

Piñon Cone and Seed Collection for Reforestation:

Frequently Asked Questions and Answers in Colorado and New Mexico

Introduction

Piñon (*Pinus edulis* Engelm.) is a culturally and ecologically important tree species that in recent decades has experienced increased mortality across its range due to drought, beetle infestations, and wildfire. Restoring piñon following such events will require seed collection. This document addresses frequent questions relating to the collection of piñon seeds for reforestation.

Piñon-juniper ecosystems occur across large parts of the southwestern United States, comprising more than 23% of forests in the Southwest ([Board et al. 2018](#)). Throughout this region, piñon co-occurs with juniper (*Juniperus spp.*), growing either in sparse savannas or dense woodlands. Two-needle piñon trees are long-lived, cold-tolerant, and drought-resistant conifers, adapted to the climatic extremes found in semi-arid regions. They typically occur at elevations between 4,500 and 7,500 feet across Arizona, Colorado, New Mexico, western Oklahoma, western Texas, and Utah (Figure 1), and their persistence is dependent on the precipitation from the North American monsoon ([West et al. 2007](#)).

In recent decades, regional drought has led to large-scale piñon die-off and predicted future climate change effects may drastically reduce the extent of this ecosystem ([Redmond et al. 2023](#)). Extensive regional-scale die-off due to drought and bark beetle infestations in recent decades has caused up to 90% mortality in some areas on the Colorado Plateau ([Breshears et al. 2005](#)). Bark beetle outbreaks (*Ips confusus*) are tightly linked with drought stress, since stressed trees are less successful in defending themselves against beetle infestations than healthy ones.

It is difficult to interpret changes in fire regime within

piñon-juniper ecosystems based on the short period of recent record keeping versus the long historical fire return intervals for these systems ([Swetnam and Betancourt 1998](#), [Romme et al. 2009](#)). Distinct from some other forested systems in the southwestern U.S., piñon-juniper ecosystems have a long fire return interval (> 400 years), and when fire does occur, it is frequently stand-replacing ([Romme et al. 2009](#)). Recent research suggests that, along with drought and the invasion of non-native grasses, there has been an increase in fire season length, number of fires, and fire size in piñon-juniper systems over the past ~30 years within the Southern Rocky Mountain ecoregion ([Board et al. 2018](#)). Post-fire recovery can be slow, lasting from several decades to centuries ([Floyd et al. 2000](#), [Miller and Tausch 2000](#)).

Increasing drought and higher temperatures have also led to declines in piñon seed production over the past century ([Redmond et al. 2012](#)). Key phases of the 26-month reproductive cycle of piñon are

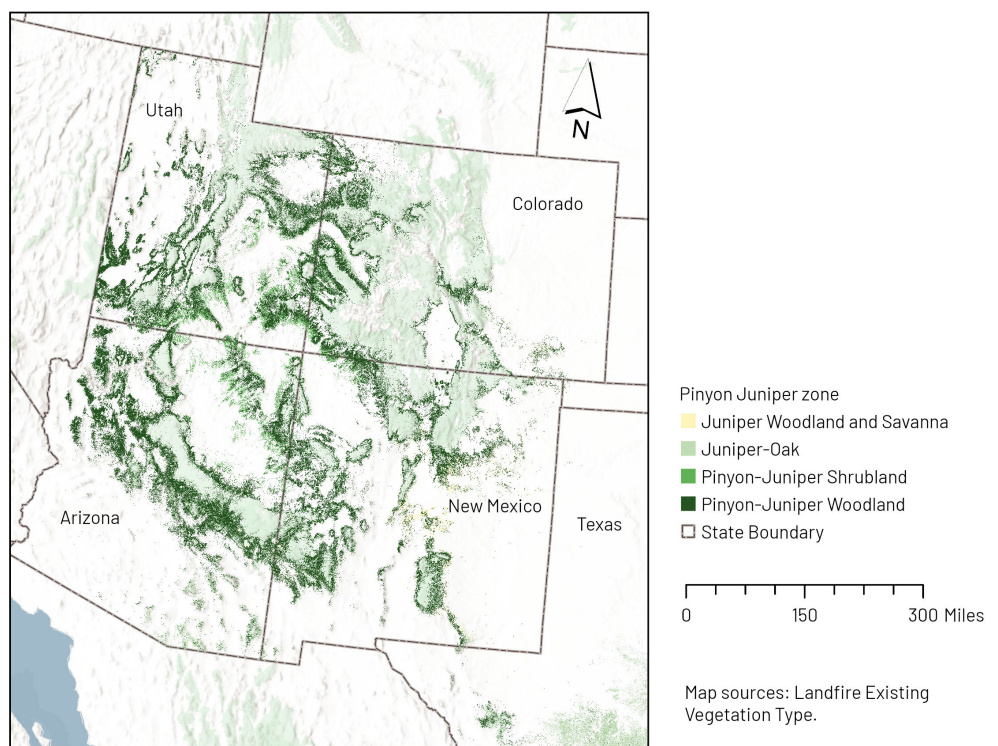


Figure 1. Distribution of piñon-juniper ecosystems in the Southwestern states, USA ([Landfire 2022](#)).

tightly correlated with weather, and cooler late summer conditions are critical during cone initiation (Ibid). As conditions throughout the Southwest become hotter and drier, a reproductive decline could have significant ecological and economic consequences throughout the region.

Also referred to as pinyon pine or nut pine, piñon seeds (or “pine nuts”) have formed part of human diets for millennia. Indigenous Peoples across the Southwest collect piñon nuts, and by the early 1900s it also became an important commercial crop. Today, most pine nuts sold in supermarkets are imported, but they remain an important source of food and tradition within the various cultures of the Southwest. The tree is also considered a foundational species for animal populations such as the imperiled pinyon jay (*Gymnorhinus cyanocephalus*), as well as for numerous other birds, rodents, and mammals (Figure 2).

This guide responds to an increasing need for piñon cone collection to provide seeds for reforestation projects seeking to restore woodlands affected by drought, beetle outbreaks, and wildfire, and in providing a short summary of the state of knowledge about piñon masting, collection, and what to expect, this guide aims to increase the speed of recovery



Figure 2. A pinyon jay atop a piñon. Photo credit: H. Eyster.



Figure 3. Piñon seeds. Photo credit: The Nature Conservancy.

and help foster resilience in a changing world. **Piñon seeds are an important food source for Indigenous Peoples and Hispanic communities in the Southwest**

Piñon seeds are an important food source, and humans have collected the seeds for millennia, a practice which continues today (Figure 3). This important cultural food source is integral to the culture and traditions of Indigenous Peoples, Pueblos, and Hispanic communities across the Southwest. Piñon is also a significant commercial crop. While this guide seeks to aid in the collection of piñon seeds for reforestation, such efforts must first respect the rights of Indigenous Peoples, Pueblos, and Hispanic communities to harvest these seeds in accordance with needs and traditions. Collection operations may need to be moved to specific regions or areas to avoid conflicts and should seek guidance in how to best protect trees during harvest, such as avoiding destructive harvest techniques like branch clipping, which can damage future crops.

Common questions asked about piñon seed development in the Southwest

Piñon cone ecology

How many months does it take a piñon to produce a cone?

Piñon cones develop over portions of three years, producing fully mature seeds at 26 months (Figure 4). The microscopic buds of seed and pollen cones initiate in late summer of the first growing season. Development that is visible to the naked eye begins

the next spring (early in the second growing season) when conelets are pollinated between May and June (Bonner and Karrfalt 2008). Once pollinated, female conelets close their scales and pollen tubes grow throughout the winter, while cones remain small. Fertilization occurs in the late spring of the third growing season and newly fertilized cones rapidly swell in size. By September, mature seeds are ready for harvest (Figure 5).

How far do piñon seeds disperse from a parent tree?

Unlike other pines with winged seeds that are primarily wind-dispersed, piñon seeds are wingless and rely on corvid birds and small rodents to disperse seeds, from a few feet up to ~6 miles from parent trees (Chambers et al. 1999). The Clark's nutcracker and pinyon jay, the primary seed dispersers of piñon seeds, scatter and hoard seeds, many of which are consumed, but other unrecovered seeds may



Figure 5. Mature piñon cone. Photo credit: The Nature Conservancy.

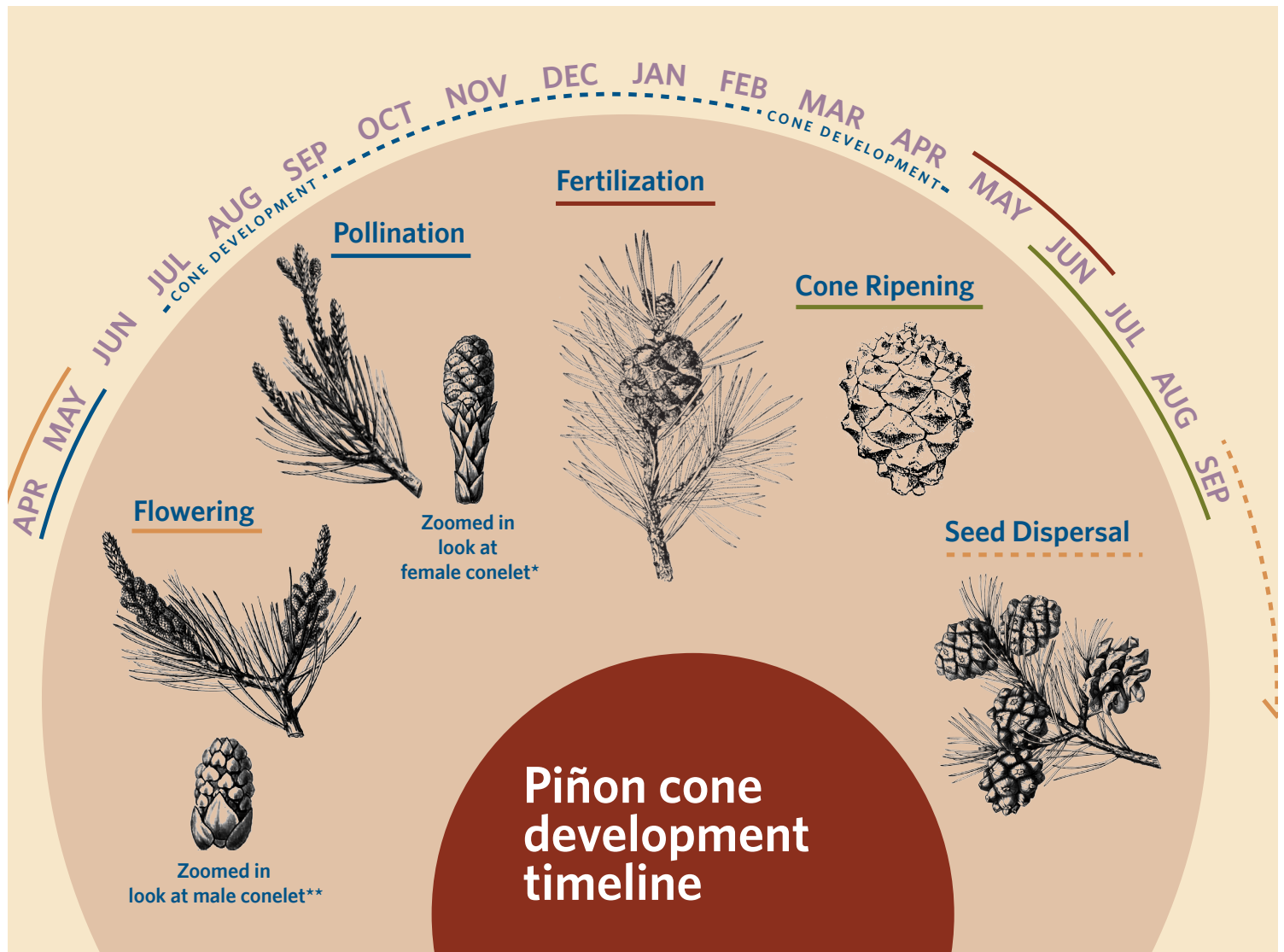


Figure 4: A timeline of piñon pine cone development from pollination to seed maturity. Portions of this figure are adapted from Sargent (1898), Britton (1908), and Shaw (1914). *Properly, megastrobili **Properly, microstrobili.

germinate ([Burns and Honkala 1990](#)). During a mast year, a flock of ~250 pinyon jays was estimated to have cached 4.5 million seeds ([Ligon 1978](#)). Additionally, rodents such as chipmunks, ground squirrels, mice, kangaroo rats, and wood rats are seed predators but may also cache seed ([Chambers et al. 1999](#)).

How often does piñon in southern Colorado and northern New Mexico produce cones?

Historically, synchronous and intermittent cone production in piñon stands in southern Colorado and northern New Mexico occurred every four to seven years, but warmer and drier conditions are altering the frequency and magnitude of these masting cycles ([Barger and Ffolliott 1972](#), [Wion et al. 2025](#)). Hindcasting of piñon seed crops identified six large mast years since 1900, with 2024 being the sixth largest mast year in that period ([Wion et al. 2025](#)). During large masting events, regional production synchrony across the southwestern U.S. spanning hundreds of square kilometers is high ([Wion et al. 2020](#)).

Reports of declining cone yields exist across the range, with declines of up to 40% between 1969-1978 and 2003-2012 in New Mexico and northwest Oklahoma ([Redmond et al. 2012](#)); 35% of seeds unfilled in 1998 and 80% unfilled seeds in 2004 in southern New Mexico ([Zlotin and Parmenter 2008](#)); and modelled range-wide declines of 30.6% over the last one-hundred years (from the 2000-2024 period as compared with a century prior) ([Wion et al. 2025](#)). Forecasts of state-level decreases in cone production in New Mexico are nearly double that of Colorado over the last century; for example, [Wion et al. \(2025\)](#) forecast a 38.8% decrease in cone production in New Mexico and a 23% decrease in Colorado.

Why does piñon mast?

Mast seeding is a way for trees to increase their potential for successful reproduction using an economy of scale. Reproductive synchrony in pollen production and female cone production increases the efficiency of pollination ([Moreira et al. 2014](#)). While some trees may produce pollen cones each year, heavy seed crops are likely to be pollinated during the years when most trees at a given site invest in pollen production. Synchrony allows for better mixing of genes, or outcrossing, and lower rates of self-pollination. Masting may also reduce seed predation by satiating seed predators, such as insects, birds, and rodents.

Do male pollen cones and female seed cones occur on the same tree?

Both male pollen cones and female seed cones are found on the same tree (properly strobili). Male pollen cones are commonly located in the lower portion of the tree while female seed cones are commonly located in the upper two-thirds of the tree ([Bonner and Karrfalt 2008](#)) (Figure 6).

At what age do piñons produce cones with viable seeds?

Piñon can produce cones as young as 25 years of age (~ 5 to 10 feet tall), but it is not until age 75 and later that they may produce large amounts of viable seeds ([Burns and Honkala 1990](#)).

Does the weather influence cone production?

Masting is frequently associated with weather cues. For example, the production of piñon seeds is highly correlated with cool late summer temperatures during the first growing season (“cone initiation”) ([Redmond et al. 2012](#)). In addition, seed production is higher at sites with cooler temperatures and increased moisture compared to lower-elevation sites with hotter and drier summer conditions (Ibid). Mast years frequently occur following years with low vapor pressure deficit, a measure of evaporative demand ([Wion et al. 2020](#)). However, a



Figure 6. First-year (small purple conelets) and second-year (larger green cones) female piñon cones. Photo credit: The Nature Conservancy.

changing climate and increases in growing season temperature, combined with reduced precipitation (i.e., drought) have contributed to decreases in cone production ([Redmond et al. 2012](#), [Wion et al. 2025](#)). A refined understanding of relationships between weather and mast seeding will improve the accuracy of forecasting for land managers ([Wion et al. 2025](#)).

Wind has long been hypothesized to aid pollen dispersal, but the available science is limited and inconclusive. One study suggests that increased wind speed can aid pollen dispersal over large distances ([Zlotin & Parmenter, 2008](#)), while another study by the same authors at a later date reports no effect of wind on pollen dispersal ([Parmenter et al. 2018](#)). Stand size and distances between trees could be more important predictors of pollination success, and further work on pollen dispersal is needed (Ibid).

What does a good production year look like?

During a large mast year, piñon stands may produce 250-300 pounds of seeds per acre and a single large tree can produce up to 20-25 pounds of seed ([Jeffers 1994](#)). Piñon averages 1,900 seeds per pound (4 pounds per bushel) ([Bonner and Karrfalt 2008](#)) (Figure 7).

Which insects attack piñon cones?

Insect predation on developing seed can decrease crop yield ([Keen 1958](#), [Chambers et al. 1999](#)). Cone beetles (*Conophthorus spp.*), whose larvae eat second-year seeds leaving behind brown, withered cones, and coneworms (*Dioryctria spp.*), which consume terminal shoots reducing current and future cone production, cause significant damage to cone crops ([Chambers et al. 1999](#)) (Figure 8).

Do some trees produce more cones than others?

The form and health of individual trees, as well as the density of the stand where those trees grow, can influence cone abundance. Large diameter trees tend to have greater cone abundance, which may reflect greater age or better site conditions. Tree diameter was found to be a better predictor of cone abundance than stand density ([O'Connell and Frey 2023](#)). The density of piñon tends to increase with elevation and precipitation, and while areas with high tree density typically have fewer cones per tree, dense stands have more trees and can produce more cones per unit area than a lower density stand (Ibid).

How many seeds are in a cone?

Individual cones may contain an average of 10 to 20 seeds but can contain up to 30 seeds ([Burns and](#)



Figure 7. Piñon cone production on a single tree during the 2024 mast seeding year. Photo credit: The Nature Conservancy.

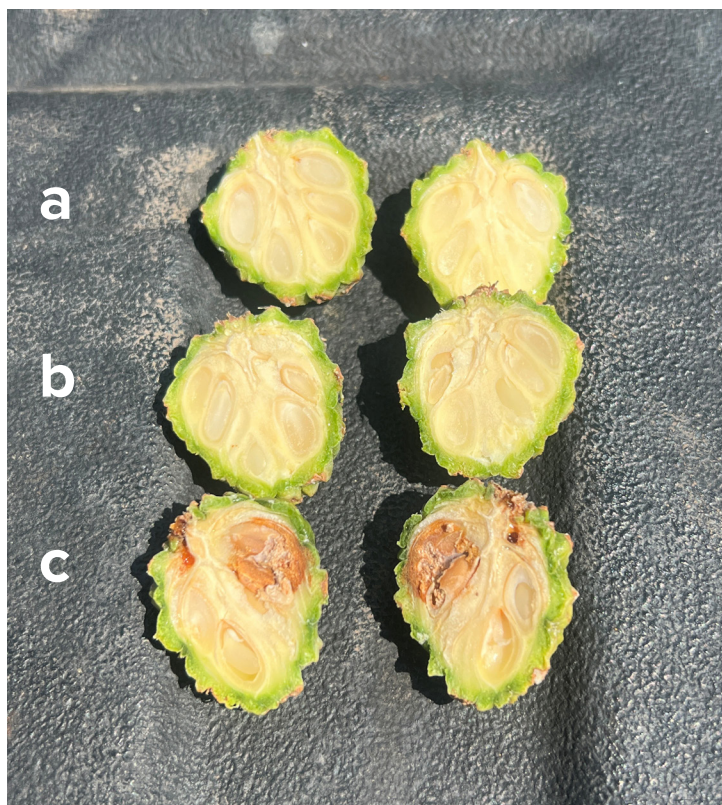


Figure 8. Comparison of healthy developing cones (a and b) and a cone with visible insect damage (c). Photo credit: New Mexico Highlands University.

[Honkala 1990](#)). Self-pollination and insect predation can significantly reduce the number of viable seeds and some report that 50% of seeds in mature cones are empty, or unfertilized ([Chambers et al. 1999](#)) (Figure 8).

How long will the stored piñon seed retain its viability?

Properly dried and stored piñon seeds can remain viable for up to a decade or more. For long-term storage, professional processing which includes drying seeds to 5-10% moisture and storing in sealed bags or containers at approximately 0 °F, is necessary to prevent moisture reabsorption and maximize the lifespan of stored seed ([Bonner and Karrfalt 2008](#)).

Is it possible to collect cones every year?

Cone crops are typically poor or abundant, rarely intermediate, and cones may be nearly absent in poor years ([Burns and Honkala 1990](#)). Collection decisions during poor years will depend on need and budget. Small crops may be disproportionately affected by insect predation.

Why should we collect piñon seeds with locally adapted traits?

The selection of an appropriate seed source for a planned planting project can influence the survival of outplanted seedlings, and although piñon is widely distributed across the Southwest, genetic variation throughout its range controls cold and drought hardiness, dates for budburst, and overall tree health. For these reasons, it is important to record the location and elevation of each collection site.

To match seedlots with planting sites, we recommend using the USDA's Seedlot Selection Tool, which relies upon current and future climate information for predictions (see URL in key resources section).

Is there a need to collect seeds from other tree species?

Yes, we need to increase seed collection for all trees species that we expect might be damaged by drought, insects, or wildfire, and whose recovery may be limited by lack of an available seed source.

How can I get involved?

There are organizations across the Southwest focused on native tree seed collection. We suggest that you check with your local city and county open space and any volunteer stewardship organizations, many of whom maintain active collection programs.



Figure 9. Male pollen cones (properly microstrobili) with a) mature pollen (light green-yellow; photo credit: Beth Wald), and b) with dried pollen (brownish orange; photo credit: New Mexico Highlands University), c and d) female first-year conelets (properly megastrobili) vary in color based on developmental phase (photo credit: The Nature Conservancy).

Cone and Seed Ecology

How can I distinguish between developing male and female cones?

- Female conelets are small, spherical structures that vary in color from dark green to purple depending on developmental phase (Figure 9c and d). Male pollen cones are green-yellow to brownish-orange depending on developmental phase and tube shaped ([Bonner and Karrfalt 2008](#)) (Figure 9a and b). Pollen cones are much smaller than mature female cones, measuring just around 0.25 inches long (Figure 9a and b).
- Mature piñon cones are typically bright green with brown woody scale tips and are often covered in sap ([Bonner and Karrfalt 2008](#)) (Figure 6). At maturity, they are 1-2 inches long and round to egg-shaped.

What do mature piñon seeds look like?

- Mature piñon seeds are larger than those of most other pines, measuring 0.4 to 0.6 inches (10-15 mm) in length, about the size of a black bean (Figure 2). They are light to dark brown in color and wingless, unlike most other pines.
- Mature cones may contain unfilled, empty seeds that have an otherwise normal woody seed coat. Up to 50% of seeds in mature cones may be empty because seed development is initiated by pollination, not fertilization ([Chambers](#)

et al. 1999). Fertilization failure, such as self-fertilization or in response to environmental factors, can also lead to embryo abortion in a fully developed seed. In the field, a hand lens, or loupe, can be used to examine seed condition, as described in Schloegel et al. (2024).

Cone Collection for Reforestation

We recommend reviewing the Ponderosa Pine Seed Collection Field Guide (Schloegel et al. 2024) for a full description of the planning for collection needs, crop forecasting, cone scouting, and collection planning processes. Below, we provide specific notes on scouting, collection, and transport of piñon, highlighting key differences from ponderosa pine that are unique to piñon.

Cone scouting

The timing for cone collection requires monitoring the cone crop for ripeness, so that collections occur when seeds are fully mature but while the cones are still closed. For piñon, as the cone ripens, cones will typically change color from green to light yellowish-green. When ripe, the scale tips will loosen to the point where they can be pulled open with fingernails or pliers, and cones will feel noticeably lighter than earlier in the season. At full ripeness before cones open, a slight rattle may even be heard when piñon cones are shaken, but they would be ready for collection before this point. Collections of ripe cones from trees will typically occur 1-2 weeks or more before cones would open to drop their seeds, meaning that such collections can help to avoid conflicts with wildlife and local collectors that would arrive later to pick seeds from the ground.

Field tests of seed maturity: The float test and the cut test

Cut tests or a kerosene float test are two field tests that can be used to gauge seed maturity. A float test in kerosene is a simple field test to measure piñon cone ripeness: if a closed cone sinks in kerosene, it is unripe and not ready for collection, whereas a cone that floats in kerosene indicates that it is ripe and ready for collection (Bonner and Karrfalt 2008). A ripe piñon cone that is ready for collection will have a specific gravity of approximately 0.8 grams per cubic centimeter. If this test is used, safety glasses and nitrile gloves are recommended, no open flames should be present, and care should be taken to avoid spills which could contaminate the site. Multiple cones from five or more trees

should be float-tested to indicate the average level of cone ripeness in the stand. All float-tested cones and kerosene should be removed from the site as waste. In addition to the float test, several cones from five or more trees should be cut in half (“the cut test”) to observe seed development in the cone. When seeds are mature and ready for collection, the embryos should be at least 90% the length of the entire seed on average. If several cones from multiple trees across the collection site meet the above criteria, then the cone crop is ready for collection.

Collection methods for piñon

For piñon seed collections for reforestation, employing bucket trucks and/or tree climbers to collect closed cones containing mature seeds from the upper portion of the canopy of crop trees can significantly increase the quantity and quality of seed yield, decrease seedlot cleaning costs, and improve the efficiency and cost-effectiveness of collection operations (Figure 10). For climbers collecting from piñon trees, a combination of lanyard-over-lanyard climbing techniques with using a cone hook to pull branch tips toward the climber to facilitate cone picking often prove to be most efficient and effective. One may also consider the use of bucket trucks depending on site conditions and access.



Figure 10. A trained climber pulls branch tips toward him to collect piñon cones. Photo credit: Charlie Rose.

Traditionally, piñon seeds have been hand-picked off the ground after cones open. Other collectors may also spread sheets or tarps under trees before shaking them to dislodge seeds from open cones (Jeffers 1994). The largest and heaviest seeds tend to fall from cones soon after cones open, while lighter, smaller, and/or empty seeds may remain in open cones on the tree after the cones open. For this reason, the use of tarps to catch falling seeds (whether trees are shaken or not) is most effective when cones are first opening. Following a ground collection, the seed may be immediately processed and cleaned by professional cleaners before drying and placement in freezer storage at a seed bank. Although ground collection requires less skilled collection personnel than climbing, these methods are less cost-effective for collection operations at the scale needed to support reforestation and may increase the potential for conflict with community members who collect for personal use.

A detailed description of these collection planning and collection methods, including the necessary safety considerations and monitoring practices needed to ensure that cones are fully ripe at the time of collection, are beyond the scope of this publication but conceptually similar to practices described for ponderosa pine (*Pinus ponderosa* Douglas ex C. Lawson) by Schloegel et al. (2024).

Cone transport and seed extraction, processing, and storage

After collection, cones would be placed in burlap sacks and handled, dried, and processed as described for ponderosa pine by Schloegel et al. (2024). Key resources for further information about seed collection, processing, and storage for reforestation include:

- Bonner, F. T., and R. P. Karrfalt, editors. 2008. **The woody plant seed manual, Agriculture Handbook 727**. U.S. Department of Agriculture, Forest Service, Washington, DC, USA.
- **National Nursery and Seed Directory** (<https://rngr.net/resources/directory>). This directory is an online source for finding businesses that support the propagation of forest and native plant materials in the US and Canada. It is possible to search the directory by name, state, product, or business type. The directory sponsored by the USDA Forest Service and Southern Regional Extension Forestry and is a

collaborative effort between these two agencies.

- **Seed Lot Selection Tool** (<https://seedlotselectiontool.org/sst/>). The Seedlot Selection Tool (SST) is a web-based map designed to help forest managers match seeds with planting sites based on climatic information. The climates of the planting sites can be chosen to represent current climates, or future climates based on selected climate change scenarios. The Seedlot Selection Tool is a collaboration between the US Forest Service, Oregon State University, and the Conservation Biology Institute.
- **Tree Planters Notes** (<https://rngr.net/publications/tpn>). Tree Planters' Notes (TPN) is a journal dedicated to technology transfer and publication of information relating to nursery production and outplanting of trees and shrubs for reforestation, restoration, and conservation.
- **USDA National Seed Lab** (<https://www.fs.usda.gov/ns/>). This website provides seed testing services, training, and research.

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