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RESEARCH ARTICLE

Effects of *Microstegium vimineum* (Trin.) A. Camus (Japanese stiltgrass) on Native Hardwood Survival and Growth: Implications for Restoration

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ABSTRACT: Invasive species are an increasing threat to native diversity and ecosystem function. *Microstegium vimineum* (Trin.) A. Camus (Poaceae) is an annual invasive grass threatening native ecosystems of the eastern United States. While information regarding the invasion, spread, and general ecology of *M. vimineum* is readily available, few studies exist regarding habitat restoration following *M. vimineum* invasion. Thus, the objectives of this study were to examine the effects of *M. vimineum* removal on the growth and survival of native planted hardwood seedlings. Two-year-old hardwood seedlings (*Acer saccharum*, *Quercus rubra*, and *Liriodendron tulipifera*) were planted in a split-plot (open vs. closed forest canopy) block design at Crummies Creek Tree Farm, Calhoun County, West Virginia, in an area that was heavily invaded by *M. vimineum*. Within each block, three treatments were employed: (1) chemical (Sethoxydim) control, (2) mechanical (hand pulling) control, and (3) no removal (experimental control). The growth (height and basal diameter) and survival of planted seedlings were assessed within each treatment over a two-year period. Hardwood seedling height and diameter differed significantly as a function of forest canopy type and among species; however, no significant treatment effects were detected. There were no differences in survival between *M. vimineum* removal treatments. These data suggest that restoration of forested habitats invaded by *M. vimineum* can be achieved by a bottom-up approach that utilizes planted native hardwood seedlings with little additional expenditure of resources for control. Restoring a mid-story tree regeneration layer will likely shade out *M. vimineum* and erode its dominance in forest stands over time.

Index terms: forest restoration, hardwood regeneration, invasive species

INTRODUCTION

Non-native invasive species are an increasing concern for forest managers and restoration ecologists due to the threat they pose to ecosystem function and diversity (Ehrenfeld 2010). The negative effects associated with invasive species are often manifested through the replacement of indigenous species, alteration of disturbance regimes (Pauchard et al. 2008), changes to hydrologic and nutrient cycles, or the modification of soil microbial communities (D'Antonio and Vitousek 1992; Meekins and McCarthy 1999; D'Antonio and Karik 2002; Kourtev et al. 2003; Callaway and Ridenour 2004; Stinson et al. 2006). However, some characteristics may make communities resistant or resilient to invasion, such as high species diversity and low resource availability (Wardle 2001; Brown and Peet 2003). An extensive literature is available regarding the effects of invasive species on diversity (Gordon 1998; Wilcove et al. 1998; Flory and Clay 2010a); however, more information is needed on the long term community effects of the removal of invasive species from invaded ecosystems.

Communities can be protected and restored from the impacts of invasive species using several management techniques. Preventative management aims to maintain the resistance and resilience of an ecosystem (D'Antonio and Chambers 2006), thus preventing the introduction of invasive species in the first place. Active management is implemented once non-native species are discovered in an area and can include mechanical removal and chemical treatments. Top-down and bottom-up control are two forms of active management response utilized when restoring invaded areas (McEvoy and Coombs 1999; D'Antonio and Chambers 2006). Top-down control involves the direct removal of an invasive species through physical or chemical means and is the most commonly used method in response to biological invasion. Bottom-up control is implemented when ecosystem function, which has been altered by the invasive species, is restored. This can be accomplished through soil amendments or direct seeding of native species, which often requires more money and effort than top-down control. DeWine and Cooper (2010) employed a bottom up approach by utilizing a native species, *Acer negundo* (box elder) to help control Tamarisk invasion. They found that Tamarisk actually facilitates the survival of *A. negundo*, the direct planting of which promotes native seedling establishment via direct competition (DeWine and Cooper 2010).

Microstegium vimineum Trin. A. Camus is an invasive grass causing impacts to native ecosystems in the eastern United States. Although the negative impacts of