous trees, and intensive management of Douglas-fir plantations appears to be increasing the frequency of sinuosity (Gartner and Johnson 2006). Additionally, sinuosity increases compression wood and leads to reduced pulp yields (Zobel 1971, cited in Adams and Howe 1985) and lower quality lumber and plywood (Shelbourne 1969; 1970, cited in Adams and Howe 1985). Sinuosity in other tree species has been associated with nutritional deficiencies (reviewed in Spicer et al. 2000), previous land use (e.g. use as pasture; Carlyle et al. 1989) and bent taproots (Gatch et al. 1999; Harrington et al. 1999). Stovall et al. (2011) found that loblolly pine height growth was not significantly correlated with the severity of sinuosity. The causes of sinuosity in Douglas-fir remain poorly understood. Gartner and Johnson (2006) showed that the leader angle was not different in more sinuous Douglas-fir. Spicer et al. (2000) showed that mean internode length did not differ among the control, high, medium, and low sinuosity groups, which suggests that leader damage is not a major cause of sinuous growth. Campbell (1965) concluded that leader length was negatively correlated with sinuosity and leader diameter was positively correlated with sinuosity, but that much of that variation in sinuosity remained unexplained. Adams and Howe (1985) showed that stem displacement, as a measure of sinuosity, had a narrow-sense family heritability of 0.59.
1.1 Forest management models

Many types of models are available to estimate characteristics associated with sustainable forest management. These models can be grouped into six general categories, including empirical growth and yield, ecological gap, ecological compartment, mechanistic, vegetation distribution and hybrid models (Monserud 2003). Each of these types of models generates different outputs and is designed to answer different questions about responses to forest management or fundamental principles of forest dynamics. Because this project is focused on environmental influences on timber production, empirical growth and yield models and mechanistic models are the most relevant to the questions I addressed. Both types of models can be designed and implemented at the resolution of individual trees or whole stands.

1.1.1 Empirical Growth and Yield Models

Empirical growth and yield models have a limited ability to predict the response of site productivity to changes in environmental conditions. Because these models predict future growth based on past growth (e.g., site index), they are primarily useful in areas that are currently forested or that have estimates of site index from previous measures of dominant height and age. Site productivity for lands that currently lack trees can be estimated from other site characteristics such as soil attributes or plant associations. In empirical growth and yield models, site index is used as a standard measure of productivity. This measure can be problematic in uneven-aged stands because trees that have never experienced growth suppression for some period of time may not be available for estimating true height growth potential. In this context, “stand age can be meaningless, and site index unreliable” (Monserud 2003). In addition, empirical models have historically not taken dynamic soil processes or annual climate fluctuations into consideration. Soil processes, such as carbon and nutrient cycling, influence site productivity directly and through their effects on water holding capacity and nutrient availability to plants. Climate, as described in section 1.2, also imposes annual variation in site productivity (Monserud 2003). Both the rate and nature of soil processes and seasonal climate conditions have the potential to change over the life of the stand. Changes in these site characteristics may lead to changes
in annual growth rates. However, most empirical growth and yield models are based on the assumption that site characteristics are static and their effects on growth remain unchanged during the life of a stand. Although this assumption has been widely recognized as an operational simplification, practical application of growth models in forest planning must face the reality that future climate conditions are not known with certainty. Coarse projections of future climatic variables have only recently become available, providing motivation for linking forest growth to possible changes in climatic conditions and related soil processes.

1.1.2 Mechanistic Models

Mechanistic models predict productivity from fundamental ecophysiological processes that are driven by light, soil attributes and weather. The outputs of most mechanistic models are not at a resolution that is useful for timber management. Additionally, a large number of predictor variables and associated parameters must be measured or estimated in order to use mechanistic models. Collecting sufficiently accurate soils and climatic data at an appropriate resolution for managing large land bases has not been practical.

1.2 Site Characteristics

Researchers have been examining relationships between site productivity and site characteristics (i.e., climate, soils, and topography) since the early 20th century (Frothingham 1918). Because of limitations in data availability, technology, and our understanding of ecophysiological processes, this work is continuing today and will likely continue well into the future. Because NPP can be used as a measure of site productivity, the environmental controls (i.e., solar radiation, temperature, nutrients and water; Cramer et al. 1995) on NPP are also helpful for understanding timber productivity of a site. Climate represents the variation in meteorological activity over a long period of time, and is typically described using 30-year “normals”, which are the arithmetic means of weather variables over a 30-year period (Helms 1998). Climate can also be used to describe shorter periods, such as five- to ten-year growth periods corresponding to typical plot remeasurement cycles. In my thesis, I use “periodic growth climate” to refer to the climate that corresponds to the growing
seasons included in specific growth periods. Weather refers to meteorological activity at a single, specific point in time. The relationship between climate and site productivity has not been thoroughly studied. Until recently, the modeling of high resolution climate data at landscape scales has been difficult. The release of multiple high resolution climate models (Daly 2006) has increased our ability to examine the relationship between climate and site productivity. The availability and accuracy of soils data has also been a barrier to quantifying relationships between soil attributes and site productivity. Nevertheless, soils processes are known to be a major factor affecting site productivity (e.g. Steinbrenner 1981). Finally, topographic site characteristics are important for their independent contributions to site productivity, such as their effects on lateral movement of ground water and nutrients, and their ability to serve as surrogates for site characteristics that are difficult to measure directly. For example, the aspect of a site can be a surrogate for the amount of photosynthetically active radiation (PAR) potentially intercepted by the forest canopy. Additionally, site characteristics such as elevation contribute to the interpolation of the climate site characteristics through incorporation in high resolution climate models.

1.2.1 Predicting forest productivity from site characteristics

Considerable effort has been devoted to relating forest productivity to site characteristics, and many models have been developed to simulate forest productivity based on fundamental growth mechanisms and their driving environmental variables. Some prominent examples are FOREST-BGC (Running and Coughlan 1988), BIOMASS (McMurtrie et al. 1990), PnET (Aber and Federer 1992), and the Physiological Principles in Predicting Growth (3-PG) model (Landsberg and Waring 1997). The 3-PG model predicts stand productivity for a wide range of forest types from climate, soils, and stand characteristics (Landsberg et al. 2003). The site productivity values predicted from this model are reliable and robust, but the outputs are provided in a format that is not directly useful for timber management.

In addition to growth models that simulate underlying processes, researchers have investigated the empirical relationships between growth and site characteristics. Fralish (1994) predicted productivity from soils and topographic site characteristics for mixed
hardwood stands in the Illinois Shawnee Hills, USA. He was able to explain 93% of the variation in basal area (BA) from available water capacity, slope position, and aspect. Iverrson et al. (1997) predicted forest productivity of mixed hardwood forests dominated by oak in Ohio, USA. The curvature and flow accumulation of water across the landscape, as well as the moisture content and total water holding capacity of the soil, were used to explain 64% of the variation in site index. Monserud et al. (2006) predicted lodgepole pine site productivity from climate and ecosystem classification and found that they could explain 27% of the variation in lodgepole pine site index using the Julian date at which growing degree days above 5°C reached 100. Wu et al. (2005) explained 72% of the variation in individual lodgepole pine 20-year height using biogeoclimatic zones and subzones. The biogeoclimatic zones were defined by elevations, growing season lengths, temperatures and moisture gradients.

1.2.2 Predicting Douglas-fir productivity from site characteristics

Douglas-fir site productivity has been predicted using one or more of the three categories of site characteristics (i.e. climate, soils and topography). In a study covering northwestern United States mountain ecosystems, Littell et al. (2008) were able to explain 53% of the total variance in Douglas-fir radial growth. They found that temperature in late spring and early summer of the current growing season was negatively correlated with growth and, conversely, that growth was positively correlated with precipitation in late spring and early summer in the current growing season and mid-to-late summer of the previous year. Chen et al. (2010) found that coastal Douglas-fir growth was limited by summer dryness and low precipitation, whereas interior Douglas-fir growth was limited by high growing season temperatures. Productivity differences among populations of Douglas-fir in the North Cascade Range, Washington, were further highlighted by Case and Peterson (2005). The growth of mid-elevation populations were negatively correlated with growing season maximum temperature and positively correlated with growing season precipitation. Conversely, high-elevation growth showed a positive correlation with annual temperature and a negative correlation with the prior year’s Pacific Decadal Oscillation index. In a study by Monserud and Rehfeldt (1990), 31% of the variation in site index at age 50 in northern Idaho
and western Montana was explained by elevation. When combined with the effects of latitude and longitude, 39% of the variation in site index was explained. In this case, latitude and longitude served as surrogates for climate. Klinka and Carter (1990) demonstrated that soil moisture regimes (SMRs) and soil nutrient regimes (SNRs) explained 84% of the variation in site index in British Columbia using a regression model. Five classes of SMR and SNR were used, ranging from scarcity to abundance. Additionally, SMRs and SNRs were better predictors of site index than more direct environmental measurements such as water deficit and soil mineralizable-N. When taking climate and soils into consideration, Steinbrenner (1981) was able to explain 74% to 90% of the variation in site index in Oregon and Washington. Effective soil depth was an important site characteristic in all of the models presented. Effective soil depth is the total soil volume minus the volume of fragments greater than 2mm. Nigh (2006) explained 55% of the variation in Douglas-fir site index in British Columbia using SNR, SMR and average annual accumulated degree-days above 5°C. Other average annual climate variables were examined, but were not significantly correlated with site index.

Climate and soils have also been incorporated mechanistically into physiologically based growth models that predict site index. To estimate site index in 3-PG, daily average air temperature, total precipitation, number of frost days, average daily daytime vapor pressure deficit, and daily total shortwave radiation were obtained from DAYMET; soil C and N content were estimated from STATSGO soil classification surveys. Estimates from 3-PG explained 55% of the observed variation in site index across the state of Oregon (Swenson et al. 2005). The 3-PG model was also used by Coops et al. (2007) to map the environmental growth limitations of Douglas-fir on Vancouver Island in British Columbia. They found that suboptimal temperatures and high vapor pressure deficits limited growth. In addition to the 3-PG mechanistic model, hybrid models have been used to predict growth in Douglas-fir. Weiskittel et al. (2010) used daily weather, topography, soils, and stand structural attributes to model Douglas-fir growth in Oregon. The growth predicted by the model was strongly correlated with the observed growth ($p < 0.0001; r = 0.73$). Corona et al. (1998) examined the relationship between site characteristics and site index of Douglas-fir plantations in central
Italy. They found that approximately 58% of the observed variation in site index could be explained by climate, soils and topographic site characteristics. The most important site characteristics were annual precipitation, water surplus, clay content, calcium-carbonate content and east-west aspect.

In the preceding examples, the genetics of the sample sites were not controlled. The ability to control genetics is an important distinguishing factor of my thesis project and is discussed in detail in sections 1.4 and 1.5.

1.2.3 Predicting other important Douglas-fir attributes from site characteristics

Site characteristics have also been used to predict other important forest attributes, such as adaptive genetic variation and disease risk (Manter et al. 2005; St Clair et al. 2005). Each of these studies resulted in maps that depicted geographic variation in these attributes. St Clair et al. (2005) correlated site climate characteristics to genetic variation in spring and fall cold damage. The climate characteristics that predicted this adaptive genetic variation were average maximum daily temperatures in February, May, and July, average precipitation in July, August, and September, and the date of the last spring frost. This work resulted in two maps covering western Washington and Oregon. One map represented the genetic variation in vigor (i.e., later bud-set, faster emergence, larger seedling sizes and increased partitioning to shoots versus roots); the other represented the genetic variation in bud burst and growth partitioning (second-year diameter versus height). Manter et al. (2005) correlated site climate characteristics to Swiss needle cast risk. The average daily temperature in December, January and February ($T_{\text{winter}}$) was positively correlated with the frequency of fruiting bodies from causal fungus in both 1- and 2-year needles. Two maps of western Oregon were developed from the resulting regression models, one representing the percent of one-year-old needles infected, and the other representing the percent of two-year-old needles infected. The ability to explain variation in both adaptive genetic variation and disease risk with site characteristics indicates that it may also be possible to explain variation in stem form.
1.2.4 Ecophysiology

Drought, temperature, light intensity, photoperiod and nutrients influence shoot growth. In Douglas-fir, drought and temperature were correlated with the duration of shoot elongation (Emmingham 1977). In woody species, late summer drought reduces the number and growth of multiple flushes (Kozlowski and Pallardy 1997), and may induce early dormancy (reviewed in Lavender 1981). Shoot growth slows in late summer even when temperature and moisture conditions are favorable for growth, indicating that photoperiod and endogenous controls also influence dormancy induction (Emmingham 1977). Late season moisture often leads to second flushing which reduces the time available for bud set and the amount of predetermined shoot growth the following season (Lavender 1981). Shoot elongation may also be reduced by exposure to warmer temperatures during bud dormancy (Kozlowski and Pallardy 1997). Late summer shoot growth may lead to later growth initiation the following spring. Temperature, light intensity and photoperiod can affect bud flush in Douglas-fir (reviewed in Lavender 1981). After shoot growth initiation, Douglas-fir shoot elongation occurs more rapidly as the temperature increases from 14°C to 22°C (reviewed in Lavender 1981). Douglas-fir grown under higher light intensities had heavier and taller shoots than those grown under low light intensities (reviewed in Lavender 1981), which can inhibit shoot growth in conifers (Kozlowski and Pallardy 1997). Nutrient deficiencies also inhibit shoot growth (Kozlowski and Pallardy 1997).

Temperature and water deficits affect cambial growth. Temperatures regulate the initiation, rate and duration of xylem and phloem production (Kozlowski and Pallardy 1997). After cambial growth has been initiated, water deficits are the major controlling environmental factor. Growth is directly inhibited by cell size limitation and differentiation of cambial derivatives, turgor requirements for cell enlargement, duration of xylem production, and initiation and duration of latewood production (Kozlowski and Pallardy 1997). Water deficits lead to earlier initiation and a shorter duration of latewood production (Kozlowski and Pallardy 1997; Robertson et al. 1990). Latewood production increases with increased spring rainfall (Robertson et al. 1990). Douglas-fir cambial growth can occur late into the fall and the vascular cambium may not endodormant (Emmingham 1977). Nutrient deficiencies indirectly
limit cambial growth by limiting the downward transport of carbohydrates (Kozlowski and Pallardy 1997).

Injury and mortality are correlated with freezing temperatures in the spring and fall, high temperatures in the summer and extreme low temperatures in the winter. Woody species need to complete growth cessation and bud set before the first frost arrives or risk frost damage (Way 2011). Buds and young leaves are particularly susceptible to frost damage (Kozlowski and Pallardy 1997). High summer temperatures are correlated with sunscald and dehydration (Kozlowski and Pallardy 1997). Low winter temperatures are associated with frost rings, winter desiccation (Kozlowski and Pallardy 1997) and freeze-thaw cycles that lead to embolisms (McCulloh et al. 2011).

1.3 Near term climate change

Based on multiple global circulation models (GCM) and regional downscaling, the climates of Oregon and Washington are projected to change measurably by the end of the century. These projections indicate that there will be overall warming throughout Oregon and Washington, and that the warming will be greater during the summer (reviewed in Chmura et al. 2011; Mote et al. 2008) and more pronounced further inland than on the coast (reviewed in Chmura et al. 2011; Leung et al. 2006; Qian et al. 2004). Contrary to this general trend, the Cascade Range is projected to have greater warming in the winter than the summer (reviewed in Chmura et al. 2011; Leung et al. 2006). For temperature, these climate projections are less variable than they are for precipitation. Chmura et al. (2011) state that projections for “annual and seasonal precipitation typically vary widely among different climate models.” Some climate models project decreases in summer precipitation and increases in winter precipitation, whereas other models project no statistical differences from the historic climate (reviewed in Chmura et al. 2011; Qian et al. 2004).

In addition to projecting the future climate of Oregon and Washington, it is essential to understand how Douglas-fir might respond to these predicted changes. The body of knowledge for whole-tree and tree-component responses to changing climate is relatively
robust. Responses of trees to increased CO$_2$ concentrations, increased temperatures, and different amounts of precipitation have all been examined. Kirschbaum (2000) reviewed photosynthetic rate increases in response to a doubling of CO$_2$ concentrations, and found that the photosynthetic rates increased 25-75% (Cure and Acock 1986; Drake 1992; Hanson et al. 1993; Kimball 1983). With an adequate water supply, trees can withstand high temperatures (Kirschbaum 2000). However, increased temperatures will most likely affect dormancy release, bud burst, bud set, growth cessation, and dormancy induction (reviewed in Chmura et al. 2011). How will Douglas-fir respond to increases in both CO$_2$ and temperature? A mesocosm experiment was conducted to examine the effects of elevated CO$_2$, temperature, and their interactions on Douglas-fir seedlings. The results were mixed, with warming effects on seasonal growth patterns and height, but no change in stem diameter, whole seedling biomass or biomass allocation (reviewed in Chmura et al. 2011; Rygiewicz et al. 2003). The effects of climate change at the stand and landscape levels are less completely understood (Chmura et al. 2011).

1.4 Tree improvement programs

Tree improvement programs consist of breeding zones, parent trees, progeny trees and progeny tree test sites. Howe et al. (2006) defined a breeding zone as “a set of environments within which the genotypes from a particular breeding population can be safely planted.” Progeny tests are used to evaluate the offspring of multiple parent trees across a variety of environments within a breeding zone. The phenotypes of Douglas-fir trees result from their genotypes, environments, and the interactions between their genotypes and environments (GxE). These interactions lead to confounding effects of genotype and environment when examining tree growth across native populations and plantations established with different seedlots. The Northwest Tree Improvement Cooperative (NWTIC) has numerous progeny tests that can be used to reduce, if not completely remove, these confounding effects when examining site productivity and stem quality. The parent trees used to establish the progeny test sites were located in natural stands and assumed to be well adapted to their sites. The trees in the first generation progeny tests are assumed to mostly represent a random sample of the populations from which they were collected.
1.5 Thesis project

Douglas-fir productivity and stem quality are important to timber producers in the PNW. The timber industry is under increasing pressure to compete with low cost imports and alternative land uses. Therefore, it is important to maximize the profitability of industrial forestlands. The ability to identify and manage sites to yield the greatest quantity and quality of logs will help PNW timber producers remain competitive in both the domestic and international markets.

Progeny tests containing common sets of families deployed over a range in environmental conditions substantially reduces the confounding effects of genetic differences, thereby providing a unique opportunity for assessing the relatively pure effects of site characteristics on productivity. My objective was to identify the specific site characteristics that explained variation in Douglas-fir productivity and stem form throughout western Oregon and Washington. In addition to minimizing confounding effects of genetic differences, my analysis provided a more detailed assessment of stem form responses to site characteristics than has been achieved in the past. These assessments were undertaken to advance our understanding of near-term climate change effects on Douglas-fir productivity and stem form. The site characteristics I focused on include climate, soils and topography. With Douglas-fir rotation lengths between 40 and 75 years, it is probable that the climate of the site will change during the rotation. As climates change, foresters must be able to predict how those changes will affect productivity and stem quality. Soil processes also influence productivity, particularly in relation to carbon and nutrient cycling and water availability. Topographic factors interact with climate and soils and serve as surrogates for site characteristics that are difficult to directly measure, such as photosynthetically active radiation (PAR) and lateral movement of ground water across landscape units. Because soils, climate, and physiographic position are known to influence tree and stand growth, I predicted that at least one climate, one soils, and one topographic site characteristic will be important for explaining variation in both Douglas-fir productivity and stem form.
2 Materials and Methods

2.1 Plant Materials

The Northwest Tree Improvement Cooperative is a collection of cooperative tree improvement programs. Breeding zones were defined cooperatively among companies and agencies. Parent trees were selected from natural stands within these breeding zones based on the following general guidelines. Selections were distributed across the breeding zone and took place during good cone years (Anonymous 1971). One seed tree and two reserve trees were generally selected per 1,000 acres (Wheat 1969). Trees were typically between 20 and 30 years old and generally had good crown development, growth, form and seed. After parent tree selection and cone harvest, seeds were sown for producing progeny trees for outplanting and testing. The first progeny trees for the earliest programs were grown in nurseries. However, to accommodate the large number of parental seedlots, greenhouses were constructed to grow containerized seedlings (Silen and Wheat 1979). The number of progeny test sites varied by program, and in some cases not all of the sites within a program were suitable for use in this study, but the test sites I studied were located in Oregon and Washington, west of the Cascade crest (Figure 2.1). The recommended number of test sites for each program was eight to twelve. Each test site was located on approximately 10 acres of uniform land. Because test sites are located on mountainous terrain, some programs have less than eight sites (Silen and Wheat 1979). Because of the large number of parent trees tested, the parents were grouped into sets of 25 to 144 trees. Two experimental designs were used: reps-in-sets and sets-in-reps (Figure 2.2). All replications of a single set were planted together in the reps-in-sets design. In the sets-in-reps design, each replication contained all the sets and families, with the families belonging to the same set planted adjacent to one another within the replication (Ye and Jayawickrama 2007b). The number of replications planted at each site ranged from 3 to 8. In some cases, all of the progeny for a single program could not be grown at the same time. Two methods were used to split the program over multiple sowing years. In the first method, all families were grown in each sowing year and only some of the test sites were planted each planting year. In the second method, a subset of the families was grown in each sowing year and planted at all of the test
Figure 2.1: Locations of Douglas-fir progeny test sites used in analyses.
Figure 2.2: Schematic illustrating the two experimental designs: (a) Sets within reps (SR) design (sets were randomized within each replication); and (b) reps within sets (RS) design.
sites in each planting year. Progeny were one to three years old when they were planted at the test sites at a spacing ranging from 1.68m by 1.68m (5.5' by 5.5') to 4.57m by 4.57m (15’ by 15’). Although site preparation and management ranged from “no action” to scarification, burning and herbicide treatment, the management regime was consistent within each site.

2.2 Measurements and derived variables

All sowings and measurements were completed between 1967 and 2005. After establishment, the HT, DBH, and mortality of the progeny at each test site were measured up to three times approximately five years apart. Not all programs recorded tree mortality. If tree mortality was not captured in the test site records, mortality was estimated based on the tree measurements (Table 2.1). Stem forks, ramicorn branches and sinuosity were measured at the same time as the final growth measurements. Stem forks were measured as the number of whorls above breast height that were forked, with scores ranging from 0-9. Ramicorn branches were measured as the number of whorls above breast height that had ramicorn branching, with scores ranging from 0-9. Sinuosity was measured as the percent deflection from the main stem. Stem forks, ramicorn branches and sinuosity measurements were square root transformed according to Ye and Jayawickrama (Ye and Jayawickrama 2007a). The program, test site and test site measurement details for the 191 sites used in this study are shown in Table 2.2. Tree volumes were calculated using Bruce and Demars (1974) volume equations for second growth Douglas-fir, except for small trees (< 1.83m (6’)) that were outside of the range of samples used by Bruce and Demars (1974). Small tree volumes were estimated as the volume of a cone. Basal diameter of the cone was subsumed by DBH and HT. The trees per hectare (tph) for a test site were estimated from the spacing and the percent of live trees. Total live test site volume (VOL) and total live test site basal area (BA) were expressed on a per hectare basis. The periodic annual growth rates for HT, DBH, VOL, and BA were calculated for six growth periods (Table 2.3). The HT responses and DBH responses were grouped as HT and DBH response groups, respectively. The VOL and BA responses were included in a biomass response group, the percent of live trees were included in a mortality response group and stem forks, ramicorn branches and sinuosity were included in a stem form response group (Table 2.3).
Table 2.1: Method for determining timing of tree mortality. The symbol “+” indicates that a tree’s HT or DBH was recorded at that specific measurement cycle. The symbol “−” indicates that no measurements were recorded at that specific measurement cycle.

<table>
<thead>
<tr>
<th></th>
<th>Measurement cycle 1</th>
<th>Measurement cycle 2</th>
<th>Measurement cycle 3</th>
<th>Inferred tree status</th>
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<td>+</td>
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<td>Dead</td>
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Table 2.2: Progeny test site (n=191) and measurement details for Douglas-fir breeding programs analyzed for site characteristic effects on growth and stem form. Growth measurements include height (HT) and diameter at breast height (DBH). Stem form measurements include stem forks (FRK), ramicorn branching (RAM), and sinuosity (SIN).

<table>
<thead>
<tr>
<th>Breeding zone</th>
<th>Experimental design(^a)</th>
<th>Sowing year</th>
<th>Planting year</th>
<th>No. of sites</th>
<th>Age(^b) by measurement cycle (1-3)</th>
<th>HT</th>
<th>DBH</th>
<th>FRK</th>
<th>RAM</th>
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<td>Burnt Woods I SR</td>
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<td>5 10 15 - - 15 15 15 15 15 15</td>
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<td>5 10 - - - 15 - - - -</td>
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Table 2.2 (Continued)

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<th>Planting year</th>
<th>No. of sites</th>
<th>Age by measurement cycle (1-3)</th>
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<td>3</td>
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<td>1988</td>
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<td>1978</td>
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<td>1980</td>
<td>8</td>
<td>-</td>
<td>14/15</td>
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<td>SR</td>
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<td>1992</td>
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<td>6</td>
<td>-</td>
<td>14/15</td>
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<td>RS</td>
<td>1980</td>
<td>1981/82</td>
<td>3</td>
<td>14/15</td>
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<td>Snoqualmie</td>
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<td>1980</td>
<td>4</td>
<td>14/15</td>
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<td>RS</td>
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<td>1971</td>
<td>6</td>
<td>14/15</td>
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<tr>
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<td>1973</td>
<td>7</td>
<td>-</td>
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<td>RS</td>
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<td>1975/76</td>
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<td>Experimental design</td>
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<td>Planting year</td>
<td>No. of sites</td>
<td>Age(^b ) by measurement cycle (1-3)</td>
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<td></td>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
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<td>RS</td>
<td>1974</td>
<td>1975/76</td>
<td>7</td>
<td>5</td>
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<td>Vernonia</td>
<td>SR</td>
<td>1967</td>
<td>1970</td>
<td>11</td>
<td>9</td>
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<td>1971</td>
<td>11</td>
<td>7</td>
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<td>Vernonia, Sunday Creek</td>
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<td>1981</td>
<td>1983</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Total or average</td>
<td></td>
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<td>191</td>
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</table>

\(^a\) RS = reps-in-sets; SR = sets-in-reps  
\(^b\) Measurement age = age since sowing  
\(^c\) One site was planted in 1972  
\(^d\) Two sites were planted in 1979  
\(^e\) One site was planted in 1981  
\(^f\) One site was planted in 1990  
\(^g\) One site was planted in 1985
Table 2.3: Douglas-fir progeny test response groups and response variables.

<table>
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<tr>
<th>Response group</th>
<th>Response variable&lt;sup&gt;a&lt;/sup&gt;</th>
<th>n&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Units</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>HT</td>
<td>HT&lt;sub&gt;1&lt;/sub&gt;</td>
<td>157</td>
<td>cm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>9.76</td>
<td>25.61</td>
<td>53.72</td>
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<tr>
<td></td>
<td>HT&lt;sub&gt;2&lt;/sub&gt;</td>
<td>186</td>
<td>cm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>10.95</td>
<td>47.36</td>
<td>74.08</td>
</tr>
<tr>
<td></td>
<td>HT&lt;sub&gt;3&lt;/sub&gt;</td>
<td>133</td>
<td>cm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>16.38</td>
<td>59.9</td>
<td>83.53</td>
</tr>
<tr>
<td></td>
<td>HT&lt;sub&gt;1-2&lt;/sub&gt;</td>
<td>153</td>
<td>cm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>19.31</td>
<td>76.82</td>
<td>140.81</td>
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<tr>
<td></td>
<td>HT&lt;sub&gt;2-3&lt;/sub&gt;</td>
<td>129</td>
<td>cm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>27.08</td>
<td>92.64</td>
<td>115.37</td>
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<tr>
<td>DBH</td>
<td>DBH&lt;sub&gt;1&lt;/sub&gt;</td>
<td>35</td>
<td>mm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>1.78</td>
<td>3.79</td>
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<td>mm year&lt;sup&gt;-1&lt;/sup&gt;</td>
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<td>6.26</td>
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<td>8.59</td>
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<td>6.77</td>
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<td>DBH&lt;sub&gt;1-3&lt;/sub&gt;</td>
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<td>mm year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>5.62</td>
<td>11.43</td>
<td>22.82</td>
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<tr>
<td>Biomass</td>
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<td>cm&lt;sup&gt;2&lt;/sup&gt; ha&lt;sup&gt;-1&lt;/sup&gt; year&lt;sup&gt;-1&lt;/sup&gt;</td>
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<td>0.0012</td>
<td>0.0044</td>
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<td>cm&lt;sup&gt;2&lt;/sup&gt; ha&lt;sup&gt;-1&lt;/sup&gt; year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.0002</td>
<td>0.0066</td>
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<td>0.0148</td>
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<tr>
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<td>VOL&lt;sub&gt;1&lt;/sub&gt;</td>
<td>31</td>
<td>m&lt;sup&gt;3&lt;/sup&gt; ha&lt;sup&gt;-1&lt;/sup&gt; year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.0002</td>
<td>0.2472</td>
<td>1.9611</td>
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<td>82</td>
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<td>0.0006</td>
<td>1.9883</td>
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<tr>
<td></td>
<td>VOL&lt;sub&gt;3&lt;/sub&gt;</td>
<td>115</td>
<td>m&lt;sup&gt;3&lt;/sup&gt; ha&lt;sup&gt;-1&lt;/sup&gt; year&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.2116</td>
<td>5.1346</td>
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<td>Mortality</td>
<td>LIV&lt;sub&gt;1&lt;/sub&gt;</td>
<td>191</td>
<td>%</td>
<td>0.57</td>
<td>0.95</td>
<td>1</td>
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<tr>
<td></td>
<td>LIV&lt;sub&gt;2&lt;/sub&gt;</td>
<td>191</td>
<td>%</td>
<td>0.57</td>
<td>0.93</td>
<td>1</td>
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<tr>
<td></td>
<td>LIV&lt;sub&gt;3&lt;/sub&gt;</td>
<td>191</td>
<td>%</td>
<td>0</td>
<td>0.88</td>
<td>1</td>
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<tr>
<td>Form</td>
<td>FRK</td>
<td>111</td>
<td>%</td>
<td>0.71</td>
<td>0.87</td>
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<tr>
<td></td>
<td>RAM</td>
<td>104</td>
<td>%</td>
<td>0.71</td>
<td>0.97</td>
<td>2.44</td>
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<tr>
<td></td>
<td>SIN</td>
<td>44</td>
<td>%</td>
<td>0.71</td>
<td>1.22</td>
<td>2.18</td>
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</table>

<sup>a</sup> HT is mean annual height growth. DBH is mean annual diameter growth. BA is mean annual basal area growth for all trees. VOL is mean annual volume growth for all trees. LIV is percent of live trees at a given measurement. FRK is the √(mean (number of stem forks/tree +0.5)). RAM is the √(mean (number of ramicorn branches/tree +0.5)). SIN is the √(mean (sinuosity score/tree +0.5)). The subscripts for the response variables indicate the growth period: 1= sowing to age at measurement cycle 1, 2= sowing to age at measurement cycle 2, 3= sowing to age at measurement cycle 3, 1-2 = age at measurement cycle 1 to age at measurement cycle 2, 2-3 = age at measurement cycle 2 to age at measurement cycle 3, 1-3 = age at measurement cycle 1 to age at measurement cycle 3.

<sup>b</sup> n is the number of groups (i.e. unique combinations of program and sowing year) with a given response.
2.3 Site characteristics

A dataset of progeny test site locations was constructed from existing maps and location information; these locations were applied to extract soils and topographic variables from other datasets and to predict climate variables. The site characteristic details are shown in Table 2.4.

2.3.1 Progeny test sites locations

The materials used to develop the progeny test site locations were the NWTIC records, the National Agricultural Imagery Program (NAIP) and Google Earth. For some progeny test sites, the NWTIC records contained hardcopy maps. However, because the test sites were visually distinct on the aerial imagery, hardcopy maps were not required to develop these locations. To use a progeny test site for this study, it must have been locatable within ± 80 m horizontal accuracy at a 95% confidence level. Of the four datasets used to describe the site characteristics, the most accurate dataset (DEM) had a horizontal accuracy of ± 12.2 meters at a 95% confidence level (USGS 1995) and the least accurate dataset (PRISM, the source for ClimateWNA) had a horizontal accuracy of ± 148.3 meters at a 95% confidence level (Daly et al. 2002). The mid-point of the range in accuracy was approximately ± 80 meters, which is why progeny test sites must be locatable within ± 80 m. Each of the materials used to develop the progeny test site locations contribute to the horizontal accuracy of the dataset. It was assumed that the NWTIC records represent the ground condition with 100% accuracy. The NAIP was compiled to meet ± 5 meters horizontal accuracy at a 95% confidence level. The NAIP aerial imagery for Oregon was available through the Oregon Imagery Explorer (http://oregonexplorer.info) and was viewed using a Web Map Service (WMS) in ArcMap. The spatial reference of the Oregon NAIP was the World Geodetic System 1984 (WGS84) geographic coordinate system (GCS). The NAIP aerial imagery for Washington was available through the United States Geologic Survey (USGS) Seamless Data Distribution System (SDDS). The spatial reference of the Washington NAIP was the North American Datum 1983 (NAD83) Universal Transverse Mercator (UTM) Zone 10. The Washington NAIP aerial images were loaded into a raster catalog to simplify viewing in ArcMap. In the cases where the test site boundary was not visible on the NAIP imagery, Google Earth historical imagery was used.
Table 2.4: Site characteristics of Douglas-fir progeny test sites. Minimum (Min), mean (Mean), and maximum (Max) were calculated from the “across-program” dataset. Ranges of climate variables are based on all six growth periods covered by individual progeny sites (see footnote to Table 2.3).

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<tr>
<th>Category</th>
<th>Source</th>
<th>Site characteristic</th>
<th>Definition</th>
<th>Units</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
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<td>Soils</td>
<td>NRCS</td>
<td>AWC</td>
<td>Available water capacity</td>
<td>cm cm⁻¹</td>
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<td>Clay</td>
<td>% clay by volume in soil profile</td>
<td>%</td>
<td>2.3</td>
<td>25.8</td>
<td>50.9</td>
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<td>TPD</td>
<td>Total profile depth</td>
<td>cm</td>
<td>7.1</td>
<td>126.6</td>
<td>171.3</td>
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<td>Topographic</td>
<td>DEM</td>
<td>cosASP</td>
<td>Measure of northerly or southerly exposure</td>
<td>cos(°)</td>
<td>-0.16</td>
<td>-0.01</td>
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<tr>
<td></td>
<td></td>
<td>Slope</td>
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<td>ClimateWNA</td>
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<td>Mean annual temperature</td>
<td>°C</td>
<td>5.7</td>
<td>10.4</td>
<td>12.9</td>
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<td>Mean warmest month temperature</td>
<td>°C</td>
<td>14.4</td>
<td>17.8</td>
<td>20.4</td>
</tr>
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<td>MCMT</td>
<td>Mean coldest month temperature</td>
<td>°C</td>
<td>-3.0</td>
<td>4.1</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TD</td>
<td>Temperature difference between MWMN and MCMT, or continentality</td>
<td>°C</td>
<td>7.2</td>
<td>13.7</td>
<td>18.5</td>
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<td>MAP</td>
<td>Mean annual precipitation (mm)</td>
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<td>1785</td>
<td>4417</td>
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<td>MSP</td>
<td>Mean annual summer (May to Sept.) precipitation (mm)</td>
<td>mm</td>
<td>130</td>
<td>280</td>
<td>630</td>
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<td>AHM</td>
<td>Annual heat:moisture index ((MAT+10)/(MAP/1000))</td>
<td>°C m⁻¹</td>
<td>4.8</td>
<td>12.6</td>
<td>29.8</td>
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<td>SHM</td>
<td>Summer heat:moisture index ((MWMN)/(MSP/1000))</td>
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<td>25.8</td>
<td>76.1</td>
<td>174.2</td>
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<td>DD &lt; 0°C</td>
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<td>DD &lt; 0°C</td>
<td>Degree-days below 0°C, chilling degree-days</td>
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<td>2.5</td>
<td>46.8</td>
<td>352.6</td>
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<td>DD &gt; 5°C</td>
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<td>DD &gt; 5°C</td>
<td>Degree-days above 5°C, growing degree-days</td>
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<td>1213.6</td>
<td>2204.6</td>
<td>2988.5</td>
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<td>DD &lt; 18°C</td>
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<td>DD &lt; 18°C</td>
<td>Degree-days below 18°C, heating degree-days</td>
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<td>2841.5</td>
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<td>Category</td>
<td>Source</td>
<td>Site characteristic</td>
<td>Definition</td>
<td>Units</td>
<td>Min</td>
<td>Mean</td>
<td>Max</td>
</tr>
<tr>
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</tr>
<tr>
<td>Climate</td>
<td>ClimateWNA</td>
<td>DD &gt; 18°C</td>
<td>Degree-days above 18°C, cooling degree-days</td>
<td></td>
<td>0.0</td>
<td>101.0</td>
<td>227.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NFFD</td>
<td>The number of frost-free days</td>
<td></td>
<td>197.4</td>
<td>292.0</td>
<td>341.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FFP</td>
<td>Frost-free period</td>
<td></td>
<td>112.5</td>
<td>204.5</td>
<td>288.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bFFP</td>
<td>The Julian date on which FFP begins</td>
<td>Julian date</td>
<td>46.5</td>
<td>102.2</td>
<td>147.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eFFP</td>
<td>The Julian date on which FFP ends</td>
<td>Julian date</td>
<td>259.0</td>
<td>306.7</td>
<td>338.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAS</td>
<td>Precipitation as snow between August in previous year and July in current year</td>
<td>mm</td>
<td>11.6</td>
<td>71.2</td>
<td>604.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMT</td>
<td>Extreme minimum temperature over 30 years</td>
<td>°C</td>
<td>-27.3</td>
<td>-16.2</td>
<td>-6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eref</td>
<td>Hargreaves reference evaporation</td>
<td>mm d⁻¹</td>
<td>567.7</td>
<td>831.1</td>
<td>1003.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMD</td>
<td>Hargreaves climatic moisture deficit</td>
<td></td>
<td>111.8</td>
<td>335.7</td>
<td>582.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tave_wt</td>
<td>Winter (Dec.(prev. yr) - Feb.) mean temperature</td>
<td>°C</td>
<td>-2.1</td>
<td>4.8</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tave_sp</td>
<td>Spring (Mar. - May) mean temperature</td>
<td>°C</td>
<td>4.4</td>
<td>9.5</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tave_sm</td>
<td>Summer (Jun. - Aug.) mean temperature</td>
<td>°C</td>
<td>13.0</td>
<td>16.4</td>
<td>18.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tave_at</td>
<td>Autumn (Sep. - Nov.) mean temperature</td>
<td>°C</td>
<td>6.3</td>
<td>11.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Category</td>
<td>Source</td>
<td>Site characteristic</td>
<td>Definition</td>
<td>Units</td>
<td>Min</td>
<td>Mean</td>
<td>Max</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>---------------------</td>
<td>-------------------------------------------------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Climate</td>
<td>ClimateWNA</td>
<td>Tmax_wt</td>
<td>Winter mean maximum temperature</td>
<td>°C</td>
<td>0.8</td>
<td>8.7</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmax_sp</td>
<td>Spring mean maximum temperature</td>
<td>°C</td>
<td>8.4</td>
<td>15.0</td>
<td>18.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmax_sm</td>
<td>Summer mean maximum temperature</td>
<td>°C</td>
<td>18.6</td>
<td>23.1</td>
<td>27.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmax_at</td>
<td>Autumn mean maximum temperature</td>
<td>°C</td>
<td>10.6</td>
<td>16.8</td>
<td>20.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmin_wt</td>
<td>Winter mean minimum temperature</td>
<td>°C</td>
<td>-4.8</td>
<td>0.8</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmin_sp</td>
<td>Spring mean minimum temperature</td>
<td>°C</td>
<td>0.0</td>
<td>3.9</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tmin_sm</td>
<td>Summer mean minimum temperature</td>
<td>°C</td>
<td>5.9</td>
<td>9.7</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PPT_wt</td>
<td>Winter precipitation</td>
<td>mm</td>
<td>235</td>
<td>756</td>
<td>2101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PPT_sp</td>
<td>Spring precipitation</td>
<td>mm</td>
<td>176</td>
<td>431</td>
<td>874</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PPT_sm</td>
<td>Summer precipitation</td>
<td>mm</td>
<td>54</td>
<td>124</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PPT_at</td>
<td>Autumn precipitation</td>
<td>mm</td>
<td>170</td>
<td>478</td>
<td>1264</td>
</tr>
</tbody>
</table>
Historical imagery was available through Google Earth on a location specific basis. The NAIP and Google Earth were interpreted at a scale of no less than 1:10,000. In accordance with the National Map Accuracy Standards (NMAS), data developed at a scale of 1:10,000 have been compiled to meet ± 8.5 m horizontal accuracy at a 95% confidence level. The additive horizontal accuracy equals ± 13.5 m (5 m + 8.5 m). After accounting for interpretation errors, the horizontal accuracy of the test site locations fall within the ± 80 m horizontal accuracy at a 95% confidence level. Because the NAIP aerial imagery for Oregon and Washington used different spatial reference coordinates systems, the progeny test sites were separated into two GIS layers: one for Oregon and one for Washington. After development, review and verification of the Washington progeny test sites, they were transformed to WGS84 UTM Zone 10. This GIS layer was merged with the Oregon GIS layer to create one progeny test site GIS layer.

### 2.3.2 Soils variables

This study used the Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) databases for the progeny test site soils variables. The SSURGO databases for Oregon and Washington were available online at [http://soils.usda.gov/survey/geography/ssurgo/](http://soils.usda.gov/survey/geography/ssurgo/). Both databases were downloaded 8 June 2009. SSURGO consists of tabular and spatial data. The data are organized into detailed map units, with each soils map unit representing a record in the state soils database. Soils map units are composed of multiple soil components and each soil component is composed of multiple soil horizons. The horizontal accuracy of the spatial data was unknown. The spatial data were originally in NAD83 UTM Zone 10 North but were transformed to WGS84 UTM Zone 10 North to match the spatial reference of the progeny test sites. The NRCS Soil Data Viewer 5.2.0016 was used to extract the available water capacity (AWC) and percent clay in profile (clay) from the tabular database for all of soils map units overlapping the progeny test sites. The aggregation method selected was weighted average of all of the horizons within a soil component within a map unit. In the case of a tie among percent compositions, the higher value was selected.
Spatial and statistical analyses were completed to associate total soil depth, AWC, and clay with the progeny test sites. ArcGIS 9.3.1 was used to complete the spatial analyses. First, the total area (m$^2$) of each progeny test site was calculated using the Calculate Geometry function in the attribute table. Next, the Intersect tool was used to identify the soils map units associated with each progeny test site and to clip the soils map units to the boundary of the associated progeny test site. The total area of each soils map unit was calculated using the same method as the total area of the progeny test sites. The percent of the total area of the progeny test site that each soils map unit covered was calculated by dividing the total area of the soils map unit by the total area of the progeny test site. After the spatial analyses were complete, SAS 9.2 was used to calculate the total soil depth. Total soil depth was calculated by finding the maximum horizon depth grouped by soil component. The component values were calculated and aggregated to single map units using weighted averages. The progeny test site values were calculated by summing the weighted map unit values.

### 2.3.3 Topographic Variables

This study used the United States Geologic Survey (USGS) Digital Elevation Model (DEM) for the progeny test site topographic variables. DEMs for the continental United States are available through the USGS SDDS. The 10-m resolution DEMs for Oregon and Washington west of the Cascade crest were downloaded in multiple pieces. The pieces were mosaicked together and transformed from NAD83 UTM Zone 10 to WGS84 UTM Zone 10. The DEM was compiled to meet ± 12.2 m horizontal accuracy at a 95% confidence level. Slope, aspect and cosine of the aspect were all calculated using ArcGIS 9.3.1. Additionally, the Zonal Statistics as Table tool was used to calculate the means of each progeny test site for all topographic variables.
2.3.4 Climate Variables

This study used Climate Western North America (ClimateWNA) for the progeny test site climate variables (Wang et al. 2010). ClimateWNA extracts and downscales Parameter-elevation Regressions on Independent Slopes Model (PRISM) to scale-free point data (Wang et al. 2010). PRISM is a local climate-elevation regression model that uses DEM grid cells and weather stations to generate climate datasets (Daly et al. 2002). The advantages of PRISM include the ability to account for (1) physiographic similarity between weather stations and target DEM grid cells and (2) spatial variations caused by elevation, terrain orientation, effectiveness of terrain as a barrier to flow (terrain-induced climate transitions), coastal proximity, moisture availability, two-layer atmospheres (cold air drainage and inversions), and topographic position (Daly 2006). PRISM was compiled to meet ± 148.278 meters horizontal accuracy at a 95% confidence level.

ClimateWNA combines the scale-free data with monthly variability data of individual years to calculate historical monthly, seasonal and annual climate variables. All of the climate variables were available for individual years and periods between 1901-2006 (Wang et al. 2010). The climate variables were calculated for each growth period at each progeny test site; therefore, each progeny test site had a unique set of climate variables corresponding to the years that were included in that site’s growth periods (Table 2.2).

2.4 Statistical analyses of growth and form traits

2.4.1 Progeny test sites

2.4.1.1 Data cleaning and outlier detection

The basic methodology for cleaning the program datasets was taken from Ye and Jayawickrama (2007a) and White (2007). All methods were implemented in SAS 9.2. Rather than removing progeny records from the data, outliers were marked and excluded from subsequent analyses. Progeny records were marked as outliers based on three criteria: tree status, growth model residuals, and DBH-HT correlation residuals. In regard to status, trees that were replacements, dead or severely damaged were excluded from the analyses. For the
remaining trees, residuals were evaluated based on the following model for calculating either site-set or site-rep means for diameter and height growth (DBH$_{1s}$, DBH$_{2s}$, DBH$_{3s}$, DBH$_{1-2s}$, DBH$_{1-3s}$, DBH$_{2-3s}$, HT$_{1s}$, HT$_{2s}$, HT$_{3s}$, HT$_{1-2s}$, HT$_{1-3s}$, HT$_{2-3s}$ as defined in Table 2.2):

\[ Y_{jkln} = \mu + R_k + \tau_{l(j)} + (R\tau)_{k(l(j))} + \epsilon_{jkln} \]

(site-set growth model for reps within sets design)

\[ Y_{jkln} = \mu + S_j + \tau_{l(j)} + \epsilon_{jkln} \]

(site-rep growth model for sets within reps design)

Where:

- $Y_{jkln}$ is the growth for the $m^{th}$ tree in the $l^{th}$ family within the $j^{th}$ set in the $k^{th}$ replication
- $\mu$ is the grand mean of a set (reps within sets design) or rep (sets within reps design)
- $S_j$ is the random effect of the $j^{th}$ set for the site-rep growth model
- $R_k$ is the random effect of the $k^{th}$ replication the site-set growth model
- $\tau_{l(j)}$ is the random effect of the $l^{th}$ family within the $j^{th}$ set
- $R \tau_{k(l(j))}$ is the random interaction effect of the $k^{th}$ replication and the $l^{th}$ family within the $j^{th}$ set for the site-set growth model
- $\epsilon_{jkln}$ is the residual or random error; $\epsilon_{jkln} \sim N(0, \sigma^2)$ and $\epsilon_{jkln}$ and $\epsilon_{jk'l'm'}$ are independent

Diameter or height growth observations that had growth model residuals with an absolute value greater than four times the root mean squared error (RMSE) were marked as outliers. DBH-HT regressions were also used to identify outliers for each site-set or site-rep combination. Any measurements that had a regression residual with an absolute value greater than four times the RMSE were marked as an outlier.
2.4.1.2 Site means

All site mean models were fitted in SAS 9.2. Within a program (n=27), some sites or sets were sown and planted in different years; therefore, sites within programs were classified into groups, which represent unique combinations of program and sowing year. This classification allowed me to account for variation among sowing years within a program. PROC HPMIXED with the LSMEANS statement was used to fit the following model and calculate site means by group for the reps within sets design:

\[ Y_{ijklm} = \mu + L_i + S_j + (LS)_{ij} + R_{k(ij)} + \tau_{l(j)} + (Lt)_{li(j)} + \varepsilon_{ijklm} \]

Where:

- \(Y_{ijklm}\) is the observation for the \(m^{th}\) tree in the \(l^{th}\) family within the \(j^{th}\) set in the \(k^{th}\) replication at the \(i^{th}\) site.
- \(\mu\) is the grand mean of a group
- \(L_i\) is the fixed effect of the \(i^{th}\) site
- \(S_j\) is the fixed effect of the \(j^{th}\) set
- \((LS)_{ij}\) is the fixed interaction effect of the \(i^{th}\) site and the \(j^{th}\) set
- \(R_{k(ij)}\) is the random effect of the \(k^{th}\) replication within the \(i^{th}\) site and the \(j^{th}\) set
- \(\tau_{l(j)}\) is the random effect of the \(l^{th}\) family within the \(j^{th}\) set
- \((Lt)_{li(j)}\) is the random interaction effect of the \(i^{th}\) site and the \(l^{th}\) family within the \(j^{th}\) set
- \(\varepsilon_{ijklm}\) is the random error; \(\varepsilon_{ijklm} \sim N(0, \sigma^2)\) and \(\varepsilon_{ijklm}\) and \(\varepsilon_{i'j'k'l'm'}\) are independent

For groups with the sets within reps design the model becomes:

\[ Y_{ijklm} = \mu + L_i + S_j + (LS)_{ij} + R_{k(i)} + \tau_{l(j)} + (Lt)_{li(j)} + \varepsilon_{ijklm} \]

Where \(R_{k(i)}\) is the random effect of the \(k^{th}\) replication within the \(i^{th}\) site and all others are the same as in model [3]. The group means resulting from these analyses described above plus the corresponding site characteristics are referred to as the “across-program” dataset. In
this dataset, the variation among group \( (\varepsilon_{ijk}) \) means contains genetic and site variation among programs, as well as site and sowing year variation within programs (Model 5).

\[
\text{[5]} \quad y_{ijk} = \mu + \varepsilon_{ijk}
\]

Where:

- \( y_{ijk} \) is the observation for \( k^{\text{th}} \) group in the \( j^{\text{th}} \) sowing year within the \( i^{\text{th}} \) program
- \( \mu \) is the grand mean
- \( \varepsilon_{ijk} \) is the residual, \( \varepsilon_{ijk} \sim \text{N}(0, \sigma^2) \) and \( \varepsilon_{ijk} \) and \( \varepsilon_{i'j'k'} \) are independent

We also created a “within-program” dataset consisting of the group mean residuals after the among-program (genetic and site variation) and among sowing year variation was removed using the following model:

\[
\text{[6]} \quad y_{ijk} = \mu + P_i + W_{j(i)} + \varepsilon_{ijk}
\]

Where:

- \( P_i \) is the fixed effect of the \( i^{\text{th}} \) program
- \( W_{j(i)} \) is the fixed effects of the \( j^{\text{th}} \) sowing year within the \( i^{\text{th}} \) program

and all other are the same as in model [5]. These group mean residuals were combined with similarly adjusted site characteristics to form the within-program dataset. Variation in site characteristics among programs and sowing years was removed using Model [6] with the exception that \( y_{ijk} \) was the site characteristic of \( k^{\text{th}} \) site in the \( i^{\text{th}} \) program in the \( j^{\text{th}} \) sowing year.

### 2.4.2 Variable Selection

A three-pronged approach was used to identify site characteristics that are associated with site-to-site variation in progeny test site productivity and stem form. Correlations, random forest analysis and linear regression were used to rank the importance of the independent variables for each of the response variables. The top ten ranked independent variables from
each analytical method were used to calculate total importance scores for all of the test site productivity and stem form responses in order to maintain analytical consistency and avoid overfitting the models.

Because of the sampling variation and colinearity of the independent variables, they were classified into site characteristic groups. Cluster analyses were performed on the independent variables for the across-program and within-program datasets. Hierarchical clustering was performed using the pvclust package (Suzuki and Shimodaira 2011) within the R statistical language (R Development Core Team 2011). Using [1-r] as the distance measure and clustering by group average linkage, I chose the number of clusters that resulted in an identical grouping of site characteristics for the across and within-program analyses.

2.4.2.1 Correlations

All correlations for the across-program and within-program datasets were calculated using PROC CORR in SAS 9.2. Correlation coefficients (r) for the ten independent variables with the smallest p-value for each response were converted to $r^2$ values and were rescaled to sum to one. This ensured that the correlation coefficients would not be given more weight when calculating the total importance scores.

2.4.2.2 Random Forests

Random forest analysis (RF) is a

“non-parametric [method] ... ideally suited to the analysis of high dimensional ecological data with hierarchical and complex relationships among the predictor variables (i.e. colinearity) and between predictor and response variables. RF is an ensemble learning algorithm that averages predictions over multiple bootstrapped regression trees; it consistently outperforms other statistical methods, including [regression tree analysis], for prediction accuracy and ranking predictor importance” (Thompson and Spies 2009)

We used the randomForest package (Liaw and Wiener 2002) within the R statistical language (R Development Core Team 2011) to calculate the relative importance of site characteristics for the across-program and within-program datasets by first selecting 3000 bootstrap
samples each containing two-thirds of the data. The remaining one-third of the data were
the out-of-bag (OOB) samples. An un-pruned regression tree was grown for each bootstrap
sample using a random one-third sample of the independent variables for each split. The
values for the OOB samples were then predicted by the forest (the 3000 regression trees).
The predicted value for each OOB observation was the average value from all the regression
trees in the forest for which that observation was part of the OOB sample. The differences
between the predicted values and the observed responses for each OOB observation were
then used to calculate the mean square error (MSE). Variable importance (VI) for the mth
independent variable was calculated by randomly permuting the values of this one variable
across all the observations in the OOB samples, re-predicting the response variable, and
calculating a new MSE. The difference between these MSEs is the VI (Breiman 2001). For
each response, the ten most important independent variables were selected for further
analyses. RF was re-run with only these variables and the resulting VIs were re-scaled to sum
to one.

2.4.2.3 Linear Regression

Best subsets variable selection was performed using the leaps package (Lumley 2009) within
the R statistical language (R Development Core Team 2011). The single best model with ten
independent variables was selected for each response in the across-program and within-
program datasets. The General Dominance Index (GDI) was calculated for the ten
independent variables for each response using the relaimpo package (Gromping 2006). The
GDIs were calculated by first selecting 3000 bootstrap samples with replacement. For each
bootstrap sample, the contribution of the mth independent variable to $R^2$ was averaged over
all permutations of the model. The GDIs were re-scaled to sum to one.
2.4.2.4 Importance scores

Method specific importance scores were calculated using the statistics (rescaled $R^2$, VI, and GDI) from the completed analyses. The correlation importance scores were calculated by multiplying the rescaled $r^2$ values by the mean $R^2$ value for the group of ten predictors with lowest p-values. The RF importance scores were calculated by multiplying the VI by the $R^2$. The LR importance scores were calculated by multiplying the GDI by the $R^2$. The total importance score for each independent variable within each of the five response groups using the following equation:

$$[7] s_m = \sum_{i=1}^{n} r_{rel}^2 \ast R_{corr}^2 + VI \ast R_{RF}^2 + GDI \ast R_{LR}^2$$

where:

- $s_m$ is importance score for the $m$th independent variable within a single response group
- $r_{rel}^2$ is the rescaled $r^2$ between the $m$th independent variable and the $i$th response from the correlation analysis, $0 \leq r_{rel}^2 \leq 1$
- $r_{corr}^2$ is the mean $r^2$ from the best predictors from correlation analysis
- VI is the rescaled variable importance for the $m$th independent variable and the $i$th response from the random forest analysis, $0 \leq VI \leq 1$
- $R_{RF}^2$ is the $R^2$ from the random forest analysis for the $i$th response. Negative values were set to zero.
- GDI is the General Dominance Index for the $m$th independent variable and the $i$th response from the linear regression analysis, $0 \leq GDI \leq 1$
- $R_{LR}^2$ is the $R^2$ from the linear regression model for the $i$th response

The site characteristics were assigned eight ranks based on the correlation, RF, LR and total importance scores from the across-program and within-program datasets. Spearman’s rank correlation coefficients were calculated for correlation vs RF, correlation vs LR, and RF vs LR for each response group in the across-program and within-program datasets. Additionally,
Spearman’s rank correlation coefficients were calculated for the total importance scores of DBH response group vs HT response group, DBH response group vs biomass response group, DBH response group vs mortality response group, HT response group vs biomass response group, HT response group vs mortality response group, and biomass response group vs mortality response group.
3 Results

3.1 Nine site characteristic groups were identified.

The correlations among site characteristics were summarized by hierarchical cluster analysis for the across-program (Figure 3.1) and within-program (Figure 3.2) datasets. Choosing the number of clusters based on identical groupings for the across and within-program datasets resulted in nine site characteristics groups (SCG) (Table 3.1).

3.2 Relationships between site characteristics and response groups were often inconsistent.

I used Spearman’s rank correlations to judge the consistency of the relationships between site characteristics versus productivity and stem form. The Spearman rank correlation coefficients were statistically significant in 4 out of 12 comparisons for the across-program productivity dataset and 2 out of 12 comparisons for the within-program productivity dataset (Table 3.2). In the across-program dataset, significant correlations were found between the correlation-RF and the RF-LR rank correlation coefficients for the DBH response group, the RF-LR rank correlation coefficients for the HT response group, and the correlation-RF rank correlation coefficients for the mortality response group. In the within-program dataset, significant correlations were found between the correlation-RF and RF-LR rank correlation coefficients for the HT response group.

The consistency of site characteristic importance scores across productivity response groups was quantitatively judged using the Spearmen’s rank correlation coefficients. For the across-program dataset, two of the six comparisons were statistically significant: HT vs biomass and HT vs mortality (Table 3.3). For the within-program dataset, two of the six comparisons were statistically significant: DBH vs HT and HT vs biomass (Table 3.3).

Consistencies of individual site characteristics were also qualitatively judged for the productivity and stem form groups. I did this by determining the percentage of individual variables in a response group that contributed to the RF, LR and correlation importance scores as well as the relative contributions of the RF, LR and correlation analyses to the
Figure 3.1: Nine site characteristic groups (Table 3.1) resulting from the across-program cluster analysis of site characteristics. Analysis was conducted using a $[1-r]$ distance measure and clustering by group average linkage.
Figure 3.2: Nine site characteristic groups (Table 3.1) resulting from the within-program cluster analysis of site characteristics. Analysis was conducted using a [1-r] distance measure and clustering by group average linkage.
**Table 3.1:** Hierarchical clustering of site characteristics into site characteristic groups (SCG). These clusters were identical for the among-program and within-program analyses of Douglas-fir progeny test sites.

<table>
<thead>
<tr>
<th>SCG</th>
<th>Site characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRECIP</td>
<td>PPT_wt, PPT_sp, PPT_sm, PPT_at, MAP, MSP</td>
</tr>
<tr>
<td>TEMP1</td>
<td>DD&lt;18° C, DD&lt;0° C, PAS, TD, bFFP</td>
</tr>
<tr>
<td>TEMP2</td>
<td>Tmin_wt, Tmin_sp, Tmin_sm, Tmin_at, Tave_wt, Tave_sp, Tave_at, Tmax_wt, Tmax_sp,</td>
</tr>
<tr>
<td></td>
<td>Tmax_at, DD&gt;5° C, MAT, MCMT, eFFP, FFP, NFFD, EMT</td>
</tr>
<tr>
<td>DRY</td>
<td>AHM, SHM, CMD, DD&gt;18° C, MWMT, Tmax_sm, Tave_sm, Eref</td>
</tr>
<tr>
<td>Slope</td>
<td>Slope</td>
</tr>
<tr>
<td>cosASP</td>
<td>cosASP</td>
</tr>
<tr>
<td>AWC</td>
<td>AWC</td>
</tr>
<tr>
<td>TPD</td>
<td>TPD</td>
</tr>
<tr>
<td>Clay</td>
<td>Clay</td>
</tr>
</tbody>
</table>
Table 3.2: Spearman’s rank correlation coefficients (p-values) between productivity importance scores for the across-program and within-program analyses using correlation (Corr), random forest (RF) and linear regression (LR).

<table>
<thead>
<tr>
<th>Response</th>
<th>Across-program</th>
<th>Within-program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corr vs RF</td>
<td>Corr vs LR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>-0.07 (0.66)</td>
<td>-0.27 (0.09)</td>
</tr>
<tr>
<td>DBH</td>
<td>0.39 (0.01)</td>
<td>-0.06 (0.70)</td>
</tr>
<tr>
<td>HT</td>
<td>0.05 (0.74)</td>
<td>-0.03 (0.87)</td>
</tr>
<tr>
<td>Mortality</td>
<td>0.33 (0.03)</td>
<td>0.28 (0.07)</td>
</tr>
</tbody>
</table>

Table 3.3: Spearman’s rank correlation coefficients (p-values) between productivity total importance ranks for the across-program and within-program response groups.

<table>
<thead>
<tr>
<th>Response</th>
<th>Across-program</th>
<th>Within-program</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBH vs HT</td>
<td>0.24 (0.12)</td>
<td>0.52 (&lt;0.01)</td>
</tr>
<tr>
<td>DBH vs Biomass</td>
<td>0.24 (0.13)</td>
<td>0.25 (0.11)</td>
</tr>
<tr>
<td>DBH vs Mortality</td>
<td>0.02 (0.92)</td>
<td>-0.20 (0.20)</td>
</tr>
<tr>
<td>HT vs Biomass</td>
<td>0.35 (0.02)</td>
<td>0.41 (0.01)</td>
</tr>
<tr>
<td>HT vs Mortality</td>
<td>0.44 (&lt;0.01)</td>
<td>-0.09 (0.59)</td>
</tr>
<tr>
<td>Biomass vs Mortality</td>
<td>0.16 (0.31)</td>
<td>-0.18 (0.26)</td>
</tr>
</tbody>
</table>
summary importance score. The biomass, mortality, forking, ramicorn branching and sinuosity response group did not have any individual site characteristics that were qualitatively consistent. In contrast, the DBH and HT response groups did have individual site characteristics that were qualitatively consistent.

For the across and within-program analyses DD<0°C, PAS and AWC consistently explained variation in the DBH response group. For the across-program dataset, DD<0°C explained variation in 66.7% of the RF analyses, 66.7% of the LR analyses, and 50% of the correlation analyses (Table A1). The RF, LR and correlation importance scores were 57.2%, 31%, and 23.8% of the across-program total importance score, respectively (Table 3.4). For the within-program dataset, PAS explained variation in 33.3% of the RF analyses, 33.3% of the LR analyses, and 66.7% of the correlation analyses (Table A8). The RF, LR and correlation importance scores were 28.8%, 41.6%, and 29.5% of the within-program total importance score, respectively (Table 3.5). For the across-program dataset, AWC explained variation in 16.7% of the RF analyses, 66.7% of the LR analyses, and 33.3% of the correlation analyses (Table A1). The RF, LR and correlation importance scores were 16.3%, 72.3%, and 11.4% of the across-program total importance score, respectively (Table 3.4). For the within-program dataset, AWC explained variation in 66.7% of the RF analyses, 50% of the LR analyses, and 66.7% of the correlation analyses (Table A8). The RF, LR and correlation importance scores were 58.5%, 29.1%, and 12.4% of the within-program total importance score, respectively (Table 3.5).

For the across and within-program analyses DD<0°C, PAS, and NFFD consistently explained variation in the HT response group. For the across-program dataset, DD<0°C explained variation in 33.3% of the RF analyses, 66.7% of the LR analyses, and 66.7% of the correlation analyses (Table A2). The RF, LR and correlation importance scores were 32.9%, 32.6%, and 34.5% of the across-program total importance score, respectively (Table 3.6). For the within-program dataset, DD<0°C explained variation in 33.3% of the RF analyses, 33.3% of the LR analyses, and 83.3% of the correlation analyses (Table A9). The RF, LR and correlation importance scores were 29.5%, 30.4%, and 40.1% of the within-program total importance
Table 3.4: Variation explained ($R^2$) by the random forest (RF), linear regression (LR), and correlation (Corr) analyses of the across-program dataset (n=number of sites). The p-values apply to the LR analyses and "NA" denotes not applicable because the number of sites was too small to conduct a valid statistical LR analysis.

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<th>LR</th>
<th>p-value</th>
<th>Corrb</th>
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</thead>
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<td>0.0002</td>
<td>5.83</td>
</tr>
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<td>NA</td>
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<td>32.08</td>
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<td>13.02</td>
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</tbody>
</table>

a Response variable abbreviations are described in Table 2.2
b Mean $R^2$ from the correlations with the 10 highest p-values
c Set to zero for calculating the importance score.
Table 3.5: Variation explained ($R^2$) by the random forest (RF), linear regression (LR) and correlation (Corr) analyses of the within-program dataset (n=number of sites). The p-values apply to the LR analyses and "NA" denotes not applicable because the sites was too small to conduct a valid statistical LR analysis.

<table>
<thead>
<tr>
<th>Response</th>
<th>n</th>
<th>RF</th>
<th>LR</th>
<th>p-value</th>
<th>Corra</th>
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</table>

a Response variable abbreviations are described in Table 2.2
b Mean R$^2$ from the correlations with the 10 highest p-values
c Set to zero for importance score.
Table 3.6: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus DBH response group for the across-program Douglas-fir dataset.

<table>
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<th>Site characteristic</th>
<th>RF Score</th>
<th>Rank</th>
<th>LR Score</th>
<th>Rank</th>
<th>Corr Score</th>
<th>Rank</th>
<th>Total Score</th>
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score, respectively (Table 3.7). For the across-program dataset, PAS explained variation in 83.3% of the RF analyses, 66.7% of the LR analyses, and 50% of the correlation analyses (Table A2). The RF, LR and correlation importance scores were 58.3%, 30.2%, and 11.6% of the across-program total importance score, respectively (Table 3.5). For the within-program dataset, PAS explained variation in 50% of the RF analyses, 16.7% of the LR analyses, and 83.3% of the correlation analyses (Table A9). The RF, LR and correlation importance scores were 38.1%, 23.9%, and 38% of the within-program total importance score, respectively (Table 3.7). For the across-program dataset, NFFD explained variation in 66.7% of the RF analyses, 33.3% of the LR analyses, and 66.7% of the correlation analyses (Table A2). The RF, LR and correlation importance scores were 35.9%, 26.6%, and 37.5% of the across-program total importance score, respectively (Table 3.5). For the within-program dataset, NFFD explained variation in 33.3% of the RF analyses, 50% of the LR analyses, and 66.7% of the correlation analyses (Table A9). The RF, LR and correlation importance scores were 25.5%, 59.1%, and 15.4% of the within-program total importance score, respectively (Table 3.7).

3.3 Cold season temperatures and available water capacity explained variation in test site productivity.

The RF, LR, correlation and total importance scores for the across-program and within-program productivity analyses are listed in Tables 3.6 – 3.13. The total importance scores and the contributions of the RF, LR and correlation importance scores are illustrated in Figure 3.3 for the across-program productivity analyses. The total importance scores and the contributions of the RF, LR and correlation importance scores are illustrated in Figure 3.4 for the within-program productivity analyses. Below the most important site characteristic groups (SCGs) are identified for each response group. Then, within these SCGs the specific variables that perform the strongest are also identified. This process is followed for both the across-program and within-program datasets.
Table 3.7: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus DBH for the within-program Douglas-fir dataset.

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Figure 3.3: Summary of important site characteristics from the across-program productivity analyses grouped by Douglas-fir growth response variable (rows), and site characteristic group (columns). Score is the total importance from the RF, LR, and correlation analyses. The biomass, DBH, and HT importance scores are calculated from six individual variables within each response group, whereas the mortality importance score is calculated from three individual variables.
Figure 3.4: Summary of important site characteristics from the within-program productivity analyses grouped by Douglas-fir growth response variable (rows), and site characteristic group (columns). Score is the total importance from the RF, LR, and correlation analyses. The biomass, DBH, and HT importance scores are calculated from six individual variables within each response group, whereas the mortality importance score is calculated from three individual variables.
Site characteristic groups (SCG) TEMP1, TEMP2 and AWC were the most consistently important site characteristic groups for the productivity response groups. SCG TEMP1 explained variation in test site DBH (Table 3.6 and 3.7), HT (Tables 3.8 and 3.9), and biomass (Tables 3.10 and 3.11).

DD<0°C was the most consistently important site characteristic from SCG TEMP1 for explaining variation in the DBH response group (see section 3.2 for details). In the across-program DBH response group DD<0°C had a total importance rank of 3 and DD<18°C had a total importance rank of 5 (Table 3.6). In the within-program DBH response group DD<0°C had a total importance rank of 5 (Table 3.7).

DD<0°C was the most consistently important site characteristic from SCG TEMP1 that explained variation in the HT response group (see section 3.2 for details). DD<0°C and PAS had higher total importance ranks for the across-program HT response group (ranks = 1 and 7, respectively; Table 3.8) and the within-program HT response groups (ranks = 8 and 7 respectively; Table 3.9). DD<18°C also had a higher total importance rank (9) for the across-program HT response group (Table 3.8). TD had a higher total importance rank for both the across-program biomass response group (rank = 5; Table 3.10) and the within-program biomass response group (rank = 6; Table 3.11).

SCG TEMP2 explained variation in test site DBH (Table 3.6 and 3.7), HT (Tables 3.8 and 3.9), biomass (Tables 3.10 and 3.11) and mortality (Tables 3.12 and 3.13). Within SCG TEMP2, multiple site characteristics have higher total importance ranks. In the across-program DBH response group, DD>5°C (rank = 10), MAT (rank = 4), Tave_sp (rank = 7), Tmax_sp (rank = 9), and Tmax_wt (total importance rank = 6) all have higher total importance ranks (Table 3.6). In the within-program DBH response group, MCMT (rank=2), Tave_wt (rank = 7), Tmax_at (rank = 8), Tmax_wt (rank = 3), and Tmin_wt (rank = 6) all have higher total importance ranks (Table 3.7). NFFD and Tmin_at had higher total importance ranks for the across-program HT response group (ranks = 8 and 5, respectively; Table 3.8) and the within-program HT response group (ranks = 5 and 9, respectively; Table 3.9). DD>5°C (rank = 4), Tave_sp (rank =
Table 3.8: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus HT response group for the across-program Douglas-fir dataset.

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Table 3.9: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus HT for the within-program Douglas-fir dataset.

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Table 3.10: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus biomass response group for the across-program Douglas-fir biomass dataset.

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Table 3.11: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus biomass for the within-program Douglas-fir dataset.

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Table 3.12 (Continued)
Table 3.13: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus mortality for the within-program Douglas-fir dataset.

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2), \text{Tmin\_sp} (rank = 3), and \text{Tmin\_wt} (rank = 6) had higher total importance ranks for the across-program HT response group (Table 3.8). \text{MCMT} (rank = 1) and \text{Tmax\_wt} (rank = 3) had higher total importance ranks for the within-program HT response group (Table 3.9). \text{Tmax\_wt} had a higher total importance rank for both the across-program biomass response group (rank = 2, Table 3.10) and the within-program biomass response group (rank = 7; Table 3.11). \text{DD>5\textdegree C} (rank = 4), \text{MCMT} (rank = 6), \text{Tave\_sp} (rank = 3), \text{Tmax\_at} (rank = 8), \text{Tmin\_sp} (rank = 1), and \text{Tmin\_wt} (rank = 7) had higher total importance ranks for the across-program biomass response group (Table 3.10). \text{Tave\_at} (rank = 2) and \text{Tave\_wt} (rank = 1) had higher total importance ranks for the within-program biomass response group (Table 3.11). For the mortality response group SCG TEMP2 consistently had site characteristics with generally higher total importance ranks. \text{EMT}, \text{Tave\_at}, \text{Tmin\_at}, and \text{Tmin\_sp} had higher total importance ranks for the across-program mortality response group (ranks = 5, 1, 7, and 8 respectively; Table 3.12) and the within-program mortality response group (ranks = 8, 3, 2, and 4 respectively, Table 3.13). For the across-program mortality response group, \text{DD>5\textdegree C} (rank = 3), \text{MAT} (rank = 4) and \text{Tmax\_sp} (rank = 9) also had higher total importance ranks. For the within-program mortality response group, \text{EFFP} (rank = 1), \text{FFP} (rank = 5), and \text{Tmin\_wt} (rank = 9) had higher total importance ranks.

\text{Tmax\_wt} was the most consistently important site characteristic from SCG TEMP2 for explaining variation in the DBH response group. For the across-program dataset \text{Tmax\_wt} was important in 50\% of the RF analyses, 0\% of the LR analyses, and 50\% of the correlation analyses. The RF, LR and correlation importance scores were 56.8\%, 0\%, and 43.2\% of the across-program total importance score, respectively (Table 3.6). For the within-program dataset, \text{Tmax\_wt} was important in 50\% of the RF analyses, 16.7\% of the LR analyses, and 50\% of the correlation analyses. The RF, LR and correlation importance scores were 77.8\%, 15\%, and 7.2\% of the within-program total importance score, respectively (Table 3.7).

\text{Tmax\_wt} was also the most consistently important variable for explaining variation in the biomass response group. For the across-program dataset, \text{Tmax\_wt} was important in 16.7\% of the RF analyses, 50\% of the LR analyses, and 16.7\% of the correlation analyses. The RF, LR,
and correlation importance scores were 10.9%, 76.6%, and 12.5% of the across-program total importance score, respectively. For the within-program dataset, $T_{\text{max, wt}}$ was important in 50% of the RF analyses, 33.3% of the LR analyses, and 66.7% of the correlation analyses. The RF, LR, and correlation importance scores were 53.4%, 23.2%, and 23.4% of the within-program total importance score, respectively.

**NFFD** was the most consistently important site characteristics from **SCG TEMP2** for explaining variation in the **HT response group** for both the across and within-program datasets (see section 3.2 for details).

**AWC** also consistently explains the variability in the **DBH response group** (see section 3.2 for details) and ranks first in total importance score for both the across-program (Table 3.6) and within-program (Table 3.7) analyses.

**SCG PRECIP** appears to be important for the within-program **HT response group** (Figure 3.4). Further examination of the within-program HT response group reveals that most of the total importance scores are coming from the RF analyses (Table A9). There is also no support for the importance of SCG PRECIP for the across-program HT response group (Figure 3.3).

**SCG DRY** appears to be important for the across-program **DBH response group** (Figure 3.3) and the within-program HT response group (Figure 3.4). For both the across-program DBH response group (Table A1) the within-program HT response group (Table A9) the importance scores come from multiple responses and multiple analyses, but there is no clear pattern indicating what might be the biologically relevant site characteristics. There is also no support for the importance for SCG DRY for either the within-program DBH response group (Figure 3.4) or the across-program HT response group (Figure 3.3).

There is also no evidence that **Slope, cosASP, TPD and Clay** are important for explaining variation in test site productivity, the results that do appear to be important for explaining variation in test site productivity are considered spurious. For the within-program HT
response group, 66.6% of the total importance score for cosASP comes from the LR analysis (Table 3.9). Furthermore, the importance of cosASP for the HT response group is not corroborated by the across-program analyses (Figure 3.3). For the within-program DBH response group both TPD (SCG H) and clay (SCG I) appear to be important. However, 96.7% of the total importance score for TPD and 75.4% if the total importance score for clay comes from the LR analysis (Table 3.7). For the across-program biomass response group 99.6% of the total importance score comes from the LR analysis (Table 3.10).

3.4 Variation in stem form was not consistently explained by the site characteristics.

The RF, LR, correlation and total importance scores for the across-program and within-program stem form analyses are listed in Tables 3.14 – 3.19. The total importance scores and the contributions of the RF, LR and correlation importance scores are illustrated in Figure 3.5 for the across-program productivity analyses. The total importance scores and the contributions of the RF, LR and correlation importance scores are illustrated in Figure 3.6 for the within-program productivity analyses.

The variation explained in the across-program stem form dataset is greater than the variation explained in the within-program stem form dataset. The across-program stem fork $R^2$ values range from 4.3 to 26.2 (Table 3.4) whereas the within-program stem fork $R^2$ values range from -27.52 to 6.29 (Table 3.5). The across-program ramicorn branch $R^2$ values range from 5.87 to 43.35 (Table 3.4) whereas the within-program ramicorn branch $R^2$ values range from 3.07 to 14.66 (Table 3.5). The across-program sinuosity $R^2$ values range from 39.69 to 71.79 (Table 3.4) whereas the within-program sinuosity $R^2$ values range from 10.20 to 34.55 (Table 3.5). Unlike the test site productivity, the test site stem form was did not have either site characteristic groups or individual site characteristics that consistently explained the variation of stem forking, ramicorn branches or sinuosity.
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**Figure 3.5:** Summary of important site characteristics from the across-program form analyses grouped by Douglas-fir form response variable (rows), and site characteristic group (columns). Score is the total importance from the RF, LR, and correlation analyses.
Figure 3.6: Summary of important site characteristics from the within-program form analyses grouped by Douglas-fir form response variable (rows), and site characteristic group (columns). Score is the total importance from the RF, LR, and correlation analyses.
Table 3.14: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus stem forks for the across-program Douglas-fir dataset.

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Table 3.19: Summary scores and ranks from the random forest (RF), linear regression (LR), and correlation (corr) analyses of site characteristics versus sinuosity for the within-program Douglas-fir dataset.

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4 Discussion

4.1 Nine site characteristic groups were identified.

Before addressing site characteristics that are associated with site-to-site variation in test site productivity and form, it is important to understand the correlations among site characteristics. The hierarchical clustering of the site characteristics resulted in nine site characteristic groups (SCG), five of which contain only one site characteristic. Because the site characteristics were modeled, the intercorrelations are probably stronger than would result if the site characteristics were directly and independently measured at each test site. Each of these SCGs has different expected ecophysiological effects. However, individual site characteristics may be correlated with site productivity and stem form because they are either physiologically relevant or strongly correlated with a different site characteristic that is physiologically relevant to Douglas-fir growth and stem form; i.e., it is difficult to determine whether they are proximate or ultimate factors in growth and stem form.

SCG PRECIP contains all of the precipitation site characteristics except PAS (Table 3.1). However, PAS is not strictly a precipitation site characteristic; because temperature determines whether precipitation occurs as snow. Therefore, the presence of PAS in SCG TEMP1 is not surprising. Both the amount and timing of precipitation affect Douglas-fir growth. Adequate water supplies are needed for shoot and cambial growth and late season precipitation can lead to multiple flushing (Lavender 1981). Multiple flushing increases the amount of shoot growth in the current growing season, but is also linked to reduced pre-formed shoot growth the following growing season (Lavender 1981). Additionally, water deficits control xylem production and the initiation and duration of latewood production (Kozlowski and Pallardy 1997). Previous research found correlations between annual precipitation and Douglas-fir productivity (Case and Peterson 2005; Chen et al. 2010; Corona et al. 1998; Littell et al. 2008), and 3-PG uses total precipitation as an input (Swenson et al. 2005). Given these results, I hypothesized that SCG PRECIP would be important for explaining variation in test site productivity, specifically MAP because of the aforementioned research results.
SCG TEMP1 contains site characteristics that may affect the induction and release of endodormancy through temperature effects on chilling and forcing requirements (Table 3.1). Although chilling requirements can be met with temperatures above freezing (Harrington et al. 2010), DD< 0°C may still be a good indicator of whether chilling requirements can be met because temperatures near freezing are the most efficient for meeting chilling requirements (Lavender 1981). Conversely, the bFFP may be correlated with when forcing units begin to accumulate. The accumulation of chilling units over the dormant season influences shoot elongation during the following growing season. Because of a decrease in accumulated chilling units, warmer winter temperatures and an earlier beginning of the frost free period may delay bud flush (Harrington et al. 2010). Conversely, warmer temperatures in the fall and early winter may result in an extended growing season that continues to be favorable for cambial growth (Emmingham 1977). Thus, the overall effects of winter temperatures on biomass remain unclear. There may be reduced productivity in terms of height, but an increase in basal area. If SCG TEMP1 affects endodormancy then I hypothesize that SCG TEMP1 would explain variation in test site productivity, specifically DD< 0°C because of its association with chilling requirements.

SCG TEMP2 contains a variety of temperature site characteristics (Table 3.1). Temperature throughout the year affects shoot and cambial growth as well as injury and mortality. Warmer winter temperatures may reduce shoot elongation during the following growing season (Harrington et al. 2010), but shoots may elongate faster in the spring as the temperature increases from 14°C to 22°C (reviewed in Lavender 1981). The initiation, rate and duration of xylem and phloem production are regulated by temperatures (Kozlowski and Pallardy 1997). Temperatures throughout the year can also cause injury and mortality. Douglas-fir are most vulnerable to low temperature injury during the transition from active growth to dormancy and vice versa. Injuries and mortality can be caused by spring and fall frosts, low winter temperatures, or high summer temperatures (Kozlowski and Pallardy 1997). In the fall, Douglas-fir must complete growth cessation and bud set before the first frost in order to avoid fall frost injury. Conversely, in the spring, new shoots and leaves are most vulnerable to spring frost injury (Way 2011). Extreme winter temperatures may also
cause cold injury such as frost rings, winter desiccation and embolisms (McCulloh et al. 2011). Additionally, previous research has correlated growing season temperature and length with site productivity (Case and Peterson 2005; Chen et al. 2010; Littell et al. 2008; Wu et al. 2005). I hypothesized that site characteristics within SCG TEMP2 would explain variation in test site productivity and stem form. I hypothesized that site characteristics associated with growing season length, such as NFFD and MAT, would explain variation in test site productivity and that site characteristics associated with injury, such as EMT and eFFP, would explain variation in test site stem form.

SCG DRY contains site characteristics that are indicators of summer drought and the relationship between temperature and precipitation throughout the year (Table 3.1). The typical climate Coast Range and western Cascades, where the test sites are located, includes dry summers (Littell et al. 2009), making drought a critical site characteristic in this region. Summer drought can induce early bud dormancy (Lavender 1981), reduce shoot growth, reduce the number and growth of multiple flushes, and cause dehydration injury (Kozlowski and Pallardy 1997). Additionally, cambial growth is directly inhibited by drought (Kozlowski and Pallardy 1997). Drought also reduces photosynthesis. Temperature, humidity, and vapor pressure deficit influence stomatal conductance and the ability of a tree to produce photosynthate (reviewed in Chmura et al. 2011; Kozlowski et al. 1997). Stomatal conductance and photosynthesis are reduced by high temperatures and increases in vapor pressure deficit as leaf temperatures increase (Kozlowski et al. 1997). Previous research has correlated summer dryness (Chen et al. 2010), suboptimal temperatures and high vapor pressure deficits (Coops et al. 2007) with Douglas-fir growth. Because drought is a critical site characteristic in this region, I hypothesized that SCG DRY would explain variation in test site productivity, specifically summer heat:moisture index (SHM) because it is a measure of summer dryness.

Two topographic site characteristics (slope and cosASP) and three soils site characteristics (AWC, TPD, Clay) clustered by themselves, resulting in five SCGs with a single site characteristic. Slope and aspect were correlated with the productivity of mixed hardwood
stands (Fralish 1994). Slope may be correlated with light intensity, which is a site characteristic that was neither directly measured nor modeled for this study. Light intensity affects shoot growth (reviewed in Kozlowski and Pallardy 1997; Lavender 1981) and conifer photosynthesis is often more efficient at high light intensities (Kozlowski et al. 1997). Steeper slopes typically have higher light intensities than even terrain (Stage 1976). Aspect is a complex environmental variable that contributes to a wide array of site characteristics. North and south facing aspects are often associated with sharp contrasts in some site characteristics (Stage 1976; Stage and Salas 2007). South facing aspects receive more radiation in the northern hemisphere (Gates 1980), thereby influencing local temperature, relative humidity, potential evapotranspiration, and many soil and vegetation processes that influence potential net primary production. Additionally, south facing aspects have greater Douglas-fir basal area growth than north facing aspects (Stage 1976). Greater total incident solar radiation can increase the amount of photosynthetically active radiation (PAR), but effects on temperature and vapor pressure deficits can also increase drought stress. Because of the interactions of slope and aspect with light intensity, PAR, temperature, and drought stress it will be challenging to interpret their relationships to test site productivity or stem form. The likelihood that either would be consistently related to test site productivity or stem form would be dependent on the climate site characteristics that explained variation. Specifically, if SCG TEMP2 or DRY explained variation, than I would expect the importance of slope and aspect to be diminished.

Productivity has been correlated with AWC (SCG G) and other measures of soil moisture (Corona et al. 1998; Fralish 1994; Iverson et al. 1997; Klinka and Carter 1990). Water moves from the soil into roots through a complex process of diffusion, osmosis, and active transport. Soils with higher AWC have higher water potential, which means that roots do not have to exert has much energy to access water (Brady 1999). Additionally, after cambial growth initiation in the spring, water deficits are the most influential factor regulating growth throughout the remainder of the season. Douglas-fir growing on soils with more plant available water tend to be more productive. Daily and seasonal changes in water stress limit net photosynthesis. Soil water deficits trigger stomatal closure, which inhibits
photosynthesis (Kozlowski et al. 1997). Douglas-fir photosynthesis may be more robust to daily changes in vapor pressure deficit and summer drought if adequate soil water is available. Therefore, I expect AWC to be important for explaining variation in test site productivity.

Total soil profile depth (TPD) and clay content (Clay) both influence the AWC of a soil. Total soil profile depth is correlated with the amount of soil volume that is available for root exploration and access to water and nutrients (Angima and Terry 2011; Brady 1999). Clay content also influences water and nutrient availability. Clay soils typically have greater micropore space, but clay holds water more tightly than other soil particles (Brady 1999). Therefore, water becomes unavailable to plants because of low water potential at higher volumetric water content. Water percolates more quickly through soils with a lower percentage of clay than with a high percentage of clay. Low clay content may cause low water holding capacity, but high clay content and higher water holding capacity may be associated with a proportion of that water being unavailable to plants. Clay particles also have greater cation exchange capacity than silt or sand, and hold important nutrient cations more tightly, thus influencing nutrient availability to plants. Because of the interactions with AWC, the relative importance of soil profile depth or clay content will be influenced by the importance of AWC. I hypothesized that TPD and Clay would have diminished importance in the instance that AWC explains variation in site productivity.

4.2 Relationships between site characteristics and response groups were often inconsistent.

My aim was to identify site characteristics that explain variation in Douglas-fir growth and stem form, regardless of the method of analysis. If a site characteristic was important across analyses, then I concluded that it is important biologically, and not an artifact. Unfortunately, my results were not consistent, as evidenced by the non-significant Spearmen’s rank correlations for different analyses of the same response group (Table 3.2) and for comparisons of total importance ranks between response groups (Table 3.3). These analyses were conducted on a relatively small sample of sites that captured a relatively narrow range
of site characteristics. For example, the range of mean summer temperatures of my sites was 5.7°C (Table 2.4), whereas the range of mean July temperatures of Littell et al. (2008) sites was 9°C. Even though care was taken to select precise and accurate site characteristic values, there are still multiple sources of inaccuracy and random variation in these data. Inaccuracies in the site characteristics include the positional errors associate with the test sites, modeling errors associated with the climate data, and positional and attribute errors associated with the soils data. Inaccuracies with the test sites include measurement errors, recording and data entry errors, and the proper identification of stem defects. Measurement errors, recording and data entry errors were largely accounted for in the data cleaning processes, however, some may have remained in the data. Accurately identifying stem defects can be very challenging. In some cases ramicorn branches may look more like stem forks and in other cases a high frequency of ramicorn branches can case the tree to look highly sinuous. These subtle differences are challenging to detect, even for an experienced forester. Furthermore, there were methodological differences among the analyses. For example, neither the correlation nor the LR analyses used bootstrapping, but bootstrapping was used in the RF analysis. Additionally, the correlation and LR analyses assumed parametric data structures and the LR analysis was not robust to multicollinearity in the independent variables. Conversely, RF analysis is intended for use with non-parametric data and is robust to multicollinearity in the independent variables. Further complicating the analyses was the number of independent variables, especially in relation to the number of observations of many of the response variables, (e.g. DBH and sinuosity; Table 3.1). Smaller ratios of independent variables to number of observations often result in overfitted models and spurious results. Finally, there are some response variables that may not be explained well by the site characteristics. Although there is inconsistency, general patterns emerged.

4.3 Cold season temperatures and available water capacity explained variation in test site productivity.

There was moderate support for the hypotheses that SCG TEMP1, TEMP2, and AWC are related to test site productivity. SCG TEMP1 explained variation in the DBH, HT and biomass response groups. In particular, DD< 0°C had consistently higher importance scores and ranks
than other site characteristics (see Tables 3.6, 3.7, 3.8, and 3.9 for total importance scores and ranks). In the biomass response group, TD was consistently the most important site characteristic in SCG TEMP1 (see Tables 3.10 and 3.11 for total importance scores and ranks). SCG TEMP2 explained variation in all of the productivity response groups. Tmax_wt had consistently higher total importance scores and ranks for both the DBH and biomass response groups (see Tables 3.6, 3.7, 3.8, and 3.9 for total importance scores and ranks). NFFD was the most consistently important site characteristic in SCG TEMP2 for the HT response group (see Tables 3.8 and 3.9 for total importance scores and ranks). The mortality response group did not have an individual site characteristic that was consistently important, but the importance of temperatures at the beginning and the end of the growing season seems to be a pattern. Tmin_at and Tmin_sp had higher importance scores in the across- and within-program mortality response groups (Tables 3.12 and 3.13). Furthermore, Tmax_sp had a higher total importance rank for the across-program mortality response group (Table 3.12), and eFFP and FFP had higher ranks for the within-program mortality response group (Table 3.13).

The patterns emerging for the importance of SCG TEMP1 and TEMP2 indicate that cold season temperatures may explain variation in test site productivity. Whether the influence of cold season temperature is positive or negative is unclear. The lack of clarity is due to the emphasis on only identifying site characteristics. In order to understand the nature of the relationship between cold season temperatures and site productivity, further exploration of their effects in the models would be necessary. Nevertheless, it is possible to speculate that the relationships are non-linear. On sites that are cold limited, shorter growing seasons might explain lower productivity. Sites with higher productivity could be associated with longer growing seasons, fewer cold temperature injuries, or a combination of those effects. Favorable growth conditions later in autumn and into early winter could result in more multiple flushing and later bud set, both of which contribute to shorter pre-determined growth the following growing season. Additionally, fewer chilling units over the dormant season might delay bud flush in the spring, even when adequate forcing units are present. The effect of temperature at the beginning and end of the growing season on mortality is
also an emerging pattern. This is not particularly surprising, given that these transitional periods contain well-documented risks for injury (Bailey and Harrington 2006; St. Clair 2006; Way 2011).

SCG AWC explained variation in the DBH response group (see Tables 3.6 and 3.7 for total importance scores and ranks). Conversely, there is no evidence to support a role for SCG PRECIP or DRY in explaining variation in test site productivity. It is surprising that precipitation and summer drought did not consistently explain variation in test site productivity. The importance of AWC for the DBH response group may provide some explanation. It could be that while precipitation and summer drought influence site productivity, the ability of the soil to store water throughout the dry summer mitigates any drought stress on the sites. It may also be that water limited sites were not adequately represented by these data, although that is unlikely. The range of mean annual precipitation for my study was 70.8 to 441.7 cm; the range of annual precipitation for the study by Littell et al. (2008) was 68 to 533 cm and they showed relationships between precipitation and annual radial growth. Additionally, the temporal resolution of the data may also explain why precipitation and summer drought did not consistently explain test site productivity. In my study, periodic growth was typically calculated over a five year time frame. The study by Littell et al. (2008) focused on the current and previous year. Ecophysiological models often integrate precipitation and vapor pressure deficit on daily, weekly, or monthly time steps. This suggests that analyzing site characteristics at different temporal resolutions may provide interesting results.

There is also no evidence that SCG Slope, cosASP, TPD and Clay are important for explaining variation in test site productivity, but as previously mentioned, the importance of these site characteristics may be masked by the importance of other site characteristics with which they interact. Both SCG Temp and AWC explained variation in test site productivity which may explain the diminished roles of Slope, cosASP, TPD, and Clay. Additionally, the results that do appear to be important for explaining variation in test site productivity are inconsistent.
4.4 Variation in stem form was not consistently explained by the site characteristics.

The within-program dataset (Table 3.5) explained less variation in test site stem form than the across-program dataset (Table 3.4). Additionally, there was no evidence to suggest that any of the site characteristic groups or individual site characteristics explained variation in test site stem form. The small amount of explained variation and the lack of consistency are partially explained by the reasons discussed in section 4.2. Another possible explanation could be that I did not look site characteristics influential to stem form in this study. Future studies may benefit from incorporating insect, disease and mechanical damage into the site characteristics.

The across-program stem fork response has a fairly flat distribution of total importance scores across all of the SCGs (Figure 3.5) which makes it difficult to conclude that any one SCG or site characteristic is more important than the others. For the within-program stem fork response, the RF analysis has a negative $R^2$ value (Table 3.5) which indicates that more variation in test site stem forking was explained when the site characteristics were randomized. These results are consistent with Xiong et al. (2010), who examined correlations between site quality and stem forking in loblolly pine and found no evidence of a relationship.

There is no evidence that any of the SCGs or individual site characteristics are important for explaining variation in ramicorn branching. Both the across and within-program ramicorn branch responses have flat distributions of total importance scores across all of the SCGs (Figures 3.5 and 3.6), making it difficult to conclude that any one SCG or site characteristic is more important than the others. The one notable exception is PPT_wt for the across-program ramicorn branch response. However, 84.2% of the total importance score comes from the LR analysis (Table 3.16) demonstrating inconsistency across analytical methods. In addition, the importance of PPT_wt is not confirmed by the within-program analysis; the total importance score of PPT_wt for the within-program ramicorn branch response is zero (Table 3.17).
There is no evidence that any of the SCGs or individual site characteristics are important for explaining variation in sinuosity. There is no consistency between the across and within-program datasets. Site characteristics that appear to be important for the across-program sinuosity response, for example PPT_sp and Tmin_wt (Figure 3.5), have total importance scores of zero for the within-program sinuosity response (Table 3.19). For the within-program sinuosity response, site characteristics that appear to be important for explaining variation have large percentages of their total importance scores contributed by the LR analysis. For example, 85.6% of the total importance score of TPD comes from the LR analysis (Table 3.19), which demonstrates inconsistency across analytical methods.
4.5 Future work

Because this thesis project was largely exploratory, general relationships have been identified but much residual variation remains, there are ample opportunities for future work, which include both different analytical strategies and different datasets. First, the differences in the RF, LR and correlation analyses may be more important than originally thought. The use of bootstrapping in the RF analyses provides more stable results that are less susceptible to small changes in the dataset. Bootstrapping methods could be similarly applied to both the LR and correlation analyses. These methods would address both the small sample size and the large number of independent variables. The small sample size would be addressed by the iterative process of bootstrapping. Rather than having one small sample, there would be many and the results would strength each other. The large number of independent variables would be reduced a random subsample for each bootstrap iteration. Another approach to addressing the large number of variables would be to run the RF, LR and correlation analyses with only 9 independent variables (i.e. one representative from each SCG). Determining which variable to select from SCG PRECIP, TEMP1, TEMP2, and DRY will be challenging. Further examination of these groupings will need to be completed to select the site characteristic that is most biologically relevant to site productivity and stem form.

Completing these analyses without the soils site characteristics is another way to address the small sample size. The NRCS SSURGO data was available for a portion of the progeny test sites. Excluding the soils site characteristics would add an additional 97 progeny test sites, bringing the total sample size to 288. The range of variation seen in the remaining site characteristics would also increase, although only marginally.

Once the important site characteristics for test site productivity and stem form have been identified, predictive models could be developed using the site characteristics to better understand the impacts of near term climate change. ClimateWNA could be used to generate climate projections for the test sites using a variety of climate scenarios. The predictive models could predict average annual growth rates or average number of stem defects per
tree for a given site. These models could also provide further insight into the direction of the relationship between site characteristics and site productivity and stem form. Given the relatively narrow range of site characteristics, the predictive modeling could prove to be very challenging. It may be that more progeny test sites will need to be mapped to complete this objective.

After the site characterization is completed, the genetics and adaptability of Douglas-fir could be more closely examined using a subset of the data. Environmental transfer distances and GxE interactions could be more closely examined using similar analytical methods. Because of the change in study units (i.e., from program to family), this step could be less influenced by the range of site characteristics.
5 Conclusion

Douglas-fir site productivity and stem form are directly related to the profitability of owning forest land for timber production and the potential economic returns on silvicultural investments that promote maximum potential tree growth. Understanding how site characteristics influence both productivity and stem form is crucial to remaining competitive in a global market, especially under the additional pressures of near term climate change. Though the results of this exploratory study are only very general, they also provide new direction and insight for future research. It may be reasonable to focus future research on summer drought, cold season temperatures and precipitation interactions with soil properties, particularly available water capacity when examining site productivity. Additionally, examining genotype by environment interactions at the family level may provide insight to the driving site characteristics for stem forking, ramicorn branching and sinuosity.
References


Bruce, D. 1974. Volume equations for second-growth Douglas-fir Pacific Northwest Forest and Range Experiment Station, Portland, OR.


Lavender, D.P. 1981. Environment and shoot growth of woody plants. Forest Research Laboratory, School of Forestry, Oregon State University, Corvallis, OR.


White, T.L. 2007. Forest genetics. CABI Pub., Wallingford, Oxfordshire, UK; Cambridge, MA.


Ye, T., and Jayawickrama, K. 2007a. A data analysis protocol for cooperative second-cycle progeny tests in the NWTIC. Oregon State University, Corvallis, OR.

Ye, T., and Jayawickrama, K. 2007b. Methodology for predicting genetic gains for cooperative first-generation progeny tests. Oregon State University, Corvallis, OR.

APPENDIX
Table A1: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus DBH for the Douglas-fir across-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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Table A3: Summary of the variable importance (VI) from RF, the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus biomass for the Douglas-fir across-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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*Note: LR = Land Rapidness; BA = Basal Area; VOL = Volume; GDI = Growth and Development Index; Score = Composite Score.*
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Table A5: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus stem forking for the Douglas-fir across-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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**Table A6:** Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus ramicorn branches for the Douglas-fir across-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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|       | PPT_at              | 0.117 | 4     | 0.132 | 1     | -      | -      | -      | -    | 4.86 | 16
|       | PPT_sm              | -    | -     | -     | -     | 0.074  | 9      | -      | 0.109 | 4   | 7.67 | 10
|       | PPT_sp              | 0.118 | 3     | -     | -     | -      | -      | -      | -    | 1.46 | 32
|       | PPT_wt              | 0.097 | 6     | 0.118 | 4     | -      | -      | -      | -    | 4.24 | 21
| TEMP1 | bFFP                | -    | -     | -     | -     | -      | -      | 0.083  | 6    | -    | 3.13 | 25
|       | DD < 0°C            | -    | -     | -     | -     | -      | 0.139  | 1      | 0.124 | 5  | -    | 15.21 | 4
|       | DD < 18°C           | -    | -     | -     | -     | -      | -      | 0.094  | 7    | -    | 3.55 | 24
|       | PAS                 | 0.066 | 9     | -     | 0.096 | 6      | -      | -      | -    | 4.45 | 19
|       | TD                  | -    | -     | -     | -     | 0.106  | 6      | -      | -    | -    | 2.75 | 28
| TEMP2 | DD > 5°C           | -    | -     | -     | -     | -      | 0.021  | 10     | -     | -    | 1.70 | 31
|       | eFFP                | -    | -     | -     | -     | -      | -      | 0.106  | 4    | -    | 4.03 | 23
|       | EMT                 | -    | -     | -     | -     | -      | -      | -      | -    | 0.00 | 33
|       | FFP                 | -    | -     | 0.064 | 9     | -      | -      | -      | 0.130 | 2  | -    | 6.61 | 12
|       | MAT                 | -    | -     | -     | -     | -      | -      | -      | -    | 0.00 | 33
|       | MCMT                | -    | -     | 0.122 | 2     | -      | -      | 0.142  | 4    | -    | 14.50 | 5
|       | NFFD                | -    | -     | 0.087 | 7     | 0.125  | 2      | -      | 0.110 | 3  | -    | 11.15 | 8
|       | Tave_at            | -    | -     | -     | -     | -      | -      | -      | -    | 0.00 | 33

Table A8: Summary of the variable importance (VI) from RF, the GDI from LR, and response-site characteristic correlations for the analyses of site characteristics versus DBH for the Douglas-fir within-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.
Table A8 (Continued)

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| | Tave_wt | 0.080 9 | 0.103 5 | 0.097 6 | 0.079 9 | - | - | - | 5.59 6 |
| | Tmax_at | - | - | - | - | 0.093 6 | - | - | 3.59 9 |
| | Tmax_sp | - | - | - | - | 0.095 5 | - | - | 3.66 8 |
| | Tmax_wt | - | - | - | - | 0.152 1 | - | - | 5.88 5 |
| | Tmin_at | 0.108 4 | 0.087 9 | 0.092 8 | - | 0.084 6 | - | - | 3.03 13 |
| | Tmin_sm | - | - | - | - | - | - | - | 0.00 31 |
| | Tmin_sp | - | - | - | - | - | - | - | 0.00 31 |
| | Tmin_wt | 0.122 1 | 0.108 4 | 0.105 2 | - | 0.078 8 | - | - | 3.43 10 |
| DRY | AHM | - | - | - | - | - | - | 0.119 2 | 0.092 9 | 5.99 4 |
| | CMD | - | - | - | - | - | - | - | 0.097 7 | 1.48 22 |
| | DD > 18°C | - | - | - | - | - | - | - | - | 0.00 31 |
| | Eref | - | - | - | - | - | - | 0.101 4 | - | 3.91 7 |
| | MWMT | - | - | - | - | - | - | 0.106 3 | - | 0.52 28 |
| | SHM | - | - | - | - | - | - | - | 0.108 3 | 1.64 17 |
| | Tave_sm | - | - | - | - | - | - | 0.084 7 | - | 0.42 29 |
| | Tmax_sm | - | - | - | - | - | - | 0.075 10 | - | 0.37 30 |
| | Slope | - | - | - | - | - | - | - | - | 0.00 31 |
| | cosASP | - | - | - | 0.091 7 | - | - | - | 0.098 4 | 1.34 24 |
| | AWC | - | - | - | - | - | 0.079 10 | - | - | 3.06 12 |
| | TPD | - | - | - | - | - | - | - | - | 0.00 31 |
| | Clay | - | - | - | - | - | - | - | - | 0.00 31 |
Table A10: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus biomass for the Douglas-fir within-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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Table A12: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus stem forking for the Douglas-fir within-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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Table A13: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus ramicorn branches for the Douglas-fir within-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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Table A14: Summary of the variable importance (VI) from RF the GDI from LR and response-site characteristic correlations for the analyses of site characteristics versus sinuosity for the Douglas-fir within-program dataset. The amount of variation ($R^2$) for RF and LR and the mean $R^2$ for correlations are shown in parentheses.

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