

Saguaro Cactus

Cultural Significance and Propagation Techniques in the Sonoran Desert

MARK J PATER AND BERNARD SIQUIEROS

ABSTRACT

The saguaro cactus (*Carnegiea gigantea* [Engelm.] Britt. & Rose [Cactaceae]) is a prominent indicator species of the Sonoran Desert. It is also a unique and highly valued plant of important cultural significance to the Tohono O'odham tribe that has its roots in the Sonoran Desert. Saguaro ribs are used as construction materials and the fruit is used to prepare food or beverages. Seed propagation techniques have been evaluated at the Tucson Plant Materials Center in order to determine and describe an efficient method to produce saguaro plants.

KEYWORDS: *Carnegiea gigantea*, saguaro, Cactaceae, Tohono O'odham, propagation, germination

NOMENCLATURE: USDA NRCS (1999)

Within the Tohono O'odham (Desert People) culture, storytelling is how history, significant events, and information are passed from generation to generation. The O'odham (The People) live in the Sonoran Desert of southern Arizona and northern Mexico (Figure 1) and proudly pass the stories of their cultural roots on to their children. They start by describing that in the beginning, I'toi (Elder Brother) instructed the Tohono O'odham on all things they needed to know to successfully overcome the challenges of living in their desert homeland. The O'odham coexisted with the plants and animals, which provided food, shelter, and clothing. The ancestors were taught that certain plants possessed medicinal properties that could be called upon for curing ailments. Plants to be used in prayer or ceremonies were also identified. To ensure harmony in the newly created world, I'toi stressed the importance of mutual respect among all living things. Although all plants are significant

to the O'odham culture, certain species are used more frequently, including ocotillo (*Fouquieria splendens* Engelm. [Fouquieriaceae]), beargrass (*Nolina microcarpa* S. Wats. [Liliaceae]), soaptree yucca (*Yucca elata* (Engelm.) Engelm. [Agavaceae]) and saguaro (*Carnegiea gigantea* [Engelm.] Britt. & Rose [Cactaceae]).

Cultural Importance

Saguaro is called ha:sañ by the O'odham. This highly regarded plant not only provides food and shelter for many insect and animal species, but also for the O'odham. O'odham lore describes the situation that led to the emergence of the first ha:sañ. Ban (coyote) cleverly deceived the individual who was given the responsibility of disposing all ha:sañ seeds into accidentally scattering them over the southern slopes of the desert mountains where they grow to this day.

Saguaro fruit, bahidaj, is harvested and processed for food and wine by the Tohono O'odham in preparation for the annual rain ceremony. Saguaro ribs are used as building



Figure 2 • *Ha:sañ*,
or saguaro,
flowering in the
Sonoran Desert

Courtesy of Arizona
Sonoran Desert Museum

material for fences, ramadas, homes, and the ceremonial roundhouse. Symbols indicating important events are carved on a saguaro rib that serves as a “calendar stick.” Ha:sañ bahidaj

(saguaro fruit) is harvested during June and July with the use of a ku'ipad, a long stick made of one or several saguaro ribs that are tied together. Creosote sticks are sharpened and tied, at an angle, to the end of a ku'ipad to allow the



Photo by Bernard Siquieros, Tucson Plant Material Center

user to pull or push the fruit from the plant. The fruit is processed to create syrup, gruel, preservative, or an intoxicating beverage.

Natural History

The saguaro is the largest columnar cactus found growing naturally in the US (Alcorn and Martin 1974) and bears the state flower of Arizona. This magnificent cactus represents the botanical symbol of North American deserts for many people around the world. These unique plants are tall, long-lived cacti that occur naturally and only in southern Arizona, northwestern portions of Sonora, Mexico, and sparsely near the lower Colorado River in California (Dodge 1985). Saguaros can live to be 200 y old (Kearney and Peebles

1960), grow 15 m tall (50 ft) and weigh as much as 9072 kg (20,000 lb) (Benson 1974). Saguaro roots radiate out from the base up to 15 m (50 ft) and close to the surface of the ground. The shallow roots allow saguaros to absorb as much water as possible, especially from light precipitation events, which they store for several years if necessary. Flowers bloom in late spring (late April through early June) and fruits ripen about 37 d after flowering (Young and Young 1992). Saguaro flowers are large, elongated, and bloom nocturnally allowing both (bats and insects) and day foragers (birds, bees, and other insects) to feed on the nectar and aid in pollination.

Salvage

A cooperative agreement involving the Tohono O'odham Soil and Water Conservation District, Natural Resources Conservation Service, and the Cyprus Tohono Corporation was initiated in 1994 to address concerns of the Tohono O'odham Nation regarding reclamation and revegetation efforts on the Cyprus Tohono Mine. Saguaro cactus salvage and transplant techniques were begun at the mine, but the technique is expen-



Figure 1 • The Tohono O'odham Nation lies on the border between Arizona and the Republic of Mexico within the Sonoran Desert.

Modified from original work of Greg Saxe and Fred Stevens, Tohono O'odham Nation.

sive (US \$30 per linear m (\$10/ft) and may not result in successful survival. Large saguaros may not show signs of decline for up to 5 y following transplanting. Saguaro propagation efforts at the Tucson Plant Materials Center (PMC) were initiated in 1998 with the idea that this would be a more cost-effective method of saguaro cactus establishment. However, the initial propagation efforts were less than successful, the primary difficulties were moderate germination percentages (< 60%) and damping-off of young seedlings. Although current, scientific literature pertaining to saguaro propagation techniques was limited, additional information was assimilated from observational trials conducted at the Tucson PMC and from advice by

Dan Bach, a local cactus grower and retailer in Tucson, Arizona.

Propagation

Fruit of the saguaro is a fleshy red berry that contains about 2500 black seeds intermixed within the pulp. The fruit is ripe when it turns deep red in color and is easily plucked from the plant. To separate seeds from pulp, the fruit is split open and the pulp is removed. The seed and pulp mixture is rinsed with water, strained, and allowed to air dry for 5 to 7 d (Figure 2). There are about 990 cleaned seeds per gram (28,000/oz)(Young and Young 1992).

To prepare for planting, pumice granules are sifted through a 6 mm (0.25 in) screen. Material too large to pass through is sifted through a 13 mm (0.5 in) screen. The large (> 13 mm), medium (6 to 13 mm), and fine (< 6 mm) pumice granules are stored separately. First, SuperSoil is mixed 1:1 (v:v) with large-granule pumice material; pumice is added in primarily for improved drainage and aeration. SuperSoil (Rod McLellan Co, 914 S Claremont Street, San Mateo, California, 94402) is an all-purpose potting mix containing a proprietary mix of fir bark, redwood, Canadian sphagnum peat moss, and clean sand. After placing this mixture in a 51 x 30 x 6 cm (20 x 12 x 2.5 in) propagation tray, saguaro seeds are lightly and evenly spread across the top of the soil mixture trying to achieve a rate of 2 seeds per 6 cm² (1 in²). This method should successfully produce approximately 200 to 250 saguaro seedlings per propagation tray. Next a layer of medium-sized pumice granules is placed over the seeds, covering some seeds while leaving others exposed as they may be found in a natural setting. Trays are covered with a tent-like structure using a pre-constructed 30-cm-tall (12-in) frame covered with a sheet of heavy-duty plastic. The plastic tent creates a humid environment more favorable to seed germination. Plastic propagation domes are commercially available and may work equally well.

After placing the tray in the greenhouse, a light water mist (enough water to saturate the top 2 mm of soil mix) is applied 2 times per day. Misting is continued until germination is observed. Greenhouse thermostats are set at 24 °C (75 °F) for night and 32 °C (90 °F) during the day. These temperatures and an 8 h photoperiod are recommended by Young and Young (1992). If the greenhouse temperatures fall below 24 °C (75 °F), the planting tray is placed on a heating pad with a temperature setting of 24 °C (75 °F). Reduction of incubation temperatures to 59 °F (15 °C) curtails germination from about 50% to < 5% (Heit 1973).

Saguaro seedlings normally have a red color that indicates the plants are getting sufficient light (Figure 3). Young and Young (1992) caution that young plants up to 30 cm (12 in) tall should be protected from intense sunlight that can easily burn them. After germination, the plastic tent should remain over plants for at least 60 d and watering to saturate the top 2 mm of soil may be reduced to once a week. After 60 d plants will have grown about 3 mm (0.125 in) tall. Maintain greenhouse temperatures at 32 °C (90 °F), and after 60 d remove the plastic tent and replace it with a shade cloth that filters out about 70% of the sunlight. After about 8 mo saguaro seedlings should be about 13 to 19 mm (0.5 to 0.75 in) in diameter and can be transferred into 51 x 51 x 76 mm (2 x 2 x 3 in) cavity trays containing a 1:1 (v:v) mixture of SuperSoil and large-granule pumice. Seedlings with brown spines are discarded. Larger plants (25 to 28 mm in diameter) in the cavity trays can be transferred after approximately 6 mo time into 3-l (1-gal) pots (Figure 4) filled with a 2:1:1 (v:v) mixture of SuperSoil, medium-sized pumice granules, and Forest Mulch (Arizona Mix; Triple A Fertilizer Co, 8665 S Alvernon Way, Tucson, Arizona, 85706) and placed in a shadehouse. These pots will accommodate height growth up to 10 to 15 cm (4 to 6 in) at which time the saguaros are ready for transplanting onto a revegetation site under nurse plants. It will gen-



Courtesy of Arizona Sonoran Desert Museum

Figure 2 • A member of the Tohono O'odham opening a saguaro fruit.

erally take 4 to 5 y to achieve transplant size.

The best period to transplant saguaros is in spring, giving the saguaro and nurse plant seedlings enough time to become established on the site. When transplanting into the target site, nurse plants provide shade and protection, by physical concealment, from rabbits, rodents, and others. Suitable nurse plants include triangle leaf bursage (*Ambrosia deltoidea* [Torr.] Payne [Asteraceae]), white bursage (*Ambrosia dumosa* [Gray] Payne [Asteraceae]), honey mesquite (*Prosopis glandulosa* Torr. [Fabaceae]), and little-leaf palo verde (*Parkinsonia microphylla* Torr. [Fabaceae] formerly *Cercidium microphyllum*). Saguaro seedlings protected by nurse plants also benefit from lower soil surface temperatures and prolonged periods of favorable soil-moisture conditions (Shreve 1914; Steenbergh and Lowe 1969). If saguaros are to be held for a longer period of time prior to transplanting, they should be transferred into 18-l (5-gal) pots or planted in the ground under a shaded storage holding area.

Conclusions

Propagating saguaro cactus seedlings and transplanting them onto revegetation sites in the Sonoran Desert may prove to be a successful and cost effective revegetation method. Saguaro seedling propagation can be a useful alternative to the salvage and transplant process if enough time is allowed for planning, propagation, and post-planting management. Although smaller saguaro transplants will initially lack the majestic presence of a more mature and multi-armed plant, proper management and patience will eventually provide a successful and aesthetically pleasing population. Saguaros are disappearing primarily due to expanding development for homes and businesses as well as theft. The development of good propagation techniques may help to replace some plants lost to urban sprawl in the Sonoran Desert.

The saguaro cactus is highly regarded for its cultural contributions by the Tohono O'odham, reflected in many of the stories that are passed from generation to generation



Figure 5 • A 6-mo-old saguaro seedling recently transplanted into a larger pot.

at tribal gatherings and ceremonies. Successful propagation of this plant is not viewed primarily as a revegetation tool; the role saguaro plays in Tohono O'odham culture is far more important. Today's O'odham spiritual leaders and elders continue to stress the original premise of respect for all living things. Respect for self, family, and all others is encour-

aged in O'odham culture. The idea of considering all things as equals is also encouraged in striving to regain harmony and balance in today's world and the world of tomorrow. A show of respect involves giving of offerings to

plants and animals when they are called upon for help. This concern regarding the future of the land and its resources is further expressed within the Tohono O'odham Nation Administrative Plan: "The elders always advise us to look far into the future. All levels of our Government should hereby adopt the Six Nations of the Iroquois' proviso; 'before Council takes final action on any resolution before them, the effect on seven generations into the future must be considered.'" The

guiding mandate in all phases of this project is best reflected in the proviso found in Wisdomkeepers (Wall and Arden 1990) which reads, "Look behind you. See your sons and your daughters. They are your future. Look farther, see your children's children and their children even unto the seventh generation. They will soon be walking the earthly path we walk today, and we must insure there is a path to walk. Think about it, you yourself are a Seventh Generation."

References

- Alcorn SM, Martin SC. 1974. *Cereus*. In: Schopmeyer CS, technical coordinator. Seeds of woody plants in the United States. Washington (DC): USDA Forest Service. Agriculture Handbook 450. p 313-314.



Figure 4 • Young saguaro seedlings. Note the reddish color indicating healthy plants.

- Benson L. 1974. The cacti of Arizona. 3rd ed. Tucson (AZ): University of Arizona Press. 108 p.
- Dodge N. 1985. Flowers of the southwest deserts. Tucson (AZ): Southwest Parks and Monuments Association. 15 p.
- Heit CE. 1973. Optimum germination testing conditions for cacti mixtures. Newsletter ASOA 47:55-56.
- Kearney TH, Peebles RH. 1960. Arizona flora. 2nd ed. Berkeley (CA): University of California Press. 569 p.
- Shreve F. 1914. The rate of establishment of the giant cactus. Plant World 13:15-23.
- Steenbergh WF, Lowe CH. 1969. Critical factors during the first years of life of the saguaro (*Cereus giganteus*) at Saguaro National Monument, Arizona. Ecology 50:825-834.
- USDA NRCS. 1999. The PLANTS database, Version 3.0. URL: <http://plants.usda.gov/plants> (accessed 10 May 2000). Baton Rouge (LA): National Plant Data Center.
- Wall S, Arden H. 1990. Wisdomkeepers. Meetings with Native American spiritual elders. Hillsboro (OR): Beyond Words Publishing Inc. 120 p.
- Young JA, Young CG. 1992. Seeds of woody plants in North America. Portland (OR): Dioscorides Press. p 100-101.

Author Information

Mark J Pater
Operations and Research Coordinator
mpater@az.nrcs.usda.gov

Bernard Siquieros
Cyprus Tohono Mine Reclamation
Specialist
bsiquieros@aztucpsmc.nrcs.usda.gov

USDA Natural Resources
Conservation Service
Tucson Plant Materials Center
3241 North Romero Road
Tucson, AZ 85705