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The effect of root and shoot pruning on early growth of hybrid poplars

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ABSTRACT

Planting stock type and quality can have an important impact on early growth rates of plantations. The goal of this study was to evaluate early growth and root/shoot development of different planting materials in typical heavy clay soils of northwestern Quebec. Using one-year-old bareroot hybrid poplar dormant stock, four planting materials were compared: (1) regular bareroot stock, (2) rootstock (stem pruned before planting), (3) whips (roots pruned before planting), and (4) cuttings (30 cm stem sections taken from the basal portion of bareroot trees, i.e. roots and shoot pruned). Rooted stock types (bareroot and rootstock) produced, on average, 1.2 times larger trees than unrooted stock types (cuttings and whips). However, shoot-pruned stock types (rootstocks and cuttings) reached similar heights and basal diameters as unpruned stock types (bareroots and whips), during the first growing season. Shoot pruning reduced leaf carbon isotopic ratios, suggesting that unpruned stock types were water-stressed during the first growing season. The stress was most likely caused by early leaf development while root growth occurred later in the summer. We conclude that shoot pruning bareroot stock is a useful management option to reduce planting stress without compromising early growth rates of hybrid poplars.

1. Introduction

Establishment of fast-growing plantations is considered one of the main tools to produce more wood on reduced land areas in order to, in part, preserve a larger proportion of native forests without affecting the forest industry (Anderson and Luckert, 2007). Rapid establishment and growth of trees are crucial in such plantations, especially where the growing season is short, such as in boreal regions of Canada. Planted trees that have rapid early growth can reduce rotation length and shade out weeds sooner, reducing maintenance costs. Planting stock type and quality can have an important impact on early growth rates and thus affect profitability of such plantations.

In Europe and United States, hybrid poplars (*Populus* spp.) are usually planted as unrooted cuttings or whips (Stanturf et al., 2001). In Quebec, Canada, planting stock provided by provincial nurseries to tree farmers is tall (approximately 1–2 m in height), one-year-old bareroot dormant stock; large bareroot stock was originally designed to avoid dear browsing problems and also to better compete with weedy vegetation (Dey and Parker, 1997). Practitioners have also moved away from planting unrooted dormant cuttings in the field because the use of herbicides to eliminate weedy vegetation in plantations is prohibited in Quebec. It is generally understood that bareroot stock is a superior competitor because of its large size (Mohammed et al., 2001; Mc Nabb and Vanderschaaf, 2005). Weeds, however, can significantly reduce growth of hybrid poplars, even if they are shorter than the planting stock, since the competition pressure comes from the soil (temperature, water and nutrients; Landhäusser and Lieffers, 1998; Coll et al., 2007). Hence, it is widely recognized that hybrid poplar plantations be kept weed-free at all times (Dickmann et al., 2001), making it unnecessary to use tall planting stock to outcompete weedy vegetation. Moreover, growth of these tall bareroot trees usually stagnates the year of planting, and the trees often show stem dieback damages (necrosis of the tree tip) during their first growing season in the field (Guillemette and DesRochers, 2008). This could be due to unbalanced root/shoot ratios (RS) of such large plants with few large woody roots, trimmed before storage and planting (Struve and Joly, 1992; South, 1996; DesRochers et al., 2004). Shoot growth stagnation and stem dieback often discourage woodlot owners to invest in the establishment of hybrid poplar plantations. Furthermore, even after the trees have established, there can be a carry-over effect from the planting stress when the transplants did not have well developed root systems (Grossnickle, 2005), reducing the productivity of the plantation over several years.

Growth stagnation, or planting stress, is often explained by a period of time needed by a tree to grow an adequate root system for the site where it is planted (Rietveld, 1989; Grossnickle, 2005). Tall poplar bareroot stock bears many leaf buds along the stem and usually develops many shoots after planting, although their root system has been trimmed to a manageable size (usually to a

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