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Short communication

Germination response of grassland species to plant-derived smoke

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ABSTRACT

In fire-prone ecosystems, many species require signals such as heat or smoke to cue seedling establishment to the relatively favorable post fire environment. Grassland ecosystems are often maintained by recurring fire and many grassland species are considered well adapted to fire. Despite this, smoke-induced germination has been studied much less in grasslands than in shrublands subject to crown fire. We tested 15 species native to the southern Great Plains and Edwards Plateau of Texas for smoked-stimulated or heat stimulated germination. Smoke and heat treatments were followed by either a true wet stratification or a dry cold period. Four species exhibited smoke-stimulated germination while the others exhibited no response or were inhibited by smoke. In two of the species that showed a positive response, smoke acted as a substitute for wet cold stratification. Heat treatments proved lethal to all species tested.

1. Introduction

Seed dormancy is a common trait among plant species that inhabit environments characterized by periodic disturbance such as fire. In fire-prone ecosystems, many species require signals such as heat or smoke to cue seedling establishment to the relatively favorable post fire environment. Smoke-stimulated seed germination has been widely reported from mediterranean-climate ecosystems (de Lange and Boucher, 1990; Dixon et al., 1995; Keeley and Fotheringham, 1998; Roche et al., 1998). Researchers in these systems have identified possible important chemical components of such cues (Flematti et al., 2004; Keeley and Fotheringham, 1997, 1998). Outside of mediterranean-climate ecosystems, smoke as a germination cue has been less often investigated. A recent study in fire-prone upland Florida habitats found smoke-cued germination to be rare (present in three of 20 species, Lindon and Menges, 2008). Grassland ecosystems are often maintained by recurring fire and many grassland species are considered well adapted to fire. Despite this, until quite recently, smoke-induced germination had not been investigated in North American grasslands. Recent work, however, demonstrated that several species of the northern Great Plains show increased germination when exposed to smoke (Jefferson et al., 2008).

Semi-arid grasslands in the southern Great Plains and rolling plains of west Texas were historically maintained by frequent fire and a reduction in fire frequency since EuroAmerican settlement is thought to be one cause of increased shrub encroachment (McPherson et al., 1988). Although the importance and prevalence of fire in these grasslands might suggest an adaptive role for smoke-stimulated seed germination, if fire was historically frequent (every several years), then fire may have been less useful as a cue. Under short fire return intervals, fire may provide less information to a seed regarding the suitability of current conditions than fire does in mediterranean-climate shrublands prone to crown fire with fire return intervals of several decades. In mediterranean-type climates, fires occur during summer or early fall, and smoke-stimulated species often require a subsequent cold stratification period to break dormancy (Keeley and Fotheringham, 1998). In the grasslands of the southern Great Plains and the mixed woodlands and savannas of Texas, fires can occur at any time of year. The lack of a dendrochronology record makes reconstructing prehistoric fire seasons difficult (Ford and McPherson, 1996). Although dormant season (winter and spring) was the preferred season for prescribed burning historically, there has been increasing interest in summer burning (Engle and Bidwell, 2001). Although many species are known to require cold stratification (Jefferson et al., 2008; Jordan and Haferkamp, 1989), depending upon the historic timing of fire relative to the growing season, it is possible that a fire-cued grassland species may require no cold wet stratification after the smoke cue.

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