Vegetation recovery in slash pile scars following restoration of an Ozark woodland

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Introduction

Restoration often involves the removal of invasive and undesirable woody biomass. Slash pile burning is one method for efficiently removing large quantities of woody debris during the restoration process. Slash piles are created by stacking large amounts of woody biomass in a single location and then allowing them to burn until all biomass has combusted (Fig. 1a). However, the prolonged extreme temperatures from pile burning are often lethal to microbial communities, vegetative propagules, and seeds that lie dormant in the upper soil horizon (Korb et al., 2004, Busse et al., 2013). These burns create slash pile scars distributed across the restored site. Further, the combustion of biomass and extreme temperatures can alter soil structure, moisture, and nutrient availability. The rate of native vegetation recovery on slash pile scars depends on burn intensity, pile area, and properties of the surrounding plant community. At degraded sites with low abundance and diversity of native plant species and without active seeding, native plant communities are expected to recover slowly. If the native plant community recovers slowly over time, it raises the concern that slash pile scars could serve as a foil for the reestablishment and spread of invasive or undesirable species.

In Ozark woodlands, little is known about how pile burning affects native plant community recovery. The objective of this study was to determine how pile burning changes the biotic and abiotic microenvironment and whether the establishment of native plant species are facilitated or inhibited in slash pile scars. We asked the following questions:

1. How does pile burning alter soil nutrient, moisture, and compaction compared to unburned soil?
2. Are some native species superior than others at colonizing burn-scar areas during the first-growing season?
3. What is the relative importance of the soil biotic and abiotic environment in determining initial germination and establishment rates in slash pile scars?

Experimental Design

Field Study

To determine if differences in the abiotic and biotic factors on vegetation recovery, a germination experiment was conducted using four soil types: burn pile soil, control soil, sterilized burn pile soil, and sterilized control soil. Burn pile soil and control soil were sterilized using an autoclave. For the experiment, each species had 15 Petri dishes, three dishes of each soil type and three additional dishes that used filter paper as the medium. Thirty seeds of a single species were placed in each dish. Germination in the dishes was monitored approximately every other week for 4 weeks.

Native Species Information

Native Species Used in Field Study

Grasses

Bromus pubescens

Bromus inermis

Composites

Symphyotrichum drummondii

Leaves

Semen marilandica

Results – Field Study

Soil Chemistry

Figure 5. Soil chemical properties from soil samples of the top 4 cm of burn pile and control soil. Soil sampling occurred six months after the slash pile burn. Differences between soil collected from burn scar plots and soil collected from control plots are apparent. Burn scars have significantly higher pH, P content, cation exchange capacity and significantly less organic matter and soil compaction.

Species Establishment in Control and Burn Plots

Results – Lab Study

Germination Experiment

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Germination probability, between the species, there was no consensus as to which soil and treatment presented a challenge for land managers attempting to restore native vegetation in burn scar areas. Differences in establishment rates existed among treatments, functional groups, and species. While four of the six species established better in the controls, all species were able to establish in the burn piles. One species, Solidago ulmifolia, showed consistently greater germination and establishment in burn scars in the field and lab study. Among functional groups, grasses had the highest establishment rates while legumes had the lowest in the field study.

While the germination experiment showed soil type and treatment are significant factors in germination probability, between the species, there was no consensus as to which soil and treatment type was best for germination. The results from the field study suggest native plants prefer better control and soil, however, the results form the lab germination experiment are inconclusive. Inconclusive germination experiment results make it challenging to determine to what degree the environment filter created by the slash pile burn is a result of biotic changes to the soil or alterations to the microbial community.

Conclusions

Experimental Design

Field Study

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