

KEY WORDS

seed propagation, double dormancy, Cupressaceae, container nursery

NOMENCLATURE

USDA NRCS (2004)

Rocky Mountain Native Plants Company (RMNP) is located in Rifle, Colorado. RMNP produces and installs native plant materials from a wide range of habitats for restoration projects and for the landscaping industry, which demands hardy, native plant materials. Currently, we are producing more than 2 500 000 native plants representing approximately 250 different species. Two of the most challenging species that we propagate are oneseed juniper (*Juniperus monosperma* Engelm. Sarg. [Cupressaceae]) and Utah juniper (*Juniperus osteosperma* (Torr) Little).

Utah juniper and pinyon pine (*Pinus edulis* Engelm. [Pinaceae]) form the extensive pinyon-juniper woodlands throughout the Great and Colorado Basins of the western US. Utah juniper has a broad range, being found from southern Montana and Idaho to California and the states of Durango and Chihuahua, Mexico. Oneseed juniper is also found throughout the range of the pinyon-juniper woodlands and in the adjacent desert grasslands of southern Colorado, New Mexico, Oklahoma, western Texas, and northern Arizona.

Both species are long-lived, drought tolerant, and inhabitants of regions that have annual precipitation averaging from 25 to 37.7 cm (10 to 15 in). These species have taproots that extend deep into the soil (as far as 4.5 m [15 ft]) and lateral roots that may extend as far as 30 m (100 ft) from the tree. They also develop fine roots at the base of the trees and on the lateral roots, thus they are important in the prevention of wind and sheet erosion of dry desert soils



Propagation protocol for

Oneseed and Utah junipers

(*Juniperus monosperma* and *Juniperus osteosperma*)

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Figure 1. A mature oneseed juniper growing in a Colorado mountain shrub community.

Photos by Emily A Schmidt

263



Figure 2. The green, hard juniper fruits develop a bluish color and are usually covered with white, glaucous bloom during the first year, but remember that fruits require 2 y to reach maturity. A cut test can help determine which fruits should be collected.

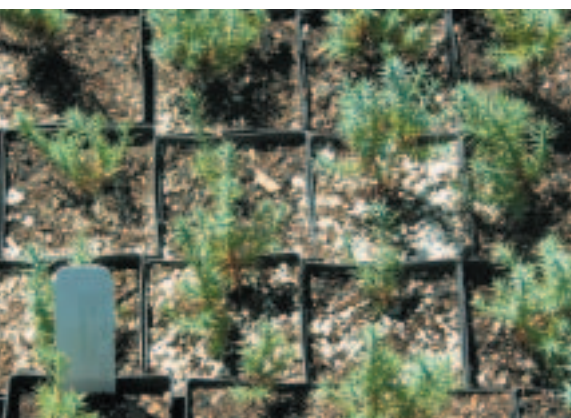


Figure 3. Young seedlings during the first growing season.



Figure 4. Some seedlings are transplanted during their first growing season into larger containers. Transplanted seedlings require 2 growing seasons before they are ready for market.

(FEIS 2003). They serve as an important cover and food source for birds and for a wide variety of mammals and reptiles.

In the past, clearing of pinyon-juniper woodlands and mining resulted in the need for these species in restoration projects. More recently, large wildfires and the need for drought-tolerant trees in landscapes of the southwestern US have contributed to the increasing demand for these species.

SEED PROPAGATION

The tiny flowers of both species emerge during the spring months. Following pollination and fertilization, the green, hard juniper fruits develop to a bluish color and are usually covered with a white, glaucous bloom during the first year. Fruits require 2 y, however, to reach maturity. Mature “fruits” are actually fleshy cones and mature fruit characteristics are important clues for harvesting fruits at the correct stage (Table 1). Regardless, a cutting test should be performed to determine seed maturity. Mature seeds of both species are usually reddish brown in color with thick seed coats.

Both types of junipers typically begin bearing cones at approximately 30 y of age with the greater seed production occurring at 50 to 200 y. Seeds of one-seed juniper are reported to remain viable for at least 21 y, while seeds of Utah juniper have germinated after 45 y of storage (Bonner 2003).

Maximizing germination success with native junipers requires: 1) avoiding collection of immature and insect damaged cones; 2) minimizing cone storage or storing surface-dried cones under well-ventilated conditions at 1 to 3 °C (34 to 37 °F) and 80% to 90% humidity; 3) macerating cones in hand-cleaner-amended water; and 4) separating light or nonfilled seeds from viable seeds with flotation (Scianna 2001).

The lack of effective seed germination techniques has been the main obstacle preventing widespread usage of

these species for large-scale restoration projects. Neither species have been successfully propagated from cuttings, so seed propagation is the only option. Although prolonged cold stratification alone has been used to improve germination of western native junipers (Benson 1976), more current studies indicate that warm stratification prior to cold stratification can give better results (Barbour 2001; Scianna 2001). Young and others (1988) found no benefit to the two-temperature treatment for Utah juniper, however, at RMNP nursery we use prolonged warm and cold stratification to overcome seed dormancy for both species.

We presoak seeds in running water for 4 h or longer and place seeds in mesh bags, which are then buried in moistened sphagnum peat moss in aerated containers. We warm stratify seeds at 21 °C (70 °F) for 70 d followed by a cold stratification at 4 °C (40 °F) in a refrigerator for 120 d. We periodically check the seeds and wash them as needed to remove mold.

We fill germination plug trays (288 cells per tray; 1.9 x 1.9 x 2.5 cm [0.75 x 0.75 x 1.0 in]) with a 1:1 (v:v) mix of Scott's Metro Mix 360 (The Scott's Company, Marysville, Ohio) and coarse perlite. We add the fungus *Trichoderma harzianum* Rifai to the medium prior to sowing as a preventive treatment against pre- and postemergence damping-off disease. This is available as the commercial product Root Shield® T-22 (BioWorks™, Fairfield, New York). Seeds are sown during late January and kept under a constant greenhouse temperature of 13 °C (55 °F).

Seeds germinate and emerge within 30 d of sowing and remain in germination plug trays for an additional 56 d or until an adequate root mass is formed. Because both species are adapted to arid environments, seedlings should not be overwatered during germination and growth. It is important to use a germination tray with deep cells because both of these species produce a taproot. Care is

also needed during transplanting to seedling containers to avoid J-root development.

We transplant plugs to individual Ray Leach 172 ml (10 in³) containers filled with Scott's Metro Mix 360 and add a 0.5 cm layer of grit mulch to the top of the container. We fertigate with Peters Professional® fertilizer (20N:10P₂O₅:20K₂O) as a continuous drip at the rate of 50 ppm with each irrigation for at least 10 wk until most plants have developed a firm root plug. Junipers are very sensitive to fertilizer burn, hence we use only low-level amounts of water-soluble fertilizer on them with the addition of water acidification to keep our overall pH reasonable. We harden off seedlings by reducing fertilizer and water from August to November and overwinter plant material in open cold frames in the outdoor nursery.

By the end of the growing season, our seedlings are 10 cm (4 in) tall with a caliper of 3 mm (0.12 in). In midsummer, however, we transplant a portion of the crop into 6.35 x 6.35 x 22.8 cm (2.5 x 2.5 x 9.0 in) Treebands; the remainder of the crop continues to grow in Ray Leach containers. Transplants will be available for sale the following season because of the slow growth typical of both species. Our decision to transplant only a portion of the crop is an economic one: several sectors of the market, such as wildland and mining restoration, are only willing to pay for smaller materials (usually 10 in³) rather than larger transplants. Therefore, we try to meet demands of both markets. Transplanted nursery stock is grown following the same horticultural practices described for 1-y-old seedlings.

We outplant seedlings on suitable sites during spring or fall as long as the hydrology is correct or supplemental water is available. Both species are xeric and require only a small amount of water on a daily basis until established.

SUMMARY

Including the long, 70-d warm and 120-d cold stratification period, it takes 1 y to produce seedlings of oneseed and Utah junipers. Seeds germinate best under a cool temperature of 13 °C (55 °F), and this appears to be very important for rapid emergence within an acceptable time frame. Germination percentages vary according to seed source and locality, however, we have found that this protocol works well in order to obtain an adequate number of seedlings from each seedlot.

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TABLE 1

Mature fruit characteristics and collection periods for oneseed and Utah juniper.

Species	Fruit collection date	Mature fruit characteristics	Mature fruit size	Seeds per kg (lb)
<i>J. monosperma</i>	Late fall to early spring of the second year	blue to blue-black sometimes becoming copper in color; fruit skin is thin and resinous; flesh is succulent or somewhat fleshy	4 to 8 mm in diameter; 1 or occasionally 2 seeds per fruit	36 350 to 41 400 (16 500 to 18 800)
<i>J. osteosperma</i>	Midwinter to early spring of the second year	Reddish purple to copper or brown; fruit skin is leathery; flesh is fibrous or mealy	8 to 16 mm in diameter; 1 to 2 seeds per fruit	7940 to 15 660 (3600 to 7100)

Sources: Carter (1997); Bonner (2003).

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