



## Restoration Planting Options for Limber Pines in Colorado and Wyoming

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Limber Pine (*Pinus flexilis*) populations in the southern Rocky Mountains are severely threatened by the combined impacts of mountain pine beetles and white pine blister rust. Limber pine's critical role in these high elevation ecosystems heightens the importance of mitigating these impacts. To develop forest-scale planting methods, six limber pine seedling planting trial sites were installed extending from the Medicine Bow National Forest in southern Wyoming to the Great Sand Dunes National Park and Preserve in southern Colorado. Seedlings came from the Colorado State Forest Service nursery and were 3 years old, container-grown, and originated from a Colorado seed source. A total of 2,160 seedlings were planted. Six plots within the sites were split between high and low density canopy conditions, with three in each canopy class.

In the canopy blocks, treatments were: 1) presence/absence of a nurse object and 2) presence/absence of Terra-Sorb Hydrogel. 1) We created nurse objects by burying 50 cm tall tree stem segments (20-40 cm dia) 10 cm in the ground. Trees were planted as close as possible to the object at the four cardinal directions to further test exposure stress. In the control treatment we planted seedlings in an east/west orientation 40 cm apart. 2) Terra-Sorb Hydrogel (Pittsburgh, PA) is a potassium-based co-polymer gel that absorbs up to 200 times its weight in

water. Hydrogels are commonly used in horticulture although scientific literature shows mixed results for tree survival. The hydrogel treatment consisted of dipping seedling roots in the hydrogel slurry before planting, per manufacturer directions. The roots of control seedlings were dipped in water before planting. The hydrogel treatment was omitted at two sites due to logistics. There were six replicates of each treatment combination, with 432 seedlings planted in each of the four sites with the Terra-Sorb Hydrogel treatment and 216 seedlings planted in each of the two sites without hydrogel treatments, for a total of 2,160 seedlings. We will continue monitoring health and survival of the outplanted seedlings in the future. Results from this project will be used to develop limber pine planting protocols for the southern Rocky Mountains.

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