



Forest Service
U.S. DEPARTMENT OF AGRICULTURE



Rocky Mountain Research Station Science You Can Use *(in 5 minutes)*

JULY 2024

“Sack Lunch” for Seedlings: Fall fertilization of rangeland shrub seedlings to improve outplanting success

In the United States, more than 1,400 native plant nurseries produce more than a billion seedlings for reforestation and restoration projects every year. Many years of monitoring and research have shown that seedling survival of native plants can be greater when the plants are grown in nurseries and outplanted compared to direct seeding or natural regeneration. Production of high-quality seedlings reduces costs and improves seedling survival and growth after outplanting.

Growing tree seedlings for outplanting has been honed over many decades, but the current knowledge for growing rangeland shrubs destined for ecosystem restoration is lacking. Kasten Dumroese, research plant physiologist and national nursery specialist with the Rocky Mountain Research Station, and colleagues sought to apply some of the tricks of the trade from trees to antelope bitterbrush (*Purshia tridentata*). The goal is ultimately to increase outplanting success, and thereby restoration success.

Bitterbrush occurs across about 138 million acres of the semi-arid western United States. This shrub is important in the diet of domestic and wild ungulates, such as mule deer and pronghorn, especially in winter, and is also an important habitat component for greater sage grouse and other at-risk species. Bitterbrush roots and their microorganism symbionts fix atmospheric nitrogen, which makes the challenging environment where bitterbrush lives a bit more hospitable for other plants. Occurrence of bitterbrush has declined because of conversion of land use to agriculture, invasion of nonnative grasses, and increasing wildfire frequency and intensity.

Dumroese and his research team applied ^{15}N -labeled fertilizer (to track nitrogen movement) at the end of the growing season in October, when the plants had already shut down new growth and nurseries typically stop fertilization, to determine greenhouse seedling nitrogen (N) content and where the fertilizer N ended up in the plants.



Closeup of antelope bitterbrush (*Purshia tridentata*). Research suggests that fall fertilization of nursery seedlings can improve outplanting success. USDA Forest Service photo by K. Dumroese.



Higher fall N fertilization rates loaded bitterbrush with nitrogen but had little effect on plant biomass. The plants translocated most of their reserve supplies of nitrogen to enhance root growth, thereby increasing their ability to take in water and other nutrients, potentially aiding their survival at outplanting. The increased nutrient concentrations also improved root collar diameter growth in the greenhouse, which should help the plants survive and recover from browsing.

Dumroese compares fall fertilization to giving seedlings “a sack lunch” of nutrients to take to the field at outplanting. He believes these results would hold for other important dryland shrubs, such as rabbitbrush, sagebrush, and chokecherry.

It’s not feasible to replant thousands of burned acres after a rangeland wildfire, but it is feasible to replant islands of important species that can then spread out from there. “We think you can jumpstart that revegetation process,” Dumroese says. “By using fall fertilization during nursery production, we may be able to tee up these seedlings for better success.”

KEY MANAGEMENT CONSIDERATIONS

- Outplanting high-quality, nursery-grown antelope bitterbrush seedlings may speed the restoration of disturbed rangelands in the western United States.
- Fall fertilization that promotes nitrogen uptake without stimulating growth (luxury consumption) can be an efficient technique to improve seedling quality. Most additional nitrogen was stored in roots.
- Stored nitrogen may support new seedling growth, especially root growth, after outplanting, thereby promoting water and nutrient uptake, which can boost photosynthesis and promote more root and shoot growth, which may then lead to more successful seedling establishment.
- Additional outplanting research is needed to evaluate these potential benefits more fully in bitterbrush, as well as the effects of fall fertilization on browsing.

Fall fertilization may be able to speed the process of range restoration and increase its efficiency, providing another tool for land managers in replanting high-priority areas.

Of course, there is no free lunch. The luxury concentration of N in outplanted seedlings may make them more attractive as browse during the first year of establishment. Additional research is needed to examine this possibility and outplanting survival of fertilized seedlings.

Antelope bitterbrush
(*Purshia tridentata*).
Adobe Stock image.



PROJECT LEAD

Kasten Dumroese was a senior scientist, research plant physiologist, and national nursery specialist with RMRS in Moscow, Idaho. He recently retired Spring 2024.

FURTHER READING

Dumroese, R. Kasten; Zhu, Yan; Acevedo, Manuel A.; Pinto, Jeremiah R.; Álvarez-Maldini, Carolina E.; Liu, Yong. 2023. [Fall fertilization during nursery production increases nitrogen status of *Purshia tridentata* seedlings: Implications for outplanting.](#) Restoration Ecology. 31(7): e13915.

Li, Guolei; Zhu, Yan; Liu, Yong; Wang, Jiayi; Liu, Jiajia; Dumroese, R. Kasten. 2014. [Combined effects of pre-hardening and fall fertilization on nitrogen translocation and storage in *Quercus variabilis* seedlings.](#) European Journal of Forest Research. 133: 983–992. <https://doi.org/10.1007/s10342-014-0816-4>.

Zhu, Yan; Dumroese, R. Kasten; Li, Guolei; Pinto, Jeremiah R.; Liu, Yong. 2013. [Fall fertilization enhanced nitrogen storage and translocation in *Larix olgensis* seedlings.](#) New Forests. 44: 849–861.

Joy Drohan is the author of this Science You Can Use.

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