

RELATIONSHIPS BETWEEN FIRE, SOIL WATER, AND INVASION OF SEMIARID SHRUBLAND BY AN EXOTIC FORB

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ABSTRACT

Persistent infestation by exotic forbs is common following fire in sagebrush steppe of southeastern Idaho, and in other cold desert shrublands of the Great Basin, USA. Whereas disturbances such as fire are commonly cited causes of exotic plant invasions, few studies clarify how fire alters site conditions to favor long-term persistence of exotic forbs, such as leafy spurge (*Euphorbia esula*). We hypothesized that fire increases deep soil water by selectively removing deep-rooted woody plants and that increases in the availability of deep soil water are key to the success of leafy spurge. We measured soil water contents, and depth of water uptake, water status, and photosynthetic water use of leafy spurge and native plants in a replicated set of burns. Soil water increased substantially below about 0.4-m depth in burned compared to control plots, due largely to removal of deep-rooted sagebrush. Spurge had no greater photosynthesis or water status than native plants. However, leafy spurge acquired water from deeper depths than native herbs, as revealed by comparisons of isotopic compositions of water in plants and soil at different depths. Sagebrush also acquired water from deeper depths than native herbs, and leafy spurge rarely occurred in unburned plots that had sagebrush. These data suggest that leafy spurge might experience less carbon uptake and water status than native herbs without access to the fire-induced increases in water availability in soils beneath rooting zones of native herbs. Many other exotic forbs in semiarid shrub and grasslands of western North America have deep roots and other traits in common with leafy spurge, and site resistance to dominance by exotic forbs may be enhanced by fire prescriptions that favor shrub reestablishment (e.g., patch burns) or restoration efforts that promote deep-rooted native species.

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