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Site Characteristics and Christmas Tree Planting (Part 1 of 2)

MEL KOELLING,
PROFESSOR EMERITUS IN FORESTRY,
MICHIGAN STATE UNIVERSITY

The 2020 Christmas tree season is now history and for most individuals associated with the natural Christmas tree industry the 2020 season will be memorable. At all levels of the industry including wholesale, retail, and cut-your-own operations, demand was strong and sales were excellent. It is quite likely total tree sales were more than in any of the past dozen years. Now the 2020 season is being evaluated from the perspective of "where do we go from here." Assuming planting stock is available, it is likely plantings will increase at both the wholesale and cut-your-own level. Most seedling and transplant nurseries report available inventories of the most popular Christmas tree species are sold out due to long standing and new orders. Savvy growers have learned to place planting stock orders well in advance of the planting season to be assured of an adequate supply. In addition to increased plantings by established growers, there is also evidence of interest in establishing new planting by would-be Christmas tree producers.

So, assuming Christmas tree plantings are going to be increased, it is perhaps important to consider some characteristics of the specific location(s) where these plantings are planned. More specifically, what are the climatic and physical features of such areas which will determine whether the new plantings are as successful as possible. To do this, the concept of site will be considered. Those characteristics which influence the favorability or productivity of a given site will be identified and explored. In the next issue of the *Great Lakes Christmas Tree Journal,* a discussion of matching species to specific sites to obtain maximum productivity will be addressed.

What Is Meant By The Term Site?

Site has been defined as "the composite expression of a variety of physical and chemical attributes of a particular area resulting from climatic, topographic, and soil inputs". The concept of site can be expressed in several different situations. Some examples include: a good building site, a good pond site, a good site for a windmill, or a good site for a Christmas tree plantation. The different expressions convey the understanding that whatever specific use is planned for a given location, the probability of success will be enhanced. Those characteristics of a specific site which will influence success or maximum productivity are variable, depending on the requirements of the proposed project.

From the perspective of a Christmas tree grower, there are several components of a site that will influence the success and productivity of a newly established plantation. Being aware of these variables before planting will increase the likelihood of success by selecting species for planting that are not adversely affected by specific site components or other limitations imposed by the site.

General Components Of Site Important To Christmas Tree Producers

For growing plants (trees) of nearly any species, site variables that should be considered before planting can be separated into three broad groups. These are:

1. Climatic
2. Topographic
3. Soil

Within each of these groups there are specific components that can be identified. Those variables in the climatic group will be considered first.

Climatic Influences

Climatic influences generally refer to those factors which are beyond the control of the local land manager, or essentially anyone else. The effects of some may be temporarily eliminated, such as covering garden plants in the spring or fall to prevent injury or death from freezing temperatures. Likewise, irrigation in a Christmas tree plantation in the summer provides water to the tees, but it does not influence average monthly or annual precipitation amounts for the particular area.

a) **Length of growing season.** The number of days above freezing is generally not a limiting factor in the production of Christmas trees throughout the northeastern United States and adjacent Canadian provinces. However, for non-native or exotic species this could be a factor. Assuming a particular species is hardy, the amount of annual growth may be limited if the selected species requires a longer growing period.

b) **Temperatures.** Temperature influences may occur as a result of both high and low temperatures. Temperature

Figure 1 *Concolor fir planted on an east facing slope showing severe winter burn in trees growing near the base of the slope.*

limitations are usually expressed through plant hardiness zones (USDA), or heat zone maps (American Horticultural Society). Hardiness zone maps are available which illustrate projected minimum air temperatures that can be expected in a particular location. Heat zone maps project the number of days in the year when air temperatures above 86 degrees Fahrenheit can be expected. If the stated hardiness zone tolerance for a specific species is higher than the minimum indicated for the local hardiness zone, it probably should not be considered for planting **(Figure 1).** Likewise, some species such as the true firs do not grow well when prolonged periods of high summer temperatures are present. Consulting the heat zone map for the local area will be helpful in selecting species for planting. Different plant hardiness and heat zones exist throughout the northeastern United States and adjacent Canada. Most often variations in these zones reflect topography, latitude, and proximity to major lakes or coastal waters.

c) **Precipitation.** Both annual and seasonal precipitation amounts are vital components of site. The form of precipitation (rain or snow) is also of concern. Obviously, adequate precipitation during the growing season is essential for survival and maximum growth. In that required precipitation amounts will vary among species, e.g. pines are generally more tolerant of dry conditions than true firs, precipitation distribution patterns will influence species selection. For most species, required precipitation amounts are greatest during the early part of the growing season.

Precipitation effectiveness is also influenced by other site factors. Among these are soil type and texture, as well as the topographic factors of slope and aspect. These characteristics can either increase or decrease the effectiveness of available precipitation. Their influence will be considered further in the following discussion of topographic and soil characteristics.

Topographic Influences

Significant variation in topography exists in all portions of the northeastern United States and adjacent Canada where Christmas trees are grown.

The influence of some topographic factors is obvious in regions such as the Appalachian and New England mountains, while other areas such as the rolling to generally flat or even level portions of the Midwest are less so. Some common components of topographic influences are identified as follows:

Figure 2 *Fir trees growing on sloping land. Note the layout of the plantation is different depending on the degree of slope.*

a) **Elevation.** Elevation simply refers to the height a particular location or area is above sea level. Obviously, some vegetation is present from sea level to near the tops of the highest peaks. However, there is not a single Christmas tree species that can be commercially produced at all elevation levels. Elevation exerts its influence through other site components such as temperature, length of growing season, and both soil physical and chemical properties.

b) **Slope.** Slope refers to the presence of significant differences in elevation over relatively short distances. Common terms which are used to express slope include mountains, hills, and valleys. Other terms which define the absence of significant slope include rolling, flat, and level **(Figure 2)**. While the presence of some slope does not preclude the growth of planted trees, it certainly can and does influence cultural practices, ability to use mechanical equipment, and ease of performing management activities. It also influences layout of tree plantations, vegetative control practices, harvesting methodology, and pest management practices.

c) **Aspect.** In rolling, hilly, or mountainous lands, aspect refers to the compass direction a particular parcel of sloping land is facing, be it north, east, south, or west. Some combination of cardinal compass directions such as northeast, southwest, etc. are also possible. Obviously, trees can and do grow on land with any of these aspects. Like other topographic influences, aspect tends to impact the contributions of temperature in affecting the favorability of a particular location for growing Christmas trees. As an example, soils on lands with a south, southwest, or west facing aspect will usually be drier and warmer than soils on locations in the same area which have an east, northeast, or north facing aspect.

d) **Frost Pocket.** In regions with valleys, slightly rolling or relatively level land, it is common to have lower lying locations in which both water drainage and air drainage are not favorable. In early spring after the growing season has begun, it is not unusual to have near freezing air temperatures for a day or two. When this occurs, colder air, often with below freezing temperatures tends to sink and settle in these low-lying areas. If trees have been planted in such locations and new growth has started, it is quite likely such growth will be severely damaged or killed. Usually the tree is not killed, but growth for the year is lost and significant corrective shearing and trimming must be completed on the damaged trees. Another consequence of these low-lying areas is the accumulation of standing water, often in the spring when snow is melting **(Figure 3)**, or following a heavy rain at any time of the year. Improving drainage by tiling or ditching is often necessary to correct this problem.

Figure 3 *Standing water resulting from melting snow. Imperfect soil drainage allows water to accumulate. Although some trees can grow on such sites, the rate of growth is significantly less than on better drained soils.*

Figure 4 *A portion of a 4-year-old planting of Canaan Fir where excessively wet soils has resulted in the death of all the planted trees.*

Soil Influences

When the climatic and topographic extremes are eliminated, it is those several properties and characteristics of soils that are of most significance to Christmas tree producers. Singularly or in combination, soil types and related characteristics impact not only where trees can be successfully grown, but also what species of tree should or should not be planted. Each of several soil properties that can and do impact tree establishment and growth will be considered. For the sake of grouping effects that are somewhat similar, physical and chemical characteristics will be considered separately.

a) **Physical Characteristics**

(1) **Soil texture –** Soil texture refers to the relative proportion of different sized soil particles (sand, silt, and clay) present in a particular soil. Twelve separate classifications are recognized. These range from coarse textured soils such as sand and loamy sand to very fine textured soils such as silty clay and clay. The typical loam soil contains approximately 20 percent clay, 50 percent sand, and 30 percent silt. Organic or muck soils are classified not on their physical particle size, but on the fact that they contain 30 percent or more organic matter.

The texture of a particular soil influences several soil characteristics. Coarse textured soils characteristically have lower nutrient holding capacities and tend to be more drought prone. Conversely, clay soils are more easily compacted, are more likely to be less well drained, and may

have undesirable chemical properties, even though nutrient holding capacity is high. Some of the undesirable aspects can be managed through various management practices, including fertilization, tiling, and organic matter additions.

(2) **Soil drainage –** Soil drainage is concerned with the movement of water into and out of the soil profile. Coarse textured soils tend to be excessively well drained to the point of becoming droughty. Heavy clay soils are often poorly drained and surface water accumulations may remain for a few to several days in the spring or following a heavy precipitation event. It is a generalization but true that "most Christmas tree species don't like wet feet". Unless corrective action such as subsoiling, tiling, or ridging to improve internal drainage is undertaken, such sites may not be suitable Christmas tree production areas **(Figure 4)**. As a minimum the selection of species tolerant of such sites will be limited.

(3) **Soil depth –** Soil depth can be understood in relation to how much soil is over underlying parent material such as bedrock, or how much topsoil is present on severely eroded sites. It may also refer to the amount of soil above an underlying "hardpan" which interferes with rooting depth and moisture percolation. If stone outcrops are present in a particular field, it is likely some impacts on tree growth and moisture relations will be present. In sloping fields, some underlying stone outcrops or hardpans may be present near the soil surface. When this is present, the soil around the emerged layers will most likely be wet. Wet soils are highly favorable for the development of root diseases such as *Phytophthora* sp., which are deadly to some Christmas tree species such as Fraser fir **(Figure 5)**.

b) **Chemical Characteristics**

When considering soil chemical properties two components are of most importance. These are total nutrient content or fertility level, and soil reaction or pH. Unlike some physical properties such as texture and soil depth, it is possible to modify chemical properties in many soil types.

(1) **Soil fertility levels –** Existing soil nutrient contents reflect several factors. These include the type of parent material from which the soil was formed, the texture of the soil, and past land use on the area. Considering original parent materials, soils derived from

limestone or many alluvial deposits are generally more fertile than soils resulting from weathering of granitic or sandstone materials. One of the reasons this is true is that soils of limestone origin usually contain a higher percentage of clay size particles. Particles of this size have a greater amount of specific surface area, and thus can "hold" more essential plant nutrients. In technical terms they are said to have a higher cation exchange capacity. In contrast, soils with higher concentrations of sand-size particles have less specific surface and thus do not possess a high nutrient holding capacity. To maintain adequate fertility levels for whatever species of tree is being grown, more frequent and larger amounts of appropriate fertilizer materials are necessary.

Figure 5 *A couple of dead Fraser Fir due to Phytophthora sp. root rot. These trees were growing on a sloping site where an underlying area of heavier soil emerged resulting in an area of wetter soil favorable for Phytophthora sp.*

Figure 6 *Hand application of fertilizer to smaller trees in a cut over Fraser fir plantation. The amount of fertilizer applied is a function of tree size.*

It is possible to modify the nutrient holding capacity of most coarse textured soils by the addition of organic matter. Animal manure applications are excellent. Additional practices such as establishment and incorporation of a green manure crop before planting and the maintenance of a managed cover crop among the rows in existing plantations will be helpful.

To establish and maintain adequate soil nutrient concentrations, most Christmas tree producers annually make one or more fertilizer applications **(Figure 6)**. However, the determination of fertilizer

nutrients that are needed and how much to apply should always be based on an initial as well as subsequent soil tests.

(2) **Soil reaction (pH) –** The acidity or alkalinity (basicity) of the soil solution is expressed through a metric called pH. The pH scale extends from 0 to 14 with a pH value of 7.0 considered to be the neutral point. Values above this point are said to be alkaline; values below this point are defined as acidic. Most plants grow best in a soil with a pH value between 6.0 and 6.5. This is considered slightly acidic. However, some plants such as blueberries, azaleas, and many conifers grow best when the pH is lower, thus the soil solution is more acidic.

The soil reaction is important to plant growth because it affects the solubility and thus availability of most nutrients deemed essential for plant growth. Generally, at a pH value of 6.0 most essential plant nutrients are present in a soluble form and can be absorbed by the plant. As pH values approach 7.0 some essential nutrients become less soluble. Although present in the soil solution, they are unavailable in a soluble form, thus a deficiency exists and deficiency symptoms in the plant become visible. Fraser fir is especially sensitive to high soil pH levels (approaching 7.0) since both manganese and iron are not present in a soluble form. Deficiency symptoms include yellowing of the foliage and stunting of growth **(Figure 7)**. The off-color symptoms are

Figure 7 *Small area of Canaan fir growing on soil with a pH value of 6.8. Note the stunted growth and yellowish foliage in contrast to other trees.*

Figure 8 *Fraser fir located near a woodlot showing results of feeding and antler rubbing by deer. This kind of damage can be expected when Fraser fir is planted near woodlots or deer wintering areas.*

particularly pronounced during the non-growing season.

In many soils, pH is related to the amount of calcium in the soil. Coarse textured soils with lower amounts of calcium tend to be acidic. Finer textured soils typically have higher amounts of calcium and generally are more alkaline. For acidic soils the pH can be easily changed through the addition of calcium carbonate in the practice of liming. While this is relatively easy and a significant change can be obtained fairly quickly, it is much more difficult to increase the acidity (lower the pH) of fine textured soils with a higher pH (7.0 or above). Through the addition of heavy applications of elemental sulfur combined with the use of sulfur containing fertilizer materials such ammonium sulfate, a reduction in the pH value can be obtained. However, the rate of change is slow and repeated applications on a continued basis are necessary.

Conclusions

When a Christmas tree plantation is established, it marks the beginning of an 8 to10 year commitment to manage and culture the planted trees into a quality, salable product. Whatever characteristics the planting location has will be dealt with throughout the entire production period. This article has attempted to identify and offer some insight on several characteristics of the planting location. There are additional aspects of site that were not described, but which will influence the success of a plantation. Among others, these include prevailing winds, shade from adjacent woodlots or other nearby large trees, proximity to winter deer yards **(Figure 8)**, and closeness to nearby roads where salt is used for dust control or snow and ice removal. The concept of site has been identified and several components of site have been described. Some cannot be changed during the management/production period. However, others can be managed to obtain maximum productivity. The more information the would-be planter has about all aspects of the planting location before the first tree is planted, the greater the probability the operation will be successful.