Spicing up restoration: can a dash of chili powder help native plants recover?

Reestablishing native plants following natural and human-caused disturbances like wildfires and road construction projects can be challenging in today’s world, because introduced plants aggressively invade newly disturbed areas and exclude native plants. The most cost-effective way to reestablish native plants following disturbances is to sow native plant seeds. However, much like farming, the success of restoration seeding is determined by the vagaries of weather - and also by seed predators. While it is difficult to control the weather, recent research suggests that we may be able to improve restoration efforts by mimicking the evolutionary strategies used by some plants to protect their own seeds from seed predators.

In the western United States, as in much of the world today, disturbances facilitate invasion by exotic invasive plants that threaten the health and diversity of native plant communities. Once established, exotic plants must be removed by chemical or physical means. However, simply removing the exotics does not ensure the recovery of native plants. One reason for this is that native seed sources may become diminished following disturbances, particularly in areas where exotics have taken over. To address this problem, restoration practitioners are increasingly sowing native plant seeds following disturbances and exotic weed removal. However, this approach is fraught with challenges due to inclement weather conditions and rodent seed predators destroying the plants before they can establish. Importantly, native plant seeds are expensive because they are not commercially produced at the scale of agricultural seeds. Therefore, it is particularly important to ensure that as many sown seeds as possible become mature plants. Accordingly, approaches that increase the likelihood that sown seeds become new plants can improve restoration. In fact, such value-added approaches can even increase the economic efficiency of restoration if the additional seed preparation cost is marginal relative to the increase in the number of plants that recruit per seeding effort.

We assembled a team of researchers and restoration practitioners to improve restoration seeding efforts. Our approach involved a form of biomimicry – that is to say we mimicked strategies used by some plants that chemically protect their seeds from rodent seed predators in natural systems. Capsaicin is the active ingredient in chili-peppers that creates the burning sensation associated with consumption of peppers by humans. This compound has a similar effect on other mammals and is believed to have evolved within wild chili peppers to protect their seeds from rodent seed predators. We attached capsaicin (in the form of ground chili powder) to native plant seeds using newly emerging seed-coating technologies in order to reduce rodent seed predation and increase plant recruitment in restoration. We tested the efficacy of the pepper application for deterring rodent seed predation in laboratory feeding trials by offering pepper-coated and uncoated seeds to native deer mice. We also evaluated the efficacy of this approach in field settings by sowing pepper-coated and uncoated seeds of native plants under conditions where rodents either had access to seeds or did not have access to them. This approach allowed us to quantify the effect of the rodent seed predators on native plant recruitment with and without pepper coatings on the seeds.

Our experiments demonstrated that rodent seed predators consistently and substantially suppressed native plant recruitment over the course of the four-year study. We also showed that attaching pepper to seeds dramatically reduced seed predation by deer mice in laboratory feeding trials. In the field, the coatings that we used in the first three years initially deterred rodent seed predators, but these effects appeared to fade over time due to weathering to such an extent that we saw no significant increase in recruitment of pepper-treated seedlings by spring. However, in the final year of the study the coating that we used substantially increased recruitment of native plants from the coated seeds, virtually negating the effect of rodent seed predators.

This study shows that applying plant-derived predator deterrent compounds to unprotected seeds can increase native plant recruitment and restoration success. Moreover, the economic assessment indicated that the final cost per recruiting seedling was lower for pepper-treated seeds than for untreated seeds due to increased recruitment rates, despite the additional cost of treating seeds with pepper. Our study provides a proof of the concept that seed coatings are an economically viable method for improving restoration success. However, these techniques will require further refinement for broader applications in the field.