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Side shelter on lowland sites can benefit early growth of ash (*Fraxinus excelsior* L.) and sycamore (*Acer pseudoplatanus* L.)

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Summary

The influence of side shelter on the growth of newly planted ash (*Fraxinus excelsior* L.) and sycamore (*Acer pseudoplatanus* L.) was investigated at a lowland site in Britain. Although tatter flag analysis classified the site as 'very sheltered' in comparison to upland sites, after three years, both species benefited to some degree from the provision of shelter, with height increment being improved by up to two to four times. The most effective shelter was provided by a wall of straw bales. Plastic netting also reduced exposure, but required regular maintenance in winter months. Our work suggests that on equivalent sites in southern Britain, where mean daily tatter rates of more than 2.4 cm^2 day^{-1} (equivalent to windiness scores of greater than 10.3) occur, without side shelter, severe suppression of height growth in ash and sycamore is likely, and that exposure to wind is likely to be a significant cause of this reduction in growth. Currently, using artificial shelter materials on a large scale on lowland sites solely to improve early tree growth is unlikely to be cost-effective in most cases. However, the provision of side shelter, particularly through use of nurse species, is likely to become an increasingly important silvicultural consideration in the future.

Introduction

In a forestry context, the term shelter can be used to describe the protection of trees from exposure to potentially damaging environmental factors, in particular wind, but also frost, sun and snow. The specific effects of shelter will vary depending on the climatological and topographical characteristics of any particular site, as well the characteristics of the protection itself. Although the main benefit of shelter is often considered to be a reduction in wind velocity, this can also be accompanied by significant changes in air temperature, solar radiation, turbulence, relative humidity, soil moisture and soil temperature. Provision of shelter will usually reduce the mixing of air, increase air temperatures around plants on sunny days and possibly reduce night-time temperatures (Gardiner *et al.*, 2006).

Exposure can affect tree physiology in several ways. Firstly, wind may cause direct mechanical damage to the leaves and result in branch and stem snap, and windthrow (Quine *et al.*, 1995). Wind can also cause stunting of plant growth and poor form (Kozlowski *et al.*, 1991), increased biomass allocation to roots at the expense of

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