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Nursery Treatments May Improve Restoration Outcomes by Reducing Seedling Transplant Shock

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Abstract : Semi-arid ecosystems across the globe have faced land conversion for agriculture and resource extraction activities, posing a threat to the important ecosystem services they provide. Revegetation-centered restoration efforts in these regions face low success rates due to limited soil water availability and high temperatures leading to elevated seedling mortality after planting. Typical methods to alleviate these stresses require costly post-planting interventions aimed at improving soil moisture status. We set out to evaluate the efficacy of applying in-nursery treatments to address transplant shock. Four native Tamaulipan thornscrub species were compared. Three treatments were applied: elevated CO2, drought hardening (four-week exposure each), and antitranspirant foliar spray (the day prior to planting). Our goal was to answer two primary questions: (1) Do treatments improve survival and growth of seedlings in the early period post-planting? (2) If so, what underlying physiological changes are associated with this improved performance? To this end, we measured leaf gas exchange (stomatal conductance, light saturated photosynthetic rate, water use efficiency), leaf morphology (specific leaf area), and osmolality before and upon the conclusion of treatments. A subset of seedlings from all treatments have been planted, which will be monitored in coming months for in-field survival and growth.First month field survival for all treatment groups were high due to ample rainfall following planting (>85%). Growth data was unreliable due to high herbivory (68% of all sampled plants). While elevated CO2 had infrequent or no detectable influence on all aspects of leaf gas exchange, drought hardening reduced stomatal conductance in three of the four species measured without negatively impacting photosynthesis. Both CO2 and drought hardening elevated leaf osmolality in two species. Antitranspirant application significantly reduced conductance in all species for up to four days and reduced photosynthesis in two species. Antitranspirants also increased the variability of water use efficiency compared to controls. Collectively, these results suggest that antitranspirants and drought hardening are viable treatments for reducing short-term water loss during the transplant shock period. Elevated CO2, while not effective at reducing water loss, may be useful for promoting more favorable water status via osmotic adjustment. These practices could improve restoration outcomes in Tamaulipan thornscrub and other semi-arid systems. Further research should focus on evaluating combinations of these treatments and their species-specific viability.

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