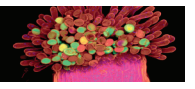


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RESEARCH PAPER

Vegetative reproduction capacities of floodplain willows – cutting response to competition and biomass loss

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ABSTRACT

While several studies on regeneration in Salicaceae have focused on seedling recruitment, little is known about factors controlling their vegetative reproduction. In two greenhouse experiments, we studied the response of floodplain willows (*Salix fragilis*, *S. viminalis*, *S. triandra*) to competition with *Poa trivialis*, and to shoot and root removal when planted as vegetative cuttings. In the first experiment, growth performance variables were analysed in relation to full competition, shoot competition, root competition and control, taking into account two different water levels. After 9 weeks, shoots were removed and the resprouting capacity of the bare cuttings was recorded. In the second experiment, the cutting performance of the three floodplain and an additional two fen willow species (*S. cinerea*, *S. aurita*) was compared when grown in three different soil compositions and with two different water levels. After 9 weeks, shoot and root biomass was removed and the bare cuttings were replanted to test their ability to resprout. Cutting performance and secondary resprouting were negatively affected by full and shoot competition while root competition had no or weak effects. The floodplain species performed better than the fen species in all soil types and water levels. Secondary resprouting capacity was also higher in the floodplain species, which showed an additional strong positive response to the previous waterlogging treatment. The results contribute to understanding of the vegetative regeneration ecology of floodplain willows, and suggest that the use of vegetative plantings in restoration plantings could be an effective strategy for recovering floodplain forests.

INTRODUCTION

In past centuries, willows and poplars formed large floodplain forests along all major rivers in Central Europe (Hager & Schume 2000) and played important roles as the first woody species to colonise and stabilise sites disturbed by flooding and sedimentation/erosion processes. Today, these so-called softwood forests are in steep decline as most large rivers are severely impacted by river regulation and floodplain fragmentation due to dams and dykes which are restricting flow-induced disturbances and subsequent regeneration (Nilsson & Bergren 2000; Tockner & Stanford 2002).

Willows have small, short-lived seeds and sexual reproduction is controlled by various factors such as the presence of competition-free, bare-ground sites, sufficient moisture in combination with suitable soil substrates, no burial by sedimentation and no extended submersion by flooding during the growing season (Karrenberg *et al.* 2002). Thus, a lack of bare-ground sites due to the lack of natural disturbances along regulated rivers leads to limited or even absent sexual reproduction (Scott *et al.* 1997). However, European woody floodplain species such as *Salix fragilis*, *S. viminalis* and

S. triandra are well known for their ability to regenerate vegetatively. Whenever fragments of branches fall into the water and are swept away by the current, they can usually resprout as soon as they are deposited onto a suitable patch of ground (Beismann *et al.* 1997, 2000; Barsoum 2002).

While several studies on regeneration in Salicaceae have focused on seedling recruitment (van Splunder *et al.* 1996; Guillois-Froget *et al.* 2002; Karrenberg *et al.* 2002), little is known about factors controlling the establishment of vegetative recruits. Some studies have examined the role of abiotic variables such as inundation/drought on the establishment of vegetative propagules under controlled conditions (Barsoum & Hughes 1998; Amlin & Rood 2001, 2002) and field investigations have revealed that asexual recruits have a wider spatial distribution within the floodplain because they tolerate broader environmental conditions than seedlings (Barsoum 2002; Moggridge & Gurnell 2009). However, biotic interactions such as competition have been widely ignored.

Pioneer habitats in natural floodplains are generally poor in vegetation, *i.e.* competition is not a major factor shaping pioneer community composition. However, man-made alterations in the flow regime lead to increased stability in formerly