Photo by Brandon Long

Propagation protocol for

# BAREROOT SAGEBRUSH

## *Artemisia* spp.

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**KEY WORDS**
nursery, Asteraceae, fertilization, cultural practices

**NOMENCLATURE**
USDA NRCS (2004)

Because of drought, maturity, and urban expansion, sagebrush areas throughout the State of Utah have been declining. Precipitation for the past 5 y has been only half of normal. Decline of sagebrush communities has been of primary concern for wildlife specialists. Recently, the Utah Division of Wildlife Resources has focused efforts on restoration of Wyoming big sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young [Asteraceae]), but that is only one of several subspecies of *A. tridentata* that occurs throughout the state.

The Lone Peak Conservation Nursery staff has worked for many years to develop reliable and predictable propagation protocols for big sagebrush. Propagation trials began in 1990 for mountain big sagebrush (*A. tridentata* Nutt. ssp. *vaseyana* (Rydb.) Beetle) and in 1995 for Wyoming big sagebrush. This work owes much to the early efforts of former managers John Justin (currently manages State of Montana Conservation Seedling Nursery) and Scott Zeidler (Community Forester, Utah Division of Forestry, Fire, and State Lands). It has also benefited greatly from collaboration with John Fairchild and Scott Walker of the Utah Division of Wildlife Resources, Ephraim Seed Warehouse, and Steve Monsen of the USDA Forest Service Shrub Sciences Laboratory in Provo, Utah.

We grow about 65 000 sagebrush seedlings annually as a 1+0 crop. Most have been used by the Utah Division of Wildlife Resources for replanting efforts in areas where direct seeding is impractical or has been unsuccessful because of drought conditions. In addition to Wyoming and mountain big sagebrush, we grow basin big sagebrush (*A. tridentata* Nutt. ssp. *tridentata*).

### SEED ACQUISITION

Two problems facing growers of *A. tridentata* are the small size (5.5 million/kg [2.5 million/lb]) and poor quality of seeds. Most lots purchased by Lone Peak

have average purity rates of 13% and germination rates < 50%. Purity rates > 10% are considered acceptable. Big sagebrush seed must be collected in late fall or early winter. Collections are typically done by hand using clubs or tennis rackets to dislodge achenes before gathering them into sacks or hoppers (see Jensen 2004). Viability rates decrease sharply after the first year so seeds are sown the first spring following collection and any unused seed remaining after the second spring is discarded.

In the first years of production, Lone Peak Conservation Nursery relied on NRCS-released varieties of seeds for mountain big sagebrush (Hobble Creek) and Wyoming big sagebrush (Gordon Creek). Since 1994, we have purchased and used seeds identified by collection area by seed vendors in addition to the Hobble Creek and Gordon Creek varieties. Unfortunately, the exact location and elevation of seed collection is often difficult to obtain from vendors.

## FIELD TREATMENTS

Our soils are a mosaic of Taylorsville sandy clay loam and clay loam with a calcareous horizon with pH that ranges from 6.5 to 8.9. In some field locations, this horizon occurs at depths less than 30 cm (12 in). We generally plow, disc, and rototill our soil before forming beds. Prior to rototilling and based on soil tests, we apply prill sulfur at a target rate of 900 kg/ha (800 lb/ac) as a precautionary buffer. At the time of bed formation, we incorporate phosphorus ($0N:45P_2O_5:0K_2O$) at 448 kg/ha (400 lb/ac).

During the past 12 y we have tried several sowing methods, but two provided the most satisfactory results. With either method, we sowed nonstratified seeds. Because we have access to inmate labor, we used crews to hand-plant seeds. We used a Love/Øyjord seed drill, with the packing wheels removed and the blades set to the most shallow position, to mark equally spaced lines to direct where to plant seeds. Inmates were given canisters of premeasured amounts of seeds to give the desired seed density within an assigned length of bed. Although this worked satisfactorily, in 2001 we added a small seed lot device to the Øyjord to ensure more even distribution of seeds. Based on experience from previous crops, we currently use purity and an average seeds per pound to try to obtain an approximate seedling density of 43 to 54 seedlings per $m^2$ (4 to 5 per $ft^2$). After sowing, we mulch seeds with a 3- to 6-mm-deep (1/8- to 1/4-in) layer of washed concrete-grade sand and lightly roll the beds to ensure adequate contact between soil and seeds.

We irrigate to keep seedbeds moist during germination and once we see that germination has occurred, we irrigate based on a combination of factors, including seedling size, weather, growth stage, soil moisture, and our experience with producing sagebrush at our nursery. Generally, we allow the top 2.5 or 5 cm (1 or 2 in) of soil to dry before irrigating. Beginning in May and continuing through July we fertilize with ammonium sulfate ($21N:0P_2O_5:0K_2O$); we usually apply 470 kg/ha (420 lb/ac) of nitrogen total.

When seedlings reach 25 to 30 cm (10 to 12 in) in height (usually late August or early September) we root prune at a depth of 30 cm (12 in). In late fall and as weather allows, we prune the tops back to a height of 25 cm (10 in) with a sickle bar mower to ensure proper balance between root and shoot and to make storage, shipment, and outplanting more manageable.

## LIFTING AND STORING

Storage and shipment present the most significant difficulties in the production of bareroot *Artemisia* seedlings—roots are susceptible to desiccation whereas the leaves are susceptible to fungi if kept too moist. We mechanically lift seedlings from the planting beds in February or early March before seedlings break dormancy. Seedlings are gathered manually, covered with damp burlap, and transferred to seedling storage coolers. At the coolers, plants are placed on pallets and stored at a consistent temperature of 3 °C (38 °F) and 94% relative humidity. Seedlings are removed from the cooler, graded for quality (height > 15 cm [6 in] and root collar diameter > 4 mm [5/32 in]), tied in bundles of 25, and returned to pallets in the coolers. The challenge has been to maintain a relative humidity sufficient to avoid root desiccation while providing enough air circulation to limit fungal growth on the persistent leaves.

Because of the rapidity with which mold can grow on the leaves and because seedlings must be packaged in containers for shipping that prevent air circulation, prompt delivery of stock and subsequent outplanting is essential. We minimize the negative impacts of shipping by using water-holding polymers to maintain humidity around the roots while shredded paper is used to absorb excess moisture around the shoots.

## SUMMARY

Satisfactory production of sagebrush seedlings is accomplished by spring-sowing nonstratified seeds collected the previous fall. Seed quality (purity and viability) has the biggest influence on resulting success. Seedlings grown at a density of 43 to 54 per $m^2$ (4 to 5 per $ft^2$) are best for our desired outplanting objectives. In the future, we hope to find seed storage methods that will allow us to purchase quality seed in quantities sufficient for multiple-year crops without losing viability. We also recognize a need to improve seedling storage and shipment to retain seedling quality. Recognizing that matching time of seedling harvest and conditions at the planting site, both of which are dependent on weather conditions, is an uncertain business, we will continue to encourage our customers to maintain a close working relationship and open lines of communication with us to ensure prompt delivery and planting of these relatively delicate seedlings.

## REFERENCES


Jensen S. 2004. Racquets, hoppers, and felt boards—low-tech devices for processing seeds. Native Plants Journal 5:50–51.

USDA NRCS. 2004. The PLANTS database, version 3.5. URL: http://plants.usda.gov (accessed 10 Sep 2004). Baton Rouge (LA): National Plant Data Center.


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