Weedy Plant Species Response to Variable Precipitation Following Restoration Seeding in Drylands

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Restoration outcomes in semiarid and arid regions are often unpredictable, as precipitation is a major driver of success. This unpredictability will only increase with the growing effects of climate change, which are projected to increase precipitation variability and occurrence of extreme events in the American Southwest. Seeding is a commonly employed restoration tool, but can fail 17% of the time, resulting in no seeded species growth. Hence, due to its high-risk nature, more research is needed to better optimize seeding mixes, timing, and rates. While seeding of native species is often used to suppress weedy or invasive species, this strategy is successful only if seeded native species can outcompete weedy ones. Seedling establishment and growth during initial years is critical in determining if desirable versus weedy species will dominate a site. Previous research has shown that timing of precipitation in relation to seeding has a larger influence on native seedling emergence, growth, and survival than site-specific characteristics. Studies have also shown that non-native invasive species tend to recover from drought quicker than native species, but results can be site-specific and not necessarily predictive. As precipitation becomes more erratic in this region, understanding how invasive versus native seedlings respond to drought will become even more critical for restoration success.

Here, we examine the effects of back-to-back years of unusually high and low precipitation on native versus invasive plant growth following seeding across an aridity gradient. Our study is part of the Restoration Assessment & Monitoring Program for the Southwest (RAMPS), a USGS program designed to foster collaboration and knowledge sharing across land managers and scientists. Our project, RestoreNet, is a network of dryland restoration plots located at 21 sites that span across the southwestern United States. The same treatments were employed across all sites to determine how restoration techniques varied across an environmental gradient. We tested two types of site-specific seed mixes: one that was optimized for current local conditions, and one that consisted of species from warmer and drier conditions, guided by climate change adaptation. Sites were monitored for 2-4 years, where we measured vegetation cover and seedling density of native and invasive species. Preliminary results revealed that the climate change-adapted seed mix did not perform as well as the local optimized seed mix, and that invasive seedlings outcompeted native seedlings following drought, but that seeded native plants outcompeted invasive ones under wetter conditions. Our work provides valuable insights into what to expect in the future under more variable inter- and intra-year precipitation in drylands, and how to harness this knowledge to deliver better restoration outcomes.

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