Saguaro Cactus: Cultural Significance and Propagation Techniques in the Sonoran Desert

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Abstract
The saguaro cactus (*Carnegiea gigantea* [Engelm.] Britt. & Rose) 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. 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, Tohono O’odham, propagation

Introduction
A cooperative agreement involving the Tohono O’odham Soil and Water Conservation District (SWCD), Natural Resources Conservation Service (NRCS), and the Cyprus Tohono Corporation was initiated in 1994 to address the concerns of the Tohono O’odham Nation in regard to reclamation and revegetation efforts on the Cyprus Tohono Mine. Efforts from this agreement have resulted in a gathering of information on the use of native plant species in the revegetation of disturbed desert lands. Revegetation trials involved greenhouse propagation and transplanting of culturally significant plants. Although all plants are significant to the O’odham culture, there are certain species that are used more frequently such as the saguaro (*Carnegiea gigantea* [Engelm.] Britt. & Rose [Cactaceae]), ocotillo (*Fouquieria splendens* Engelm. [Fouqueriaceae]), beargrass (*Nolina microcarpa* Wats. [Liliaceae]), and soaptree yucca (*Yucca elata* Engelm. [Liliaceae]). Propagation of saguaro cactus seedlings for eventual transplanting into a revegetation site may prove to be more successful than the salvage and transplant techniques used for much larger saguaros.

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, Elder Brother, “I’itoi” instructed...
the Tohono O’odham on all things they needed to know in order to successfully overcome the challenges of living in their desert homeland. The O’odham co-existed 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 insure harmony in the newly created world, I’itoi stressed the importance of mutual respect among all living things.

**Cultural Importance**

Saguaro is called “Ha:sañ” by the O’odham (Figure 2). This highly regarded plant not only provides food and shelter for many insect and animal species, it also provides the same 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.

The saguaro is the largest columnar cactus found growing naturally in the United States (Alcorn and Martin 1974) and bears the state flower of Arizona (Figure 3). 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). Saguars can live to be 200 years old (Kearney and Peebles 1960), grow to heights of 15.25 m (50’) and can weigh as much as 9,072 kg (20,000 lbs.) (Benson 1974). The roots of the saguaro radiate out from the base, close to the surface of the ground, up to 15.25 m (50’). These shallow roots allow the saguaro to absorb as much water as possible, especially from light precipitation events, which it stores for several years if necessary. Young and Young (1992) describe the saguaro flowers as beginning to bloom in late spring (late April through early June) and the fruit ripening about 37 days after flowering. Saguaro flowers are large, elongated and bloom nocturnally allowing both night (bats and insects) and day foragers (birds, bees and other insects) to feed on the nectar and aid in pollination.
Saguaro fruit, “bahidaj”, is harvested and processed for food and wine in preparation for the annual rain ceremony by the Tohono O’odham. The ribs of the saguaro are used as building material in the construction of 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 the months of June and July. The fruit is removed from the saguaro 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 user to pull or push the fruit from the plant. The fruit is processed to create syrup, gruel, preservative or an intoxicating beverage.

Materials and Methods

Saguaro cactus salvage and transplant techniques were initiated at the Cyprus Tohono Mine in 1994. The salvage and transplant technique is expensive ($10 per linear foot) and is not guaranteed to be fully successful in terms of survival. It may take up to 5 years following transplanting before a large saguaro will begin to exhibit signs of decline. 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 Mr. Dan Bach, a local cactus grower and retailer in Tucson, Arizona.

The 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 the seeds from the pulp, the fruit is split open and the pulp is removed. The seed/pulp mixture is rinsed with water, strained and allowed to air dry for 5 to 7 days (Figure 4). There are about 990 cleaned seeds per gram (Young and Young 1992). To prepare for planting, pumice granules are sifted through a 6.35 mm (¼”) screen and the remaining material through a 12.7 mm (⅛”) screen. The large, medium, and fine pumice granules are then separated and stored, this material is primarily for improved drainage and
The planting procedure first involves mixing 50% SuperSoil® with 50% large-granule pumice material. SuperSoil® is an all-purpose potting mix that includes fir bark, redwood, Canadian sphagnum peat moss and clean sand. After placing this mixture in a 51x30.5x6.35 cm (20x12x2.5”) propagation tray, lightly spread saguaro seeds evenly 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 - 250 saguaro seedlings per propagation tray. Next place a layer of medium-grain pumice granules over the seeds, covering some seeds while leaving others exposed as they may be found in a natural setting. The next step requires the creation of a tent-like structure to cover the propagation tray using a pre-constructed 30.5 cm (12”) tall frame covered with a sheet of heavy-duty plastic. The plastic tent creates a humid environment more favorable to saguaro seed germination. Plastic propagation domes are commercially available and may work just as well. The frame we constructed allows for approximately 30.5 cm (12”) of space between plastic tent and the propagation tray. After placing the tray in the greenhouse a light water mist should be applied 2 times per day using a water wand and applying enough water to saturate the top 2 mm of soil mix. This should be continued until germination is observed. Set the greenhouse thermostat at 24 °C (75 °F) for night and 32 °C (90 °F) during the day. If the greenhouse temperatures fall below 24 °C (75 °F), the planting tray should be placed on a heating pad with a temperature setting of 24°C (75 °F). Germination test procedures recommended by Young and Young (1992) are 68/86 °F (20/30 °C) incubation temperatures with at least 8 hours of light. Reduction of incubation temperatures to 59 °F (15 °C) curtails germination from about 50% to less than 5% (Heit 1973).

Saguaro seedlings will normally have a red color that indicates the plants are getting sufficient light (Figure 5). Young and Young (1992) caution that plants up to 30.5 cm (12”) tall should be protected from intense sunlight that can easily burn the young plants. The plastic tent should remain over the plants for at least 60 days and watering may be reduced to once a week using the water wand and saturating the top 2 mm of soil mix. After 60 days the plants will have grown to an approximate height of 3 mm (¼”). Maintain greenhouse temperatures at 32 °C (90 °F), after 60 days remove the plastic tent and replace it with a shadecloth that filters out about 70% of the sunlight. After about 8 months the saguaro seedlings should have grown to a size of 13 – 19 mm (½-¾”) in diameter. These young plants can now be transferred into
51x51x76 mm (2x2x3") cavity trays containing a mixture of 50% SuperSoil® and 50% large-granule pumice. Do not transfer seedlings that have brown spines or those that are less than 13 mm in diameter. The larger plants in the cavity trays can be transferred after approximately 6 months time into 1-gallon pots (Figure 6) and transferred to a shadehouse. A soil mixture of 50% SuperSoil®, 25% pumice granules and 25% Forest Mulch (Arizona Mix) should be used for transplanted seedlings. These pots will accommodate growth of up to a 10 - 15.25 cm (4 – 6") height. The saguaros will be ready for transplanting into a revegetation site under nurse plants once the 10 – 15 cm heights are reached.

Saguaros are considered ready for transplanting when the plant reaches a height of 15 cm (6”). It will generally take 4 to 5 years to achieve this. The best period to transplant the young saguaros is in the spring to allow the saguaro and nurse plant seedlings enough time to become established on the site. When transplanting into the target site, saguaro establishment success is improved with the help of nurse plants that provide shade and protection, by physical concealment, from rabbits, rodents and others. Saguaro seedlings protected by nurse plants also have the benefit of a reduction in soil surface temperatures and prolonged periods of favorable soil-moisture conditions (Steenbergh and Lowe 1969). The major benefits of using nurse plants with young saguaro transplants lies in protective shading which reduces soil surface temperatures and extends periods of favorable soil moisture conditions (Shreve 1914). If saguaros are to be held for a longer period of time prior to transplanting into the target site, they should be transferred into 5-gallon pots or planted in the ground under a shaded storage holding area.

Conclusions:

Saguaro cactus seedling propagation for use as transplant material onto revegetation sites in the Sonoran Desert may prove to be a successful and cost effective revegetation method for this species. 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 the use of these 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. These plants 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 that are lost to urban sprawl in the Sonoran Desert.

The saguaro cactus is highly regarded by the Tohono O’odham for its cultural contributions. This is reflected in many of the stories that are passed from generation to generation at tribal gatherings and ceremonies. The successful propagation of this plant is not primarily viewed as a revegetation tool, the role it 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 encouraged 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


